

# Pacific Coast Shells

The thirty-fourth in Nature Magazine's series of educational inserts.

By E. LAURENCE PALMER

THE tenth of this series of educational inserts (June-July, 1940), presented pictures and descriptions of fifty-two shells common along the Atlantic and Gulf coasts of the United States. It was suggested that a subsequent unit would consider similar organisms to be found on the Pacific Coast. The eighth unit in the series (February, 1940) gave more detailed accounts of a few shells of great economic importance, some of which are to be found on both coasts. To avoid unnecessary duplication, we are assuming that these earlier inserts will be available for use.

When these units appeared we were living in a safer period. Now many of us are widely scattered, and some may be isolated on Pacific strands, dependent on what the shore affords. Thus the mollusks are important. A few are poisonous, or even capable of biting.

In Europe, they say a sack of periwinkles is a standard picnic equipment. Of course, no mollusk is safe to eat if it has lived in polluted waters. Even oysters are dangerous if exposed to sewage, and especially if dead, and a single bad oyster in a stew may sicken a large number of persons. In general it is safer to eat a two-shelled mollusk than a one-shelled animal. Authorities generally seem agreed that the cone shells and the drills (*Terebra*) should be avoided. These are abundant in the Philippines, and some are reported to have a poisonous bite. For the most part, however, the shells found by the average amateur naturalist along our coasts are perfectly harmless.

It has been repeatedly demonstrated that the study of shells has value in restoring shell-shocked minds to normal. This alone should testify to the desirability of studying shells in these days of stress, whether at home or abroad. Many in the armed forces are making collections of shells. It would be well to encourage shell collecting by these men, and by those in training. Probably, as time goes on, interest in shells will not decrease. It is unfortunate that there is so little popular literature to guide the activities of amateurs. Obviously shells and shell collecting hold an appeal for all classes.

If you have a file of back numbers of *Nature Magazine* you may supplement the material given here, and in the previous inserts, by referring to a number of instructive articles. Important among these are the following: November, 1928, pp. 297-300; March, 1929, pp. 165-166; July, 1933, pp. 13-16; July, 1934, pp. 23-26, and November, 1938, pp. 541-544. Of these, the second reference, on the goosuck, should be "required reading" since an account of this delectable clam cannot be included here. The Pacific oyster, many mussels, barnacles and others must also be omitted.

A number of useful references are available to those wishing to study the subject more fully. Important are the following:

*West Coast Shells*, by Josiah Keep, revised by Joshua L. Baily, Jr., Stanford University Press, Stanford University, California. 1935.

*Seashore Animals of the Pacific Coast*, by Myrtle Elizabeth Johnson and Harry James Snook, The Macmillan Company, New York City. 1935.

*The Marine Shells of the West Coast of North America*, in four parts, by Ida Shepard Oldroyd, Stanford University Publications. Geological Sciences. Stanford University, California. 1924.

*Marine Shells of Puget Sound and Vicinity*, by Ida Shepard Oldroyd, Puget Sound Biological Station of the University of Washington, University of Washington Press, Seattle, Washington. 1924.

*Molluscan Fauna from San Francisco Bay*, by E. L. Packard, University of California Press, Berkeley, California. 1918.

*The Edible Clams, Mussels and Scallops of California*, by Frank W. Weymouth. Fish Bulletin, Number 4, State of California Fish and Game Commission, Sacramento, California. 1920.

*The Life History and Growth of the Pismo Clam*, by Frank W. Weymouth. Fish Bulletin, Number 7, State of California Fish and Game Commission, Sacramento, California. 1923.

*Illustrated Key to West North American Pelecypod Genera*, by A. Myra Keen and Don L. Frizzell. Stanford University Press, Stanford University, California. 1939.

*Summary of the Marine Shellbearing Mollusks of the Northwest Coast of America, from San Diego, California to the Polar Sea Mostly Contained in the Collection of the United States National Museum, with Illustrations of Hitherto Unfigured Species*, by William Healey Dall. Bulletin 112, Smithsonian Institution, United States National Museum, Washington, D. C. 1921.

*Pacific Coast Shells*, by Katherine V. Palmer. Slingerland-Comstock Company, Ithaca, New York. 1925.

*Survival on Land and Sea*, by Ethnographic Board and Staff of the Smithsonian Institution, Publications Branch, Office of Naval Intelligence, United States Navy. Washington, D. C. 1944.

The illustrations here are by Dr. Katherine V. Palmer, and credit is gratefully given her for counsel and guidance.

## The Pelecypods or Bivalves

(Plates 1 and 2, pages 194 and 195)

FAMILY PECTINIDAE. The scallops of the Atlantic Coast were discussed in detail in the eighth and tenth educational inserts. *Pecten irradians*, the commercial scallop of the East, was figured in both of these inserts, and its detailed life history was presented in the eighth. These well-known shells are common subjects of art and appear freely in commercial advertisements. The notch under the ear of the shells marks the opening through which an attaching byssus may be spun.

(1) Pink Scallop. *Pecten hercicus*. Length: 1 to 2½ inches. A conspicuously pink shell, with unequal ears, thin, with the ribs bearing slender spines. The under valve is white, while the upper one is pink-banded and with fewer ribs. It is a deep water species more common to the north but found from Port Althorp, Alaska, south to San Diego, California. Off San Juan Island, Washington, it is found at depths of 150 to 200 feet.

(2) Pacific Scallop. *Pecten circularis aesquisulcatus*. Length: to 3 inches. Typical form, with shell more bulging than in the variety, so that the variety is sometimes called Equally-grooved Scallop, while the typical form is called the Round Scallop. The shell is found in deep water, or at shoreline at low tide, lying on the right side, or attempting to escape. While the whole soft part of the animal is edible, commercial shellers extract the "meats," or adductor muscle, for sale, and reject the darker parts. It ranges from Santa Barbara to Cape San Lucas in Lower California, and is dredged commercially at Anaheim, California.

(3) Purple-hinged Scallop. Rock Scallop. *Hinnites giganteus*. Length: to 6 inches. Height: to 4 inches. Diameter: to nearly 2 inches. When young, it is free swimming, with the shells nearly alike, but with age it becomes attached to a rock by one shell, which becomes modified to conform to the rock. The shell near the hinge inside is always a deep purple. When disturbed, an adult may clap its shells together, forcing a stream of water several feet into the air. It is not abundant enough to be of commercial importance, nor is it easily taken. It ranges from the Aleutian Islands to Magdalena Bay in Lower California.

