National Geographic Society-Tulane University
Program of Research in Yucatan

The Archaeological Use and Distribution of Mollusca in the Maya Lowlands

E. Wyllys Andrews IV

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Middle American Research Institute
Tulane University

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Frontispiece — Two Maya paintings of the sea, murals in the Chac Mool Temple, buried under the Temple of the Warriors at Chichen Itza. Modified Florescent period. (From Morris, Charlot, and Morris, 1931, pls. 139, 159).

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Contents

Illustrations

Tables·

Acknowledgments

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All archaeological work has been done under contract with, and direction of, the Secretaría de Educación Pública of Mexico, through the Instituto Nacional de Antropología e Historia, which will be the repository of the collections described. Thanks for help and guidance are due the late Dr. Eusebio Dávalos Hurtado, Director of the Instituto, as well as the several Directors of Prehispanic Monuments and their Yucatan representatives during our long period of work.

15 December 1966

Introduction

In the excavations at Dzibilchaltun between 1956 and 1965, over 2300 identifiable marine shells and fragments appeared, in addition to remains of many other forms of marine life. A large number of artifacts were made of shell which had so lost its original form that the species was unidentifiable. It soon became clear that the sea, only 10 miles north of the ruins, played a very significant role in the life of the ancients. This role was a multiple one. Marine animals, from their frequent appearance in tombs and ceremonial caches and portrayal in sculptures, were important in ceremonial life. Fish and molluscs appear to have been much used as food. Much of the jewelry and artifacts at the site were made of several molluscan species, and we cannot escape the conclusion that Maya of old, as we of today, collected many attractive shells of no utilitarian value simply because it pleased them. It also became apparent that modes in shell-collecting and usage as well as trade varied greatly from period to period in history.

As the Dzibilchaltun collection is by far the largest and chronologically most comprehensive yet taken in Yucatan (and will probably be so for some time to come), we believe it worthwhile to review in some detail the exact identification of material from our own site and that previously reported from Yucatan. We have included an unpublished collection of some 6500 molluscs from a shell midden on the Caribbean coast of Isla Cancun, Quintana Roo. This midden, representing a brief Late Formative occupation, I excavated in 1963 (Andrews, 1965, pp. 42–45).

I have attempted to establish original provenience of the specimens for clues to early trade. Under each listing is a reference to any new or published knowledge regarding use and association, as well as age of the deposits in which the specimens were found. Comparison with the Yucatan material may be made with reported marine life forms from the southern Maya lowlands, including the British Honduras and Peten sites and Copan, but only with items of unusual interest from farther afield. Some species have not been reported archaeologically from Yucatan, but have appeared at other lowland sites and are common in coastal waters of the peninsula.

Excavations still in progress by the University of Pennsylvania at Tikal, Guatemala, have contributed the largest body of comparative material available. Much of their collection has not been finally identified by species, and data on archaeological association have, of course, not been completed. I have drawn heavily on Hattula Moholy-Nagy's summary of material collected through 1962, and I am grateful for her generosity in making available manuscript notes on further collections through 1964, which furnished a number of additional entries in the checklist.

The present report summarizes some 15,000 archaeological specimens of 192 species from 18 sites. At some sites, shells were never identified below the generic level, and at all sites this was of necessity true of certain shells. These items are not included in the tabulations except in the few instances where the presence of a genus seemed important *per se*, or some significant alteration made the specimen of particular interest.

If geographic distributions and taxonomic identifications seem overly precise or sophisticated in an area as yet virtually undocumented malacologically, it is because we have drawn heavily on a manuscript on the ecological distribution and make-up of the modern molluscan fauna of the Yucatan Peninsula now in preparation by the present author. More than 15,000 specimens of over 600 species have been catalogued from more than 50 stations from the Turneffe Islands, British Honduras, around the peninsula to the Laguna de Terminos in Campeche, and on the distant atolls at the outer edge of the Campeche Bank.

Most archaeological reports have listed shells alphabetically by genera and species within genera. This is convenient for the reader unfamiliar with zoology but has the disadvantage that closely related shells (e.g., *Arca* and *Noetia* or *Arcopagia* and *Tellina*) lie at different ends of the list, making discussions of the groups difficult and clumsy. As discussions will be rather lengthy, I have drawn up listings under families and genera in phylogenetic order, generally following the scheme used by Abbott (1954). Species within genera are listed in alphabetical order. For the convenience of readers to whom this ordering offers difficulty, an alphabetical index by genera and species is added at the end. Syno-

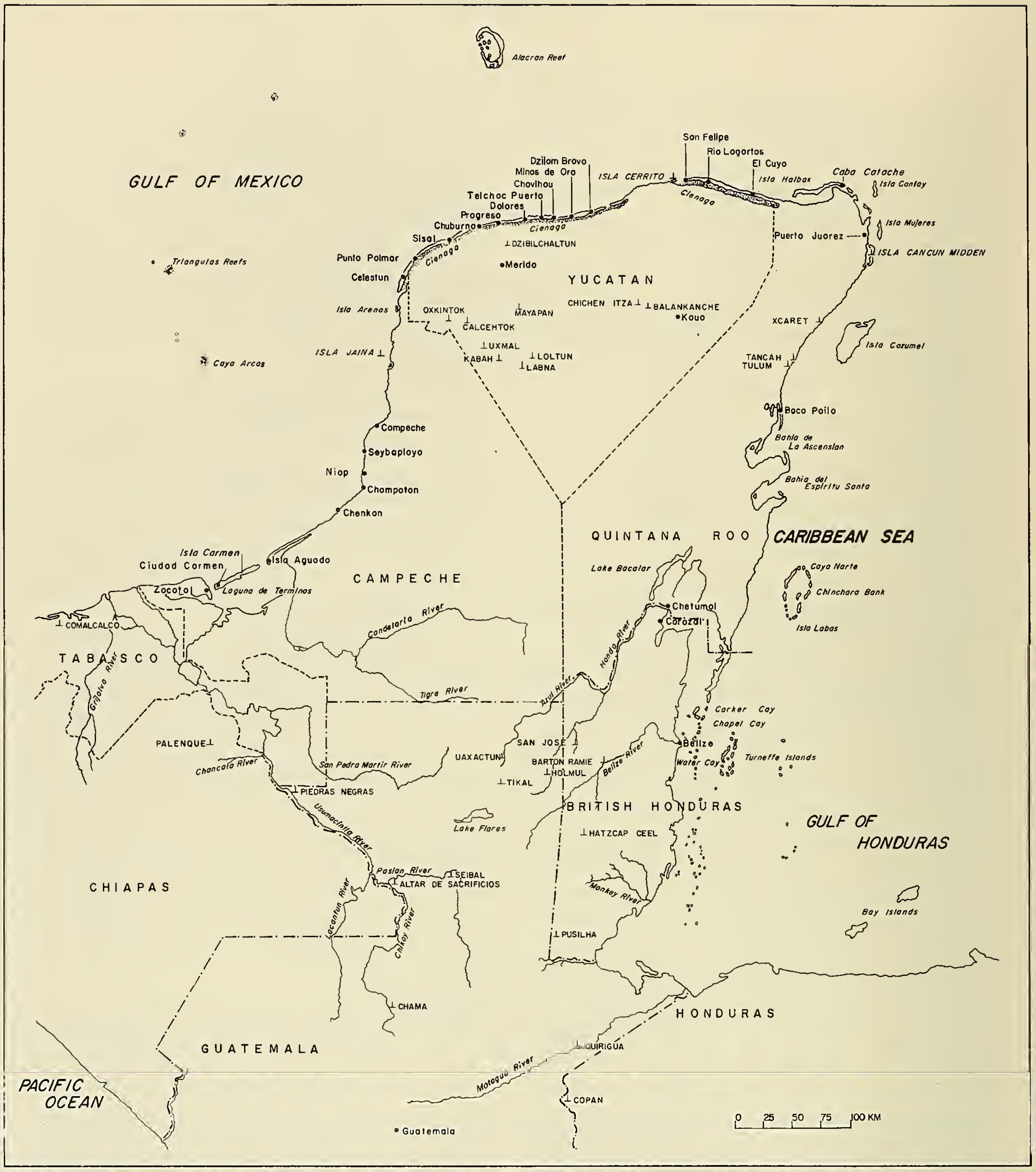


FIG. 1 — Map of the Maya area, showing locations mentioned in the checklists.

nyms have not been listed except when there is some confusion in the literature or recent change in taxonomy.

I had long felt that publication of photographs of often fragmentary unworked shells in archaeological field reports was an unnecessary expense, one which I intended to avoid. However, in the course of preparating this report, I realized that two factors made such illustration strongly desirable. First, during the continuous change and rearrangement which characterizes all zoological taxonomy, generic and specific terms rapidly become obsolete (e.g., of the 18 Atlantic molluscs listed on p. 61 of Kidder's *Artifacts of Uaxactun*, 11 of the names have become obsolete since publication in 1947). Often, without the actual specimen or a photograph at hand, it is difficult to be sure to which taxon these obsolete names refer.

Second, because of their poor preservation and sometimes fragmentary condition, identification of archaeological shells is often extremely difficult and errors are bound to occur. As reference collections and knowledge of the local fauna increase, these misidentifications may often be corrected, but only if the originals or clear photographs are at hand. For example, the large conch *Strombus costatus* is extremely common on the north coast of Yucatan. On the Caribbean coast of the peninsula, it is almost entirely replaced by the larger and quite distinct form *S. gigas*, which never appears on the north coast. At Dzibilchaltun, 486 identifiable *Strombus* shells and fragments were all of *costatus*, as would be expected from gathering on the nearby coast. Proskouriakoff (1962, pp. 384–85, figs. 43, 47), however, reported the common large conch at Mayapan to be *S. gigas*, which would imply a lack of access to the neighboring north coast and unnecessary trade in bulk with the Caribbean coast over 200 miles away across Quintana Roo. This, as we shall see below, would be in direct contradiction to much other evidence now on hand. Without illustration, the reader would be forced to accept this identification, but with Proskouriakoff's excellent illustrations the problem is quickly resolved. The specimens are clearly the north coast *costatus*, not the east coast *gigas*.

For these reasons, we are illustrating our collection and also going a step further. On plates 1–21, the archaeological specimens are designated by single lowercase italic letters (*a, b, c*). Where these are too fragmentary to give a proper impression of the shell, a complete specimen from our modern collection is added to the illustration beside the fragment it amplifies. These modern shells are designated by double lowercase italic letters (*aa, bb, cc*).

Some of the fragments illustrated may seem to be slim grounds for identification, but those published here are reasonably certain. A small fragment of hinge is usually sufficient for immediate identification of pelecypod genus and often species, and final identification can be often aided by a process of elimination. For example, a small part of the ligamental area of an ark shell identifies it as *Noetia*; there is only one species of *Noetia* known in American Atlantic waters; ergo our specimen is *N. ponderosa*. Similarly, a relatively tiny fragment of gastropod can often be precisely identified by comparison with purposely broken modern specimens from the area. We have been greatly helped by Harold and Emily Vokes, invertebrate palaeontologists from Tulane University, both specializing in Tertiary and Recent Mollusca. Their job, like the archaeologist's, has often required precise identification of fossil material from small fragments, so our problem was by no means new to them. They were kind enough to spend many days in the field with us working on the archaeological collections (in the course of many weeks helping with our present project), and have checked every identification presented in this discussion. Without their help, we would have been extremely hesitant to publish these pages. Thanks are also due to Dr. Alan Solem of the Field Museum of Natural History, who not only identified land and freshwater molluscs, but was kind enough to check in manuscript the corresponding two annexes to the checklist.

The modern distributions, unless otherwise noted, are strictly peninsular, not implying presence or absence in other adjacent or remote areas. They reflect only the specimens in our own collection; we have not yet collated the scattered peninsular reportings in malacological literature. As noted above, our collection of larger species has been sufficiently intensive to make most of the geographical listings approximately correct. But we must bear in mind that it is still only a *sampling* and that some species surely have a larger range on the peninsula than we have indicated.

Although some recent sources have attempted to distinguish between complete specimens and fragments, sometimes estimating the number of complete specimens represented by fragments, we decided not to attempt this distinction in the tabulations. The metric volume of our excavations, chosen for elucidation of stratigraphic or architectural problems (and frequently to enlarge the sample of rare ceramic forms), would almost never correspond to any definable percentage of total occupational debris which could make an estimate of the original number of entire specimens significant. This same volume is so insignificant in terms of the total surrounding deposits that there would be little hope of accuracy in attempting such an estimate. We have usually not, therefore, overcomplicated the summaries below by attempting to distinguish between "complete" specimens and fragments which might have been broken from them or matrices in nearby deposits. Where the discovery of whole shells has some significance in terms of votive, ornamental, or dietary function, we have tried to include this in the text. A precise record of each entire or broken shell or fragment is on file with the Middle American Research Institute of Tulane University, for the use of specialists desiring this information.

It should be noted that, in the tabulations, numbers of pelecypods always refer to single valves unless noted as pairs.

Fuller descriptions and extra-peninsular distributions of most of the Atlantic molluscs discussed may be found in Abbott (1954) and Warmke and Abbott (1961). All Pacific species mentioned are described in Keen (1958) and Olsson (1961, pelecypods only). These comprehensive works ably define the larger fauna which we only sample in our restricted area. Where we have occasionally deviated from the terminology used in such major studies, it has been because of recent taxonomic revisions or new material acquired locally. In this report, we have not wished to overburden the reader with taxonomic detail in justification of our identifications. If at times we seem to the professional zoologist to have presumed too much, may we ask provisional quarter until our larger study of the modern collections reaches print.

It has long been customary in malacological literature intended for others than specialists in the field to include the English popular name, despite the fact that, in the true meaning of the word, most shells do not have and never had popular names. These have often been made up by the specialist, sometimes by simply translating the Latin binomial (often with fascinating results, e.g. "Rigid Venus"), sometimes by reversing it, sometimes by using the name of the author of the species or the person in whose honor it was named (e.g. "von Salis' Triton," "Doc Bales' Ark"). In this area, of course, popular names would have been in Spanish or Maya. But normally differentiation of shells below the generic level would be of interest only to the malacologist. Terms of larger scope, usually of generic or family stature, are useful for popular identification. Therefore, we have, where feasible, placed popular names in parenthesis after the family headings; these are often descriptive of the particular genera listed in our area rather than of the family as a whole.

The following abbreviations indicate principal sources of comparative material:

C	— Coe, 1959
K	— Kidder, 1947
M	— Moholy-Nagy, 1963
M–MS	— Moholy-Nagy, manuscript notes
P	— Proskouriakoff, 1962
RR	— Ricketson and Ricketson, 1937
T	— Thompson, 1939
W	— Willey and others, 1965

Annotated Checklist of Marine Species

CLASS: *GASTROPODA*
FAMILY: FISSURELLIDAE (keyhole limpets)

Diodora cayenensis (Lamarck)
Illustration: Plate 1,*b*.
Modern distribution: Common on the entire periphery of the peninsula from Turneffe Islands, B.H., to Laguna de Terminos, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, from Cenote Xlacah, presumably an offering, undated.
TIKAL: 2 unworked, not dated (M–MS).

Diodora listeri (d'Orbigny)
Illustration: Plate 21,*aa*.
Modern distribution: North and east coasts, from Turneffe Islands, B.H., to Telchac Puerto, Yuc., and at Alacran Reef.
Archaeological occurrence:
TIKAL, 1 unworked, not dated (M, p. 67).

Fissurella barbadensis (Gmelin)
Illustration: Plate 1,*a*.
Modern distribution: Restricted to Caribbean coast of the peninsula, from Turneffe Islands, B.H., to Isla Contoy, Q.R.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, in unstratified deposit.
CHICHEN ITZA: 1 unworked, from Sacred Cenote (J. Ladd, personal communication)
TIKAL, 1 unworked, not dated (M–MS).

COMMENT: Limpets rare at Dzibilchaltun, Chichen Itza, and Tikal, not reported elsewhere, including Isla Cancun midden. Therefore they were probably not used for food, although common on rocky shores and delicious to eat. They may have been strung through "keyhole" as jewelry. More probably they were collected for pleasure or as a votive offering. If identification of Dzibilchaltun *Fissurella* is correct, this is one of the few shells not reported from adjacent beaches in the archaeological fauna of the site.

FAMILY: TROCHIDAE (top shells)

Calliostoma jujubinum (Gmelin)
Illustration: Plate 1,*c*,*cc*.
Modern distribution: East coast of the peninsula, from Belize, B.H., to Isla Contoy, Q.R., also Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Cittarium pica (Linné)
Illustration: Plate 1,*d*,*dd*.
Modern distribution: Very common on east coast from Belize, B.H., to Isla Contoy, Q.R. Not seen on north or west coasts.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, in unstratified deposit.
ISLA CANCUN MIDDEN: 364, unworked, Formative.
TIKAL: 1 unworked, not dated; 2 perforated for suspension, both Classic (M–MS).
PIEDRAS NEGRAS: 1 unworked, Late Classic cache (C, pp. 55, 82, as "*Livona pica*," which is this species).

COMMENT: Discarded magpie shells (*Cittarium pica*) are favored for reoccupation by the hermit crab, and are frequently found in the coconut trees of the east coast plantations. The actual sea snail, locally known as *sigua*, is eaten extensively by the coastal population, either raw or cooked as soup, which is delicious.

FAMILY: TURBINIDAE (star shells)

Astraea caelata (Gmelin)
Illustration: Plate 1,*e*,*ee*.
Modern distribution: Common on Caribbean coast from Turneffe Islands, B.H., to Isla Cancun, Q.R., and on offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Astraea phoebia Röding [=*A. longispina* Lamarck]
Illustration: Plate 1,*f*,*ff*.
Modern distribution: Common on all coasts, from Turneffe Islands, B.H., to Isla Carmen, Camp., and on offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 4 unworked, Formative.

Astraea tecta americana (Gmelin)
Illustration: Plate 1,*g*.
Modern distribution: Common on east and north coasts, from Turneffe Islands, B.H., to Sisal, Yuc., and on offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

COMMENT: It is strange that these common and often strikingly beautiful shells were not more widely collected and traded in ancient times.

FAMILY: NERITIDAE (nerites)

Nerita fulgurans Gmelin
Illustration: Plate 2,*aa*,*aa'*.
Modern distribution: Southern part of west coast, from Isla Carmen to Champoton, Camp.; not collected farther north; absent on north and east coasts.
Archaeological occurrence:
MAYAPAN: (?) "several examples," both pierced and unpierced, probably Decadent period (P, p. 387, fig. 44, *b*,*g*).
TIKAL: 3 unworked, not dated (M–MS).

COMMENT: It can be seen from the above modern distribution that if Proskouriakoff's identification is correct, these must be trade pieces from southern Campeche. Her photographs are of the backs of shells, and two of the three are very unclear. The third (fig. 44,*g*) looks much more like *N. tessellata* (see below), lacking the much finer spiral cording which distinguishes *fulgurans* from this species. We are handicapped in identification by the usually complete loss in archaeological specimens of the strong color patterns which characterize the various nerites. We suggest, however, that the Mayapan specimens are *N. tessellata*, thus placing their provenience in the same geographical province as the other molluscan fauna of the site.

Nerita peloronta Linné
Illustration: Plate 2,*c*,*cc*.
Modern distribution: Common on Caribbean coast and the offshore atolls only; Boca Paila to Isla Contoy, Q.R.; Alacran Reef, Cayo Arcas.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 20 unworked, Formative.

Nerita tessellata Gmelin
Illustration: Plate 2,*b*,*b'*.
Modern distribution: Common on the Caribbean coast and the offshore atolls, Turneffe Islands, B.H., to Isla Contoy, Q.R.; Alacran Reef and Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: (?) 1 unworked, Formative, a damaged specimen with 3 rather than the 2 parietal teeth usually characterizing this species.
MAYAPAN: See *N. fulgurans*, comment.
ISLA CANCUN MIDDEN: 2 unworked, Formative.
UAXACTUN: 1 unworked, in late Classic stela cache (RR, p. 199, pl. 67,*e*,15; also K, p. 61; listed in both sources as "*Nerita praecognita* C. B. Adams," a West Indian variety of *tessellata*. This specimen is probably the latter, which is common on the nearby Caribbean shore.

Nerita versicolor Gmelin
Illustration: Plate 2,*d*,*dd*.
Modern distribution: Common on Caribbean coast only. Turneffe Islands, B.H., to Isla Contoy, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 96 unworked, Formative.
TIKAL: 5 unworked, not dated (M–MS).

Neritina meleagris Lamarck
Illustration: Sowerby, 1841, pl. 94.
Modern distribution: Not collected in peninsular waters.
Archaeological occurrence:
SAN JOSE: 24 unworked, from S.J. IV cache (T, p. 180).

Neritina virginea (Linné)
Illustration: Plate 2,*e*,*ee*.
Modern distribution: Common along entire littoral of the peninsula, from Turneffe Islands to Isla Carmen; also on the offshore atolls.
Archaeological occurrence:
DZIBILCHALTIN: 1 unworked, Formative.
MAYAPAN: Proskouriakoff mentions "one *Neritina* specimen of unidentified species has a large round hole" (P, p. 387). As *virginea* is the only species reported from peninsular waters, it is most probably this.
SAN JOSE: 1 unworked specimen in cache vessel, S.J. IV (Late Early period) (T, p. 180).

Comment: The inland Neritas and Neritinas were probably collected for votive purposes (surely at San Jose) or curiosity. The larger nerites from the Cancun midden were probably used for food. I am told they make a very tasty broth. They are abundant along the Caribbean, thus very easy to collect for food. They are rare, as are the rocks they grow on, along the sandy shelf of the north coast. Numerous shore specimens were perforated by the drill holes of a number of predators. It is very difficult to distinguish these perforations from those made by the ancients for purposes of suspension.

Family: LITTORINIDAE (periwinkles)

Littorina ziczac (Gmelin)
Illustration: Plate 2,*h*,*hh*.
Modern distribution: Caribbean coast from Turneffe Islands, B.H., to Isla Contoy, Q.R. Absent on north coast. Collected at Seybaplaya, Camp.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Nodilittorina tuberculata (Menke)
Illustration: Plate 2,*f*,*ff*.
Modern distribution: East coast only. Tulum to Cozumel, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Echininus nodulosus (Pfeiffer)
Illustration: Plate 2,*g*,*g′*.
Modern distribution: East coast only. Turneffe Islands, B.H., to Isla Contoy, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

Tectarius muricatus (Linné)
Illustration: Plate 2,*i*,*i′*.
Modern distribution: East coast only. Turneffe Islands, B.H., to Isla Contoy, Q.R. Also at Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 4 unworked, in Florescent cache. 1 unworked in unstratified deposit.
ISLA CANCUN MIDDEN: 11 unworked, Formative.

Comment: The *Tectarius* specimens from Dzibilchaltun were probably traded from the Quintana Roo coast for votive purposes. The littorinids from Isla Cancun may well be intrusive in the midden deposits, as these molluscs live in the "spray zone" above high-tide limit, and often climb the distance from the water to the present height of the midden. If used for food, they would have been found in much greater quantities in the midden.

Family: TURRITELLIDAE (turret shells)

Petaloconchus irregularis (d'Orbigny)
Illustration: Plate 3,*a*.
Modern distribution: Uncertain, as not thoroughly collected. Reported at a number of stations from Belize to Tancah, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 4 unworked, Formative, possibly intrusive on larger shells in Midden.

Family: SILIQUARIIDAE (worm shells)

Vermicularia spirata Philippi
Illustration: Plate 3,*c*,*cc*.
Modern distribution: All three coasts, from Isla Mujeres, Q.R., to Chencan, Camp. Also at Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, in cache container, Late Early period. (Lacks tiny coiled spire, as do most beach specimens. Therefore might also be *V. knorri* Deshayes, distinguished only by white spire instead of brown as on this species.)
TIKAL: "Various fragments, representing about 31 unmodified valves, 19 occurrences" (M, p. 67, age not noted.)
PIEDRAS NEGRAS: Found in two Early period caches (C, p. 55).

Family: PLANAXIDAE (planaxis)

Planaxis nucleus (Bruguière)
Illustration: Plate 3,*b*,*bb*.
Modern distribution: Caribbean coast only. Turneffe Islands, B.H., to Isla Contoy, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

FAMILY: MODULIDAE (modulus)

Modulus modulus (Linné)
Illustration: Plate 21,*ee*.
Modern distribution: Common on all three coasts, from Turneffe Islands, B.H., to Isla Carmen, Camp. Also found on the offshore atolls.
Archaeological occurrence:
TIKAL: 1 unworked (M–MS).

FAMILY: CERITHIIDAE (ceriths)

Cerithium eburneum Bruguière
Illustration: Plate 3,*d*,*dd*.
Modern distribution: Common on entire periphery of peninsula, from Turneffe Islands, B.H., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked among Formative burial offerings; 1 unworked from Formative deposit same structure (605); 1 unworked in crypt of double child burial, Late Early period.
ISLA CANCUN MIDDEN: 3 unworked, Formative.

Cerithium floridanum Mörch
Illustration: Plate 3,*ee*.
Modern distribution: Common on entire periphery of peninsula, from Water Cay, B.H., to Isla Carmen, Camp.
Archaeological occurrence:
UAXACTUN: 1 unworked from Classic stela cache (RR, p. 199, pl. 67,*e*,16). This is presumably the same shell listed by Kidder (K, p. 61).

Cerithium literattum (Born)
Illustration: Plate 3,*f*.
Modern distribution: Common on east coast, from Turneffe Islands, B.H., to Isla Contoy, Q.R. and on offshore atolls. Rare on north coast; 1 specimen from Telchac Puerto, Yuc.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

Cerithium maculosum Kiener
Illustration: Keen, 1958, fig. 211.
Modern distribution: Pacific.
Archaeological occurrence:
TIKAL: 1 unmodified, not dated (M, p. 67).

Cerithium variabile C. B. Adams
Illustration: Warmke and Abbott, 1961, pl. 13,*w*.
Modern distribution: Very common on entire coast of peninsula, from Turneffe Islands, B.H., to Ciudad Carmen, Camp., and on offshore atolls.
Archaeological occurrence:
SAN JOSE: 1 unworked, in S.J. IV cache (T, p. 180, identified as *C. lutosum* var. *eriense*, which is probably this species).