FAMILY ANOMIIDAE. The Plain Jingle Shell of the Atlantic, *Anomia simplex*, member of this family, discussed in insert 10.

(4) Rock Oyster. Jingle Shell. Pearly Monia. *Anomia macrochisma*. Length: to 4 inches. Attached to rocks or to other shells, one shell being much smaller than the other and bearing a hole through which a muscle scar is visible. It is rough outside, but a beautiful pearly cast inside, with purple and green tints. The flesh is bright orange and is edible, although it is not considered to be commercially important. It ranges from the Pribilof Islands and the southern Bering Sea area to Japan and the Sea of Okhotsk on the West, and to the East along the whole coast to Lower California. At Puget Sound, it is found at depths of 100 to 250 feet.

FAMILY MYTILIDAE. Edible Mussel. *Mytilus edulis*. This is identical with the Atlantic Coast species, discussed in insert 8.

(5) Straight Horse-Mussel. *Modiolus rectus*. Length: to 4 inches. This mussel, unlike some other Pacific Coast species, has shells brown rather than black, and the "umbo" is not at the extreme end. The shells are also either conspicuously ridged or bearded. This mussel is usually solitary, partly buried in mud or gravel, and attached. It is edible but not commercially important. Ranges Bolinas Bay, California, to Magdalena Bay, Lower California.

(6) Pea-Pod Shell. Hooked Pea-pod Shell. *Adula falcata*. Length: to 3 inches. Shell: thin and flexible being pearly white inside and dark chestnut outside with a series of conspicuous transverse wrinkles. The animal can and does bore holes in solid rock and then attaches itself with a strong byssus. It is more common in sheltered shallow water than on exposed wave-beaten rocks. It ranges from Coos Bay in Oregon to San Diego, California.

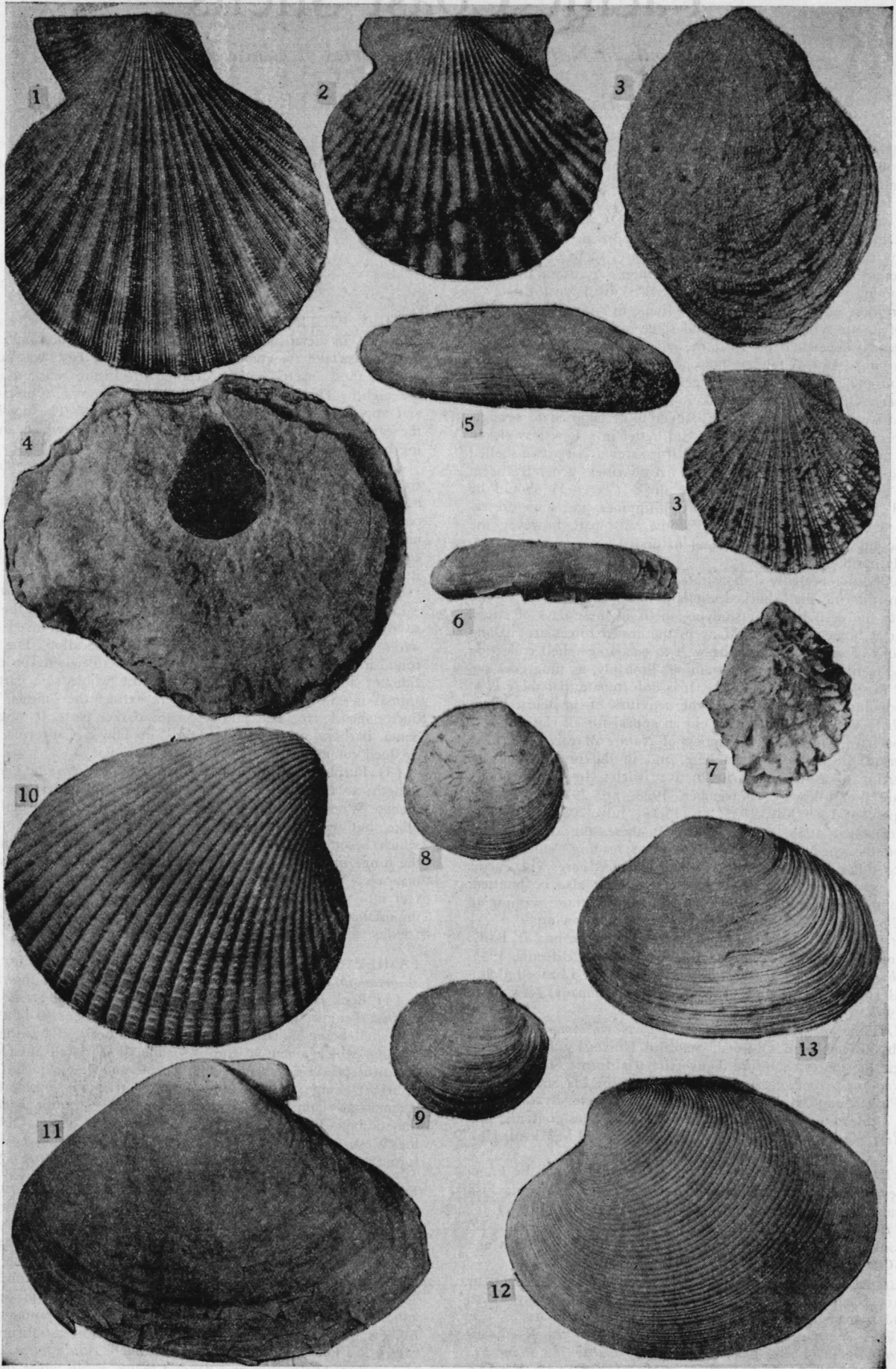


Plate No. 1

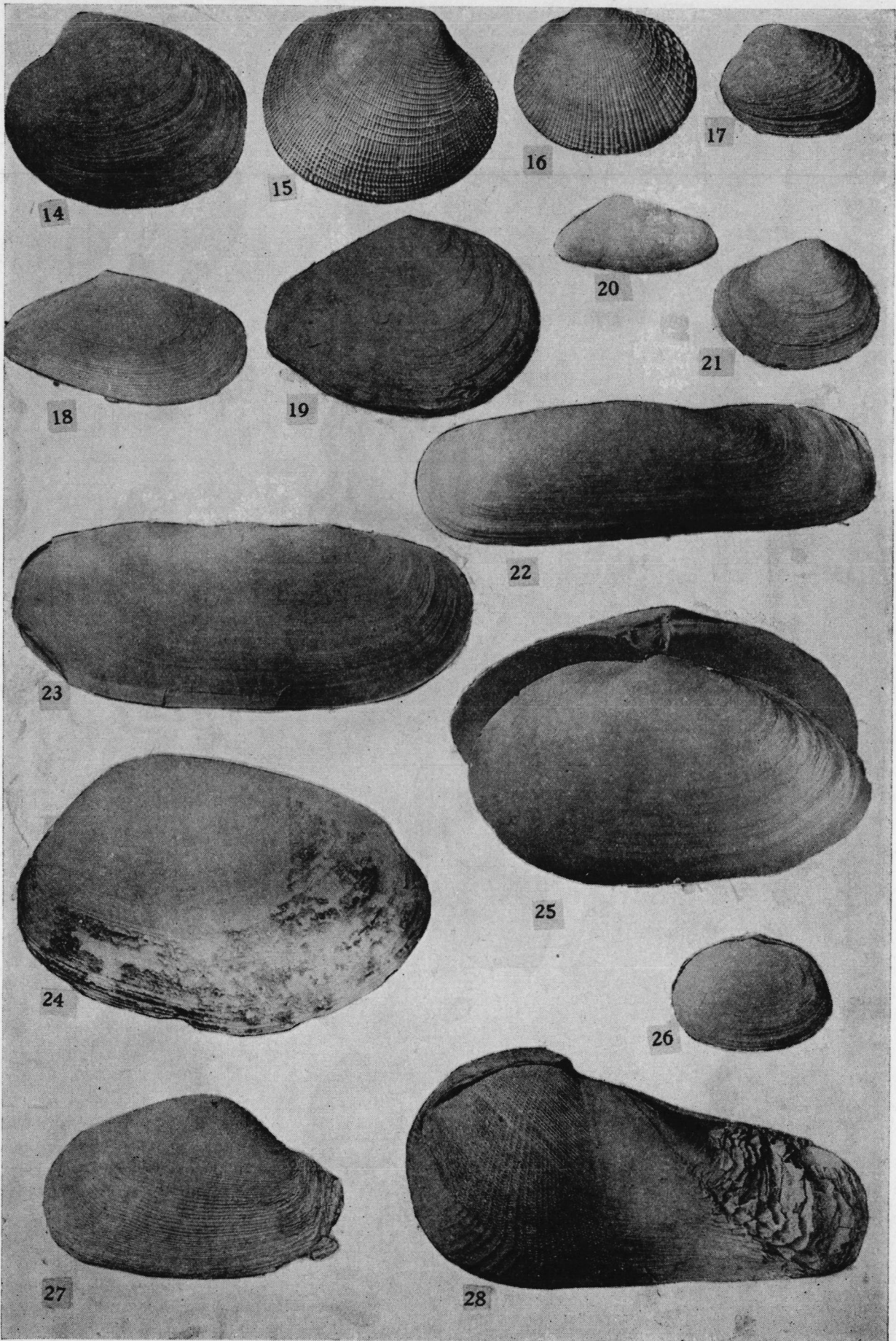


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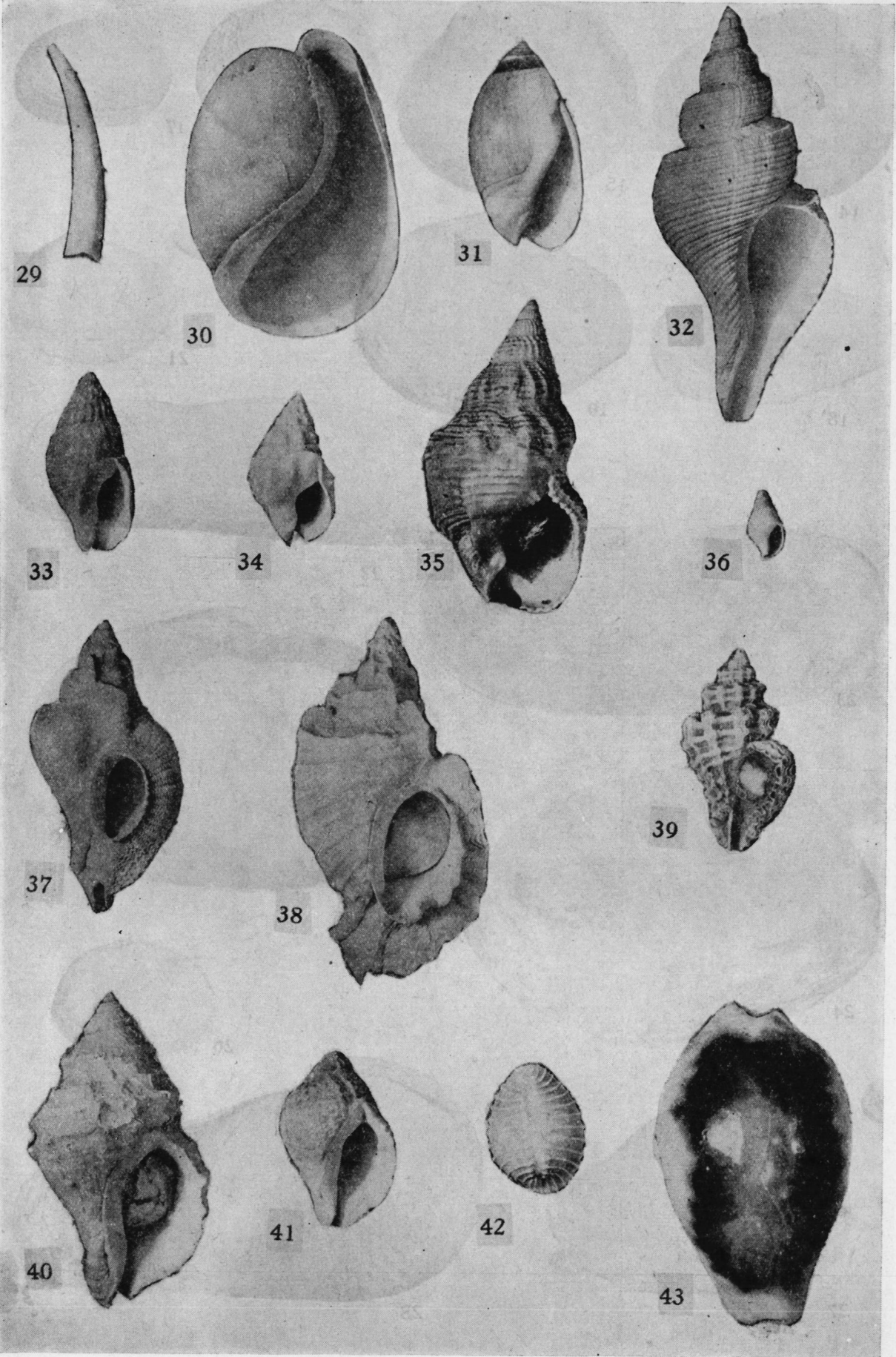