COMMENT: The inland specimens clearly destined for votive use. Cancun midden specimens might have been discards from collections made for this purpose.

FAMILY: CALYPTRAEIDAE (cup-and-saucers, slipper shells)

Crucibulum auriculum (Gmelin)
Illustration: Plate 3,*i*,*ii*.
Modern distribution: Common on entire littoral of peninsula from Water Cay, B.H., to Isla Carmen, Camp. Also offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative. Possibly intrusive on some larger shell.
TIKAL: 22 unmodified (M, p. 67, archeological context not noted).

Crucibulum spinosum (Sowerby)
Illustration: Keen, 1958, fig. 254.
Modern distribution: Pacific.
Archaeological occurrence:
PIEDRAS NEGRAS: 1 unworked, Late Classic cache (C, p. 55).

Crepidula aculeata (Gmelin)
Illustration: Plate 3,*hh*.
Modern distribution: Common from Isla Contoy, Q.R., to Isla Carmen, Camp.
Archaeological occurrence:
TIKAL: 35 unmodified (M, p. 67, archaeological context not noted).

Crepidula fornicata (Linné)
Illustration: Plate 3,*g*,*gg*.
Modern distribution: Common, from Isla Mujeres, Q.R., to Isla Carmen, Camp.

Archaeological occurrence:

DZIBILCHALTUN: 3 unworked in cache, Late Early period, might have been intrusive on large *Strombus* included in cache.

ISLA CANCUN MIDDEN: 1 unworked, Formative.

TIKAL: 8 unmodified (M, p. 67, archaeological context not noted).

Comment: Although presence in caches at Dzibilchaltun might have been accidental, the considerably larger number found at Tikal would indicate intentional offerings of these unspectacular shells.

Family: STROMBIDAE (conchs)

Strombus costatus Gmelin

Illustration: Plate 4,*b*.

Modern distribution: This is the common conch of the sandy north-coast beaches. On the east coast, it becomes rare from Holbox south, largely replaced by *S. gigas* and others. On the northwest and west coasts it becomes rarer, largely replaced by *S. pugilis*. However, it is found as far south as Niop, Camp., on the west coast, and Isla Lobos, Chinchorro Bank on the east coast. Also found at Alacran Reef.

Archaeological occurrence:

DZIBILCHALTUN: 412 unworked, 74 worked from all periods (see Table 2). Used as tomb or cache offerings, and as materials for jewelry and artifacts.

MAYAPAN: Proskouriakoff (P, pp. 384–85) lists 10 complete, 9 cut spires, and 72 "altered fragments," presumably mostly Decadent period, all identified as *S. gigas*. She notes their use as "trumpets" and as raw material for a variety of artifacts. As this is the commonest as well as the heaviest shell at the site, strong trade with the Caribbean coast would be implied. However, her illustrations (figs. 43, 47) show that this shell is *S. costatus*, probably from the nearby shore.

ISLA CANCUN MIDDEN: 493 unworked, Formative.

Strombus gigas Linné

Illustration: Plate 4,*a*,*aa*.

Modern distribution: This is the common conch along the Caribbean coast, from Turneffe Islands to Isla Contoy, Q.R. Unreported on the north and west coasts; prevalent on offshore atolls.

Archaeological occurrence:

ISLA CANCUN MIDDEN: 1,871 unworked, Formative. (Does not include 1,022 undifferentiated fragments of *Strombus* which might have been either *costatus* or *gigas*).

BARTON RAMIE: 37 unworked and worked fragments, all but 1 are Classic or Postclassic (W, pp. 526, 528).

TIKAL: 1 unworked "probably *gigas*," not dated (M–MS).

UAXACTUN: 5 specimens with body whorl removed, then pierced below shoulder for suspension, numerous other unworked fragments, presumably Classic (RR, p. 199, pl. 68,*a*). Kidder K, p. 61) lists the species, perhaps on RR material, but gives no further data.

Strombus pugilis Linné

Illustration: Plate 4,*c*.

Modern distribution: This is the common conch of the northwest and west coasts. West of Chuburna, it gradually replaces *S. costatus*. It is rare east of Progreso, and has been reported only as far south as Isla Mujeres on the Caribbean. It also occurs on the offshore atolls.

Archaeological occurrence:

DZIBILCHALTUN: 1 unworked fragment, Formative.

MAYAPAN: 1 with "cut spire," presumably Decadent period (P, fig. 47,*h*, not in text).

ISLA CANCUN MIDDEN: 1 unworked, Formative.

CHICHEN ITZA: 1 damaged specimen from the Sacred Cenote, possibly worked (J. Ladd, personal communication).

BARTON RAMIE: 1 perforated near columella for suspension, broad groove cut from perforation to shoulder on body whorl, Classic period (W, p. 507, fig. 510,*l*).

SAN JOSE: 1 unworked, with burial "perhaps S.J. II" (T, p. 180; this shell is illustrated and further described in Richards and Boekelman, 1937, p. 169, pl. 6, no. 7).

UAXACTUN: "One complete shell was the only object found under Stela 5, Group B" (RR, p. 199); "a massive pendant made from the [perforated columella] of a large *S. pugilis*" (RR, p. 201, pl. 69,*d*,2; archaeological context not noted). Ricketson suggests that several of the crude Early

Classic figurines from the site were made from the body whorl of this shell. One unworked specimen, Chicanel, one unworked specimen, Tzakol 1 (K, p. 61).

Strombus raninus Gmelin
Illustration: Plate 4,*d*.
Modern distribution: Common on Caribbean coast from Turneffe Islands, B.H., to Isla Contoy, Q.R., and the offshore atolls. Unreported from north and west coasts.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 57 unworked, Formative.

COMMENT: The striking all-year abundance of conchs on the entire Yucatan coast, especially the Caribbean littoral and the offshore atolls, offered a plentiful supply of food in return for a minimum of labor. *S. gigas* and *S. costatus* are still eaten with relish from British Honduras to Tabasco (and delightedly by me), raw with spices, shredded and boiled as a broth, or fried in oil as "biftec de concha." The smaller *S. raninus* (which I have not sampled) was obviously eaten in Formative days at Cancun.

The ponderous shells were probably stripped of their small animals (as they are today) before the meat was shipped inland, leaving the shells to form coastal middens. In the inland cities, which surely enjoyed the meat, the shells served as the most important single material in the manufacture of jewelry and a variety of small artifacts.

FAMILY: CYPRAEIDAE (cowries)

Cypraea cervus Linné
Illustration: Plate 5,*a*,*aa*.
Modern distribution: Rare, on north coast only. One specimen each from Chavihau and Sisal, Yuc.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked fragment in Formative deposit.
ISLA CANCUN MIDDEN: 1 unworked in Formative deposit.
TANCAH, Q.R.: 1 outer lip, apparently unworked (illustrated but not identified in Sanders, 1960, fig. 19 *b*, 14, called "ornament (?) of shell"; this might be *C. zebra*).

Cypraea cinerea Gmelin
Illustration: Plate 5,*d*,*dd*.
Modern distribution: Common on Caribbean coast, Turneffe Islands, B.H., to Isla Contoy, Q.R., and on offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 10 unworked, Formative.

Cypraea zebra Linné
Illustration: Plate 5,*c*,*cc*.
Modern distribution: Common on east coast from Turneffe Islands, B.H., to Isla Contoy, Q.R. Also Cayo Arcas.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 39 unworked, Formative.
BARTON RAMIE: 2 unworked, one Formative (Barton Creek), one Protoclassic (Floral Park) (W, pp. 526, 528).
TIKAL: 5 unworked, "either *zebra* or *cervinetta*," the latter a Pacific species (M–MS).

COMMENT: It is odd that the cowry, which was used in so many parts of the world for ornaments or for money, seems to have been of little interest to the ancient Maya. The numerous specimens from Cancun were probably collected as food.

FAMILY: OVULIDAE

Cyphoma gibbosum (Linné)
Illustration: Plate 5,*b*,*bb*.
Modern distribution: Uncommon on Caribbean coast, from Turneffe Islands, B.H., to Isla Contoy, Q.R. Also offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.
HOLMUL: 4, all with 2 holes pierced on back for suspension (Merwin and Vaillant, 1932, pl. 35,*z*, not mentioned in text).
TIKAL: 5, perforated, four from Early Classic cache, one from Late Formative (Cauac) tomb (M–MS, "*Cyphoma*, probably Atlantic," therefore probably this species); 7, unworked, undated (M–MS, "*Cyphoma* sp.," probably this species).
UAXACTUN: 1, with 2 perforations broken through wall (K, p. 62).

Family: NATICIDAE (moon shells)

Polinices duplicatus (Say)
Illustration: Plate 3,*j*,*j'*.
Modern distribution: Southwest coast only, from Chencan to Isla Carmen.
Archaeological occurrence:
TIKAL: 2 pierced for suspension, one Formative (Chuen), one probably Late Classic (M–MS).

Polinices hepaticus (Röding)
Illustration: Plate 3,*l*,*l'*.
Modern distribution: East coast only, from Turneffe Islands, B.H., to Isla Mujeres, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Polinices lacteus (Guilding)
Illustration: Plate 3,*k*,*kk*.
Modern distribution: Common on Caribbean coast only, from Turneffe Islands, B.H., to Isla Contoy, Q.R. Also the offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 9 unworked, Formative.

Natica canrena (Linné)
Illustration: Plate 6,*jj*.
Modern distribution: Common on entire periphery of the peninsula from Belize, B.H., to Isla Aguada, Camp. Also at Alacran Reef.
Archaeological occurrence:
MAYAPAN: Probably Decadent period, 3 "pierced" specimens (P, p. 387, fig. 44,*e*).
CHICHEN ITZA: "6, one of these cut at base, two with large round holes, two perforated" (P, p. 422, archaeological context not noted).

Family: CASSIDIDAE

Morum oniscus (Linné)
Illustration: Plate 6,*dd*,*dd'*.
Modern distribution: Uncommon on east coast, from Turneffe Islands, B.H., to Cancun, Q.R., and on west coast (Chencan, Camp.). Also found on the offshore atolls.
Archaeological occurrence:
BALANKANCHE: 1 tinkler, spire and shoulder cut off, drilled perforation at base, age uncertain (Andrews, 1969, p. 54, fig. 55, *d*).

Morum tuberculosum (Reeve)
Illustration: Keen, 1958, fig. 316.
Modern distribution: Pacific.
Archaeological occurrence:
PIEDRAS NEGRAS: 1 tinkler, spire and shoulder removed and base perforated, probably Classic (C, pp. 55, 57, fig. 52,*n*).
SAN JOSE: 1, in S.J. V tomb (T, pp. 180–1, "as *Lambidium tuberculosa morum*," which is this species).

Comment: It is strange to find the Pacific species at San Jose and Piedras Negras when the almost identical Atlantic form was to be obtained so near to both sites. Separation of highly altered specimens into the two species is precarious. Identification of the Balankanche tinkler was influenced by geographic provenience; it might also have been the Pacific species.

Phalium granulatum (Born)
Illustration: Plate 6,*b*,*bb*.
Modern distribution: Isla Cancun and Isla Mujeres, on east coast only.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 6 unworked, Formative.

Phalium inflatum (Shaw)
Illustration: Plate 6,*a*,*aa*.
Modern distribution: North and west coasts only, from Isla Holbox, Q.R., to Isla Carmen. Also Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: 1 fragment, unworked in Formative debris.
MAYAPAN: Proskouriakoff (P, p. 387, fig. 47,*v*) lists "*Phalium* sp.," which is probably *inflatum*, as this is the only north-coast species, and is very closely resembled by her illustration.
COPAN: Longyear (1952, fig. 94,*d*) illustrates what is probably a shell of this genus. It is not mentioned in the text.

Comment: Large samples of both these species on the east and north coasts show neither geographical overlap nor morphological intergrading. They differ in that *P. granulatum* is about half the size of *inflatum*, is relatively much heavier and thicker-shelled, strongly cancellate rather than spiral sculpture, and in adult specimens has a strong former varix roughly opposite the aperture.

Cassis madagascariensis Lamarck
Illustration: Warmke and Abbott, 1961, pl. 1,*f*.
Modern distribution: East coast, Corker Cay, B.H., to Isla Mujeres, Q.R.
Archaeological occurrence:
TIKAL: 2 unworked, "probably *madagascariensis*," undated (M–MS).

Cassis tuberosa (Linné)
Illustration: Plate 11,*a*.
Modern distribution: East coast, from Turneffe Islands, B.H., to Isla Contoy, Q.R. Also Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 36 unworked, Formative.
SAN JOSE: 1 artifact of *Cassis*, "probably *tuberosa*," S.J. III (T, p. 181, pl. 28,*c*).
TIKAL: 1, slightly altered, probably Late Classic debris (M–MS).

Cypraecassis testiculus (Linné)
Illustration: Plate 6,*c*,*cc*.
Modern distribution: East coast, from Turneffe Islands, B.H., to Isla Contoy, Q.R. Also Cayo Arcas.
Archaeological occurrence:
MAYAPAN: 1 fragment, unworked, probably Decadent period (P, p. 387).
ISLA CANCUN MIDDEN: 11 unworked, Formative.

FAMILY: CYMATIIDAE (tritons)

Charonia variegata (Lamarck) [= *C. tritonis nobilis* (Conrad)]
Illustration: Plate 7,*a*.
Modern distribution: Frequent on east coast from Belize to Isla Mujeres. A single shell from Chavihau on north coast. Also found on offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 7 unworked, Formative.

Cymatium femorale (Linné)
Illustration: Plate 7,*b*,*bb*.
Modern distribution: Rare. East coast from Turneffe Islands, B.H., to Isla Mujeres. El Cuyo on northeast coast. Alacran Reef.
Archaeological occurrence:
MAYAPAN: 1 unworked, "from a house mound cist, together with smaller perforated shells," Decadent period (P, p. 387, fig. 47,*n*).
ISLA CANCUN MIDDEN: 2 unworked, Formative.
BARTON RAMIE: 1 unworked, Classic (W, p. 526).

Cymatium parthenopeum (von Salis)
Illustration: Plate 7,*c*,*cc*.
Modern distribution: Uncommon on all three coasts, from Isla Mujeres to Isla Carmen.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, from Cenote Xlacah, probably thrown in as offering. Not datable.
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Cymatium pileare (Linné) [= *C. martinianum* (d'Orbigny)]
Illustration: Plate 7,*d*,*dd*.
Modern distribution: Uncommon on all east and north coasts and on the offshore atolls. Turneffe Islands, B.H., to Punta Palmar, Yuc.
Archaeological occurrence:
DZIBILCHALTUN: 1 perfect specimen, unworked, in Late Early period deposit.
ISLA CANCUN MIDDEN: 1 unworked, Formative.

FAMILY: TONNIDAE (tun shells)

Tonna galea (Linné)
Illustration: Plate 7,*f*,*ff*.
Modern distribution: Rare on east and north coasts, and at Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

Tonna maculosa (Dillwyn)
Illustration: Plate 7,*e*,*ee*.
Modern distribution: More common on east coast from Turneffe Islands to Isla Contoy. Collected at Chavihau and Sisal on north coast, and at Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 4 unworked, Formative.

COMMENT: Taken for food?

FAMILY: FICIDAE (fig shells)

Ficus communis Röding
Illustration: Plate 7,*g*.
Modern distribution: Common on east coast south to Isla Mujeres, north coast and west coast to Isla Carmen.
Archaeological occurrence:
DZIBILCHALTUN: 96 unworked; most datable specimens are Formative (see Table 2).
MAYAPAN: 3 unworked, presumably Decadent period (P, p. 387, fig. 47,*q*, "*Ficus papyratia* Say," which is this species).
ISLA CANCUN MIDDEN: 2 unworked, Formative.

COMMENT: The frequency of this very delicate shell at Dzibilchaltun, particularly in the Formative deposits, suggests that it may have been used as food. The shell is so thin that it could have had no use as material for jewelry or other artifacts.

FAMILY: MURICIDAE (murex)

Murex dilectus A. Adams
Illustration: Plate 8,*cc*.
Modern distribution: East coast north of Isla Cancun, north coast, and west coast to Isla Carmen, also at Alacran Reef. Fairly common.
Archaeological occurrence:
TIKAL: 3 unworked (M, p. 67, "*Murex*, probably *florifer* Reeve," archaeological context not noted).

COMMENT: Emily Vokes called to my attention that all our peninsular specimens of this form were the above species, not *M. florifer* Reeve, a larger and much heavier, although related, form. It is strange that this beautiful and fairly common shell has not appeared in the Yucatan archaeological collections.

Murex fulvescens Sowerby
Illustration: Plate 8,*a*,*aa*.
Modern distribution: A fragment of this species was found by Emily and Harold Vokes at Isla Carmen, Campeche. It has not been collected elsewhere on the peninsula. Abbott (1954) gives its distribution as "North Carolina to Florida and to Texas."
Archaeological occurrence:
CHICHEN ITZA: 1 unworked, found by me on surface in area of Modified Florescent construction.

COMMENT: Location in Modified Florescent area at Chichen Itza would fit well with its apparent importation from the western Gulf coast.

Murex pomum Gmelin
Illustration: Plate 8,*b*,*bb*.
Modern distribution: The common *Murex* on the entire peninsular periphery; Turneffe Islands, B.H., to Isla Carmen, Camp. Also on offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, in the Cenote Xlacah, probably as an offering. Undatable.
ISLA CANCUN MIDDEN: 2 unworked, Formative.
TIKAL: 1 unworked in Early Classic structure cache (M–MS).
UAXACTUN: 1 unworked, Tzakol (K, p. 61).

COMMENT: In 1964 this species was collected and used for food by natives at Corker Cay, B.H.

Murex rubidus Baker
Illustration: Plate 21,*dd*.
Modern distribution: Rare on west coast only. Celestun, Yuc., to Chencan, Camp.
Archaeological occurrence:
TIKAL: 1 unworked, as "*Murex recurvirostris*" (M–MS).

COMMENT: *M. rubidus* was originally called *M. recurvirostris rubidum* F. C. Baker, the local form of this species. It has recently been given specific status.

Purpura patula (Linné)
Illustration: Plate 8,*e*.
Modern distribution: Common on Caribbean coast, from Turneffe Islands, B.H., to Isla Contoy, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Thais deltoidea (Lamarck)
Illustration: Plate 8,*ff*.
Modern distribution: Caribbean coast, Cozumel to Isla Contoy. Cayo Arcas.

Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Thais rustica (Lamarck)
Illustration: Plate 8,*d*,*dd*.
Modern distribution: Caribbean coast only, from Turneffe Islands, B.H., to Isla Contoy, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

FAMILY: COLUMBELLIDAE (dove shells)

Columbella mercatoria (Linné)
Illustration: Plate 6,*e*.
Modern distribution: Entire littoral of peninsula, Turneffe Islands to Isla Carmen. Offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 2 unworked, Formative.
ISLA CANCUN MIDDEN: 1 unworked, Formative.
SAN JOSE: 2 unworked, in cache vessel, S.J. IV (T, p. 180).
TIKAL: 2 unworked, not dated; 1 perforated, Early Classic, 1 perforated, Classic (M–MS).

FAMILY: BUCCINIDAE

Cantharus auritulus (Link)
Illustration: Plate 6,*g*.
Modern distribution: Collected at Isla Mujeres and Isla Cancun only.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

FAMILY: MELONGENIDAE (crown conchs, whelks)

Melongena corona (Gmelin)
Illustration: Plate 10,*b*,*b'*.
Modern distribution: Common on all three coasts, from Boca Paila, Q.R., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 226 unworked, all but seven of known age were Formative.
MAYAPAN: 1 unworked, probably Decadent period (P, p. 387, fig. 47,*s*, called "*M. bispinosa* Philippi," which is this species. I agree with Abbott (1954, p. 234) that *bispinosa* is not a valid species. Proskouriakoff's specimen is clearly *corona*).
ISLA CANCUN MIDDEN: 555 unworked, Formative.

Melongena melongena (Linné)
Illustration: Plate 10,*a*,*a'*.
Modern distribution: Common on all coasts from Turneffe Islands, B.H., to Isla Carmen.
Archaeological occurrence:
DZIBILCHALTUN: 135 unworked, all but one datable example in Formative deposits (Table 2).
ISLA CANCUN MIDDEN: 1 unworked, Formative.
BARTON RAMIE: 1, unworked, Classic (W, pp. 504, 526).
TIKAL: 5 unworked, undated; 5 slightly altered, four of these Early Classic (M–MS).
UAXACTUN: 1 worked, Tzakol, three sawed cuts in form of an H perforated in body whorl near orifice, probably intentionally imitating the perforation of hollow logs in the making of the ancient drum, or *tunkul* (K, pp. 61, 62, fig. 48).

COMMENT: Except for the single example from Uaxactun and the 5 from Tikal which were "slightly altered", none of the 925 archaeological specimens of this genus were worked. The whorls are so thin that only on exceptionally large specimens would the shell be of any use as material. At Dzibilchaltun both species were found as offerings at Cenote Xlacah, and are common in votive caches during the Formative. The enormous quantities present at Dzibilchaltun and Isla Cancun leave no doubts that this mollusc was an important source of food.

The almost total absence during later deposits, in contrast to its abundance in the Formative (see Table 2), is a striking example of the change in usage over time at the site.

Busycon coarctatum (Sowerby)
Illustration: Plate 9,*c*,*cc*.
Modern distribution: Uncommon on east and north coasts from Isla Mujeres, Q.R., to Punta Palmar, Yuc., and at Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked juvenile specimen, found under floor of Late Early period vaulted building.
ISLA CANCUN MIDDEN: 4 unworked, Formative.

Busycon contrarium (Conrad)
Illustration: Plate 9,*a*,*aa*.
Modern distribution: Rare on east coast at Isla Mujeres and Isla Contoy. Common on north coast from Isla Holbox to Sisal. Rarer on northwest and west coasts from Sisal to Isla Carmen, where it is largely replaced by *B. perversum*. Collected at Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 118 unworked, largely from Formative (see Table 2); 9 worked fragments, 8 from Formative and Copo complex deposits, where it was used in the manufacture of jewelry.
MAYAPAN: 2 specimens, probably Decadent period, unworked (P, p. 387, fig. 47,*o*, listed as *B. perversus* but clearly from photograph it is this species).
GRUTA DE OXKINTOK: 1 unworked, in deposits dated by Brainerd as Florescent (identified by Mercer as "*Fulgur perversum* Linné var. *coarctatum* Sowerby"; photograph shows this sinestral shell is *B. contrarium* whereas *coarctatum* is dextral. Cf. Mercer, 1896, pp. 47, 53, 173–74, figs. 17, 18; Hatt and others, 1953, p. 111).
ISLA CANCUN MIDDEN: 581 unworked, Formative.
TIKAL: 2 unworked (M, p. 67, also listed as *perversum*; she also lists "about 105, tiny, immature, unmodified" as *Busycon* sp., which may be this shell); 2 cut fragments, one of which is late Classic (M–MS).
UAXACTUN: 1 unworked, in Chicanel deposit (K, p. 61, as *perversum*).

Busycon perversum (Linné)
Illustration: Plate 9,*b*,*bb*.
Modern distribution: Common from Progreso on western north coast to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, Formative.

COMMENT: *B. contrarium* and *perversum* are different species on the peninsula, the former the "normal" form, the latter characterized by a much heavier shell and a strong swollen ridge about the middle of the body whorl in semimature to mature specimens. This difference cannot be detected in juveniles, which are much commoner than the adult shell, and is often impossible to distinguish in smaller fragments. These doubtful specimens have been assigned to the locally common species *contrarium* in the above tabulations. We have followed the taxonomy of Abbott (1954, p. 236).

Busycon spiratum (Lamarck)
Illustration: Plate 9,*d*,*dd*.
Modern distribution: Common on all three coasts, from Isla Mujeres, Q.R., to Isla Carmen, Camp. Also at Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: 12, unworked, in most periods (see Table 2); one found in Late Early period cache.
MAYAPAN: 1 unworked, probably Decadent period (P, p. 387, fig. 47,*p*, as *B. pyrum* Dillwyn, which is this species).
LABNA: 1, pierced near base for suspension, otherwise unworked, probably Pure Florescent (E. H. Thompson, 1897b, pl. X, 18, illustrated but not identified).
ISLA CANCUN MIDDEN: 19 unworked, Formative.

FAMILY: NASSARIIDAE (mud snails)

Nassarius vibex (Say)
Illustration: Plate 6,*ff*.
Modern distribution: In or near swamp areas on all three coasts, from Turneffe Islands, B.H., to Chencan, Camp., and Cayo Arcas.
Archaeological occurrence:
UAXACTUN: 1, drilled with single hole for suspension, Tepeu; found with lot of *Prunum apicinum virgineum* and a single *Oliva reticularis*, also with a single perforation (K, p. 61, as "*Nassa vibex*").

FAMILY: FASCIOLARIIDAE (tulips, horse conchs, latirus)

Fasciolaria hunteria (Perry)
Illustration: Plate 10,*c*,*cc*.
Modern distribution: Collected only on north coast of Yucatan, Celestun, and the Alacran Reef.
Archaeological occurrence (the following occurrence is outside modern known habitat, although Cancun was very heavily collected):
ISLA CANCUN MIDDEN: 1 unworked, Formative.
UAXACTUN: The Ricketsons report one "*Fasci-*

olaria distans Lam." with two perforations for suspension, in Chultun 3 (RR, pp. 199–200, probably repeated in K, p. 61). This may be *F. hunteria* (see comment below).

Comment: Regarding confusion of *F. hunteria* and related forms, see Hollister, 1957. There is an original form, obtained from shrimp trawlers, for which he opts the *F. lilium* (F. v. Waldheim), and a later-named Florida species which has been called *F. hunteria* (Perry). A third, also obviously closely related form, taken by shrimp trawlers off Campeche, is *F. branhamae* Rehder and Abbott. Oddly, our specimens from the peninsula are clearly the Florida species, *hunteria*, including those from Campeche which were all collected in or near shallow water. *F. distans* Lamarck is a later synonym for *F. lilium*, not *hunteria*.