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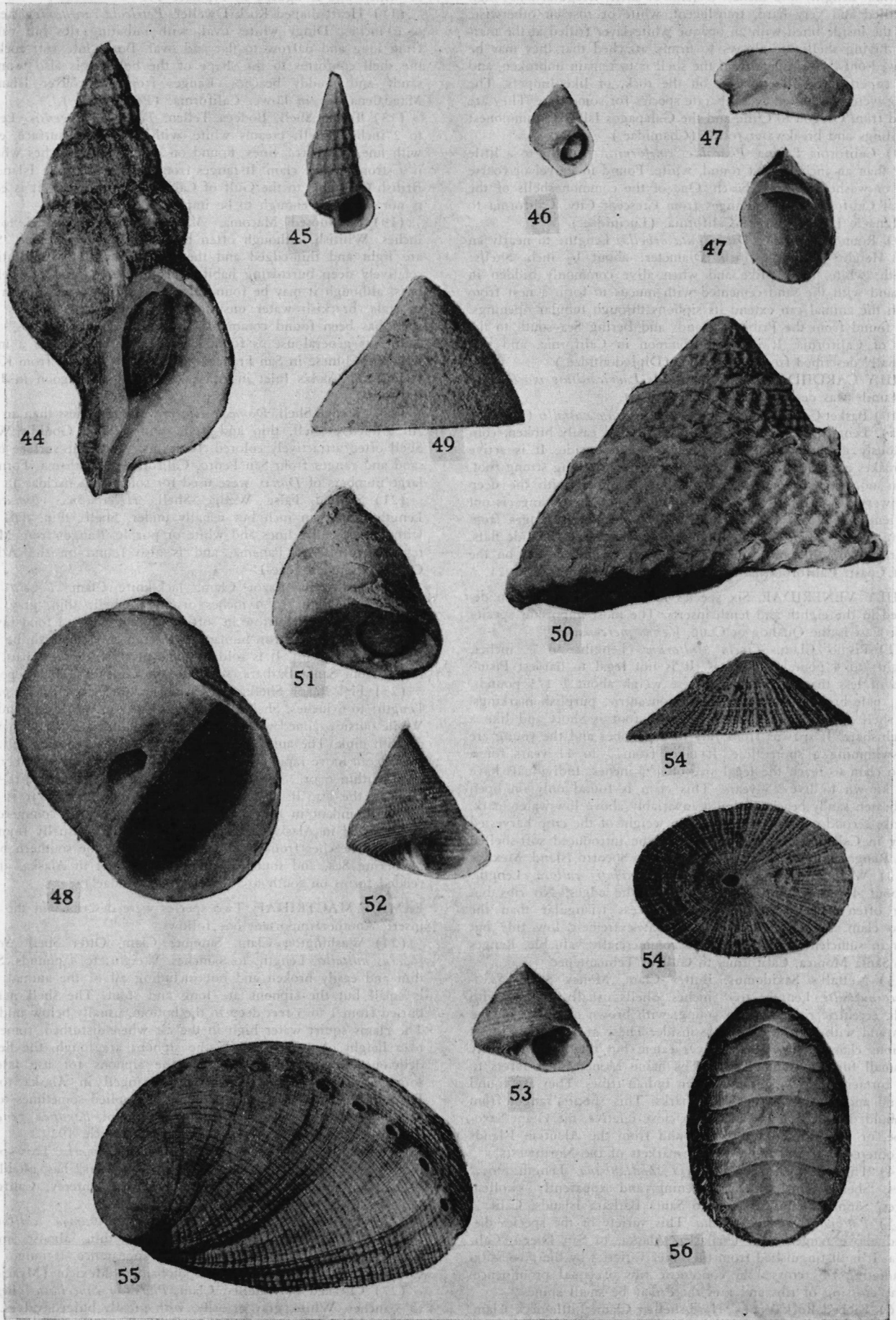


Plate No. 4

FAMILY CHAMIDAE. (7) Agate Chama. Rock Oyster. *Chama pellucida*. Length: to 2 inches. Outside of shell: irregular and rough or frilled and very hard, translucent, white or rosy or otherwise, with the inside lined with an opaque white layer frilled at the margins. Living shells are always so firmly attached that they may be removed only with difficulty, if the shell is to remain unbroken, and look superficially like nubbins on the rock, or like limpets. The young were considered as a separate species for some time. They are found from Oregon to Chile and the Galapagos Islands; commonest on pilings and breakwater rocks. (Chamidae.)

(8) California Lucina. *Phacoides californica*. Length: to a little more than an inch, almost round, white. Found in gravel or coarse sand or washed up on a beach. One of the common shells of the central California Coast. Ranges from Crescent City, California to San Ignacio Lagoon, Lower California. (Lucinidae.)

(9) Round Diplodon. *Diplodonta orbella*. Length: to nearly an inch. Height: about  $\frac{3}{4}$  inch. Diameter: about  $\frac{1}{2}$  inch. Shells: smooth, white, marble-like and when alive commonly hidden in the sand with the sand cemented with mucus to form a nest from which the animal can extend its siphons through tubular openings. It is found from the Pribilof Islands and Bering Sea south to the Gulf of California. It is not uncommon in California, and was originally described from San Diego. (Diplodontidae.)

FAMILY CARDIIDAE. Morton's Cockle *Laevicardium mortoni*, of this family was described in the tenth insert.

(10) Basket Cockle. Heart Shell. *Clinocardium nuttallii* (*Cardium corbis*). Length: to 4 inches. Shell: brittle and easily broken, conspicuously grooved on the outside and white inside. It is active and makes a shallow burrow with the help of the long strong foot. It has no long siphon tube such as are common with the deep burrowers. It is edible, but in the southern part of its range is not sufficiently abundant to be commercially valuable. It ranges from Bering Sea to Japan and to San Diego, and is found on tide flats. According to some authorities it is the commonest species on the West Coast. California marketed more than seven tons in 1921.

FAMILY VENERIDAE. Six species in this family have been described in the eighth and tenth inserts. The most important species in the East is the Quahog or Clam, *Venus mercenaria*.

(11) Pismo Clam. *Tivela stultorum*. Length: to 7 inches. Weight: to 4 pounds 3 ounces. It is not legal to harvest Pismo clams of less than  $4\frac{3}{4}$  inches. These weigh about 1  $\frac{1}{3}$  pounds. Shell: pale brown, often with faint, concentric, purplish markings. The shell appears to be varnished. The foot is short and like a plough-share. It spawns from July to September and the young are free-swimming a short time. It takes from 7 to 11 years for a Pismo clam to reach the legal size of  $4\frac{3}{4}$  inches. Individuals have been known to live 25 years. This clam is found only on open surf-beaten sandy beaches, almost invariably above low-water mark. It ranks second only to the abalone in weight of the crop harvested yearly in California, but is rivalled by the introduced soft-shelled clam. Range, Half Moon Bay, California, to Socorro Island, Mexico.

(12) White Amiantis. Sea Cockle. *Amiantis callosa*. Length: to about 4 inches. Pure white. Thin at the edges. No ribs but many often paired, concentric ridges. Less triangular than the Pismo clam. Found on open beaches at extremely low tide but never in sufficient abundance to be commercially valuable. Ranges from Santa Monica, California, to Gulf of Tehuantepec.

(13) Nuttall's Saxidomus. Butter Clam. Money Shell. *Saxidomus nuttallii*. Length: to 5 inches. Shells usually marked with rough, eccentric ridges; when young, with brown markings on the beaks and with a trace of purple inside. These are about the most delicious clams the writer has ever eaten, but they are ordinarily too small for use commercially. The name Money Shell refers to their former use as money by certain Indian tribes. They are found in sand and gravel between tide marks. This species ranges from Humboldt Bay to San Diego, and a close relative, the Giant Saxidrome, or Washington Clam, is found from the Aleutian Islands to Monterey Bay. Sometimes in the markets of the Northwest.

(14) Thin Copper Shell. *Marcia subdiaphana*. Length: to 2 inches. Shell: thin, white, glistening and apparently swollen. Ranges, Sannak Island, Alaska, to Santa Barbara Islands, Calif.

(15) *Paphia staminea laciniata*. This variety of the species discussed above ranges from Unalaska, Alaska, to San Diego, California. It is distinguished from the other varieties by the possession of radiating ribs crossed by concentric ribs of equal prominence. At the crossing of ribs and rays there may be small spines.

(16) Ribbed Rock Venus. Hard-shelled Clam. Little-neck Clam. *Paphia staminea*. Length: rarely over 3 inches. With deeply arched valves so that it appears round. It is longer than the true cockle. The foot is flattened, and although strong, is not long. It is found in bays or gravel but not in deep mud. It is of some, although not great, commercial importance. It ranges from Commander and Aleutian Islands to Kamchatka and Japan; to Puget Sound and

south to Socorro Island. There are several varieties of this species, of which one is figured as Number 15.

(17) Heart-shaped Rock Dweller. *Petricola carditoides*. Length: to 2 inches. Dingy white, oval, with radiating ribs but variable from long and narrow to flat and oval. Bores into soft rock and the shell conforms to the shape of the hole. It is also found on sandy and muddy beaches. Ranges from Vancouver Island to Magdalena Bay in Lower California. (Petricolidae.)

(18) Tellen Shell. Bodega Tellen. *Tellina bodegensis*. Length: to 2 inches. Shell: creamy white, with a polished surface, etched with fine, concentric lines. Found on outer sandy beaches where it is a strong, active clam. It ranges from Queen Charlotte Islands off British Columbia to the Gulf of California, and, while it is edible, is not abundant enough to be important. (Tellinidae.)

(19) Bent-nosed Macoma. *Macoma nasuta*. Length: to  $2\frac{1}{2}$  inches. Whitish, although often brown, stained with mud. Shells are light and thin-edged and the siphons are long, indicating a relatively deep burrowing habit. It is found in mud in sheltered bays, although it may be found also on sandy beaches. It can exist in stale, brackish water unsuitable for some other species. This shell has been found commonly in Indian "middens heaps," indicating its general use as food. These clams have found a market with the Chinese in San Francisco. The animal ranges from Kodiak Island and Cook's Inlet in Alaska to Scammon Lagoon in Lower California.

(20) Wedge Shell. *Donax californica*. Length: less than an inch. An attractive shell, thin and light, with related Gould's Wedge Shell often attractively colored. Lives just under the surface of the sand and ranges from San Pedro, California, to Panama. Formerly, large numbers of *Donax* were used for soups. (Donacidae.)

(21) Spotted False Wedge Shell. *Heterodonax bimaculata*. Length: about an inch but usually under. Shell: thin, flat, oval, with fine eccentric lines and white or purple. Ranges from Monterey, California, to Panama, and is also found on the Atlantic Coast. (Psammobiidae.)

(22) California Razor Clam. Jack-knife Clam. *Tagelus californianus*. Length: to 4 inches or more. Shell: thin, gray, dull, living in a vertical burrow in soft, sandy mud. It is a food favored by ducks, is edible for humans, although too small to be commercially important. It is sold in some places for use as bait. It is found from Santa Barbara, south to the Gulf of Tehuantepec.

(23) Flat Razor Shell. Sea Clam. Razor Shell. *Siliqua patula*. Length: to 6 inches. Shell: thin and brittle, smooth inside and out. White outside, zoned with violet, or inside tinted either with violet or with pink. The animal is not wholly included in the shell. The animal can move rapidly through the sand, and can completely bury itself within 6 or 7 seconds. When disturbed, it may squirt water high in the air. It is delicious and a favorite where it is sufficiently abundant in the south to warrant harvesting commercially. It is canned in Alaska and in Washington. It is usually found on the outer beaches from the Sea of Okhotsk to the southern border of Bering Sea, and south through Cook's Inlet in Alaska, and in related forms on south to Monterey. (Solenidae.)

FAMILY MACTRIDAE. Two species were described in the tenth insert. Another important one follows.