Fasciolaria tulipa (Linné)
Illustration: Plates 10,*d*,*dd*; 11*b*.
Modern distribution: Common on all three coasts, from Turneffe Islands, B.H., to Isla Carmen, Camp. Also offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 37 unworked, mostly Formative; 1 may have been drilled for suspension, but this may have been natural (see Table 2).
MAYAPAN: 1 unworked, probably Decadent period (P, p. 387, fig. 47,*t*).
ISLA CANCUN MIDDEN: 478 unworked. Formative.

Pleuroploca gigantea (Kiener)
Illustration: Plate 11,*d*.
Modern distribution: Rare on east coast, collected from Corker Cay, B.H. Common on north and west coasts from Isla Holbox, Q.R., to Isla Carmen. Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 25 unworked and 4 cut, preparatory to some use as jewelry, Formative through Pure Florescent (see Table 2).
MAYAPAN: 1, spire removed, Proskouriakoff suggests may have been used as trumpet (P, p. 384, fig. 47,*g*, as "*Fasciolaria gigantea*," which is this species), 1 unworked (P, p. 387, listed as "*Fasciolaria papillosa*", which may have been this species; cf. Abbott, 1954, p. 242); both probably Decadent period.
CHICHEN ITZA: 1 juvenile specimen, unworked, illustrated (P, fig. 51,*h*) and correctly captioned as this species, not listed in text (provenience of lot: "Chichen Itza and Balam Canche"). Dr. J. Ladd (personal communication) notes that two adult specimens were recovered from the Sacred Well, one of which had its spire cut off.
ISLA CANCUN MIDDEN: 84 unworked, Formative.
BARTON RAMIE: 1 unworked, in mixed debris (W, pp. 526, 528, as *Fasciolaria gigantea*).
TIKAL: 34 unmodified, immature (M, p. 67; period not yet determined); 3 cut fragments, one Middle Formative (Chuen), one Early Classic, one undated; 3 slightly altered, two of these Early Classic, one undated (M–MS).
UAXACTUN: 1 with spire removed, which Ricketsons suggest is trumpet; identification not given, but from photograph (RR, pl. 69,*c;* K, p. 61, both as "Fasciolaria"), it is clearly this species.

Latirus ceratus (Wood)
Illustration: Keen, 1958, fig. 603.
Modern distribution: Pacific.
Archaeological occurrence:
TIKAL: 2 unworked, not dated (M–MS).

Latirus infundibulum (Gmelin)
Illustration: Warmke and Abbott, 1961, pl. 2,*i*.
Modern distribution: Not collected on peninsula.
Archaeological occurrence:
TIKAL: 1 unworked, not dated (M–MS).

Family: TURBINELLIDAE (chank shell)

Turbinella angulata (Solander)
Illustration: Plate 11,*e*.
Modern distribution: Common on all three coasts, from Turneffe Islands, B.H., to Isla Carmen. Also on offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 24 unworked, mostly Formative (see Table 2); 1 with spire removed for use as a trumpet, in Formative cache; 3 other pieces of body whorl and columella partially cut for use in manufacture.
ISLA CANCUN MIDDEN: 96 unworked, Formative.
HOLMUL: 2, one with spire removed, one neatly cut in half vertically with resultant edges finely

smoothed (Merwin and Vaillant, 1932, p. 87, fig. 27, pl. 34,*f*,*j*, no date listed).

BARTON RAMIE: "A hinge portion of a Xancus shell, which has carefully ground edges, has a central perforation" (W, p. 507, fig. 310,*e*). *Turbinella* [*Xancus*], being a gastropod, has no hinge; further, as this is listed among the perforated bivalves, it is clearly a mistake.

TIKAL: 2, described as trumpets, neither of certain date (M–MS).

UAXACTUN: 1 unworked, Tzakol 1 (K, p. 61).

Comment: The family Turbinellidae and the genus *Turbinella* are published as Xancidae and *Xancus*. For changes in nomenclature, see Vokes, 1964.

Family: VASIDAE (vases)

Vasum capitellum (Linné)
See comment under *V. muricatum* below.

Vasum muricatum (Born)
Illustration: Plate 11,*c*.
Modern distribution: Uncommon on north and east coasts, from Turneffe Islands, B.H., to Punta Palmar, Yuc.
Archaeological occurrence:

DZIBILCHALTUN: 1 shoulder fragment, cut on 2 sides, unfinished, Late Early period.

ISLA CANCUN MIDDEN: 2 unworked, Formative.

TIKAL: 1 unworked (M, p. 67, as "*V. capitellum*," see comment below).

Comment: The Vokes, who have checked our *Vasum* species from the peninsula, feel that they are all *muricatum*, even though in some characteristics they resemble *capitellum*. It is unlikely that archaeological specimens from the Peten would be of a separate species, for which reasons I include the Tikal occurrence above.

We have followed Keen (1958, p. 432) in assigning *Vasum* to a separate family rather than to the Turbinellidae.

Family: OLIVIDAE (olive shells)

Oliva caribaeensis Dall and Simpson
Illustration: Plate 12,*a*,*aa*.
Modern distribution: Isla Cancun and Isla Contoy, Q.R., and Punta Palmar, Yuc.
Archaeological occurrence:

ISLA CANCUN MIDDEN: 14 unworked (2 surely, 12 doubtfully this species), Formative.

Oliva porphyria (Linné)
Illustration: Keen, 1958, pl. VIII.
Modern distribution: Pacific.
Archaeological occurrence:

COPAN: 9 unworked, Full Classic; 6 tinklers, spire removed, drilled hole at bottom, Full Classic (Longyear, 1952, p. 110, fig. 109,*k*).

TIKAL: 8 "uncut tinklers," Early Classic; 1 "cut tinkler," probably Late Classic (M–MS).

Oliva reticularis Lamarck
Illustration: Plate 12,*c*,*cc*.
Modern distribution: East coast, Isla Cozumel to Isla Contoy, and Isla Jaina, Campeche. Not collected on north coast.
Archaeological occurrence:

DZIBILCHALTUN: 1 unworked in Cenote Xlacah, presumably an offering; 1 with background flat and drilled for suspension, spire not removed, Late Early period or Pure Florescent; 5 tinklers, spire cut off and either "sawed" (four) or drilled (one) perforation for suspension, three Formative (two in burial), one in Cenote Xlacah, one in unstratified deposit; 3 ornaments made by sawing off horizontal sections of shell and perforating tip for suspension, one in Pure Florescent cache, one in unstratified deposit, one from Cenote Xlacah.

LABNA: 3 tinklers, apex removed, base with sawed perforation, probably Pure Florescent (E. H. Thompson, 1897b, pl. X,16,22,23, illustrated but not identified).

GRUTA DE LOLTUN: 1 tinkler, with sawed perforation, spire not removed, period not known (E. H. Thompson, 1897a, fig. 10 illustrated but not identified).

MAYAPAN: 73, probably mostly Decadent period, ranging from unworked through tinklers with a variety of perforations, to a number of specially carved examples, of which Proskouriakoff gives a detailed description (P, pp. 385–86). Certain of the specimens illustrated (*ibid*., fig. 45) are surely not *reticularis*; see *O. sayana* below.

CHICHEN ITZA: "77 [*sic*]. 2 unaltered, 8 with cut spire; 39 cut horizontally or broken with slit perforation near base; 5 with drilled perforation, 6 with two slit perforations, 5 with perforation near spire; 1 carved; 7 others" (P, p. 422, fig. 51,*h*). The specimen illustrated is surely this species. J. Ladd reports 2 additional specimens from the Sacred Cenote, one with spire ground down.

ISLA CANCUN MIDDEN: 106 unworked, Formative.

TANCAH, Q.R.: 2, with 2 holes apparently drilled at shoulder for suspension (illustrated but not identified by Sanders, 1960, fig. 19,*b*,15, 16).

BARTON RAMIE: 2 pierced by drilled hole for perforation, one with spire removed (W, pp. 507–08, figs. 309,*b*; 310,*g*); identified as "*Olivella*" but clear from illustration that these are much larger (as well as differently shaped) than any *Olivella* known from this area. They are probably *Oliva reticularis.*

TIKAL: 2 unworked "probably *O. reticularis*"; 22 tinklers, "weathered and probably of various species"; all have spires cut off and have a cut or drilled suspension hole near the apex (M, pp. 67, 70).

UAXACTUN: Ricketsons report 15 Olivas, all but one from Mamom deposits; some of those illustrated are surely *reticularis* (RR, p. 201, fig. 131,*d*, pl. 68,*b*); Kidder reported 9, Tzakol and Tepeu, "some surely, others presumably, *Oliva reticularis*" (K, pp. 63–64, fig. 85,*d*).

Oliva sayana Ravenel

Illustration: Plate 12,*b*,*bb*.

Modern distribution: West coast only, from Celestun to Isla Carmen.

Archaeological occurrence:

DZIBILCHALTUN: 2 unworked, one Formative, one unstratified; 11 tinklers, with both sawed and drilled perforations, all with spire removed, Formative and Early periods or in undated deposits (Table 2).

LABNA: 1 tinkler, spire removed, sawed for perforation, probably Pure Florescent (E. H. Thompson, 1897b, pl. X,21, illustrated but not identified).

GRUTA DE LOLTUN: 1 tinkler with spire removed and sawed perforation, period unknown (E. H. Thompson, 1897a, fig. 11, illustrated but not identified).

MAYAPAN: Used for tinklers (P, p. 385, fig. 45). Some of these specimens, tentatively identified as *O. reticularis*, must be either *sayana* or *caribaeensis.*

ISLA CANCUN MIDDEN: 3 unworked, Formative.

BARTON RAMIE: 2 tinklers, both with "sawed" perforation and spires removed (W, pp. 507–08, figs. 309,*a*; 310,*j*, identified as "*Olivella*"). Several times larger than any *Olivella,* they clearly belong to genus *Oliva*, and may be identified as either of the 2 closely related species *sayana* or *caribaeensis.*

SAN JOSE: 1 unworked, with S.J. IV sherds (T, p. 180).

TIKAL: 1 unworked (M, p. 67) "*Oliva,* probably *sayana*"; age not listed.

UAXACTUN: Although not reported as such, probably the tinkler fourth from left in Ricketson's illustration (pl. 68,*b*) and nos. 5–9 in Kidder's illustration (fig. 85,*d*) are either this species or *O. caribaeensis.* They might be the Pacific *O. porphyria.*

Oliva spicata (Röding)

Illustration: Keen, 1958, fig. 625.

Modern distribution: Pacific.

Archaeological occurrence:

COPAN: 14 tinklers, spire sawed off and hole drilled in base, from Full Classic tomb (Longyear, 1952, p. 110).

Comment: A large collection of fresh specimens of large olive shells from the northern islands of the east coast shows complete intergradation in the characteristics used to define *O. sayana* and *O. caribaeensis*, making me feel that these are really varieties of the same species. Distinction between the two in bleached and altered specimens must be questionable, as must be the distinction of damaged fragments of both these from the Pacific *O. porphyria.* Twelve Isla Cancun specimens, not definitely identified as *sayana,* have been included with the *caribaeensis.*

The differentiation between these larger species and the smaller *reticularis,* which I have suggested on the basis of photos and measurements of Uaxactun and Mayapan specimens, is more specific. *O. reticularis* is the more globose and much smaller shell. Abbott (1954, p. 245–46) lists the size of *reticularis* as 38–44 mm., *sayana* as 51–66 mm. All our modern specimens fall within this range, so we are fairly safe in assuming that an *Oliva* 50 mm. long after removal of spire (K, fig. 85) or 60 mm. complete (P, p. 385) is one of the larger species, rather than *reticularis*.

Olivella dealbata (Reeve)
Illustration: Plate 12,*e*.
Modern distribution: Very common on all three coasts, from Turneffe Islands, B.H., to Isla Aguada, Camp. Also Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: 14 with apex ground off for stringing, offering in Late Early period or Pure Florescent tomb.
GRUTA DE BALANKANCHE: 153, apex ground off for stringing as beads, from a wrist-band or pectoral.
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Olivella nivea (Gmelin)
Illustration: Plate 12,*d*.
Modern distribution: East and north coasts, from Isla Cozumel, Q.R., to Dolores, Yuc. Also collected at Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 3 unworked, Formative.

COMMENT: Archaeological, or even beach-worn Olivellas, particularly when broken or intentionally altered, are extremely difficult to assign to one of the many similar species. The species *nivea*, above, is relatively easy to separate because of size and the fact that the similar *Jaspidella jaspidea* lacks the marked callus on the columella. The lots of smaller Olivellas, all of which I have classified as *dealbata*, may well contain specimens of *O. mutica*, *O. rosolina*, and perhaps other local species identified largely by color.

FAMILY: MITRIDAE (miters)

Mitra florida Gould
Illustration: Plate 21,*b*, *bb*.
Modern distribution: Rare, one specimen taken at Isla Lobos, Chinchorro Banks.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

COMMENT: For data on this very rare species see Johnson, 1964.

FAMILY: CANCELLARIIDAE (nutmegs)

Cancellaria reticulata (Linné)
Illustration: Plate 6,*hh*.
Modern distribution: Uncommon on north coast, collected only at Telchac Puerto. Absent on east coast. Commoner on west coast, from Celestun to Isla Carmen.
Archaeological occurrence:
TIKAL: 6 unworked (M, p. 67); 2 slightly altered, in an Early Classic structure cache (M–MS).

FAMILY: MARGINELLIDAE (marginellas)

Prunum apicinum apicinum (Menke)
Illustration: Abbott, 1954, pl. 11,*n*.
Modern distribution: One specimen collected at Dolores, Yuc.
Archaeological occurrence: See *P. apicinum virgineum* (Joussaume), below.

Prunum apicinum virgineum (Joussaume)
Illustration: Plate 12,*h*.
Modern distribution: Common on all three coasts from Turneffe Islands, B.H., to Isla Carmen, Camp. Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 28 unworked, 75 pierced for suspension, all Formative; 1 pierced in Late Early period deposit; 1 pierced from Cenote Xlacah.
MAYAPAN: 20, fifteen of which were pierced for suspension, probably Decadent period (P, p. 386, fig. 44,*d*; listed as *Marginella apicina* Menke). However, the 7 illustrated are about 8 mm. in length, whereas *apicinum apicinum* Menke in this area is at least twice that size; they are probably the subspecies *virgineum*.
ISLA CANCUN MIDDEN: 3 unworked, Formative.
SAN JOSE: 1 unworked in S.J. III cache (T, p. 181).
COPAN: "About a handful from Tomb 1, averaging 7 mm. long. Each shell has a hole broken through the back" (Longyear, 1952, p. 110, fig. 107,*n*).Again, this is only half the average size of *apicinum*, and is probably the present subspecies.

TIKAL: 3 unmodified, 4 pierced for suspension (M, p. 67, "*Marginella,* probably all *apicina* Menke"; however, as she cites Proskouriakoff's photo, above, and Kidder's photo, below, it is most probably this subspecies).

UAXACTUN: Ricketsons list 64 unworked "*Marginella apicina*" in two cists, 2 perforated in another (RR, pp. 199–200, pl. 63,*d*). Kidder lists 185 in two Tepeu caches, all pierced (106 in jar with snake vertebrae and 1 *Olivella*; K, pp. 61–62, fig. 82,*b*). As at Mayapan, above, it is clear from Kidder's illustration that these shells are half the size of *apicinum apicinum* Menke or less, and are probably this subspecies.

COMMENT: This tiny shell was apparently not considered worth drilling for perforation. In all pierced examples at Dzibilchaltun, the hole was broken, not drilled. Kidder mentions the same at Uaxactun; this seems to be true also at Mayapan.

Prunum guttatum (Dillwyn)
Illustration: Plate 12,*g*.
Modern distribution: Common on all three coasts from Turneffe Islands, B.H., to Chencan, Campeche and on the offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 4 unworked, Formative.

Prunum labiatum (Valenciennes)
Illustration: Plate 12,*f*.
Modern distribution: Moderately common on all three coasts, Isla Cozumel, Q.R., to Isla Carmen, Camp. Also the offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 46 unworked, Formative; 1 with drilled hole near rim, Formative; 4 unworked, probably Formative; 1 unworked, Late Early period; 1 tinkler, spire removed, sawed perforation at base. Late Early period or Pure Florescent; 1 unworked, Pure Florescent.
MAYAPAN: 8, all but one perforated, probably Decadent period (P, p. 386, fig. 44,*c*, as "*Marginella labiata*").
CHICHEN ITZA: 1 perforated (P, p. 422, fig. 51,*h*).
TIKAL: 1 unworked, not dated; 5 perforated, four of these Formative (Chuen), one probably Late Classic (M–MS).

Prunum, cf. *storeria* (Couthouy)
Illustration: Couthouy, 1837, pl. 9, figs. 1,2.
Modern distribution: Not collected on peninsula.
Archaeological occurrence:
TIKAL: 2 unworked, not dated (M–MS).

COMMENT: Marginellas, in general, are exceedingly common in Formative deposits in Yucatan as unaltered specimens. Later they occur less commonly, usually perforated for use as beads (see Table 2).

FAMILY: CONIDAE (cones)

Conus floridanus Gabb
Illustration: Plate 12,*k*,*kk*.
Modern distribution: Common on all three coasts, from Isla Mujeres, Q.R., to Isla Carmen, Camp. Collected at Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, Formative; 1 with spire cut off (unfinished tinkler?), Formative; 1 unworked, Pure Florescent.

Conus mus Hwass
Illustration: Plate 12,*l*,*ll*.
Modern distribution: Common on east coast, from Turneffe Islands, B.H., to Isla Contoy. Also Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

Conus regius Gmelin
Illustration: Plate 12,*j*,*jj*.
Modern distribution: Uncommon on Caribbean coast from Belize to Isla Cancun, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 5 unworked, Formative.

Conus sozoni Bartsch
Illustration: Plate 12,*m*.
Modern distribution: Not collected on peninsula.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative. Identification of these eroded specimens is uncertain.

Conus spurius atlanticus Clench
Illustration: Plate 12,*i*,*ii*.
Modern distribution: Common on all three coasts,

from Isla Mujeres, Q.R., to Isla Carmen, Camp. Collected at Alacran Reef.

Archaeological occurrence:

DZIBILCHALTUN: 6 unworked (two Formative, one Late Early period, one probably Decadent period, two unstratified); 6 worked fragments of body whorl (three Formative, three Late Early period), each a triangular pendant, with 2 perforations at top for suspension.

LABNA: 1, pierced near base for suspension, probably Pure Florescent (E. H. Thompson, 1897*b*, pl. X,20, illustrated but not identified; probably this species).

MAYAPAN: Proskouriakoff lists 2 "small conch trumpets" of *Conus* with "cut spires" (P, p. 384, refers to fig. 47,*l* and *m*, but *l* is missing). The illustration is surely this species. I agree with Proskouriakoff in questioning the use of these small shells as trumpets.

ISLA CANCUN MIDDEN: 3 unworked, Formative.

TIKAL: 1 unmodified (M, p. 67, date not listed); 1 tinkler, probably late Formative (Cauac); 1 tinkler, Early Classic (M–MS).

Family: *TEREBRIDAE* (augers)

Terebra (?) *dispar* Deshayes

Illustration: None.

Modern distribution: Not collected.

Archaeological occurrence:

SAN JOSE: 5 unworked from S.J. IV cache (T, p. 180).

Comment: *T. dispar* is a West Indian species, not collected in peninsular waters. As the identity is queried by the author, I suggest that the specimens may be what we now know is the common augur in these waters, *Terebra cinerea* (Born), and which is very similar to the exotic *dispar* (Warmke and Abbott, 1961, pl. 25,*b*).

Family: *BULLIDAE* (bubbles)

Bulla occidentalis A. Adams

Illustration: Plate 21,*ff*.

Modern distribution: Common on all three coasts, from Water Cay, B.H., to Isla Carmen, Camp.

Archaeological occurrence:

DZIBILCHALTUN: 4 unworked, one Formative, two Late Early period (1 in cache), one in Cenote Xlacah; 1 clearly fossil, but much hand-rubbed specimen obviously kept for some purpose, in Late Early period deposit.

Family: AURICULIDAE (coffee beans)

Melampus coffeus (Linné)

Illustration: Plate 6,*i*,*ii*.

Modern distribution: All three coasts, from Turneffe Islands, B.H., to Isla Aguada, Camp. Collected at Cayo Arcas.

Archaeological occurrence:

ISLA CANCUN MIDDEN: 2 unworked, Formative.

Class: *SCAPHOPODA*

Family: DENTALIIDAE (tooth shells)

Dentalium texasianum cestum Henderson

Illustration: See below.

Modern distribution: Collected by us only on Cayo Norte, Chincharro Banks. Richards and Boekelman (1937) note it has been collected from Monkey River, B.H.

Archaeological occurrence:

"RIO HOK SKUM" (near Corozal, B.H.), 1 unworked, in burial mound dug by Thomas Gann (Richards and Boekelman, 1937, pp. 167–68, pl. 6, no. 4).

Comment: Willey notes 25 beads of *Dentalium* (not identified as to species), with a similar number of sea-urchin spines from a Spanish Lookout Phase burial (W, pp. 509, 526, fig. 309,*k*). Note Richards' and Boekelman's ideas cited above.

Class: *PELECYPODA*

Family: ARCIDAE

Arca imbricata Bruguière [= *A. umbonata* Lamarck]

Illustration: Plate 13,*a*,*aa*.

Modern distribution: Common on the entire coast of peninsula, Turneffe Islands to Isla Carmen. Also on the offshore atolls.

Archaeological occurrence:

ISLA CANCUN MIDDEN: 9 unworked, Formative.

PIEDRAS NEGRAS: 1 unworked, in Late Classic cache (C, p. 55).

Arca pacifica Sowerby
Illustration: Keen, 1958, fig. 37.
Modern distribution: Pacific.
Archaeological occurrence:
UAXACTUN: 2 unworked, one Chicanel, one Tzakol (K, p. 61).

Arca zebra Swainson [= *A. occidentalis* Philippi]
Illustration: Plate 13,*b*,*bb*.
Modern distribution: Common on all coasts, from Belize, B.H., to Isla Carmen, Camp. Also on offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 2 unworked in Formative deposits, 2 (pairs) in cache box of Late Early period.
ISLA CANCUN MIDDEN: 6 unworked, Formative.
MAYAPAN (?), 1 unworked, probably Decadent period (P, p. 387, fig. 46*e*, listed as *Arca* sp.? in text, is almost certainly this species.)
TIKAL: 56 unworked (M, p. 66, archaeological association not noted). Some of these, from 2 probably Late Classic caches (Coe and Broman, 1958, p. 44).
UAXACTUN: 1 unworked, apparently Formative (RR, p. 199, fig. 129; K, p. 61; both listed as "*Arca noae* Linné," a Mediterranean species).
PIEDRAS NEGRAS: 3 unworked, in Late Classic caches, one coated with cinnabar on inside (C, p. 55, fig. 52,*h*).

COMMENT: The Ricketsons illustrated a specimen of *A. zebra* to show the deep scratchings on the ligamental area, which do look much like incised design. They quote Clench as thinking these "were probably the result of boring sponges and not of human industry." Actually, they are the normal ligamental grooves of this species. They aroused our curiosity and speculation when we first found them in the field.

Anadara grandis (Broderip and Sowerby)
Illustration: Keen, 1958, fig. 56.
Modern distribution: Pacific.
Archaeological occurrence:
COPAN: 1 unworked, in cache of Stela 7, Late Classic (Longyear, 1952, p. 53, as "*Arca grandes*").

Anadara notabilis (Röding)
Illustration: Plate 13,*c*,*cc*.
Modern distribution: Found on all three coasts of the peninsula, from Turneffe Islands, B.H., to Isla Aguada, Camp. Also on offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 3 with broken, not drilled, hole below umbo, possibly for suspension. Formative.
ISLA CANCUN MIDDEN: 5 unworked, Formative.

Anadara transversa (Say)
Illustration: Plate 13,*d*,*dd*.
Modern distribution: North and west coasts only, Minas de Oro, Yuc., to Isla Aguada, Camp. Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: 5 with irregular broken hole below umbo, probably for suspension, Formative; 4 unworked, one of Decadent period, others not datable.
MAYAPAN: 1 unworked, probably Decadent period (P, p. 387, fig. 64,*f*, listed as "*Arca* sp.," but clearly from photo it is this species).
TIKAL: 28 unworked, 1 pierced for suspension, not dated (M, p. 66).

Lunarca ovalis (Bruguière)
Illustration: Plate 13,*gg*,*gg'*.
Modern distribution: Collected only at Isla Carmen and nearby Zacatal, Camp. These would seem to be the southernmost limits of a western Gulf Coast distribution, as they are not found farther north on the peninsula or on other coasts.
Archaeological occurrence:
BARTON RAMIE: 1 unworked, Classic (W, p. 526).
TIKAL: 8 unworked, not dated (M–MS).

COMMENT: The Barton Ramie specimen, whose identity I re-checked, would be the only shell at the site imported from considerable distance if the above modern distribution is complete. However, the shell may exist as a rarity which we failed to collect on the east coast.

Noetia ponderosa (Say)
Illustration: Plate 13,*e*,*ee*.

Modern distribution: West coast, Campeche only, Isla Arenas to Isla Carmen.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, Formative.
TIKAL: 22 unworked, not dated (M, p. 66).

Family: GLYCYMERIDAE (bittersweets)

Glycymeris decussata (Linné)
Modern distribution: East coast (Cozumel and Cancun Islands), west coast (Isla Carmen), and the offshore atolls. Not collected on north coast.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 19 unworked, Formative.

Glycymeris undata (Linné)
Illustration: Plate 13,*h*.
Modern distribution: East coast only. Xcaret to Isla Mujeres.
Archaeological occurrence:
MAYAPAN: 1 unworked, probably Decadent period (P, pl. 46,*g* illustrates a specimen of "*G. pennacea*" = *decussata*). It lacks the posteriorly pointing umbo of that species, and more closely resembles *undata*.
ISLA CANCUN MIDDEN: 40 unworked, Formative.

Comment: Whichever of the two species it is, the Mayapan specimen is one of the few archaeological shells from Yucatan apparently imported from a considerable distance.

Family: MYTILIDAE (mussels)

Modiolus demissus granosissimus Sowerby
Illustration: Plate 14,*a,aa*.
Modern distribution: Collected at scattered sites, always near mangrove swamps, on east, north, and west coasts.
Archaeological occurrence:
DZIBILCHALTUN: 2 unworked valves, Formative.

Comment: The form *granosissimus* can now be found in abundance in the mangroves in the swamps behind Progreso (near Dzibilchaltun) and Dzilam Bravo, and probably elsewhere. It is eaten locally and also sent to Merida as a delicacy.

It is strange that *Modiolus americanus*, by far the commonest present mussel on the north coast, is not found in archaeological context.

Brachidontes exustus (Linné)
Illustration: Plate 14,*b,bb*.
Modern distribution: Collected at scattered sites in Quintana Roo, Yucatan, and Campeche.
Archaeological occurrence:
DZIBILCHALTUN: 3 unworked specimens in cache offering, Late Early period.
TIKAL: Unworked valves, "probably *exustus*" (M–MS).

Musculus lateralis (Say)
Illustration: Warmke and Abbott, 1961, pl. 31,*c*.
Modern distribution: Not collected from periphery of peninsula.
Archaeological occurrence:
TIKAL: 6 unworked (M, p. 67, archaeological context not stated).

Family: ISOGNOMONIDAE (tree oysters)

Isognomon alatus (Gmelin)
Illustration: Plate 14,*c,cc*.
Modern distribution: All three coasts of the peninsula, Turneffe Islands, B.H., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 37 unworked fragments from Formative strata, 35 unworked and 33 worked from Late Early period and Pure Florescent deposits.
ISLA CANCUN MIDDEN: 4 unworked, Formative.

Isognomon radiatus (Anton)
Illustration: Plate 14,*d,dd*.
Modern distribution: All three coasts from Belize, B.H., to Isla Jaina, Camp. Also offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked and 2 worked, Formative; 1 unworked, unknown date.
ISLA CANCUN MIDDEN: 2 unworked, Formative.

Comment: It is difficult, or impossible, to separate the above two species unless the hinge is present, which it is not on most of the small fragments used for mosaic or thoroughly worked. Most of the smaller fragments, which might have been either species, have been tabulated above with the larger *alatus*.

FAMILY: PTERIIDAE (wing oysters, pearl oysters)

Pteria colymbus (Röding)
Illustration: Plate 14,*f*,*ff*.
Modern distribution: All three coasts of Yucatan, Isla Mujeres, Q.R., to Isla Aguada, Camp. Also the offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, in unstratified deposit. 1 unworked in Copo deposit.

Pinctada radiata (Leach)
Illustration: Plate 14,*e*,*ee*.
Modern distribution: All three coasts, Cozumel Island, Q.R., to Chencan, Camp. Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 4 unworked, Formative; 4 unworked, Late Early period; 1 unworked, 1 worked, Late Early period or Pure Florescent; 1 unworked, from cenote.
MAYAPAN: 1 unworked, probably Decadent period (P, p. 387, fig. 46,*d*).
ISLA CANCUN MIDDEN: 1 unworked, Formative.
TIKAL: "2 unmodified, 10 fragments, 4 worked pieces," not dated (M, p. 67).

COMMENT: As with the Isognomonidae, these oysters rapidly lose their attractive surface coloration when dead. They were apparently valued for the highly nacreous undershell, which was useful for ornamentation, including mosaics.

FAMILY: PINNIDAE (sea pens)

Atrina seminuda (Lamarck) [= *A. rigida* (Dillwyn)]
Illustration: Plate 15,*a*,*aa*.
Modern distribution: All three coasts from Isla Mujeres to Isla Carmen.
Archaeological occurrence:
DZIBILCHALTUN: 9 unworked in Formative deposits, 11 unworked fragments and 1 *adorno* of this shell in Late Early period offertory caches, 1 worked in Pure Florescent tomb, 3 unworked from Cenote Xlacah, and 3 others unworked in undated debris.

COMMENT: Boekelman (1935, pp. 257–63, figs. 1–3) describes archaeological use of Pinnidae in some detail, all outside area of lowland Maya. They were used as hoes (strapped to a wooden handle), as a source of inferior pearls, and as food. Their absence in the Cancun Midden, although common on the beach there, might indicate that they were not used by the Maya as food. The many fragments at Dzibilchaltun were probably brought in as material for mosaics, for which they are most suitable. They occur in several of the "jewelers' caches" in the structures opposite the Temple of the Seven Dolls, which usually contained a wide variety of raw material, obsidian tools, and several unfinished and finished items of jewelry.

FAMILY: PLICATULIDAE (kitten's paws)

Plicatula gibbosa Lamarck
Illustration: Plate 15,*e*.
Modern distribution: Very common on all three coasts, from Cozumel to Isla Carmen, Camp. Also at Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: 1 unmodified, from Cenote Xlacah, not datable.
TIKAL: Reports numerous unworked "*Plicatula* sp.," perhaps this species (M–MS).

FAMILY: PECTINIDAE (scallops)

Pecten laurenti Gmelin
Illustration: Plate 21,*c*.
Modern distribution: Collected at Isla Cancun, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 fragment, unworked, Formative.

Lyropecten nodosus (Linné)
Illustration: Plate 15,*d*,*dd*.
Modern distribution: Usually uncommon on all three coasts. Collected from Isla Mujeres, Q.R., to Isla Aguada, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 3 fragments, all from broken pectoral made of 1 valve, in Late Early period cache.
ISLA CANCUN MIDDEN: 6 unworked, Formative.
TIKAL: 1 unworked, undated; 1 perforated, Early Classic (M–MS).

Lyropecten subnodosus (Sowerby)
Illustration: Keen, 1958, fig. 137.
Modern distribution: Pacific.
Archaeological occurrence:
TIKAL: 11, perforated for suspension, ten from an Early Classic burial, one undated (M–MS).
UAXACTUN: 2, each drilled with 3 holes for suspension, in Tzakol burial (K, pp. 61–62).

Aequipecten gibbus (Linné)
Illustration: Plate 15,*bb*.
Modern distribution: All three coasts of the peninsula. Isla Mujeres, Q.R., to Isla Carmen, Camp., common. Also Cayo Arcas.
Archaeological occurrence:
"RIO HOK SKUM," near Corozal, B.H.: 1 unworked in burial, "may be derived from a fossil deposit" (Richards and Boekelman, 1937, p. 166, pl. 6, no. 2, cited as *P. gibbus exasperatus* Dall).

Aequipecten muscosus (Wood)
Illustration: Plate 15,*c*.
Modern distribution: Common on all three coasts of the peninsula from the Turneffe Islands, B.H., to Isla Carmen, Camp. Also Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 1 with 2 holes drilled on wings for suspension, Late Early period; 1 with 2 holes crudely broken on wings for suspension, in unstratified debris. Several very well preserved fossils, unworked, found in archaeological deposits, may have been part of the cultural remains.

COMMENT: Note that the Pacific species is the only one found at Uaxactun and is the most frequent at Tikal, although the very similar Atlantic species is common on nearby shores.

FAMILY: SPONDYLIDAE (thorny oysters)

Spondylus americanus Hermann
Illustration: Plate 15,*f*,*f'*.
Modern distribution: Common on east and north coasts from Turneffe Islands, B.H., to Sisal, Yuc. and on the offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 11 unworked valves or fragments, all but one (unstratified) found among raw materials in the "jewelers' caches," Late Early period. 52 worked valves, fragments, or small artifacts, from all periods, but mostly Late Early period, where they were very common in caches (see Table 2). Unaltered or slightly altered valves pierced as pendants. Worked fragments were made into beads, carved pendants and a variety of *adornos*, these often for inclusion in mosaic.
BALANKANCHE: 2 beads.
MAYAPAN: 16 whole and broken valves, probably Decadent, also used widely as raw material for beads, etc. (P, p. 385, fig. 44,*a*).
ACTUN XKYC (CALCEHTOK): 1 complete valve with sawed incision, then finished at 2 ends with drilled perforations for suspension; in deposits identified by Brainerd as Late Early period or Pure Florescent (as "*Spondylus echinatus*" = *S. americanus*; see Hatt and others, 1953, p. 118, pl. 3, fig. 1).
ISLA CANCUN MIDDEN: 111 unworked, Formative.
BARTON RAMIE: 45 worked and unworked, from all periods (W, p. 526, 528).
TIKAL: 5 pairs, unworked (M–MS).

Spondylus princeps Broderip
Illustration: Keen, 1958, pl. II.
Modern distribution: Pacific.
Archaeological occurrence:
COPAN: Frequent in Full Classic tombs and stela caches, none worked. Several pairs used as "jewel boxes" to hold pearls, jade, cinnabar, and other small shells (Longyear, 1952, pp. 42, 110, fig. 94, as "*S. crassisquama*," which is not this species).
PUSILHA: 3 pairs, unworked, undated; all used containers for "small personal ornaments (Gruning, 1930, p. 483, pl. XXI, fig. 1, as "*Spondylus*," but almost surely this species.).
SAN JOSE: 3 valves, unworked, in caches, two are S.J. IV, one may be S.J. III (T, pp. 180–81).
UAXACTUN: 15 unworked, two in Tzakol, thirteen in Tepeu burials and caches; 27 with two drilled holes for suspension, twenty-six of them in Tzakol burials, one in undated debris (K, pp. 61–62, fig. 82,*a*, as "*S. crassisquama*").
TIKAL: 3 pairs, unworked, undated; 148 valves, slightly altered, mostly in burials and caches as follows: 1 Formative (Cauac), 84 Early Classic, 58 Late Classic, 5 uncertain (M–MS, "probably most of these are *S. princeps*").

PIEDRAS NEGRAS: 12+ in Classic burials and caches; 3 perforated for suspension in Classic burials and caches; several pairs were used as "jewel boxes" (C, pp. 55–56, as *S. limbatus*, which is a Persian Gulf species).

COMMENT: The very large amounts of *Spondylus* found at Tikal still are and may largely remain undifferentiated between the Pacific *princeps*, and the Atlantic *americanus*, except as noted above. Of more than 5200 worked valves and chips collected by 1964, more than 2500 were beads (mostly Formative) and over 2400 were "cached fragments" (mostly Early Classic).

FAMILY: LIMIDAE

Lima lima (Linné)
Illustration: Plate 15,*gg*.
Modern distribution: Only on Caribbean coast (Turneffe Islands to Isla Mujeres) and on the offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Lima scabra (Born)
Illustration: Plate 15,*h*,*hh*.
Modern distribution: East coast from Isla Cozumel and Xcaret to Isla Cancun, Q.R. Also Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

FAMILY: ANOMIIDAE (jingle shells)

Anomia simplex d'Orbigny
Illustration: Plate 15,*i*.
Modern distribution: All three coasts, from Isla Mujeres, Q.R., to Isla Carmen, Camp. Rare at Alacran Reef, common elsewhere.
Archaeological occurrence:
DZIBILCHALTUN: 19 unworked, from Late Early period deposits (sixteen in a single votive cache), 1 unworked in a Florescent deposit, 1 unworked in Cenote Xlacah, presumably an offering.
MAYAPAN: 13 specimens, all but two pierced for suspension, usually a single hole near the center, sometimes with a second smaller perforation; 1 cache contained 10, nine of which were pierced (P, pp. 386–87, fig. 44,*b*).

FAMILY: OSTREIDAE (oysters)

Ostrea equestris Say
Illustration: Plate 16,*a*.
Modern distribution: Collected only at Isla Cancun, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

Ostrea frons Linné
Illustration: Plate 16,*c*,*cc*.
Modern distribution: Common on east and north coasts only, from Chapel Cay, B.H., to Punta Palmar, Yuc. Also on offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.

Crassostrea virginica (Gmelin)
Illustration: Plate 16,*bb*.
Modern distribution: All three coasts, from Isla Mujeres, Q.R., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 3 unworked, juvenile, in cache, Late Early period, possibly attached to large *Strombus*.
ISLA CANCUN MIDDEN: 2 unworked, Formative.
SAN JOSE: 2 unworked in cache, S.J. IV or V (T, p. 180, specimens illustrated by Richards and Boekelman, 1937, p. 166, pl. 6, no. 6).
COROZAL: Richards and Boekelman (*op. cit.*) list this species from a burial mound at "Rio Hok Skum" near Corozal.

COMMENT: Thompson (1939, p. 180) quotes Boekelman as stating that, "so far as present knowledge goes, the area between Cabo Catoche and Puerto Castillo is not at the present time inhabited by any type of oyster." But we have collected four species in the area: *Ostrea equestris*, *O. frons*, *Crassostrea rhizophorae*, and *C. virginica*. A fifth oyster closely resembling *O. permollis* Sowerby was taken at Alacran reef.

FAMILY: CARDITIDAE

Carditamera floridana Conrad
Illustration: Plate 15,*j*,*j'*.
Modern distribution: Common on all three coasts, Isla Mujeres, Q.R., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 8 in Formative deposits, 7 unworked, 1 pierced below umbo for suspension; 1 with hole drilled below umbo for suspension as bead, Late Early period; 1 unworked in probably Decadent period deposit; 2 unworked, unstratified, 1 an offering in Cenote Xlacah.
TIKAL: 1 unworked, not dated (M–MS).

FAMILY: CORBICULIIDAE

Pseudocyrena floridana (Conrad)
Illustration: Plate 16,*d*,*dd*.
Modern distribution: Common on all three coasts from Turneffe Islands, B.H., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 2 unworked, in Formative deposits.

FAMILY: DIPLODONTIDAE

Diplodonta semiaspera Philippi
Illustration: Warmke and Abbott, 1961, pl. 35,*l*.
Modern distribution: Collected at Dolores, Yuc.
Archaeological occurrence:
DZIBILCHALTUN: 1, unworked, in Late Early period cache.

COMMENT: This tiny shell may have been introduced inadvertently in beach drift inside a large conch.

FAMILY: LUCINIDAE (lucines)

Lucina pensylvanica (Linné)
Illustration: Plate 16,*e*,*ee*.
Modern distribution: Common on east coast from Belize to Isla Holbox, and on Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 5 unworked, Formative.

Phacoides pectinatus (Gmelin) [= *L. jamaicensis Lamarck*]
Illustration: Plate 16,*f*.
Modern distribution: Common on entire littoral of the peninsula, from Chapel Cay, B.H., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 6 unworked, Formative; 1 with 2 perforations near ventral margin for suspension, Formative; 1 unworked in Late Early period or Pure Florescent.
ISLA CANCUN MIDDEN: 9 unworked, Formative.

Phacoides radians (Conrad)
Illustration: Warmke and Abbott, 1961, pl. 36,*j*.
Modern distribution: Collected at Chavihau, Yuc.
Archaeological occurrence:
DZIBILCHALTUN: 1 unworked, in Late Early period cache.

COMMENT: This tiny pelecypod may have been introduced inadvertently in beach drift inside large conchs in the offering.

Codakia orbicularis (Linné)
Illustration: Plate 16,*g*.
Modern distribution: Common on all three coasts from Turneffe Islands, B.H., to Isla Jaina, Camp. Collected at Alacran Reef.
Archaeological occurrence:
DZIBILCHALTUN: 2 unworked, one in Formative deposit, one unstratified.
ISLA CANCUN MIDDEN: 7 unworked, Formative.
BARTON RAMIE: 1 pierced for suspension, hinge downward, margin considerably reduced, Spanish Lookout phase (W, p. 507, fig. 310,*k*).
TIKAL: 5 unmodified (M, p. 66, age not given).

FAMILY: CHAMIDAE (jewel boxes)

Chama congregata Conrad
Illustration: Plate 17,*bb*.
Modern distribution: East coast from Turneffe Islands, B.H., to Isla Contoy, Q.R. Also at Alacran Reef and Cayo Arcas.
Archaeological occurrence:
DZIBILCHALTUN: 1 pair, 1 single valve, all unworked, in Late Early period cache (was probably attached to large conch in offering).

COMMENT: As Dzibilchaltun specimens were probably attached to a large *Strombus costatus* in the cache, they almost surely originated on the nearby north coast, although the species has not been recorded in modern north coast collections.

Chama echinata Broderip
Illustration: Keen, 1958, fig. 239.
Modern distribution: Pacific.
Archaeological occurrence:
TIKAL: 28 unworked, not dated; 4 slightly altered, Early Classic (M–MS, "*Pseudochama echinata*").

Chama florida Lamarck
Illustration: Plate 17,*d,dd*.
Modern distribution: East coast, from Turneffe Islands to Isla Contoy, and the offshore atolls. Not collected on north or west coasts.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 8 unworked, Formative.

Chama macerophylla Gmelin
Illustration: Plate 17,*a,aa*.
Modern distribution: Common on all three coasts, from Belize, B.H., to Isla Aguada, Camp. Also on the offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 13 unworked, Formative.
SAN JOSE: 1 unworked, within cache, "probably San Jose III" (T, p. 181; this shell illustrated in Richards and Boekelman, 1937, pl. 6).
COROZAL: (Burial mound at "Rio Hok Skum" excavated by Gann): 1 unworked, which may have derived from a fossil deposit (*ibid*., p. 169, pl. 6).

Chama sarda Reeve
Illustration: Plate 17,*c,cc*.
Modern distribution: Common on east coast, Turneffe Islands, B.H., to Isla Mujeres, Q.R. Also offshore atolls. Rare on north coast; collected at Telchac Puerto and Chavihau. Not collected on west coast.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 38 unworked, Formative.

Chama sinuosa Broderip
Illustration: Plate 17,*e,e'*.
Modern distribution: East coast only, Turneffe Islands, B.H., to Isla Contoy, Q.R.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 50 unworked, Formative.

Pseudochama radians (Lamarck)
Illustration: Plate 17,*f,f'*.
Modern distribution: All three coasts from Turneffe Islands to Isla Carmen, Camp., and the offshore atolls.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 1 unworked, Formative.

FAMILY: CARDIIDAE (cockleshells)

Trachycardium egmontianum (Shuttleworth)

This form has not been collected from the peninsula, where it almost certainly is replaced by the closely related but distinct species *T. isocardia*. The latter has been collected at 25 stations, from Isla Cancun, Q.R., to Isla Carmen, Camp.

Moholy-Nagy reports 31 unmodified *T. egmontianum* from Tikal. These should be re-examined. It is probable that they are actually *T. isocardia*.

Trachycardium isocardia (Linné)
Illustration: Plate 18,*a,aa*.
Modern distribution: Common on all three coasts from Isla Cancun, Q.R., to Isla Carmen, Camp.
Archaeological occurrence:
DZIBILCHALTUN: 58 unworked, from all periods (Table 2), fourteen of these among the raw materials in one of the Late Early period "jewelers' caches;" only two reasonably complete valves appeared.
MAYAPAN: Probably Decadent period, listed in collection but not illustrated (P, p. 387).
TIKAL: See *T. egmontianum* above.

Trachycardium magnum (Linné)
Illustration: Plate 18,*c,cc*.
Modern distribution: Rare. Collected only at Isla Mujeres, Isla Cancun, and Alacran Reef.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 2 unworked, Formative.
UAXACTUN: Listed in RR (p. 199) and K (p. 61) as "*Cardium magnum*." No illustration; archaeological association not given.

Trachycardium muricatum (Linné)
Illustration: Plate 18,*b,bb*.
Modern distribution: Common on all three coasts, from Belize, B.H., to Isla Aguada, Camp. Cayo Arcas.

Archaeological occurrence:

DZIBILCHALTUN: 18 unworked, in all periods except Decadent (Table 2), mostly Formative.

MAYAPAN: 1 valve listed (P, fig. 46,*b*) as "*Cardium*, unidentified species," probably is *T. muricatum*. Probably Decadent period.

ISLA CANCUN MIDDEN: 2 unworked, Formative.

TIKAL: 4 unmodified, archaeological context not given (M, p. 67).

UAXACTUN: 1 entire and 1 fragment, unmodified in cache under Stela A-11 (RR, p. 199; K, p. 61 as "*Cardium muricatum*").

PIEDRAS NEGRAS: In Late Classic cache (C, p. 55 as "*Cardium muricatum*").

Dinocardium robustum vanhyningi Clench and L. C. Smith

Illustration: Plate 18,*d*,*dd*.

Modern distribution: From Isla Contoy at north tip of east coast to Isla Carmen, Camp. Very common on north coast.

Archaeological occurrence:

DZIBILCHALTUN: 1 drilled for suspension near ventral margin, coated on both surfaces with red pigment, Formative; 418 unworked, mostly Formative, but nevertheless frequent in later deposits (Table 2). Surprisingly, only 3 occurrences of reasonably entire valves of this hardy shell: 1 in foundation of undated house-mound; 1 in Cenote Xlacah, presumably an offering; 16 perfect specimens carefully nested, formed all of Cache 1, Str. 38, Late Early period.

MAYAPAN: *D. robustum* Solander is listed but is almost certainly this subspecies; frequency or date, although probably Decadent period, not listed. This shell clearly not as important as it was at Dzibilchaltun (P, p. 387; her fig. 46,*a*, captioned as unidentified *Cardium*, is probably this subspecies).

TIKAL: 34 unmodified, 1 perforated (M, p. 66, age not noted).

Comment: The Cardiidae are the most numerous family of molluscs at Dzibilchaltun, although almost never used for jewelry or artifacts and not common as votive offerings. Were these imported in the shell and used for food?

Family: VENERIDAE (venus clams)

Antigona listeri (Gray)

Illustration: Plate 19,*a*,*aa*.

Modern distribution: Caribbean coast, from Belize to Isla Contoy, Q.R. Offshore atolls.

Archaeological occurrence:

ISLA CANCUN MIDDEN: 4 unworked, Formative.

Antigona rigida (Dillwyn)

Illustration: Plate 19,*b*.

Modern distribution: Collected only at Isla Cancun, Q.R., and Cayo Arcas.

Archaeological occurrence:

ISLA CANCUN MIDDEN: 2 unworked, Formative.

Mercenaria campechiensis (Gmelin)

Illustration: Plate 19,*c*,*cc*.

Modern distribution: North and west coasts, common from Isla Holbox, Q.R., to Isla Carmen, Camp. Cayo Arcas.

Archaeological occurrence:

DZIBILCHALTUN: 46 unworked, mostly Formative but found in Early period and Copo complex deposits (Table 2); 3 worked, two incomplete specimens, one perhaps a broken triangular pendant, Formative; 1 partially cut fragment, Late Early period.

UAXACTUN: 1 unworked, in Chicanel deposit (K, p. 61, "*Venus campechiensis*").

Chione cancellata (Linné)

Illustration: Plate 19,*d*.

Modern distribution: Entire periphery of the peninsula, Turneffe Islands, B.H., to Isla Carmen, Camp. The commonest shell on the north coast. Also found on the offshore atolls.

Archaeological occurrence:

DZIBILCHALTUN: 76 unworked, commonest in Formative, 3 perforated for suspension (2 Formative; 1 Late Early period) (Table 2). Found as offerings in 1 tomb and 3 caches of Late Early period. 5 specimens found in mortar of a small section of Str. 500 (Formative).

MAYAPAN: 3 unworked, probably Decadent period (P, fig. 44,*i*, not in text).

TIKAL: 25 unmodified (M, p. 66, age not listed).

Anomalocardia cuneimeris (Conrad)

Illustration: Plate 19,*e*.

Modern distribution: Very common on entire periphery of peninsula, from Water Cay, B.H., to Isla Carmen, Camp.

Archaeological occurrence:

DZIBILCHALTUN: 9 unworked, eight Formative, one Pure Florescent.

MAYAPAN: Mentioned as found, probably Decadent period (P, p. 387).

TIKAL: Moholy-Nagy mentions "8 *Anomalocardia* sp., unmodified," probably this species, not dated (M–MS).

Transennella cubaniana (d'Orbigny)

Illustration: Warmke and Abbott, 1961, pl. 39,*d*.

Modern distribution: Collected at Isla Mujeres and Isla Cancun, Q.R., on east coast; only at Chavihau, Yuc., on north coast.

Archaeological occurrence:

DZIBILCHALTUN: 4 valves, unworked, in Late Early period cache.

COMMENT: These tiny pelecypods might have been included inadvertently in beach drift inside large conchs in cache.

Macrocallista maculata (Linné)

Illustration: Plate 19,*g*,*gg*.

Modern distribution: Common on all three coasts, from Isla Mujeres, Q.R., to Isla Carmen, Camp. Also at Cayo Arcas.

Archaeological occurrence:

DZIBILCHALTUN: 2 unworked, in unstratified deposits.

MAYAPAN: 2, with sawed hole below umbo for suspension, probably Decadent period (P, fig. 44,*j*, not in text).

Dosinia concentrica (Born)

Illustration: None.

Modern distribution: Not collected on peninsula.

Archaeological occurrence:

MAYAPAN: See discussion of *D. elegans* below.

Dosinia discus (Reeve)

Illustration: None.

Modern distribution: Not collected on the peninsula.

Archaeological occurrence:

TIKAL: 1 unworked (M–MS). As this shell has not been collected from peninsular waters, whereas the very similar *D. elegans* is abundant on all three coasts and at three archaeological sites, the Tikal specimen may be the latter species.

Dosinia elegans (Conrad)

Illustration: Plate 19,*f*.

Modern distribution: Collected only at Isla Contoy on the east coast. Common on north and west coasts, Isla Holbox, Q.R., to Isla Aguada, Camp.

Archaeological occurrence:

DZIBILCHALTUN: 11 unworked, in Formative, Early period and Florescent deposits, two as offerings in Cenote Xlacah; 1 Late Early period with single hole for suspension, 1 Formative considerably altered with 2 drilled holes for suspension.

MAYAPAN: Proskouriakoff lists both *elegans* and *concentrica*, illustrating only one, which is captioned *D. concentrica*. As *concentrica* has not been collected on the peninsula and the very similar but less inflated *elegans* is quite common on the nearby coast, and as the local form had not been established when this identification was made, both specimens may be *elegans* (P, p. 387, fig. 46,*c*).

ISLA CANCUN MIDDEN: 1 unworked, Formative.