(24) Washington Clam. Summer Clam. Otter Shell. *Schizothaerus nuttallii*. Length: to 8 inches. Weight: to 4 pounds. Shell: thin and easily broken and not including all of the animal. Foot is small but the siphons are long and stout. The shell may lie buried from 1 to 3 feet deep in the bottom, usually below mid-tide. The clams squirt water high in the air when disturbed, sometimes to a height of 3 feet. While the siphons are tough, the flesh is delicious. Indians formerly dried the siphons for use later in soups and chowders. Found from Wrangell in Alaska to San Diego, California. The name goosuck is applied sometimes to this species but the term is the Indian name for *Panopea generosa*, Family Saxicavidae. See *Nature Magazine*, March, 1929.

(25) Sand Clam. Soft-shelled Clam. *Mya arenaria*. This species, introduced from Victoria, British Columbia, to Monterey, California. It is described in the tenth insert. (Myacidae.)

(26) California Soft-shelled Clam. *Cryptomya californica*. Length: to about an inch. Shell: white, thin, almost smooth, slightly gaping and sometimes ashy in appearance. It ranges from Chichagoff Island, Alaska, to Topolobampo, Mexico. (Myacidae.)

(27) Checked Soft-shelled Clam. *Platydon cancellatus*. Length: to 3 inches. White, gray or ashy, with greatly bulged valves. Surface marked by fine, irregular growth lines overlain with a brownish-gray cover. It is found in or near bay entrances where the current is brisk and where it burrows in firm, hard clay, not in rock or in shifting sands or mud. While it is edible, it is not found in quantities of commercial importance. It ranges from Bolinas Bay, California to San Diego, California. (Myacidae.)

FAMILY PHOLADIDAE. The Angel Wing Shell and the Little Piddock of the Atlantic Coast were members of this family described in the tenth insert.

(28) California Piddock. *Parapholas californica*. Length: to 5 inches. Upper end of the shell displays scales. Shells are white and delicate. The animal burrows in mud and in hard clay, and uses the waste material to build a stout, cone-like channel above it to protect the siphons, which reach up to the open water. The animal is edible but not of commercial importance. It ranges from southern Oregon to San Diego, California.

### Class Scaphopoda

(Plate 3, Number 29, Page 196)

FAMILY DENTALIIDAE. The Tusk Shells. These shells and their animal inhabitants suggest relationships both with the pelecypods and with the gastropods. Like the former, they lack a true head and are bilaterally symmetric; like the latter, they have a single shell. They belong to a group midway between these two, called the Scaphopoda.

(29) Tooth Shell. Tusk Shell. Precious Tusk-shell. *Dentalium pretiosum*. Shells resemble small, slightly curved, hollow, delicate, white teeth or tusks, an inch or more long, with the larger open end being the lower, from which the animal extends the foot that is useful in digging in the sand. From the smaller, upper end, the animal extends the tentacles to capture the minute animals that constitute its food. I have a necklace made by Indians of the Northwest in which tooth shells alternate attractively with circular discs cut from other shells. Both of these shell materials were recognized as having money value by the Indians. The animals live mostly in the sand. They were collected by comb-like dredges. From Forrester Island, Alaska, to San Diego, California.

### The Gastropods or Univalves

(Plates 3 and 4, Numbers 30 to 55, Pages 196 and 197)

To the twenty-seven gastropods discussed in the Atlantic Coast unit, we here add twenty-six from the Pacific Coast.

(30) Bubble Shell. Gould's Bubble Shell *Bullaria gouldiana*. Length: to 2 inches. Like a thin, polished, mottled brown or white, slate, or yellowish egg shell, and almost as delicate, with the spire, to be expected at the top, instead apparently pushed inward. Lives in and on mud flats from Santa Barbara, California, to Mexico. (Bullaridae.)

FAMILY OLIVIDAE. The Olive Shell described for the Atlantic Coast belongs to the genus *Oliva*, the members of which do not have an operculum with which to close the opening at the mouth of the shell. In *Olivella* of the Pacific Coast, the animal does possess a protective operculum.

(31) Rice Shell. Purple Olive Shell. Little Olive. *Olivella biplicata*. Length: about 1 inch. About the size and shape of an olive pit but smooth. Polished and beautifully and finely marked. White to dark slate colored, usually with purple markings. Live for the most part just under the surface of the sand, through which the animal can plow, leaving the siphon free to extend upward to above the sand. Ranges from Vancouver Island to Magdalena Bay, Lower California. The shells were considered sufficiently rare and interesting to the Indians to be used as money, or as ornaments.

FAMILY BUCCINIDAE. Of the more than two-dozen shells that can be considered as being relatively common on the West Coast and belonging to this family we can consider but one. Many of these are limited to the colder waters of the Alaska region.

(32) Tabled Whelk. *Chrysodomus tabulatus*. Length: to 4 or 5 inches. Diameter: to 2 inches. A coarse but beautiful shell, yellowish-white and with the whorls flat-topped and making a spiral table that is responsible for the common name. Outer lip is thin and smooth, while the inner is hard crusted. Lives in water from 150 to 1200 feet deep and is widely distributed, ranging from British Columbia south to San Diego, California.

(33) Columbian Amphissa (also called Wrinkled Amphissa). *Amphissa columbiana*. Length: to nearly an inch, the average being about  $\frac{3}{4}$  inch. Light yellowish-brown and closely related to the Joseph's-coat Amphissa, which is only about  $\frac{1}{3}$  its length but highly variable in color. Columbian Amphissa is found in the mud where the sea is a hundred feet deep, more or less. It ranges from Chiachi Islands, Alaska, to San Pedro, California, and is abundant off Catalina Island. (Columbellidae.)

FAMILY NASSARIIDAE. Two Atlantic Coast Dog Whelks were discussed in the unit on Atlantic Coast shells.

(34) Tile-roof Dog Whelk. *Alectrion* [*Nassarius*] *tegula*. Length: to  $\frac{3}{4}$  inch. With a stout, strong, evenly-tapering, pointed

spire and a relatively small opening. Dark gray, with rather conspicuous bumps forming interrupted ridges from one end to the other. It is essentially an animal of the mud flats, and is found from San Francisco to San Diego, California.

(35) Channeled Dog Whelk. *Alectrion* [*Nassarius*] *fossatus*. Length: to  $1\frac{1}{4}$  inch. Diameter: to  $\frac{3}{4}$  inch. In older animals, the lip is much thickened in its outer areas. General color of the shell is pale, ash-gray but the enamel showing at the lip is bright orange. There are 7 whorls in a mature shell, these being marked by conspicuously spiralling ridges crossed by more coarse and obscure, longitudinal ridges. A long breathing tube extends into clear water above the mud while the animal forages rather actively for food relatively deeply in the mud. It ranges from Vancouver Island, south to Cerros Island off Lower California.