TIKAL: See under *D. discus* above.

FAMILY: TELLINIDAE (tellins)

Tellina lineata Turton

Illustration: Plate 20,*c*,*cc*.

Modern distribution: On east coast, collected only on Water, Corker, and Chapel Cays, B.H. Very common on north and west coasts, from Isla Holbox, Q.R., to Isla Carmen, Camp. Also at Cayo Arcas.

Archaeological occurrence:

DZIBILCHALTUN: 1 unworked, in Formative deposit.

MAYAPAN: 1 unworked, probably Decadent period (P, p. 387).

Tellina listeri Röding

Illustration: Plate 20,*b*,*b'*.

Modern distribution: East coast, from Turneffe Islands, B.H., to Puerto Juarez, Q.R. Also offshore atolls.

Archaeological occurrence:

ISLA CANCUN MIDDEN: 18 unworked, Formative.

Tellina radiata Linné

Illustration: Plate 20,*a*,*aa*.

Modern distribution: Fairly common on Caribbean coast, from Turneffe Islands, B.H., to Isla Contoy, Q.R. Also on offshore atolls. Absent on north and west coasts.
Archaeological occurrence:
ISLA CANCUN MIDDEN: 100 unworked, Formative.

Arcopagia fausta (Pulteney)
Illustration: Plate 20,*d*,*dd*.
Modern distribution: East coast from Turneffe Islands, B.H., to Isla Contoy, Q.R. Not collected from north coast. West coast from Punta Palmar, Yuc., to Isla Jaina, Camp. Also the offshore atolls.
Archaeological occurrence:
DZIBILCHALTUN: 1 fragment, in Formative deposit.
ISLA CANCUN MIDDEN: 3 unworked, Formative.

COMMENT: One of the few shells from Dzbilichaltun not found on nearby beaches.

Apolymetis intastriata (Say)
Illustration: Plate 20,*ee*.
Modern distribution: East and north coasts, from Turneffe Islands, B.H., to Punta Palmar, Yuc. Alacran Reef.
Archaeological occurrence:
TIKAL: 1 unmodified (M, p. 66, not dated).

FAMILY: MACTRIDAE (surf clams)

Mulinia lateralis (Say)
Illustration: Plate 20,*ff*,*ff′*.
Modern distribution: On west coast, collected only as far north as Seybaplaya, Camp. Absent on north and east coasts.
Archaeological occurrence:
TIKAL: "about 42," unworked (M, p. 67, no age listed).

FAMILY: GASTROCHAENIDAE

Gastrochaena hians (Gmelin) (= *Rocellaria hians*)
Illustration: Warmke and Abbott, 1961, pl. 44,*k*.
Modern distribution: Collected at Telchac Puerto, Yuc., in coral thrown on beach.
Archaeological occurrence:
MAYAPAN: Unworked, reported by Proskouriakoff as "*Rocellaria* sp." (P, p. 387). This is the only species of this genus known in these waters.

Annotated Checklist of Freshwater Species[1]

CLASS: *GASTROPODA*
FAMILY: AMPULLARIIDAE

Pomacea flagellata arata (Crosse and Fischer)
Illustration: Plate 21,*h*.
Archaeological occurrence:

DZIBILCHALTUN: 2 unworked, one in Late Early period fill, one in Formative fill. This species is very common in all levels of mud in Cenote Xlacah, where it is not found alive today.

BARTON RAMIE: 45, unworked, about 39 of these from Formative deposits, the other 6 Spanish Lookout phase, Protoclassic (W, pp. 526–27, fig. 309,*r*, "*Pomacea flagellata* Say").

TIKAL: 1 cut fragment, Late Classic debris; 5 perforated, one in Early Classic cache, one in Early Classic burial, one in Late Classic burial, two in Late Classic debris. 189 unworked were listed to 1964, archaeological context not yet available (M–MS).

PIEDRAS NEGRAS: 1 unworked in Late Classic cache (C, p. 55).

COMMENT: The Dzibilchaltun specimens have been identified as subspecies *arata* by Alan Solem. Specimens from the four other sites were all published as *P. flagellata* Say.

Pomacea flagellata ghiesbrechti (Reeve)
Illustration: Coe, 1959, fig. 52,*q*.
Archaeological occurrence:

PIEDRAS NEGRAS: Various unworked in Late Classic caches; 1 with 2 large drilled holes in Late Classic cache (C, pp. 55–56, fig. 52,*q*).

FAMILY: THIARIDAE

Pachychilus glaphyrus (Morelet)
Illustration: Willey and others, 1965, fig. 309,*u*,*v*.
Archaeological occurrence:

BARTON RAMIE: 248 unworked, from various periods, heavily concentrated in the Formative phases (W, pp. 526–27, fig. 309,*u*,*v*).

TIKAL: 3 unworked, archaeological context not available (M, p. 68).

Pachychilus indiorum (Morelet)
Illustration: none.
Archaeological occurrence:

PIEDRAS NEGRAS: Listed as present; archaeological association not described (C, p. 55).

Pachychilus largillierti (Philippi)
Illustration: Willey and others, 1965, fig. 309,*s*,*t*.
Archaeological occurrence:

BARTON RAMIE: 557 unworked, from various periods, but heavily concentrated in the Formative phases (W, pp. 526–27, fig. 309,*s*,*t*).

COMMENT: Moholy-Nagy (M–MS) notes identification of one "*Hemisinus* sp." at Tikal, archaeological context not yet available. She also collected one at Tayasal on Lake Flores, and informs me that the local name is *jute*, the popular name for *Pomacea*.

CLASS: *PELECYPODA*
FAMILY: UNIONIDAE

Nephronaias goascoranensis (Lea)
Illustration: Richards and Boekelman, 1937, pl. 6,*q*.
Archaeological occurrence:

SAN JOSE: 1 unworked, in burial, probably S.J. II (T, p. 180; see also Richards and Boekelman, 1937, p. 169, pl. 69).

Nephronaias ortmanni (Frierson)
Illustration: Willey and others, 1965, fig. 309,*n*.
Archaeological occurrence:

BARTON RAMIE: 3 unworked, 4 perforated for suspension, in 2 Spanish Lookout phase burials; 758 others, all unworked, from various periods but mostly in Preclassic contexts (W, pp. 504, 507, 526–27, fig. 309, *l-n*).

Nephronaias cf. *yzabalensis* (Crosse and Fischer)
Illustration: Fischer and Crosse, 1894, pl. 44; figs. 4; 4,*a*; 4,*b*.
Archaeological occurrence:

SAN JOSE: 10, with bored holes for suspension, in tombs of S.J. III, IV, V, and possibly S.J. I; others, bored and unbored, found elsewhere in excavations (T, p. 180).

[1] Modern distributions are not given here as they are not accurately enough known to reflect trade practices. Most freshwater molluscs were probably collected locally.

Psoronaias quadratus (Simpson)
Illustration: Coe, 1959, fig. 52,*k*.
Archaeological occurrence:
PIEDRAS NEGRAS: 1 unworked in Late Classic burial (C, p. 55, fig. 52,*k*), as "*Quadrula quadrata*," which is this species).

Psoronaias semigranosus (v. d. Bush)
Illustration: Plate 21,*g*.
Archaeological occurrence:
DZIBILCHALTUN: 4, pierced for suspension, in Late Formative tomb; 3 unworked, Late Early period.
MAYAPAN: 1, pierced, probably Decadent period (P, p. 387, fig. 44,*h*).

Comment: Unclassified freshwater clams have been listed from Uaxactun by the Ricketsons (RR, p. 199) and by Kidder (p. 61). Moholy-Nagy lists 61 slightly altered (usually pierced) Unionidae clams, including five paired valves, and a smaller number of unworked valves (M–MS).

Annotated Checklist of Land Species

Land mollusca present problems separate from those of their marine or freshwater cousins in that they form an almost ever-present normal component of the materials used for construction fill in Maya architecture. Once favored living conditions such as open rubble have been established, they migrate into these artificial environments in enormous numbers. Workers are wont to retain these intruders with human artifacts collected in excavations, particularly as some are most attractive. To establish them as human artifacts, one must demonstrate their provenience in a completely sealed receptacle, show that they were intentionally altered by human effort, or prove that they were amassed in quantities which could not have occurred in nature. This has rarely been possible in the Maya lowlands. We have little reason to believe that land molluscs (in contrast to freshwater genera such as *Pomacea*) were ever an important source of food. Today they are not eaten. Peninsular species were and are so thin-shelled that they would have been of no use as raw material and most ephemeral ornaments if perforated for use as pendants. Any usage would probably have been symbolic.

Despite these strictures, a number of land molluscs have been reported in archaeological publications. For the sake of completeness in this checklist we briefly list them, in the customary geographic order.

DZIBILCHALTUN: Although all our excavations were heavily peppered with land molluscs, including tombs and all but the most tightly sealed caches, no clear evidence of archaeological use of any was obtained. The largest, most attractive, and thickly shelled of these, *Orthalicus princeps princeps* (Broderip), was frequently encountered, but never with evidence of intentional alteration. It is a common arboreal species.

MAYAPAN: Proskouriakoff reports 2 specimens of *Orthalicus princeps* (one pierced by an irregular hole), and "also unworked shells of a *Phalium* species and *Oleacina*, which may be intrusive" (P, p. 387, fig. 47,*u*). *Phalium* is a purely marine genus, and could be intrusive only through human agency. We see no reason to believe that the land species were of other than natural occurrence.

ISLA CANCUN: A number of species of small land molluscs were found in the deeply sealed parts of the midden, but they were only those which would have been expected to inhabit the site during its brief occupation.

TIKAL: Moholy-Nagy's preliminary notes list 1 perforated "*Orthalicus princeps*" in Late Formative (Chuen) debris. She also lists the following unworked molluscs, on which archaeological context is not yet available:

Aplexa elata (Gould) (1)
Euglandina sp. (numerous)
Helicina sp. (numerous)
Neocyclotus (fragment)
Neocyclotus dysoni (Pfeiffer) (30)
Orthalicus princeps (Broderip) (30)

PIEDRAS NEGRAS: Coe lists 6 land snails in a single Late Classic cache, K–5–5, *Euglandina decussata* (Deshayes) and *Choanopoma radiosum* (Morelet), but does not state whether or not the cache was found in condition which would disallow intrusion.

BARTON RAMIE: Willey lists 3 species from the Belize Valley sites:

Euglandina carminensis (Morelet) (7)
Bulimulus sp. (109)
Neocyclotus dysoni (Pfeiffer) (12)

All were unworked. He notes that the *Bulimulus* is found in various periods, but is very heavily concentrated in the Formative phases—possible evidence that the specimens are not intrusive (W, pp. 526–27).

Discussion

Ecology

Collection of molluscs by humans must depend on what forms are available along any particular beach or coast and, particularly in the significant collection for food, in what quantity they are present. Some species are found virtually everywhere; others demand rather specific environmental conditions and are therefore of more restricted distribution. In archaeological shell, these distributions can often define original proveniences, and must be carefully taken into consideration when attempting to reach any conclusions regarding early trade relationships.

The coast of the Yucatan Peninsula falls into several quite distinct ecological provinces (fig. 2).

Zone I, Caribbean Province, comprising the mainland coast and nearby offshore islands of Quintana Roo, Mexico, and British Honduras. Both coast and islands are largely a coral-reef formation, characterized by alternating sandy and rocky shores dropping off sharply to very deep waters. Water, even near the shore and inside the islands, is ordinarily clear and clean all year. With offshore winds, which prevail most of the year, waves are frequently very large, and their effects on the shallow-water fauna very violent.

Zone II, Offshore Atolls, Alacran Reef to Cayo Arcas. Along the edge of the Campeche Bank, where it drops off into deep water, there is a series of coral reefs, usually in the form of atolls, which seem to form a separate ecological province. The fauna includes not only most of the species present on the Caribbean coast and absent on the Campeche Bank, but also others characteristic of the sandy shelf whose outer edge they inhabit. Although numerous, the principal atolls are the so-called Alacran and Triangulos Reefs, Isla Arena, and Cayo Arcas, only the first and last of which have been collected by us. (For more detailed description of the geology and ecology of these fringe atolls, see Kornicker and others, 1959; Rice and Kornicker, 1962, 1965.)

Zone III, North Coastal Province, from Isla Holbox, Q.R., to Punta Palmar, Yucatan. This is the final extension of the Campeche Bank, which slopes very gradually from the shore to a depth of 25 fathoms at about 100 miles, then drops sharply into deeper water. Virtually the entire north coast is bordered by a brackish-water swamp of mud and mangroves (*la ciénaga*) extensively mined for salt, both before and after the Spanish conquest. Except for a broken area between Dzilam Bravo and the mouth of Rio Lagartos at San Felipe, a low narrow sandbar separates the swamp from the Gulf of Mexico, usually extending out as a sandy floor to the edge of the Campeche Bank. All coastal settlements are situated on this sandbar. Water along the shore, in strong contrast to Zone I, is usually murky, either from *ciénaga* mud, or the fine calcareous sand. Accumulations of seaweed are common on the beach. Because of the shallow gradient, wave disturbance is much less severe than on the Caribbean coast.

Zone IV, West Coast Province, from Punta Palmar to Isla Carmen and the Laguna de Terminos, Campeche. This coast again is bordered by the Campeche Bank, and the consequent shallow gradient found on the north coast. It is a lee shore, protected by the peninsula from the prevailing northeast trade winds and lacking the strong east-west current traversing the north coast. Perhaps because of its protected position, sandy beaches are much less common, and large sections of the coast are formed of mangrove swamp.

It will be seen that the north and west coasts are much less sharply differentiated from each other than they are from the Caribbean Province and the atolls. A number of the faunal changes (e.g., *Strombus costatus* to *pugilis* or *Busycon contrarium* to *perversum*) begin well to the east of Punta Palmar. Much distinctive material from the west coast may well be extensions of the western gulf fauna onto the peninsula (e.g., *Nerita fulgurans, Mulinia lateralis, Lunarca ovalis*). It might well be wiser (although I have not done so because of our interest in precise provenience) to suggest only the deep, clear-water reef environment as one ecological province (calling Zones I and II above I and Ia) and the deeply contrasting shallow, turgid waters of the Campeche Bank as a second (calling Zones III and IV above II and IIa). The faunal changes involved are, of course, more marked in the much larger collection of present-day Mollusca than they are in the few selected species found in archaeological deposits.

Table 1 specifies archaeological provenience and known present-day distribution of the species listed in the checklist, to facilitate discussion in the next section. It should be re-emphasized at this point that the modern distributions are solely those of our own collecting in the area and at times may often be incomplete.

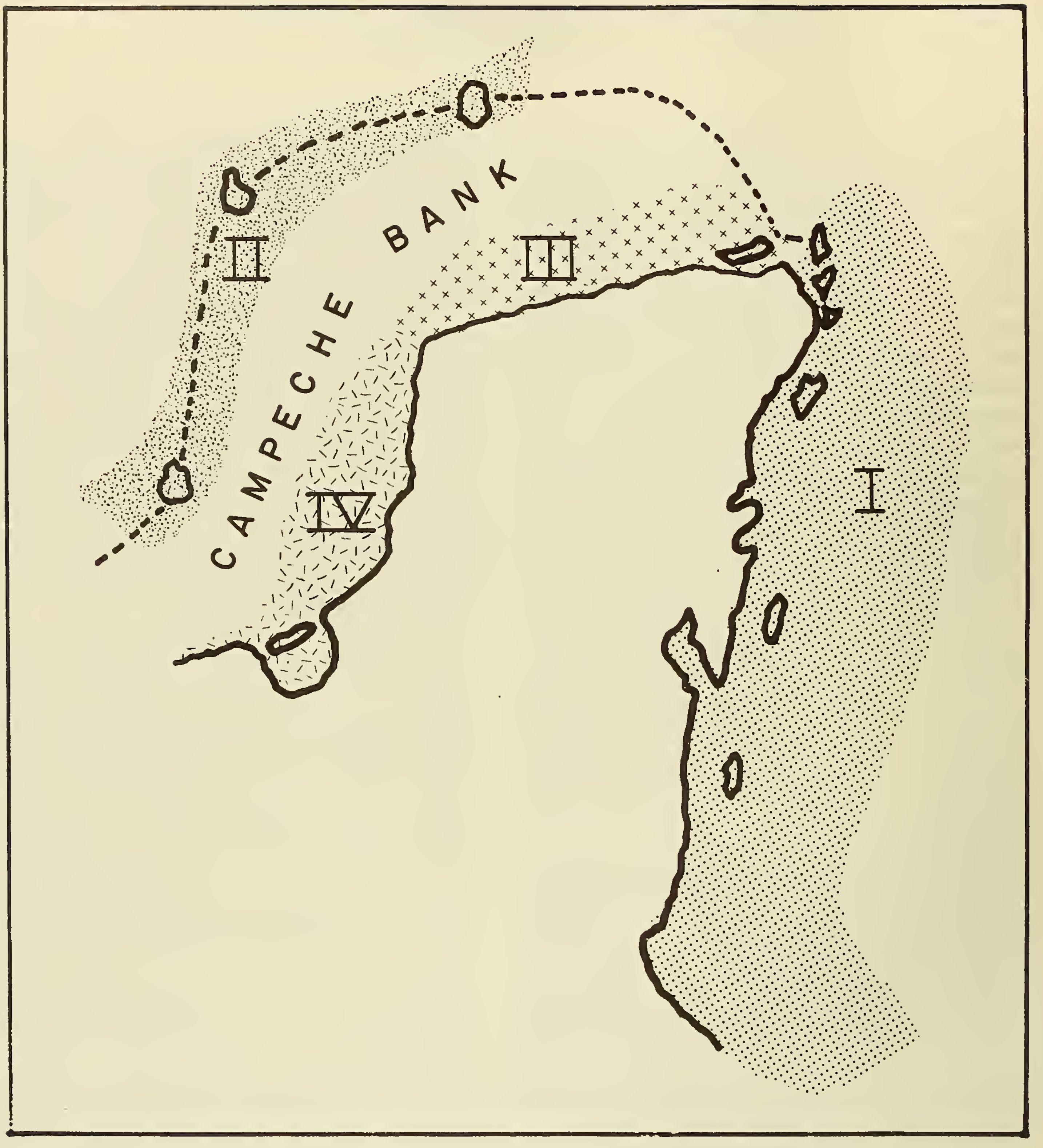


FIG. 2 — Ecological provinces of the Yucatan littoral. I, The Caribbean Coast; II, The offshore atolls bordering the Campeche Bank; III, The North Coast; IV, The West Coast.

Table 1 — ARCHAEOLOGICAL OCCURRENCE AND MODERN DISTRIBUTION OF MOLLUSCS FOUND AT LOWLAND MAYA SITES

Species	Archaeological Occurrence*	Modern Distribution Zone I	Zone II	Zone III	Zone IV
MARINE GASTROPODS					
Diodora cayenensis	D, T	X		X	X
Diodora listeri	T	X	X	X	
Fissurella barbadensis	D, C, T	X			
Calliostoma jujubinum	I	X	X		
Cittarium pica	D, I, P, T	X			
Astraea caelata	I	X	X		
Astraea phoebia	I	X	X	X	X
Astraea tecta americana	I	X	X	X	
Nerita fulgurans	M(?), T				X
Nerita peloronta	I	X	X		
Nerita tessellata	D, I, M(?)	X	X		
Nerita versicolor	I, T	X			
Neritina meleagris	S		(*not collected*)		
Neritina virginea	D, M, S, U	X	X	X	X
Littorina ziczac	I	X			X
Nodilittorina tuberculata	I	X			
Echininus nodulosus	D, I	X	X		
Tectarius muricatus	I	X			
Petaloconchus irregularis	I	X			
Vermicularia spirata	D, T, P	X	X	X	X
Planaxis nucleus	I	X			
Modulus modulus	T	X	X	X	X
Cerithium eburneum	D, I	X		X	X
Cerithium floridanum	U	X		X	X
Cerithium literattum	I	X	X	X	
Cerithium maculosum	T		(Pacific)		
Cerithium variabile	S(?)	X	X	X	X
Crucibulum auriculum	I, T	X	X	X	X
Crucibulum spinosum	P		(Pacific)		
Crepidula aculeata	T	X		X	X
Crepidula fornicata	D, I, T	X		X	X
Strombus costatus	D, M, I	X	X	X	X
Strombus gigas	I, U, T(?), B	X	X		
Strombus pugilis	D, M, C, I, S, B, U	X	X	X	X
Strombus raninus	I	X	X		
Cypraea cervus	D, I, Tancah(?)			X	
Cypraea cinerea	I	X	X		
Cypraea zebra	I, T(?), B	X	X		
Cyphoma gibbosum	I, H, U, T(?)	X	X		
Polinices duplicatus	T				X
Polinices hepaticus	I	X			
Polinices lacteus	I	X	X		
Natica canrena	M, C	X	X	X	X
Morum oniscus	K	X	X		X
Morum tuberculosum	S, P		(Pacific)		
Phalium granulatum	I	X			
Phalium inflatum	D, M, CN(?)		X	X	X

* Key to symbols:

B = Barton Ramie
C = Chichen Itza
CN = Copan
D = Dzibilchaltun
I = Isla Cancun Midden
H = Holmul
K = Balankanche
M = Mayapan
P = Piedras Negras
S = San Jose
T = Tikal
U = Uaxactun

Species	Archaeological Occurrence*	Modern Distribution Zone I	Zone II	Zone III	Zone IV
Cassis madagascariensis	T	X			
Cassis tuberosa	I, S, T	X	X		
Cypraecassis testiculus	M, I	X	X		
Charonia variegata	I	X	X	X	
Cymatium femorale	M, I, B	X	X		
Cymatium parthenopeum	D, I	X		X	X
Cymatium pileare	D, I	X	X	X	
Tonna galea	I	X	X	X	
Tonna maculosa	I	X	X	X	
Ficus communis	D, M, I	X		X	X
Murex dilectus	T	X	X	X	X
Murex fulvescens	C				X
Murex pomum	D, I, T, U	X	X	X	X
Murex rubidus	T				X
Purpura patula	I	X			
Thais deltoidea	I	X	X		
Thais rustica	I	X			
Columbella mercatoria	D, I, S, T	X	X	X	X
Cantharus auritulus	I	X			
Melongena corona	D, M, I	X		X	X
Melongena melongena	D, I, U, T, B	X		X	X
Busycon coarctatum	D, I	X	X	X	
Busycon contrarium	D, M, I, T, U, Oxkintok	X	X	X	X
Busycon perversum	D			X	X
Busycon spiratum	D, M, I, Labna	X	X	X	X
Nassarius vibex	U	X	X	X	X
Fasciolaria hunteria	I, U(?)		X	X	X
Fasciolaria tulipa	D, M, I	X	X	X	X
Pleuroploca gigantea	D, M, C, I, B, T, U	X	X	X	X
Latirus ceratus	T		(Pacific)		
Latirus infundibulum	T		(*not collected*)		
Turbinella angulata	D, I, B, H, T, U	X	X	X	X
Vasum capitellum	(*see text*)		(*not collected*)		
Vasum muricatum	D, I, T	X		X	
Oliva caribaeensis	I	X		X	
Oliva porphyria	CN, T		(Pacific)		
Oliva reticularis	D, M, C, I, B, T, U, Labna, Loltun, Tancah	X			X
Oliva sayana	D, M, I, B, S, T, U, Labna, Loltun				X
Oliva spicata	CN		(Pacific)		
Olivella dealbata	D, K, I	X	X	X	X
Olivella nivea	I	X	X	X	
Mitra florida	I	X			
Cancellaria reticulata	T			X	X
Prunum apicinum apicinum	(*see text*)			X	
Prunum apicinum virgineum	D, M, I, U, T, CN	X	X	X	X
Prunum guttatum	I	X	X	X	X
Prunum labiatum	D, M, C, T	X	X	X	X
Prunum *cf.* storeria	T		(*not collected*)		
Conus floridanus	D	X	X	X	X
Conus mus	I	X	X		
Conus regius	I	X			
Conus sozoni	I		(*not collected*)		
Conus spurius atlanticus	D, M, I, T, Labna	X	X	X	X
Terebra dispar (?)	S(?)		(*not collected*)		
Bulla occidentalis	D	X		X	X
Melampus coffeus	I	X	X	X	X
SCAPHOPODS					
Dentalium t. cestum	B(?), Corozal	X			

Species	Archaeological Occurrence*	Modern Distribution Zone I	Zone II	Zone III	Zone IV
MARINE PELECYPODS					
Arca imbricata	I, P	X	X	X	X
Arca pacifica	U		(Pacific)		
Arca zebra	D, M, I, T, U, P	X	X	X	X
Anadara grandis	CN		(Pacific)		
Anadara notabilis	D, I	X	X	X	X
Anadara transversa	D, M, T		X	X	X
Lunarca ovalis	T, B(!)				X
Noetia ponderosa	D, T				X
Glycymeris decussata	I	X	X		X
Glycymeris undata	M, I	X			
Modiolus d. granosissimus	D	X		X	X
Brachidontes exustus	D, T	X		X	X
Musculus lateralis	T		(*not collected*)		
Isognomon alatus	D, I	X		X	X
Isognomon radiatus	D, I	X	X	X	X
Pteria colymbus	D	X	X	X	X
Pinctada radiata	D, M, I, T	X	X	X	X
Atrina seminuda	D	X		X	X
Plicatula gibbosa	D, T(?)	X	X	X	X
Pecten laurenti	I	X			
Lyropecten nodosus	D, I, T	X		X	X
Lyropecten subnodosus	U, T		(Pacific)		
Aequipecten gibbus	Corozal	X	X	X	X
Aequipecten muscosus	D	X	X	X	X
Spondylus americanus	D, M, K, I, B, T, Actun Xkyc	X	X	X	
Spondylus princeps	CN, S, Pusilha, U, T, P		(Pacific)		
Lima lima	I	X	X		
Lima scabra	I	X	X		
Anomia simplex	D, M	X	X	X	X
Ostrea equestris	I	X			
Ostrea frons	I	X	X	X	
Crassostrea virginica	D, I, S, Corozal	X		X	X
Carditamera floridana	D, T	X		X	X
Pseudocyrena floridana	D	X		X	X
Diplodonta semiaspera	D			X	
Lucina pensylvanica	I	X	X		
Phacoides pectinatus	D, I	X		X	X
Phacoides radians	D			X	
Codakia orbicularis	D, I, B, T	X	X	X	X
Chama congregata	D	X	X		
Chama echinata	T		(Pacific)		
Chama florida	I	X	X		
Chama macerophylla	I, S, Corozal	X	X	X	X
Chama sarda	I	X	X	X	
Chama sinuosa	I	X			
Pseudochama radians	I	X	X	X	X
Trachycardium egmontianum	T(?)		(*not collected*)		
Trachycardium isocardia	D, M, T(?)	X		X	X
Trachycardium magnum	I, U	X	X	X	
Trachycardium muricatum	D, M, I, T, U, P	X	X	X	X
Dinocardium r. vanhyningi	D, M, T	X		X	X
Antigona listeri	I	X	X		
Antigona rigida	I	X	X		
Mercenaria campechiensis	D, U		X	X	X
Chione cancellata	D, M, T	X	X	X	X
Anomalocardia cuneimeris	D, M, T	X		X	X
Transennella cubaniana	D	X		X	
Macrocallista maculata	D, M	X	X	X	X
Dosinia discus	T(?)		(*not collected*)		
Dosinia elegans	D, M, I	X		X	X

Species	Archaeological Occurrence*	Modern Distribution Zone I	Zone II	Zone III	Zone IV
Tellina lineata	D, M	X	X	X	X
Tellina listeri	I	X	X		
Tellina radiata	I	X	X		
Arcopagia fausta	D, I	X	X		X
Apolymetis intastriata	T	X	X	X	
Mulinia lateralis	T				X
Gastrochaena hians	M			X	
FRESHWATER GASTROPODS					
Pomacea flagellata arata	D, B, T, P		(*not sufficiently collected*)		
Pomacea f. ghiesbrechti	P		" " "		
Pachychilus glaphyrus	B, T		" " "		
Pachychilus indiorum	P		" " "		
Pachychilus largillierti	B		" " "		
FRESHWATER PELECYPODS					
Nephronaias aff. calamitarum	D		" " "		
Nephronaias goascoranensis	S		" " "		
Nephronaias ortmanni	B		" " "		
Nephronaias *cf.* yzabalensis	S		" " "		
Psoronaias quadratus	P		" " "		
Psoronaias semigranosus	M		" " "		
LAND GASTROPODS					
Oleacina sp.	M		" " "		
Euglandina carminensis	B		" " "		
Euglandina decussata	P		" " "		
Euglandina sp.	T		" " "		
Orthalicus princeps princeps	D(?), M, T		" " "		
Bulimulus sp.	B		" " "		
Aplexa elata	T		" " "		
Neocyclotus dysoni	B, T		" " "		
Choanapoma radiosum	P		" " "		
Helicina sp.	T		" " "		

TOTAL: 192 species

TRADE

Table 1 gives some definite clues to probable trade activities in ancient times. Two categories show up immediately:

A. *Shells from coastal midden* (only Isla Cancun, to date). These were Mollusca collected at coastal encampments either for immediate eating or, at the most, for extraction of the edible portions of the animal for shipment inland. One would expect them to be entirely of local fauna, and therefore irrelevant to matters of trade or commerce.

B. *Shells from inland sites* (the balance of our material). These finds of Mollusca were in largest part brought from the ocean for use of the shell rather than the animal inside, although at sites close to the sea, such as Dzibilchaltun, some animals may have been brought in their shells as table delicacies.

Category A, the Isla Cancun series, is, as would be expected, entirely composed of local material. The 99 species listed are without exception found on the local beaches today. The dwellers at the midden may well have *exported* both seafood and shells.

Category B is composed of shells largely imported as such. An examination of where these shells might have come from shows interesting evidence of trade. We stress again at this point that the modern distributions listed in Table 1 are based on our own collections and may be incomplete, but we believe these reservations are not sufficient to invalidate the general patterns described below.

We also note here (as discussed fully in the next section) that there is little probability of faunal change on the shores of the peninsula during the brief 2000–3000 years represented by our collections. At Isla Cancun, where we have positive evidence, there is no hint of difference in the 2200 years between the midden collections and present-day shore fauna.

At Dzibilchaltun, only 33 of the 2,380 specimens represent species not commonly found on the immediately adjacent north coast. Of the 33, 23 are *Oliva reticularis* and *O. sayana* (or *caribaeensis*), which could have come from either east or west coast, and which were, as noted below, so widely used as tinklers. The remaining handful show that although Dzibilchaltun utilized in all periods largely its local molluscan fauna, trade from a distance did exist. Nine shells of five species were probably imported from the Caribbean coast: *Fissurella barbadensis* (1), *Cittarium pica* (1), *Tectarius muricatus* (5, in one cache offering), *Nerita tessellata* (1), *Arcopagia fausta* (1). One specimen of *Noetia ponderosa* was probably traded from the west coast of the peninsula. Shells were clearly not an item of desiderata in trade, probably because of their abundance on nearby beaches.

At Mayapan, 50 miles farther inland, a much smaller collection of shell produced a similarly striking lack of trade specimens. The exception, as at Dzibilchaltun, was the *Oliva* used for tinklers, of which 73 were found. Only three shells were clearly imported from a distance, all from the east coast: *Glycymeris undata* (1), *Cymatium femorale* (1), and *Cypraecassis testiculus* (1).

Shell artifacts from Chichen Itza have mostly not been identified by species. As at Mayapan, Olivas for tinklers are very common (77). No other evidence published by Proskouriakoff (1962) indicates trade other than with the north coast. I found one complete and unaltered *Murex fulvescens* on the surface in the Modified Florescent complex. This was almost surely imported from southern Campeche or the west shore of the Gulf of Mexico.

Archaeological shell from Yucatan proper, in summary, although found in huge quantities, seems to have been gathered mostly along the north coast. The Olivas are an exception, but were available at no great distance on the west coast. A handful of specimens were brought in, possibly as souvenirs, from the Caribbean coast, perhaps by the numerous pilgrims who we know visited the shrines of pre-Columbian Cozumel Island. In terms of trade in shell, the northwest peninsula seems to have been logically self-contained.

Barton Ramie and other Belize River Valley settlements share the general pattern of the northern sites described above (Willey and others, 1965). Land snails and clams, doubtless gathered locally, formed a vast majority of the Formative shell encountered; at other sites they are less frequent. Despite the proximity of the sea, marine species first appear in numbers only in the Classic period. The nine species identified by Willey do not offer much clue to broader trade relations. They could have been imported from nearby British Honduras beaches, where (with one possible exception) all are to be found. The numerous *Spondylus* are all of the Atlantic species.

At San Jose in British Honduras, Thompson

(1939) reports nine Atlantic species, none of limited distribution which might give hints of trade, all of which we collected along the nearby Caribbean coast. More interesting are reportings of two shells from the Pacific coast: *Spondylus princeps* and *Morum tuberculosum* (as "*Lambidium tuberculosa morum*," which is this species). We shall see more of both the latter species below.

At Holmul, near the British Honduras border in Guatemala, Merwin and Vaillant (1932) report an inordinate amount of shell but give no specific identifications. From their illustrations, we can identify only *Cyphoma gibbosum* and *Turbinella angulata*, both common on the nearby coast. Vaillant notes (*ibid.*, pp. 88–89):

> The presence of so much worked shell at Holmul raises the question of the source of manufacture of the raw product. In view of the isolated character of the site, during Periods II–IV, as attested by the pottery, it seems strange to observe shell as the only evidence of trade relations with a coastal people. It is possible that most of British Honduras was of relatively low culture until the closing days of the "Old Empire," and the manufacture of shell into ornaments was done at Holmul. On the other hand high cultures might have existed in the seaboard contemporaneously with Holmul, while only their ornaments were sought by the inland folk. It is certainly true that there is almost no evidence of Holmul II–IV pottery on the coast, so that social relations cannot have been very close.

In the inland cities of the southern lowlands, the picture was very different. A large amount of shell was traded from great distances, often apparently from much farther than necessary. This probably reflects the existence of a number of well-established trade routes.

Uaxactun, in the central Peten, produced the first considerable collection of shell from the area (Ricketson and Ricketson, 1937; Kidder, 1947). Of the 19 species of Atlantic molluscs reported, 5 give some hint as to provenience. Three species have been collected only on the Caribbean coast and were presumably traded from that area: *Strombus gigas*, *Cyphoma gibbosum*, and *Trachycardium magnum*. Two species have been found only on the north and west coasts and were presumably traded from that area: *Fasciolaria hunteria* and *Mercenaria campechiensis*. It is clear that Uaxactun was in trade contact with both the Caribbean and Gulf coasts.

Three species from Uaxactun were imported from the Pacific coast: *Arca pacifica*, *Lyropecten subnodosus*, and *Spondylus princeps*. (See pp. 43–45 for further discussion of these trade pieces.)

Tikal, near Uaxactun in the Peten, has recently produced an impressive quantity of archaeological shell. Hattula Moholy-Nagy published a valuable preliminary report (1963) of material gathered through the 1962 season. She generously offered us further manuscript notes on specimens acquired through 1964, of which we have made grateful use. Much material from Tikal still remains unidentified, or identified only to genus, and much has not yet been collated with stratigraphic position of the lots, but this must await future publication. Seventeen of the 47 presently identified Atlantic species have a sufficiently restricted distribution to warrant specific inferences regarding trade. Six of these come from Caribbean waters: *Fissurella barbadensis* (1), *Cittarium pica* (3), *Nerita versicolor* (5), *Cassis madagascariensis* (2), *C. tuberosa* (1), and *Strombus gigas* (1). Two species have been collected only from the north and east coasts: *Diodora listeri* (1) and *Apolymetis intastriata* (1). Two have been collected only from the north and west coasts: *Cancellaria reticulata* (6) and *Anadara transversa* (29). Two have been taken only on the west coast: *Oliva sayana* (1) and *Murex rubidus* (1). Five species have been collected only on the southernmost west coast, where they seem to be overlappings of a western Gulf shore fauna: *Nerita fulgurans* (3), *Polinices duplicatus* (3), *Lunarca ovalis* (8), *Noetia ponderosa* (22), and *Mulinia lateralis* (42). Thus, where we can make an educated guess at provenience, 8 of 17 species and only 15 of 130 specimens originated on the nearby Caribbean shore, whereas 9 of 17 species and 115 of 130 specimens seem to have been traded in from the much more distant Gulf of Mexico. We would have expected much the reverse.

Six species reported from Tikal are of Pacific origin: *Cerithium maculosum* (1), *Latirus*, probably *L. ceratus* (1), *Oliva porphyria* (9), *Lyropecten subnodosus* (11), *Chama echinata* (32), and *Spondylus princeps* (150+). Actually, over 500 additional *Spondylus fragments* (divided almost equally between beads and cached chips) could not be classified as Atlantic or Pacific species.

At Copan, Honduras, Longyear (1952) found but five species, only one of which is Atlantic in origin: "*Marginella apicina*," which we have noted above is probably *Prunum apicinum virgineum*. A shell illustrated (*ibid.*, fig. 94,*e*) but not mentioned in the text is clearly of the genus *Phalium*, probably the species *granulatum* referred to above collected on the east coast of the peninsula. The Pacific species are: *Oliva porphyria*, *O. spicata*, *Anadara grandis* ("*Arca grandes*"), and *Spondylus princeps* ("*S. crassisquama*"). These proveniences are remarkable in that the bulk of shell from the site was imported from the more distant Pacific ocean.

Piedras Negras, on the Usumacinta River, has an equally interesting molluscan fauna, although shell does not seem to have been as abundant or varied as at other sites. Of eight marine species reported (Coe, 1959), five are Atlantic, only one of which may be of significant distribution: *Cittarium pica* ("*Livona pica*"), which in our peninsular collections has appeared only on the Caribbean coast, where it is very common. Three species are of Pacific origin: *Crucibulum spinosum, Morum tuberculatum*, and *Spondylus princeps* ("*S. limbatus*"). Again we have the anomalous situation that half the species, and the bulk of actual shell found, are imported from the Pacific and the Caribbean instead of the much closer Gulf of Mexico. At Piedras Negras, as at Barton Ramie, there is extensive offertory use of freshwater and land molluscs (six species).

Quite different patterns emerge for the northern and southern Maya lowlands. In the north—at Dzibilchaltun, Mayapan, and Chichen Itza—the overwhelming mass of archaeological shell is traceable to the nearest convenient beaches, with a handful of exceptions apparently brought from the more distant Caribbean coast. Interest in the sea and its products is emphatic here as it is elsewhere, but local supply seems to have been the dominant factor in choice.

In the south, where most sites are at some distance from the sea, trade routes or selective choice of material were obviously stronger factors than simple geographic propinquity, perhaps because of ethnic barriers of which we are not yet aware. Where we have evidence worthy of consideration, the tides of trade which brought in shells to the Peten area in general came from the distant Gulf of Mexico, not the closer Caribbean shores whence one would expect simple forms of sea life to be collected. Perhaps more significant, the southern Maya lowlands imported a very large proportion of their shell from the much more distant Pacific coast.

With two species, this is quite understandable. The first, *Oliva porphyria*, is an exceptionally beautiful shell (see Keen, 1958, pl. VIII) and, given the very widespread fondness for tinklers, much more attractive in color and design than any of the Atlantic Olivas. Boekelman (1935, pp. 267–72, figs. 8–13) discusses distribution of this shell outside the lowland Maya area, noting its trade as far as Roatan and Guanaja in the Bay Islands. He identified the species on ornamented girdles on four Copan stelae and one from Quirigua, noting, "Wherever the shell is found sculptured in stone, it is probable that the natural shell will be found also." Longyear subsequently found the natural shell at Copan. Moholy-Nagy points out several representations of this shell on Tikal stelae, again as belt ornaments. And, as noted above, the natural shell is also found there.

The second, *Spondylus princeps*, is again a strikingly beautiful shell (see Keen, 1958, pl. II), understandably traded very widely in pre-Columbian times. Boekelman (1935, pp. 262–66, figs. 4–7) outlines its history of use and its distribution: "The writer has been able to trace its use from the Southwestern district of the United States down to the Peruvian territory, throughout which, among the higher types of cultures along the Pacific Coast, it appears to have been a very highly prized shell, especially closely connected with religious superstitions" (*ibid.*, p. 265). It has been found at San Jose, Pusilha, B.H. (Gruning, 1930, p. 483, pl. XXI, fig. 1), Tikal, Uaxactun, Copan, and Piedras Negras in the lowlands and was probably present at other southern sites where the genus is common but the species not differentiated. Wherever intensive excavation has been undertaken in the south, *Spondylus* seems to have been of constant ceremonial import, as well as the raw material for a number of artifacts.

To explain the frequent occurrence of the Pacific species on the Atlantic watershed, Boekelman notes that the Atlantic species does not contain the deep red colors of *princeps*. There is also to be considered the fact that both *americanus* and *princeps* are denizens of deep water (10 fathoms or more) and could be collected in pre-aqualung days only by very skilled divers. Groups of such divers played an important role on the Pacific coast (e.g., the Kingdom of Colima paid an annual tribute to Montezuma of 1600 valves), and the profession must have been important. Such feats would be far beyond the ability of the Atlantic or Gulf coast fishermen of

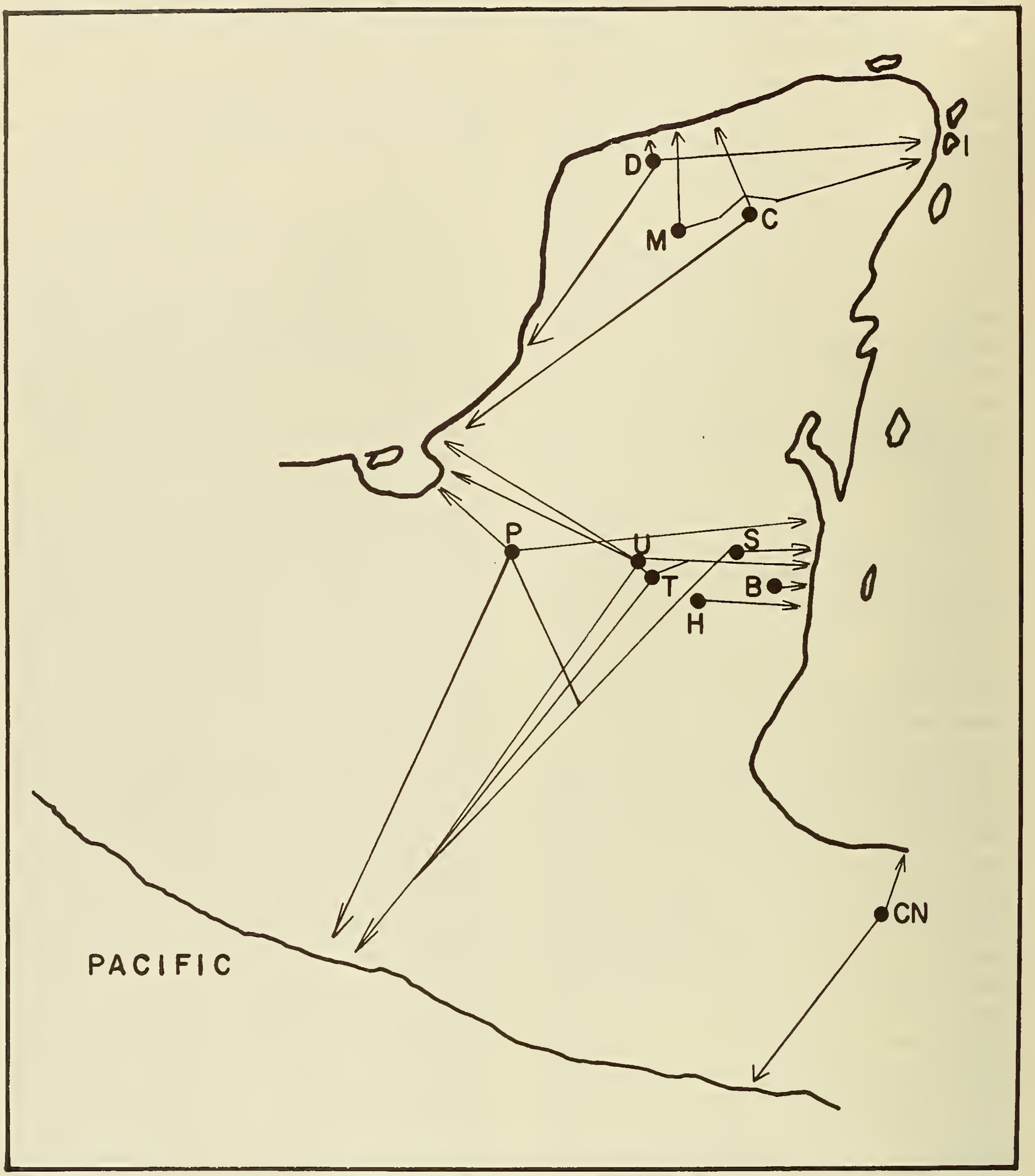


Fig. 3 — Trade relations suggested by archaeological finds of Mollusca in the lowland Maya area. B, Barton Ramie; C, Chichen Itza; Cn, Copan; D, Dzibilchaltun; H, Holmul; I, Isla Cancun; M, Mayapan; P, Palenque; S, San Jose; T, Tikal; U, Uaxactun.

today, and probably were in early times. Trade would obviously have been a more efficient answer than transplantation of divers over such distances.

Spondylus is actually a common shell on the beaches of both oceans, but by the time dead valves are thrown on the beach they have always lost the feathery fronds which make the shell so impressive. These beach-worn specimens, however, have all the cameo qualities of white, orange, and red layering that made the shell such a valuable material for artifacts, particularly beads. They were used extensively, as we have seen above, at the northern sites for just these utilitarian purposes. This could have been true at the southern sites, where the raw material was relatively near at hand. It would be interesting to pursue further the identification of the less glamorous specimens in the southern lowlands to see if they are possibly the beach-worn specimens of the Atlantic species, *americanus*, which were abundant nearby.

At widely separated San Jose and Piedras Negras, the Pacific mulberry shell, *Morum tuberculosum* was used for tinklers. The Piedras Negras examples are striking, as the almost identical Atlantic species, *M. oniscus*, was common on the nearby shores of the Gulf of Mexico. Because of these southern occurrences, another tinkler from the Gruta de Balankanche in Yucatan was also tentatively identified as *tuberculosum*. Later comparison with modern specimens indicated that it was probably the Atlantic species, although its much altered and eroded condition makes the identification doubtful.

Lyropecten is another large, often very brightly colored and attractive shell, which would understandably be traded to great distances. The Atlantic species *nodosus*, relatively common on the entire peninsular periphery, was used for pendants in Yucatan. At Uaxactun only the Pacific species *subnodosus* is found, and at Tikal most specimens are of this species, although imported from a much greater distance—another item to accentuate the Pacific trade route.

Chama echinata is another attractive Pacific bivalve, of which 32 unworked and worked were found at Tikal. It is less colorful and much less graceful than the Atlantic species, such as *C. macerophylla*, which were quite common in Atlantic and Gulf waters, much closer to the Peten.

The six other Pacific coast imports are scarce and unimpressive shells: *Arca pacifica* (2) at Uaxactun, *Cerithium maculosum* (1) and *Latirus*, probably *L. ceratus* (1) at Tikal, *Anadara grandis* (1) and *Oliva spicata* (14) at Copan, and *Crucibulum spinosum* (1) at Piedras Negras. These are positive evidence of the strength of Pacific trade connections, but they were probably items that filtered in with the trade rather than causing or supporting it. Moholy-Nagy has called my attention to the fact that, with the possible exception of *Spondylus princeps*, all trade in Pacific species apparently terminated by the end of the Early Classic at Tikal.

Temporal Factors

Table 2 was prepared partly to summarize Dzibilchaltun archaeological molluscs, partly to plot these by periods to see if time was a significant factor in the choice of specimens. Examination of the table makes it clear that vogues in shell definitely changed from period to period.

The numerical frequency of shells as listed obviously is related to the amount of excavation in debris of the various periods. Of this we can make only a subjective appraisal. It is our belief (and this must be only approximate) that our actual excavations into debris of the various periods is fairly closely proportionate to the frequency of such deposits at the site. There were two periods of great population (and therefore deposition): the Dzibilchaltun Middle Formative, roughly 500–300 B.C., and the Late Early period and Pure Florescent, roughly A.D. 450–750. Between these peaks, and after the second (from Modified Florescent to modern times), the population was greatly reduced. We believe that the frequencies recorded in Table 2 reflect fairly accurately the amount of shells used at Dzibilchaltun in the various periods. The differing figures from the two peak periods of occupation are probably proportionate. The paucity of specimens during epochs of low population will, of course, reflect the paucity of deposition in those times rather than a diminished use of molluscs by the fewer inhabitants.

Ceramic complexes and broader cultural periods do not always coincide at Dzibilchaltun (or elsewhere). Architecture of the Late Early period and Pure Florescent is unmistakably different, but the pottery of this entire span, which we call the Copo complex, continues with only minor change. So, when excavations and the resultant stratigraphy are associated with architecture, we can distinguish readily between the two periods; but when the association is purely ceramic, as is often the case, we cannot. The column headed "Copo complex" in Table 2 includes this less firmly dated material.

Although, as we have just noted, the excavated deposits of the Formative and the Late Early period –Pure Florescent were of roughly equal volume, it is interesting that the former contains almost three times as many shells as the latter (1,409 vs. 522). This is despite the fact that the latter epoch is much richer in artifacts, of shell or other material.

Closer examination of Table 2 makes it clear that this disparity is mostly traceable to several species of shell which were present in great abundance in Formative deposits and rare or absent later.

TABLE 2 — ARCHAEOLOGICAL SHELL FROM DZIBILCHALTUN

SPECIES	FORMATIVE		EARLY PERIOD I		EARLY PERIOD II		COPO COMPLEX		PURE FLORESCENT		MODIFIED FLORESCENT		BLACK ON CREAM		DECADENT		UNSTRATIFIED		CENOTE		TOTAL
	U	W	U	W	U	W	U	W	U	W	U	W	U	W	U	W	U	W	U	W	
GASTROPODA																					
Diodora cayenensis																			1		1
Fissurella barbadensis																	1				1
Cittarium pica																	1				1
Nerita tessellata	1																				1
Neritina virginea	1																				1
Tectarius muricatus									4								1				5
Vermicularia spirata					1																1
Cerithium eburneum	2				1																3
Crepidula fornicata					3																3
Strombus costatus	236	23	4		46	12	16	10	10	4					1		96	19	3	6	486
Strombus pugilis	1																				1
Cypraea cervus	1																				1
Phalium inflatum	1																				1
Cymatium parthenopeum																			1		1
Cymatium pileare					1																1
Ficus communis	53				13		6		2								21		1		96
Murex pomum																			1		1
Columbella mercatoria	2																				2
Melongena corona	215				2		1		4								3		1		226
Melongena melongena	133				1												1				135
Busycon coarctatum					1																1
Busycon contrarium	86	4			11	1	5	3	3								10	1	3		127
Busycon perversum	1																				1
Busycon spiratum	2				3		1		4				1				1				12
Fasciolaria tulipa	27				7	1											3				38
Pleuroploca gigantea	15	1			4	1	2			1							4	1			29
Turbinella angulata	14	3			5	1											4		1		28
Vasum muricatum						1															1
Oliva reticularis		3						1		1								2	1	2	10
Oliva sayana	1	1				3											1	7			13
Olivella dealbata								14													14
Prunum apicinum virgineum	28	75				1														1	105
Prunum labiatum	46	1			1			1	1								4				54
Conus floridanus	1	1							1												3
Conus spurius atlanticus	2	3			1	3											3				12
Bulla occidentalis	1				2															1	4
PELECYPODA																					
Arca zebra	2				2																4
Anadara notabilis		3																			3
Anadara transversa		5													1		3				9
Noetia ponderosa	1																				1
Modiolus d. granosissimus	2																				2
Brachidontes exustus					3																3
Isognomon alatus	37				35	23		6		4											105
Isognomon radiatus	1	2																1			4
Pinctada radiata	4				4		1	1									1				2
Pteria colymbus							1											1			11

Table 2 — *Continued*

Species	Formative U	Formative W	Early Period I U	Early Period I W	Early Period II U	Early Period II W	Copo Complex U	Copo Complex W	Pure Florescent U	Pure Florescent W	Modified Florescent U	Modified Florescent W	Black on Cream U	Black on Cream W	Decadent U	Decadent W	Unstratified U	Unstratified W	Cenote U	Cenote W	Total
Atrina seminuda	9				11	1				1							3		3		28
Plicatula gibbosa																			1		1
Aequipecten muscosus						1															3
Lyropecten nodosus						3													1		2
Spondylus americanus		5			10	34		3		7							1	2		1	63
Anomia simplex					19				1										1		21
Crassostrea virginica					3																3
Carditamera floridana	7	1				1											2		1		12
Pseudocyrena floridana	2																				2
Diplodonta semiaspera					1																1
Phacoides pectinatus	6	1					1														8
Phacoides radians					1																1
Codakia orbicularis	1																1				2
Chama congregata					3																3
Trachycardium isocardia	15				19		2		1						3		15		3		58
Trachycardium muricatum	9				4		1		1								2		1		18
Dinocardium r. vanhyningi	223	1	3		77		10		7				1				79		18		419
Mercenaria campechiensis	28	2	1		5	1	1										11				49
Chione cancellata	37	2			17	1	2		1						3		13		3		79
Anomalocardia cuneimeris	8								1												9
Transennella cubaniana					4																4
Macrocallista maculata																	2				2
Dosinia elegans	3	1			2	1	1		1								2		2		13
Tellina lineata	1																				1
Arcopagia fausta	1																				1
FRESHWATER MOLLUSCA																					2
Pomacea flagellata arata	1				1																7
Nephronaias aff. calamitarum		4			3																2,376

Total: 73 species

U, unworked; W, worked.