(36) Frieze-covered Dove Shell. Eel-grass Shell. *Columbella gausapata*. Length: to less than  $\frac{1}{2}$  inch. Shell described as about the size of a grain of wheat, chestnut-brown, polished, glistening and marked with spots or stripes or dots. The spire is conical and the lip is thickened. The animal lives at the roots of eel-grass in enormous numbers, and the dead shells may be most abundant on the shore. It ranges from Port Etches, Alaska, to San Diego, Calif.

FAMILY MURICIDAE. The Borer and Oyster Drill shells found on the Atlantic Coast were members of this family that were discussed in the tenth insert.

(37) Festive Rock-shell. *Murex festivus*. Length: to 3 inches, or more. Shell is elaborately ornamented by coarse frills and by fine ridges and sculpturings. White or gray or dingy, and sometimes the young are a brilliant scarlet, a color that is lost if the shell is boiled. The animal is commonly found clinging to sunken trash such as sea-weeds, piles or driftwood, and it thrives best in the warmer waters to the south. The range is from Santa Barbara, California, south to Cerros Island off Lower California.

(38) Leafy Horn-mouth. *Purpura* [*Ceratosoma*] *foliata*. Length: to more than  $3\frac{1}{2}$  inches. Breadth: to more than  $2\frac{1}{2}$  inches. Conspicuous because of 3 broad, wing-like structures that appear like shingles on a roof. There are also strong spiral ridges that spread out in a fan-like manner. Dull-white in color but commonly stained. It is more northern than the species just discussed and ranges from Sitka, Alaska, to San Diego, California.

(39) Sculptured Rock-shell. *Tritonalia interfossa*. Length: to 1 inch. Breadth: to  $\frac{1}{2}$  inch. Definitely spindle-shaped with the spirals marked by deep, well-defined grooves. Yellow, gray, brown and dull outside but white inside. While the shell is small, it appears coarse and rugged. The animal clings to the rocks and is relatively common along the whole of our Pacific Coast, ranging from Semidi Islands in Alaska south to San Diego, California.

(40) Wrinkled Thais. Purple Dog Winkle. *Thais lamellosa*. Length: to 2 inches. The exterior varies greatly, some being smooth while others are wrinkled or even frilled. Some are plain white, while others are conspicuously painted with rich brown bands. In general, these shells are more conspicuously colored or more elaborately marked when found in the northern part of their range. They are found from the waterline to depths of 150 feet or more and are not only common but usually popular with shell collectors. They range from Port Clarence, Bering Strait and southward, on the west to the Japan Sea; on the east, to the Aleutian Islands and south to Santa Barbara, California. The species has been found in fossil deposits of the Pliocene and Pleistocene of California and Oregon.

(41) Unicorn Shell. *Acanthina spirata punctulata*. Length: to about 1 inch, or sometimes  $1\frac{1}{2}$  inches. The spire in a mature shell has 4 whorls. There is a small aperture or openings bounded by a series of tooth-like knobs. The general appearance is like that of a waterworn piece of granitic rock that would be natural for the territory between the tide lines along the shore where the animal is commonly found. It usually is on rocks among sea-weeds. There are a number of closely related unicorn shells, such as the Angular Unicorn-shell, the Sad Unicorn-shell and the Orange Unicorn-shell, from which this is distinguished as the Spotted Unicorn-shell. It ranges from Monterey, California, to San Tomas, Lower California, with the relatives extending the range, particularly to the north.

FAMILY TRIVIIDAE. (42) Solander's Trivia. Sea-button. *Trivia solandri*. Length: to nearly 1 inch. Back, with a horizontal groove crossed by conspicuous ridges at right angles, the groove exposing the white area that underlies the colored surface. General color, dark chocolate-brown to light pink. This species ranges from Santa Barbara, California, south to Panama.

FAMILY CYPRIEIDAE. In this family are the Cowry Shells that are to be found in most collections, and that have been highly prized by modern and by primitive collectors. Our native cowries are relatively few, and are, for the most part, found in the warmer

seas. A cowry is likely to be in the collections of most members of our armed forces who return from the South Seas. In the Hawaiian Islands, they are used as bait for capturing octopuses that are used as food. They may be bought in the public market or from tourist shops. Ordinarily, they are not easy to collect.

(43) Chestnut Cowry. *Cypraea spadicea*. Length: rarely to 2 inches. In general, the color is brown but the lips on the under side are bluish and with about 20 whitish "teeth." The central part of the back is lighter brown than the adjacent area, with the outer margin much lighter. Young shells are thin, short-spined cones with a large aperture. The shell is rarely found, but is so highly prized and representative of so many popular shells from elsewhere in the Pacific, that it seemed best to include it here. It ranges from Santa Barbara, California, to Cerros Island, Lower California.

(44) Oregon Triton. *Argobuccinum oregonensis*. Length: to about 4 inches. The outside of the living animal has the shell apparently covered with a brownish hairy material so that the animal looks shaggy. The inside is pure white. It ranges from the line of floating ice in winter in the Bering Sea, near the Pribilof Islands, to Okhotsk Sea and Japan, and south to San Nicholas Island and San Diego, California. (Cymatiidae.)

(45) California Horn-Shell. *Cerithidea californica*. Length: to slightly more than an inch. Black outside and glossy brown within, with 10 strongly-ribbed whorls and a relatively large, nearly circular aperture that is closed by a thin, brown operculum when the animal withdraws to the shell's protection. The animals are found in the mud of tidal flats, seemingly undisturbed by being exposed to the air. They range from Bolinas Bay to San Diego, California.

FAMILY LITTORINIDAE. An Atlantic Coast periwinkle was discussed in the tenth insert of this series.

(46) Checkered Littorine or Checkered Periwinkle. *Littorina scutulata*. Length: to slightly more than 1/2 inch. Greenish to brownish-gray marked with lighter whitish bands or spots, and with the inside of the shell showing a conspicuous purple at the aperture. Found clinging to rocks between the tide marks and ranging from Kodiak Island in Alaska, south to Turtle Bay in Lower California and Socorro Island.

FAMILY CALYPTRAEIDAE. (47) Hooked Slipper Shell. *Crepidula adunca*. Length: to 4/5 inch. Shaped somewhat like a slipper or shallow boat but recurved at the tip, with the surface brown and the "deck" white. Younger animals have the point at the end sharp and less recurved. The range is from Vancouver Island, British Columbia, to Cape San Lucas, Lower California.

FAMILY NATICIDAE. Two Atlantic coast Naticidae were described in the tenth insert of this series. One other follows.

(48) Lewis's Bull's-eye. *Polinices lewisii*. Sometimes to 6 inches through, but more normally 3 or 4 inches in diameter. Yellowish-white, smooth-surfaced, and with the rather large aperture closed by a broad, horny, brown operculum. The animal is strictly carnivorous, preying for the most part on other shelled animals such as clams, through whose thick shells the Bull's-eye can drill a hole permitting access to the soft flesh inside. The Bull's-eye has an unusually large foot and moves freely about in search of its prey. It ranges from Duncan Bay, British Columbia, to Santa Barbara Islands, California.

(49) White-cap Limpet. *Acmaea mitra*. Length: to about 1 inch. The shell looks like a small cone or tent, with the surface smooth and pure white. The animal is able to move about somewhat, but when disturbed clamps so tightly to the rock that it can hardly be removed without breaking the shell. If, before the creature is disturbed, a blade of a table knife is suddenly thrust under the shell, the animal is forced free easily. The animals are sometimes eaten by men, but are more commonly used as fish bait. The shells are sometimes used as ear-rings. The animal ranges from the Pribilof Islands, Bering Sea, south to San Diego, California. (Acmaeidae.)

(50) Wavy Turbine Shell. *Astraea undosa*. Length: to 4 inches. A pearly-white shell covered with a brownish fibrous skin, with the whorls variously wrinkled and ornamented. The operculum of the shell is horny within. Apparently, the animal is vegetarian. It ranges from Laguna Beach, California, south to Cerros Island, Lower California. (Turbinidae.)

(51) Black Top-shell. *Tegula funebris*. Length: somewhat more than an inch, but more commonly smaller than that. Purple to black outside, but greenish-white and pearly as the outer layers are worn or broken off. There are normally 4 whorls of which the uppermost may well be worn off where there is violent wave wash. These animals are sometimes so abundant as to carpet the rocks exposed to waves, and the animals have the ability to fasten themselves relatively firmly to these rocks. They are eaten freely by fish.

Range is from Vancouver Island, British Columbia, south to Cerros Island, Lower California. (Trochidae.)

(52) Ringed Top-shell. *Calliostoma annulatum*. Length: to about 1 inch. Beautifully and finely-engraved pointed cones, with the spiral grooves usually marked with deep purple, with the major color reddish or yellowish-brown. Some have stripes in violet rather than in purple. The edge of the lip is fine and thin. The animals do not live on the wave-beaten shore but on seaweeds in deeper water. On bright days they may be found near the surface, but in rough dark weather they retreat to the quieter depths. The range is from Forrester Island, Alaska, to Catalina Island, California. (Trochidae.)

(53) Puppet Margarites. *Margarites pupillus*. Length: about 1/3 inch. Yellow-brown. Whorls: four, and plainly marked with spiral ridges. Opening is nearly circular. The range is from Nunivak Island in Bering Sea, south to San Pedro, California. Here it is found in deep water off San Pedro. (Trochidae.)

FAMILY FISSURELLIDAE. Key-hole Limpets. (54) Rough Key-hole Limpet. *Diodora* [*Diadora*] *aspera*. Length: more than 2 inches, although usually smaller. Conical, with an elliptical base and with ridges and grooves radiating from the hole at the crest of the cone. The outside is dark purplish to gray-brown, and the inside is a pure pearly-white. The animals cling to rocks. The range is from Cook's Inlet, Alaska, to Magdalena Bay, Lower California.

(55) Blue Abalone. *Haliotis fulgens*. Length: to nearly a foot and about 3/4 as wide. The spiral is almost obscure and the shell looks more like a broad, shallow, oval bowl with a number of relatively small oval holes in a line along one side. The outside is rough, coarse and frequently covered with other organisms so that the animal is not easily detected. The inside of the shell is a layer of mother-of-pearl, or nacre, rich in rainbow tints and glistening. The animal can remain closely attached to the rock since the holes permit the passage of the necessary water to supply the gills with their needed water. As the shell increases in size the older holes become filled and new ones appear.

So firmly can this shell grip the rock that it has been reported that divers who have attempted to pull them loose have been held under water. We have no authentic record of drownings having been caused by this, but it is obviously possible. It is for these shells (possibly collected elsewhere) that divers off Catalina Island amuse tourists cruising in glass-bottom boats. The diver points out one of these shells obviously placed on the bottom and offers to get the shell for the tourist—at a price. The shells have some commercial value. We have a dozen excellent specimens in which the holes have been plugged. They provide unique bowls for serving clam chowder and supplement the set of cockle shells from which we serve such side dishes as apple sauce, and the pectens on which we serve salads.

The flesh of the abalone has a definite commercial value, and in one year the abalone harvest in California weighed three times as much as all the Pismo clams, soft-shelled clams, sea mussels, cockles, Washington clams and bay mussels combined, the total being more than 700 tons of abalones in a single year. They may be bought as abalone steaks in the California restaurants or fish markets, or the animals are cut up and used in making chowders. Their harvest is subject to certain legal restrictions as to size. This species ranges from the Farallones and Catalina Island, California, south to the Gulf of California, Mexico. (Haliotidae.)

## Class Amphineura

(Plate 4, Number 56, Page 197)

The chitons, representative of the Class Amphineura, possesses plates described by some as looking like a set of false teeth, by others as looking like a section of a tiled floor. The central ones have been described as butterfly shells. We choose as a representative the following.

(56) Mossy Chiton. *Mopalia muscosa*. This strange animal is up to about 2 inches in length, and apparently composed of jointed sections bordered by a fringe of moss-like hairs. The outside is, in Nature, usually covered by foreign growths that obscure the tile-like upper plates. The interior is bluish-green. The animal may be removed from the rock or other solid substance to which it is attached by inserting a knife blade under it. If one attempts to make a specimen of the shell and removes the flesh-like girdle, the shingle-like plates will fall apart. They are sometimes dried flat on a piece of wood or placed in some liquid preservative. This species ranges from Shumagin Islands, Alaska, south to Rosario in Lower California. (Mopaliidae.)