Most striking are *Melongena melongena* and *M. corona*, of which there are 348 specimens, from Formative deposits, only 8 datable as Early period or Florescent. These were found in cache offerings, but were also scattered through domestic debris, sometimes in piles. We shall state later our belief that these were brought in to eat, although such scavengers are now considered inedible.

Another example is the *Marginella*. The tiny *Prunum apicinum virgineum*, of which 105 were found (75 with a hole broken for suspension as beads), is almost entirely Formative in occurrence, only 1 datable to later periods. Its larger and much more beautiful cousin is *Prunum labiatum*; of 54 specimens, 47 were Formative period, only 3 datable to later deposits. Unlike the tiny-Marginellas, these beauties were apparently not collected for beads; only one was possibly perforated for suspension. Their use is problematical, perhaps religious or medicinal.

A number of other larger pelecypods and gastropods appeared in impressive abundance during the Formative period, but continued in moderate use during later periods. These include the cockles, particularly the oversized *Dinocardium r. vanhyningi*, *Ficus communis*, and *Fasciolaria tulipa*, as well as most of the larger conchs of the genera *Strombus*, *Busycon*, *Pleuroploca*, and *Turbinella*. It will be noted later that the disproportion between periods may reflect a change to bringing only the meat, rather than animal with shell and all, from the ocean for table use.

Only two distributions follow a reverse pattern. Of 21 *Anomia simplex*, none are from Formative deposits. And of 63 *Spondylus americanus*, only 5 are of Formative age. Both these cases probably reflect an increase of jewelry making in Early period and Florescent times.

Although it is possible to do no more than conjecture their significance, these striking changes of mode from Formative to later times are definitely present.

USE OF SHELLS AS VOTIVE OFFERINGS

It is plain from Table 2 that the vast preponderance of shell from Dzibilchaltun is completely unworked. Only 333 shells or identifiable fragments out of a total of 2,376 showed any sign of working, about 14 per cent. The larger part of these were tiny Marginellas worked as beads and small nacreous fragments possibly used in mosaic.

Some of the shells were doubtless brought for the table, but this would still not account for the bulk of material found. Other shell was probably brought in for slight alteration and use as ornaments, or for simple raw material in jewelry; but the number of unworked specimens cannot be accounted for as simply an artisan's backlog.

The Maya seem to have endowed the marine mollusc with magic or symbolic properties which led to a number of ritual (or possibly only superstitious) usages. Unfortunately, I know of no survival of such beliefs or practices into historic times. "Ethnomalacology" in this area is an empty word. This is in startling contrast to the Maya's continuing knowledge of their botanical environment. My Merida housekeeper's Maya vocabulary for plant species is awesome in size and in specific definition, as is her knowledge of their life history and medicinal qualities. Time after time, as we collect plants, she gives most specific Maya names and lists of therapeutic properties which look as if they were borrowed verbatim from the early works of George Gaumer or from Ralph Roys's *Ethnobotany of the Maya* (1931). But despite the 73 species at inland Dzibilchaltun, our informant knows only one word describing shells—the Spanish word *concha*. Efforts to obtain Maya names for marine shells, even among the coastal population, were fruitless. The generic term *hub* occurs in early dictionaries with the meaning of 'shell' or 'shell trumpet' (e.g., Pérez, 1866–77, p. 143) and is still occasionally used in the more general sense today. Roys (1931, p. 328) cites the name *boc* for oyster in the San Francisco Dictionary.[1] Any cult of interest has certainly long since vanished.

We shall see in many ways that cults of interest did exist, and some of these can be traced to the very distant past. Shells were deeply involved in Maya ideas of cosmogeny. The Old God of the ancients (Schellhas' and Anders' God N, referred to by Thompson as "The Mam") is frequently depicted as carrying a large conch on his back, and occasionally as emerging from one. The godhead and the molluscan symbol are associated with the underworld, with death, and (according to Förstemann) the five unlucky days at Uayeb at the end of the year. By extension, the shell became associated with water, with the moon goddess Ixchel (who was the goddess of fertility and childbirth and also a water deity), and with childbirth. In hieroglyphic writing, the shell was symbolic of completion, being used as the basic glyph for zero and a component of various glyphs describing completion, such as period-ending signs. Thompson (1950, pp. 133–34), examines this symbolism in some detail and illustrates (fig. 21) a number of graphic representations. More comparative material is assembled by Schellhas (1904), Spinden (1913, pp. 83-84, figs. 108–11), Tozzer (1957, p. 107, figs. 166–83) and Anders (1963, numerous references and illustrations).

Most of the portrayals of the Old God with the conch are in the codices, some of which probably date to not long before the conquest. But the concept is a much earlier one. Several columns in Modified Florescent structures at Chichen Itza portray an old man emerging from a large conch shell (Spinden, 1913, fig. 110; Tozzer, 1957, fig. 175). Two of the gold disks recovered from the Sacred Well at Chichen Itza portray this motif (cf. Lothrop, 1952, pp. 61–62, fig. 43). In one the emerging figure is an old man who might well have been God N. In the other, however, the figure is clearly that of the deity with the long, decorated nose whom Schellhas called God K, of whom we shall see more later. Lothrop believed these gold disks belong to the very beginnings of the "Toltec" period (Modified Florescent) at Chichen Itza, as the central panels contain design forms which are largely of Mexican plateau inspiration, and the peripheries still con-

[1] Prof. Alfredo Barrera Vásquez, whose knowledge of Maya faunal and floral terminology is unparalleled, knows of only one specific name; *Pleuroploca gigantea*, the largest of our marine molluscs, is called *chacpel*. "Chac" means red in Maya; "pel" is the vernacular (*"termino indecente,"* Pérez, 1866–77, p. 275) for the female genitalia. The brilliant red *Pleuroploca* is thus somewhat graphically separated from the white animal of *Strombus* and *Busycon*, or the black *Turbinella*, the other large conchs. Both *Pleuroploca* and *Turbinella*, however, are known to most modern coastal fishermen by the Spanish name *abulon*. Some popular names for freshwater and land molluscs will be mentioned below.

tain pure Maya glyphic forms and designs. Recent research has shown that such "Toltec" motifs did appear far back into the Pure phase of the Florescent.

The Iglesia, attached to the Casa de las Monjas at Chichen, is of Pure Florescent date. Two of the niches in the front façade of this structure contain representations in carved stucco of individuals emerging from conch shells (best illustrated by Bolles, 1963). Tozzer has suggested that these might have been later replacements of original carvings, but no such stuccowork is known from the Modified Florescent. A polychrome bowl from the Bliss Collection, said to be from Yucatan (Lothrop, 1957, pl. LXXXII), has a beautiful panel representing God N sitting on or emerging from an enormous conch shell. This vessel, of Early period date, may well have been imported from the southern Maya lowlands.

In the southern area, no less than six different representations of the Old God with the conch shell are found on four pottery vessels from Chama in the Alta Verapaz (Dieseldorff, 1926–33, vol. 1, figs. 70, 71, 136–137, 237, 239). On two of these vessels, in paired panels, the god is emerging from the conch in one, seated in front of it in the other. These vessels may be assigned to the Late Classic of the south (Late Early period in Yucatan). On the Tablet of the Foliated Cross at Palenque (also Late Classic), one of the principal figures stands on a representation of God K, the god with the elongated, decorated nose, emerging from a large conch, holding in his hand what is probably growing corn (Maudslay, 1889–1902, vol. 4, pls. 80, 81). This is reminiscent of the gold disk from Chichen Itza mentioned above. Moholy-Nagy (1963, p. 78) notes that at Tikal, "Four wizened, gnome-like creatures, probably Mams, are shown emerging from what seem to be conch shells along the sides of Altar 4, which is Early Classic in style and type of stone."

From the above it is clear that shells, or at least conchs, were firmly entrenched in ancient Maya religious beliefs and customs. But—for the same reason that we cannot believe that the *Oliva* tinklers so frequently used for belt ornaments in the Early period were worn to remind the wearer of the underworld, death, or parturition—we cannot believe that the enormous quantity of unworked shell at Maya sites accumulated for the same reason. Rather, we believe they were also important to the Maya because they symbolized, or at least were reminiscent of, the sea. Precisely what the religious or superstitious context of this association was, we shall probably never know, but the continuous presence of other forms of marine animals with shells in caches, and other offerings, must be significant.

In the paragraphs below we shall touch only upon raw shells intentionally introduced as such. Jewelry of shell or shell perforated for use as jewelry are not considered germane to this topic, and will be described in separate volumes on "Tombs and Caches" and "Artifacts."

Of the many tombs at Dzibilchaltun, only seven have offerings of shells. Two are Formative and five are associated with the Copo complex, one datable to the Late Early period. The species found are:

Cerithium eburneum (2)
Strombus costatus (1)
Ficus communis (1)
Arca zebra (1 pair)
Chione cancellata (4)

None of the seven contained other forms of marine life. At Mayapan, where burials were presumably all of the Decadent period, occasional lots of shell and marine materials were included as offerings, but no identification of the tomb material, as such, was published (A. L. Smith, 1962). At Copan three tombs contained offerings; one held four unworked *Oliva porphyria*; the second a *Spondylus princeps* valve, containing pearl, jade, and cinnabar; the third "shell fragments" (Longyear, 1952, pp. 35–50). At Barton Ramie only two burials, both Protoclassic, contained offerings of shell, both the freshwater clam *Nephronaias ortmanni* (W, fig. 309, *l-n*). At San Jose only two burials had such material, both probably S.J. IV; one had a large ostreid cupped over the face, the other contained a single *Nephronaias* (T, pp. 193–220). At Tikal all the tombs and several of the minor burials contained shell offerings, prominently *Spondylus*. Our working definition of tombs has been "stone-walled and stone-roofed or vaulted areas containing burials." This is at variance with the Tikal Project's definition of tomb, whereby floor space is in excess of the needs of the single interment (M, p. 74). The rare cases where this is true at Dzibilchaltun are away from the major ceremonial structures, and are not relatively richly endowed with offerings of any sort. No rich tombs of the type found at Tikal have appeared at Dzibilchaltun. Those in ceremonial structures and in thatched dwellings, although numerous, shared the same simple stone cists and the same shabby offerings. No one believed, apparently, that you could "take it with you." In the most fashionable burial areas, the pottery offerings were often either broken or worn out before deposition. With these strictures, the frequency of shell offerings at the two sites does not seem too disparate, nor do those at other sites in the Maya lowlands. In Uaxactun, five Early and Late Classic burials had offerings of raw shell (K, p. 61). At Piedras Negras, one Late Classic tomb (the most elaborately equipped at the site) contained three *Spondylus princeps* valves and one *Psoronaias quadratus* (C, p. 55). Over the area as a whole, in summary, burials occasionally, but at some sites very rarely, contained offerings of unworked molluscs. A considerably higher proportion contained pendants of perforated but otherwise unaltered shells or jewelry made of this material, which might have served the same symbolic purpose.

Unworked shell played a prominent role as a component of caches at Dzibilchaltun. Ten caches contained unaltered specimens; 16 contained assortments of fragments, some of which showed marks of cutting or grinding, but most of which were simply smashed. We shall have much to say about this material in the volume on artifacts, but shall here note only that we are usually uncertain whether such fragments were considered as raw material suitable for making small jewelry such as mosaic, or whether they were rejects or waste material from such operations. A surprising number of species occurred in caches (numerals indicate unaltered specimens):

Tectarius muricatus (4)
Vermicularia spirata (1)
Crepidula fornicata (3)
Strombus costatus (5 + fragments)
Ficus communis (3 + fragments)
Melongena corona (50)
Melongena melongena (12)
Busycon contrarium (3)
Busycon spiratum (1)
Fasciolaria tulipa (fragments)
Pleuroploca gigantea (fragments)
Prunum a. virgineum (3)
Bulla occidentalis (fragments)
Arca zebra (1 pair)
Brachidontes exustus (3)
Isognomon alatus (fragments)
Atrina seminuda (fragments)
Spondylus americanus (fragments)
Anomia simplex (16)
Crassostrea virginica (3)
Diplodonta semiaspera (1)
Phacoides radians (1)
Chama congregata (3)
Trachycardium isocardia (fragments)
Trachycardium muricatum (fragments)
Dinocardium r. vanhyningi (16)
Mercenaria campechiensis (fragments)
Chione cancellata (3 + fragments)
Anomalocardia cuneimeris (2)
Transennella cubaniana (4)

Several caches contained only a single species of shell, without container or other offerings. A Copo Complex cache contained 16 carefully nested *Dinocardium r. vanhyningi*—obviously arranged as single valves, therefore not pairs which might have contained animals as food offerings (fig. 4). A single Formative cache from Str. 500 contained 22 perfect Melongenas, evenly divided between the species *corona* and *melongena*. Distribution of species in the caches followed even more rigidly the temporal variations discussed on pp. 45–48, above. For example, all but one of the 62 cached Melongenas were found in Formative context; all of the 18 Dinocardiums were associated with the Copo Complex. A number of other forms of marine life appeared in the caches. Thirty barnacles were found in one cache, possibly brought in on large conchs. Three caches contained colonies of bryozoans; one, nine of such. One contained a chunk of marine coral. Various inclusions of fish remains, particularly spines of the stingray and the spiny scales of the boxfish, will be discussed in detail elsewhere in our reports. No substela caches were found at Dzibilchaltun; all that were found fall in the class of "structure caches" as used by other writers.

At Mayapan, in his summary of 27 residential caches, Smith (1962, pp. 256–63) lists only one unidentified shell and no marine material. Proskouriakoff notes, to the contrary, that "small conchlike shells, apparently unworked, have been found in many cists and caches containing other artifacts." She mentions specifically only a *Cymatium femorale*. Six pieces of coral, of at least three species, were found "in tombs or in association with objects of ceremonial nature" (P, p. 387).

At Copan, all of the 14 caches found had been placed under stelae. Six were listed as containing marine shells, of which only *Spondylus princeps* and *Anadara grandis* are identified, both Pacific species. One Copan cache contained coral fragments

Fig. 4 — Dzibilchaltun, Str. 38, Cache 1: 16 nested unworked valves of *Dinocardium robustum vanhyningi*. Associated with Copo Complex ceramics.

and a stingray tail; another contained a pearl. A novel component was stalagmites, which appeared in four caches. At Balankanche in Yucatan we find these connected with rain ritual (Andrews, 1967).

At Barton Ramie, only three caches were found, none containing shell of any kind. However at San Jose, 7 structure caches of the 20 found contained unworked shell and/or other marine material. All were of Classic date, mostly S.J. IV. The species found are:

Neritina meleagris (24)
Neritina virginea (1)
Cerithium variabile (1)
Columbella mercatoria (2)
Terebra (?) *cinerea* (5)
Crassostrea virginica (1)
Spondylus princeps (17)

Again, there is a tendency to include other products of the sea, including eight pumice fragments, several corals or bryozoans, a pearl, numerous boxfish spines, and even two manatee bones (T, pp. 184–92).[2]

[2] Thompson (1931, p. 273, pl. 31) reports a fragment of branch coral from a structure cache at Hatzcap Ceel, B.H., along with unworked, unidentified shells.

Of the 64 caches recovered at Uaxactun (A. L. Smith, 1950, p. 92) only five have been recorded as containing identified unworked shells. Four caches of the Tzakol period contained the following species (RR, p. 199):

Crepidula sp. (1)
Strombus pugilis (1)
Prunum a. virgineum (54)
Ostrea sp. (1)
Trachycardium muricatum (2)

One Tepeu cache contained 19 valves of *Spondylus princeps*. A. L. Smith lists a number of other caches as containing unworked shells, but these are not individually identified (*op. cit.*, pp. 103–05). Also present in the caches were coral, pearls, marine worm casts, and stingray spines.

Specifics are not yet available on the uniquely rich caches recovered in the Tikal excavations, which are still in progress as this is written. However, Moholy-Nagy's 1963 paper gives valuable preliminary summary of the data through the 1962 season. Unworked shell and marine material is common in earlier caches, later becoming unusual, and finally disappearing from the offerings. They are completely absent in the 22 stela caches dating after

9.13.0.0.0. Of 55 structure caches, 42 contained marine objects. In fact, Moholy-Nagy notes that "the contents of these caches . . . comprise most of the unmodified shells known from Tikal" (M, pp. 72–74). This is in strong contrast with Dzibilchaltun, where shells in caches are frequent but form only a tiny percentage of the total from the site. Comparison between the two sites, however, is difficult. Although the great mass of unworked shell from Tikal comes from early Classic caches, this is a period of little construction at Dzibilchaltun; and correspondingly few caches have been found. The very large number of caches from Dzibilchaltun are mostly of Late Early period and Pure Florescent date; and where these overlap the occupation of Tikal, caches at the latter site are characterized by decreasing amounts of raw-shell offerings. A very large variety of non-shell marine material was obtained at Tikal, relatively, apparently much more than at Dzibilchaltun, although the former is more than ten times as far from the sea. This includes pearls, several species of corals, bryozoans, gorgonians, sea-urchin fragments, a sand dollar, sponge, chunks of coquina, stingray spines, and fish vertebrae, spines and scutes (M, pp. 69–70, M–MS). Specific association of these specimens is not yet available, although Moholy-Nagy notes that they are more common in Late Classic caches, when introduction of actual unworked shell become less frequent.

At Piedras Negras, unworked shells played a less prominent but nonetheless important role in the composition of caches. Of 94 such offerings, 15+ contained shells of 8 marine, 2 freshwater and 2 land species:

Cittarium pica (1)
Vermicularia spirata (2)
Crucibulum spinosum (1)
Arca imbricata (2)
Arca zebra (5)
Spondylus princeps (11)
Ostrea sp. (1)
Trachycardium muricatum (1)
Pomacea flagellata arata (1)
Pomacea flagellata ghiesbrechti (4)
Euglandina decussata }
Choanopoma radiosum } (6)

One cache contained a single piece of coral. Again in strong contrast to Dzibilchaltun, Coe notes that unworked shell and marine material have not been found outside of offerings (C, pp. 55, 77–119). The species that were brought in for this purpose, with the exception of valuable *Spondylus*, were not suitable for manufacture of jewelry.

Summarizing briefly, unworked molluscs and other forms of marine life were included rarely to frequently at different sites and different times as components of the votive offerings we refer to as caches. They are more frequent in caches than in tombs, but never apparently an indispensible component of the assemblages of offerings.

Another but probably closely related form of votive cult is found in the cenotes or freshwater wells of the northern peninsula. The most famous is that of the Sacred Well at Chichen Itza, first explored by Edward H. Thompson in 1904, most recently by the Instituto Nacional de Antropología e Historia of Mexico in cooperation with the Club de Exploraciones y Deportes Acuáticos de Mexico and the National Geographic Society of the United States. None of the results have been completely published (but cf. Lothrop, 1952; Tozzer, 1957; Dávalos H., 1961; Littlehales, 1961). Although an immense quantity of pottery and artifacts of gold, copper, jade, and other materials was introduced as sacrificial offerings with human beings, few marine animals or materials have been reported. Dr. J. Ladd, who is studying Harvard's collections from the Sacred Cenote, reports six molluscs of four species:

Fissurella barbadensis (1)
Strombus pugilis (1)
Pleuroploca gigantea (2)
Oliva reticularis (2)

as well as several fragments of gorgonians obviously brought from the sea.[3]

A smaller but much deeper cenote within the ceremonial group at Dzibilchaltun, Cenote Xlacah, has yielded, after several seasons of diving, a very large collection of artifacts dating from Formative times until virtually the present (Andrews, 1959, 1962; Marden, 1959). Most of this long series of offerings date to the Late Early period and Pure Florescent, when most of the ceremonial center was built. Mixed with this large and rich assortment of artifacts, forming, as it were, one continuous cache, were 48 unworked marine molluscs of 20 species:

[3] Large intentional offerings of pottery have been found on the floor of Lake Amatitlan in Guatemala (Borhegyi, 1959), and Luis Marden informs me that large numbers of offertory vessels in a very distinct tradition were encountered in a brief hour of diving below the waters of Lake Flores (Peten-Itza) in Guatemala. No material of marine origin was forthcoming.

Diodora cayenensis (1)
Strombus costatus (3)
Cymatium parthenopeum (1)
Ficus communis (1)
Murex pomum (1)
Melongena corona (1)
Busycon contrarium (3)
Turbinella angulata (1)
Oliva reticularis (1)
Bulla occidentalis (1)
Pinctada radiata (1)
Atrina seminuda (3)
Plicatula gibbosa (1)
Anomia simplex (1)
Carditamera floridana (1)
Trachycardium isocardia (3)
Trachycardium muricatum (1)
Dinocardium r. vanhyningi (18)
Chione cancellata (3)
Dosinia elegans (2)

Also introduced were 14 gorgonians (sea fans) and a lump of coral (note that gorgonians have also been found at Tikal). It is impossible to tell whether or not the large number of *Pomacea flagellata arata* found in the cenote were introduced by humans; the species is not found alive there today.

It is clear from the above data that the amazing quantity of unworked shells found at Maya sites, even far from the sea, must be accounted for, at least in part, by religious or superstitious belief or ritual. Unfortunately no trace of such belief or practice has survived into modern times to give us a springboard for speculation—as Landa's scattered information on the calendar did for epigraphers. Quite beyond aesthetic or utilitarian usages (which *did* exist), two distinct patterns seem to emerge: (1) Shells (conchs in particular) were closely associated with death, the underworld, water and childbirth—and are depicted in the codices, architectural and monumental sculpture, and pottery—at least as far back as the Early Classic in the south. These beliefs might account for the occasional occurrence of shells in tombs at a number of sites. The association, at best, is a doubtful one. (2) A large part of the unworked shell from the area seems part of a larger configuration of marine life forms and representations, ranging from shells to gorgonians, corals, sand dollars, and even clusters of byrozoans, in all an obviously intense preoccupation with the sea. Shells, although the most frequent items, would seem to lose their immediate identity in this broader configuration. The intent was clearly not primarily an aesthetic one. The shells chosen for offerings were not attractive species, nor were they usually perfect specimens (both of which would have been so easily available on the beaches near Dzibilchaltun). The larger shells were apparently favored if covered with barnacles or other marine parasites (which often could easily have been removed but were not). These shells were so frequently partly filled with sand and beach drift that they were obviously collected after death, not placed in the offerings as food. Many of the marine forms were broken or fragmentary when introduced.[4] At Dzibilchaltun, at least, there is no evidence of any attempt to clean or prepare these offerings as items of beauty or value. To the contrary, every effort was made to conserve the original identity with the sea.

We have much other evidence in Yucatan of preoccupation with the sea. The medial molding of the north façade of Str. 1-sub (Temple of the Seven Dolls) at Dzibilchaltun, the side facing the sea, is adorned with a parade of maritime creatures, stingrays, unidentified fish, aquatic birds (fig. 5). Much later, the Chac Mool Temple (buried beneath the Temple of the Warriors) at Chichen Itza, featured at least two very naturalistically painted murals of seashore life (frontispiece), including charming renditions of various molluscs, horseshoe crabs, aquatic birds, and fish (emphasizing the obviously still important stingray).

On the basis of our Dzibilchaltun evidence, we would be inclined to surmise that this strong emphasis on the sea and marine life reflected what must have been a real economic dependence in ancient times. We have suggested elsewhere that control of the coastal salt marshes might have been an important factor in the support of a population at Dzibilchaltun which was at times vastly beyond what could have been supported by local agriculture. However, this "cult of the sea" is as strong or stronger at Tikal, where the sea is at a much greater distance and could have had much less direct influence on economic life.

Use of Shells as Ornaments

Worked shell is usually divided into two categories by the archaeologist, on the basis of whether it has or has not retained its original form. In the former, for aesthetic or religious purposes, it is still

[4] Moholy-Nagy (1963, p. 73) notes that this was the case at Tikal.

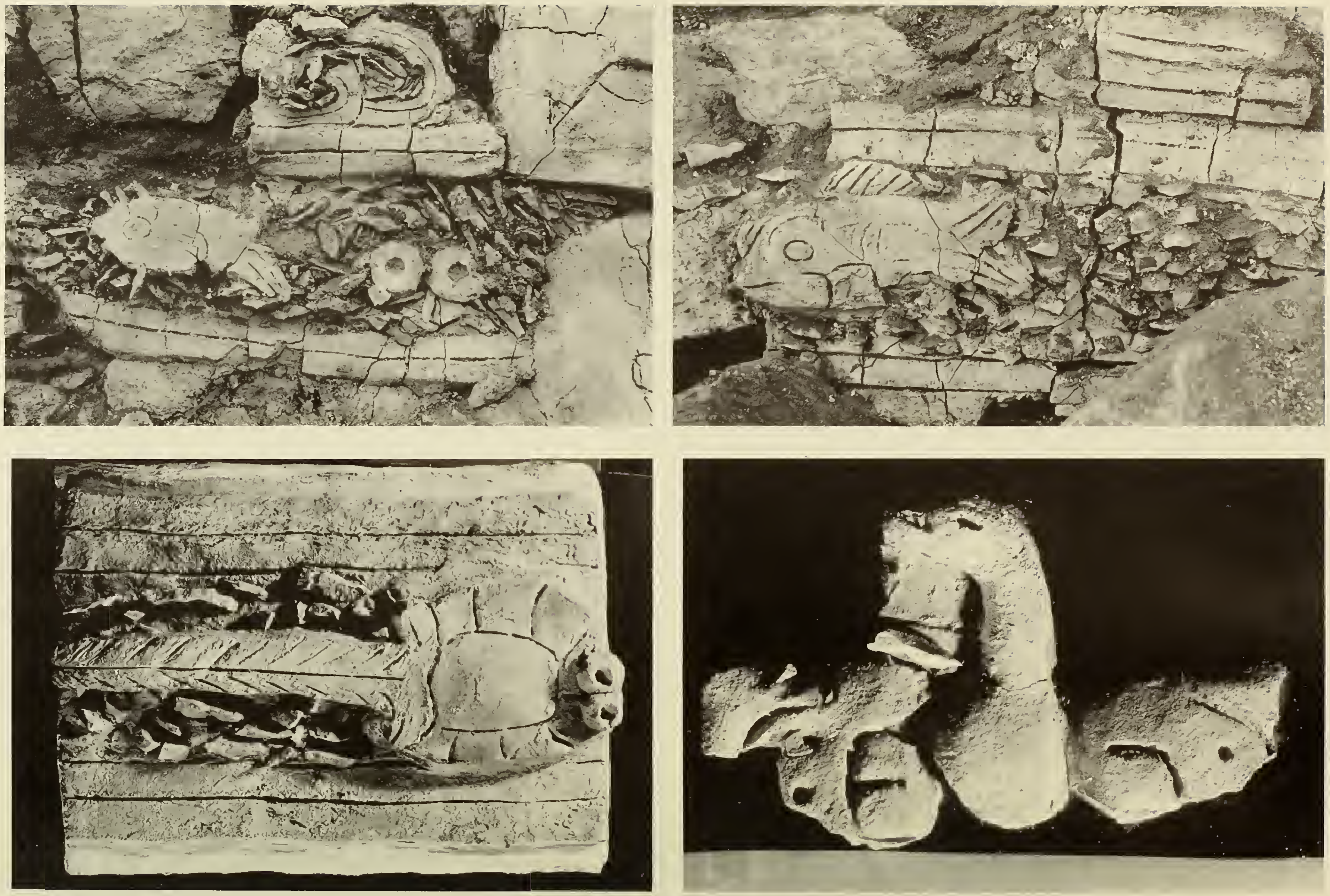


Fig. 5 — Details of the medial molding, north façade, Str. 1-sub (Temple of the Seven Dolls), Dzibilchaltun. From the beginnings of the Late Early period. Note unidentified fish, stingray, aquatic bird. The stingray is 39 cm. long; other specimens to same approximate scale.

a shell; in the latter it is simply a material used to make something else. Occurrences of both are listed in detail in the checklist above. Detailed discussion and comparative study of both will be reserved for our separate study of Dzibilchaltun artifacts.

Twelve species of pelecypods were used at Dzibilchaltun to make pendants, usually with two drilled perforations at or near the hinge for suspension:

Anadara notabilis (3)
Anadara transversa (3)
Aequipecten muscosus (2)
Lyropecten nodosus (3)
Spondylus americanus (10)
Carditamera floridana (2)
Phacoides pectinatus (1)
Dinocardium r. vanhyningi (1)
Mercenaria campechiensis (1)
Chione cancellata (2)
Dosinia elegans (1)
Nephronaias aff. *calamitarum* (4)

Pendants were also made of three species of smaller gastropods, usually perforated near the shoulder for vertical suspension:

Fasciolaria tulipa (1)
Conus floridanus (1)
Conus spurius atlanticus (1)

A remarkably long-lived ornament of shell, usually called a tinkler, is found throughout the Maya area from Early Classic times in the south to the Decadent period in the north—always apparently a popular item of jewelry. They are usually made of an Atlantic or a Pacific species of *Oliva*, but, as we have seen above, are sometimes of quite different shells. Usually, the spire is cut off, approximately at the shoulder (sometimes it is merely perforated twice), and a sawn hole is cut near the base. The pattern of alteration is clearly not for suspension, but to enable firm stitching to a fabric (see K, fig. 85,*d*,4). Usually the shell, with its attractive design, was left intact, but some specimens (fig. 85,*d*,6) were elaborately reworked. The species used at Dzibilchaltun are:

Oliva reticularis (7)
Oliva sayana (11)
Prunum labiatum (2)

Where shells largely retaining their original form were used as beads, drilled perforation seems to have been considered more labor than the product warranted. Sometimes the apex was ground off; more often a single hole was broken in the side to permit stringing. The species used at Dzibilchaltun were:

Olivella dealbata (14)
Prunum apicinum virgineum (77)

Two further uses of almost unaltered shells are difficult to place within our highly artificial archaeological taxonomy. Pairs of *Spondylus* shells were found at Copan, Pusilha, and Tikal used as "jewel boxes," to contain offerings of pearl, tiny jade beads, and other small offerings. At Piedras Negras, a pair

Fig. 6 — Two tinklers from the collection of Richard E. Hedlund in Merida, exact provenience unknown. A similar, but much cruder, specimen is illustrated from Mayapan (P, fig. 45,*a*). Scale 3/4.

of *Arca zebra* was used for this purpose. The valves were sometimes painted with cinnabar.

Effective trumpets could be made by cutting off the apical whorls from the larger conchs (*Strombus*, *Pleuroploca*, *Turbinella*, *Busycon*), and we know this to have been done at various sites. A trumpet made from a large *Turbinella angulata* was cached under a Middle Formative structure at Dzibilchaltun. When I finally succeeded in producing a blast on this instrument (and it was a *blast*), I was convinced that much of my lip membrane was permanently destroyed and my front teeth perilously shaken. Another, perhaps unique, use of shells is to be found at a small ruined temple some 1500 m. up the Caribbean shore from the lighthouse at Punta Celarain, the southern tip of Cozumel Island. The small temple itself has, as a roof ornament, a perfect diminutive temple some 50 cm. high with a rounded spire atop. Set into the spire, and facing the four directions, are four vertical series of *Strombus* trumpets of varying sizes—perhaps the earliest recorded wind-vane with built-in sound.

USE OF SHELL AS RAW MATERIAL

At Dzibilchaltun, several species of molluscs were used for making jewelry and a very few utilitarian artifacts, in all of which the shell form had been almost or entirely lost. Again, detailed discussion and comparative study are considered more appropriate to our separate report on artifacts of the site, and will be presented there.[5]

The 169 fragments of identified altered shell represented 8 species of pelecypods, 7 of gastropods. Fine flakes of *Atrina* (1), *Isognomon* (31), and *Pinctada* (1) were mostly found in caches containing other materials such as jade and pyrites, and were probably used, or intended for use, in mosaics. Five smaller pelecypods were used in altered form as pendants: *Chione* (1), *Dinocardium* (1), *Dosinia* (1), and *Mercenaria* (2). Two small gastropods were given special uses: *Conus spurius atlanticus* (6) was used to cut out small triangular pendants, probably retaining the shell's original attractive coloration. Horizontal sections of *Oliva reticularis* (3) were cut to make corkscrew-like artifacts of unknown use. The great bulk of shell for jewelry making was from the larger conchs and the *Spondylus*: *Strombus costatus* (74), *Busycon contrarium* (1), *Pleuroploca gigantea* (4), *Turbinella angulata* (3), *Vasum muricatum* (1), and *Spondylus americanus* (39). It should be noted that a considerable number of smaller conch fragments and most of the finished jewelry of white shell could not be identified surely even to genus, and are therefore not included in the present tabulations. Most of this material was probably *S. costatus*. *Spondylus*, on the other hand, is more completely listed, as even small fragments of the shell can be recognized from its cameo-like qualities. Finally, we should re-emphasize that all of the worked shell from Dzibilchaltun forms but a very small fraction (14 per cent) of the total recovered at the site.

USE OF MOLLUSCS AS FOOD

Molluscs, when used for food, will usually be collected from the nearest available shore. They will not normally be transported over any considerable area from their point of collection, and the shells would normally be left on the beach to form the familiar coastal middens (a 5-pound conch would not be carried far inland for its half-pound of edible meat). But inlanders under dietary need will go to unbelievable lengths to enjoy products of the sea. When I was surveying the upper Candelaria drainage along the Guatemala frontier in 1938–39, one ate well in the area if he had a gun—and most people had, and used it. When only wild turkey, venison, and peccary were available as meat (which was a delight for us), the natives would lament that if we had only come a week earlier or later, it would have been flavored with *cazon* (the baby hammerhead shark so traditionally dear to Campechanos). We suffered little, but did have a rough time adjusting to local gourmets' tastes when the occasional *muladas* would arrive loaded down with 5–10-day-old, liquified shark (which we could smell many hours before the mulada arrived, if the wind were in the right direction). This would then, with gusto, be merged with all tortillas, soups, or the meat dishes which otherwise would have been so tasty. I cannot believe that the choice, by a people otherwise discriminating, could have been other than purely gustatory. When one considers trade from the sea, such irrational factors must be considered.

[5] Techniques of manufacture are well described in Fewkes, 1883. An excellent survey of Mesoamerican shell artifacts may be found in Kidder, Jennings, and Shook, 1946, pp. 145–52.

The Isla Cancun Midden is a sealed Late Formative (Chicanel) deposit of human debris dated by radiocarbon at 250 B.C. It consists of a mixture of shell, turtle, animal and fish bones, pottery and ash. Only a few shell artifacts occurred, and the remains are clearly kitchen refuse of a small population. Such middens are an invaluable asset of archaeology, but this is the first to be excavated in the Maya area. It, therefore, gives us a hitherto unavailable insight into Maya utilization of local fauna for subsistence. And, as we have quite thoroughly collected the modern beaches, it acts as a gauge of possible faunal change over the last 2000 years. This can then be extended to our appraisal of the inland sites, where the shells and not the animals must largely have formed the basis of value.

Whatever shells occurred in the Cancun Midden were clearly collected for gastronomic purposes, either for the local settlement or for possible trade of the meat to the interior. We, of course, have no evidence of the latter possibility.

Our tabulations are very surprising, at least to me. First, comparison between the midden collections and those taken on the present-day shore show no change in fauna over the 22 centuries which have elapsed. Second, it is clear that the ancients' appetite for seafood must have been voracious: 99 species are found in the midden, comprising not only the tasty larger conchs, but a variety of other minor molluscs, often scavengers which we, after reading modern works on the subject, would have considered totally inedible. Apparently, the ancients took whatever molluscan fauna was available—and used it for food—and presumably knew what they were about. Where we were able to find molluscs on the present beaches which were not on the menu in the midden, each appeared to be a rarity which had not occurred in our archaeological sample. Table 3 summarizes what was eaten at Isla Cancun.

In present times, most of the larger conchs, *Strombus*, *Pleuroploca*, *Cassis*, and *Turbinella*, are not only eaten by coast-dwellers, but shipped inland (without shell) where transportation is available, to larger inland cities, where they are prepared in *escabeche* as cocktails or soups which are considered as choice "regional" dishes. One cannot visit the cantinas of Chetumal without sampling this specialty. *Pleuroploca* and *Turbinella*, by the way, because of the darker color of the meat are called not "*Concha*" but "*Abulon*." In taste they resemble the Pacific gastropod from which they are misnamed.

TABLE 3 — MARINE MOLLUSCS FROM ISLA CANCUN MIDDEN, QUINTANA ROO, MEXICO

SPECIES	ENTIRE	FRAGMENTS	TOTAL
GASTROPODA			
Calliostoma jujubinum	1	0	1
Cittarium pica	145	219	364
Astraea caelata	1	0	1
Astraea phoebia	4	0	4
Astraea t. americana	1	1	2
Nerita peloronta	15	5	20
Nerita tessellata	2	0	2
Nerita versicolor	66	30	96
Littorina ziczac	1	0	1
Nodilittorina tuberculata	1	0	1
Echininus nodulosus	2	0	2
Tectarius muricatus	10	1	11
Petaloconchus irregularis	4	0	4
Planaxis nucleus	1	0	1
Cerithium eburneum	3	0	3
Cerithium literattum	2	0	2
Crucibulum auriculum	1	0	1
Crepidula fornicata	1	0	1
Strombus costatus	81	412	493
Strombus gigas	353	1518	1871
Strombus pugilis	1	0	1
Strombus raninus	51	6	57
Cypraea cervus	0	1	1
Cypraea cinerea	6	4	10
Cypraea zebra	25	14	39
Cyphoma gibbosum	1	0	1
Polinices hepaticus	1	0	1
Polinices lacteus	6	3	9
Phalium granulatum	1	5	6
Cassis tuberosa	17	19	36
Cypraecassis testiculus	7	4	11
Charonia variegata	5	2	7
Cymatium femorale	1	1	2
Cymatium parthenopeum	1	0	1
Cymatium pileare	1	0	1
Tonna galea	0	2	2
Tonna maculosa	4	0	4
Ficus communis	2	0	2
Murex pomum	1	1	2
Purpura patula	1	0	1
Thais deltoidea	0	1	1
Thais rustica	1	0	1
Columbella mercatoria	1	0	1
Cantharus auritulus	2	0	2
Melongena corona	258	297	555
Melongena melongena	1	0	1
Busycon coarctatum	3	1	4
Busycon contrarium	219	362	581
Busycon spiratum	8	11	19
Fasciolaria hunteria	1	0	1
Fasciolaria tulipa	89	389	478
Pleuroploca gigantea	14	70	84

Table 3 — *Continued*

Species	Entire	Fragments	Total
Turbinella angulata	57	39	96
Vasum muricatum	2	0	2
Oliva caribaeensis	14	0	14
Oliva reticularis	101	5	106
Oliva sayana	3	0	3
Olivella dealbata	1	0	1
Olivella nivea	3	0	3
Mitra florida	2	0	2
Prunum a. virgineum	3	0	3
Prunum guttatum	4	0	4
Conus mus	2	0	2
Conus regius	5	0	5
Conus sozoni	2	0	2
Conus spurius atlanticus	3	0	3
Melampus coffeus	2	0	2
Unidentified fragments, mostly Strombus sp.	—	1022	1022
Subtotals:	1628	4445	6073
PELECYPODA			
Arca imbricata	7	2	9
Arca zebra	6	0	6
Anadara notabilis	5	0	5
Glycymeris decussata	18	1	19
Glycymeris undata	38	2	40
Isogomon alatus	1	3	4
Isogomon radiatus	1	1	2
Pinctada radiata	1	0	1
Pecten laurenti	0	1	1
Lyropecten nodosus	1	5	6
Spondylus americanus	75	36	111
Lima lima	0	1	1
Lima scabra	0	1	1
Ostraea equestris	1	0	1
Ostraea frons	2	0	2
Crassostrea virginica	2	0	2
Lucina pensylvanica	5	0	5
Phacoides pectinatus	8	1	9
Codakia orbicularis	7	0	7
Chama florida	8	0	8
Chama macerophylla	9	4	13
Chama sarda	37	1	38
Chama sinuosa	47	3	50
Pseudochama radians	1	0	1
Trachycardium magnum	1	1	2
Trachycardium muricatum	0	2	2
Antigona listeri	1	3	4
Antigona rigida	1	1	2
Dosinia elegans	0	1	1
Tellina listeri	4	14	18
Tellina radiata	52	48	100
Arcopagia fausta	1	2	3
Subtotals:	340	134	474
99 species Totals:	1968	4579	6547

Many other molluscs are eaten as delicacies today. The mangrove swamps of the north-coast *ciénaga* and much of the west coast abound in mussels. Probably many species are used. Most popular are the "Ribbed Mussels," here *Modiolus demissus granosissimus*, which are harvested in great quantities in the *manglares* (mangrove swamps) near Progreso and Dzilam Bravo, and probably elsewhere.

Several varieties of oyster are available year-round in the peninsular restaurants, and are ever-present in the smaller pueblos. Most popular is the oyster we eat in the north, *Crassostrea virginica*, here a diminutive but very tasty race now supplied mostly from beds in the Laguna de Terminos, but found on the entire periphery of the peninsula. In Campeche, *the* specialty in restaurant or street-stand is the "Campechanito," a 14-oz. glass half-filled with baby shrimp (immaculately cleaned) capped with dime-sized but tasty baby oysters (*Ostrea frons* ?). Both these delicacies now come from Champoton.

Cittarium pica is a beautiful, nacreous shell, with a most unattractive snail in residence. But this animal, when boiled, is much tastier than the larger conchs, and makes a delightful broth, frequently consumed by natives of the Caribbean coast of the peninsula. I am told that the same is true of many other intertidal species, notably the Nerites.

Both ancients and moderns (among the latter particularly in Campeche) have been devoted eaters of the species of *Pomacea*, choice, fat, freshwater snails, common in archaeological deposits from Dzibilchaltun and Mayapan in the north to Barton Ramie, Uaxactun, and Piedras Negras in the south. At Tikal, 195 were found in excavations (to 1964), their archaeological context not yet evaluated. Thompson (1939, p. 181) notes that these snails, called *hute* [*jute*] in Spanish, *hooties* in creole, were eaten in large quantities in British Honduras at the time he wrote—and they probably are today.

Prof. Alfredo Barrera Vásquez (verbal information) has noted what may be a unique practice in the New World. In the cenote at Kaua, 18 km. east of Chichen Itza on the modern highway to Valladolid, a large freshwater gastropod (which we have not seen, but from description may probably be identified as a *Pomacea*) is eaten as a regional specialty by visitors, who come equipped with salt and lime juice as well as natatory intentions, and picnic on the raw snails. At certain times of the year, when the molluscs are loaded with brilliant red eggs, these are carefully separated, spread at the water's edge in zones where they are assiduously protected to assure the permanence of this culinary attraction.[6]

Excavations in the Belize River Valley have furnished evidence that other freshwater molluscs were an important source of food in ancient times: 765 specimens of the clam *Nephronaias ortmanni,* and 805 univalves of the species *Pachychilus glaphyrus* and *largillierti* were found in the trenches. Although a few examples of each of these were scattered throughout the stratigraphy, the heavy preponderance was in the Formative phases, after which either the supply diminished or the culinary interest dwindled. At Barton Ramie, over 100 land snails of the genus *Bulimulus* were found. Examination of the archaeological context of each specimen showed that, again, most of them were deposited during the Formative phases, which would indicate that they were intentionally collected and probably used as food. However, with the exception of the large Pomaceas, no freshwater molluscs, univalve or bivalve, are known to be used for food in the area today.[7]

Whereas we can be sure that the ancients drew heavily on the sea for food and delicacies, as they do today, we pointed out above that the shells were probably left on the shore in most cases when the animals were, shipped any distance inland. So that even at a site as near to the sea as Dzibilchaltun, catalogues of archaeological shell offer little if any gauge of the extent or variety of use of marine molluscs as food. The great quantity of shell we find in the ruins was probably brought in for other purposes. However, when certain categories of shell are exceedingly common, and where other uses seem to be completely ruled out, it is hard to escape the conclusion that molluscs were brought from the sea in their shells to be eaten.

As many as 493 valves or fragments of cockleshells, mostly the largest species, *Dinocardium r. vanhyningi* (419), littered the site. Only one fragment (a fragment of ventral margin with a drilled hole for suspension) showed any sign of working. Some of the larger specimens might have been used as cups or dippers, but would have made a sorry substitute for the gourds used today and probably in ancient times. It has also been suggested that they were used to striate the surface of unslipped utility jars (or the preslip incised jars of the Formative). But if used for such a purpose, they would not appear in such great quantities (we have no evidence that *any* pottery was actually made at Dzibilchaltun). Food seems the only logical use, and these animals are large and eminently edible.

The genera *Melongena* (361) and *Ficus* (96) seem another case in point. Not a single worked fregment has been found, nor can I suggest any use other than food for these small, thin-walled gastropods. It may be significant that the mass of species mentioned thus far are found in Formative deposits.

On the other hand, if these were brought from the sea in the shell for eating, we face the problem of the striking absence of shells of other species which we can be almost certain *were* used for food. No adult oyster shell appeared, but *Ostrea frons* and *Crassostrea virginica* are common on the shore. Only five mussel valves appeared (two Formative, three in an Early period cache). The very numerous larger conchs (*Strombus, Busycon, Pleuroploca, Turbinella*) can be well accounted for ty the variety of commercial uses to which the shell was put. But here again it should be noted that the great bulk of these larger shells were found in Formative deposits, where manufactured shell artifacts and jewelry are relatively scarce.

At Dzibilchaltun, we shall risk what may be a rash guess that a number of clams and snails were brought from the sea in their shells in the Formative period. Later, efficiency experts seem to have decreed that shells should be left on the beach unless they were to serve some purpose in the ceremonial or commercial life of the inland city.

[6] Teobert Maler (1901–03, p. 17), during his explorations of the Chancala River in the Peten, noted that "all the streams are filled with edible snails (*Melania levissima*= *Xot* . . . of the Mayas)." Prof. Barrera Vásquez has suggested (verbally) that this word is probably *X-hot* in Maya (*hot* in various dictionaries means an object with face or head down and rear parts elevated, which would fit well with these animals) and that this may be the Maya derivation of the words *jute* and *hootie* above. This may have been a generic name for freshwater univalves (see notes by Moholy-Nagy on p. 32).

[7] Euell Gibbons (1964) has published an interesting, if necessarily very incomplete, account of the edible molluscs, including, for the gourmet, suggestions on how many of them may be tastily prepared.

Summary and Conclusions

Molluscs, particularly marine molluscs, as well as other forms of marine life, are surprisingly frequent in archaeological excavations in the Maya lowlands. What began as a brief listing of the specimens recovered at Dzibilchaltun, was expanded to include the also unpublished material from our excavations at the Late Formative midden at Isla Cancun, Quintana Roo, and finally to add other previously published material from the lowland area. The resulting checklist of some 15,000 specimens of 192 species from 19 sites includes modern distributions for most. These have been drawn from a larger study of the modern fauna now in preparation, which, if still incomplete, offers more precise grounds for specific identifications than existed before. Photographs are included of most of the archaeological species, with better-preserved modern counterparts where considered useful. The checklist forms the bulk of the present monograph.

In brief sections following the checklist, we have considered the marine ecology of the area, possible aspects of ancient trade which might be inferred from the geographic distribution of ancient species, and possibly significant chronological variations in archaeological usage. Finally we have considered the ceremonial, aesthetic, and commercial importance of mollusca and marine life to the early Maya. Some results of these considerations have been of interest.

Ecologically, the peninsular littoral falls into four distinct zones, and merges into what would seem to be a fifth (fig. 2). Much of the molluscan fauna extends through all of these zones, but many of the species are quite restricted in their habitat. Making the generally accepted assumption that no significant faunal change has come about during the last 2000 years (confirmed by the identity of our pre-Christian and present-day collections at Isla Cancun), we should then be in a position to predict roughly where archaeological specimens of the restricted species were collected on the coast. There were enough of these to give at least some strong hints regarding pre-Columbian trade.

The northern Yucatan sites utilized almost entirely the malacofauna of the neighboring north coast. A handful of shells were probably brought from the East Coast; and there was no hint of trade in shells with the south. The Belize Valley sites, near the coast, followed the same pattern of local trade. However, the central Peten sites, which were at some distance from any sea coast, were deeply committed to trade routes which probably made excellent sense in general merchandise but not in terms of shell. Much of the shell, including the treasured *Spondylus princeps*, was imported from the distant Pacific. But imports included a number of less impressive Pacific species whose very similar Atlantic cousins could be obtained much nearer. At Copan, farther south, nearly all the archaeological shell was of Pacific origin, despite the proximity of the Gulf of Honduras. Even at Piedras Negras at the north corner of the Peten, Pacific influence is prominent. More interesting is the fact that the central Peten sites appear to have imported most of their Atlantic shell not from the nearby Caribbean but from the considerably more distant Gulf of Mexico. This might imply ethnic barriers to trade of which we are not otherwise aware. Despite the northward flow of Peten trade pottery, which is so heavily evidenced at Dzibilchaltun, we have no hint of marine molluscs being traded in the reverse direction, even though we have inferential evidence that salt from the north may have been a significant factor of balance. Table 1 summarizes the geographical distribution of archaeological and modern species.

Table 2 summarizes the occurrence of 73 molluscan species in the various periods of history at Dzibilchaltun. Molluscan remains in Formative context are strikingly different from those of the Early period and the Florescent. Although there was surely no change in the fauna available for use, the commonest species in Formative deposits are virtually absent in later times, probably because of a change in dietary habits. Increasing frequencies of certain species in the later periods may reflect an increase in the manufacture of jewelry and ornaments.

A brief examination was made of the evidence for ritual or votive significance of shells and other forms of marine life. We found that shells had a definite religious connotation documented in sculptures, ceramics, and the codices as far back at least as Phase I of the Early period. Shells occur frequently (but by no means always) in tombs, caches, and other offerings. Here they are often (but again not always) associated with other forms of life from the sea, to the extent that we feel the shells have lost specific symbolic identity *as such* and have become part of a larger configuration of association with the sea which was remarkably deep seated in Maya art and ritual practice. This would be simple to explain at sites as close to and possibly economically dependent on the sea as Dzibilchaltun. It is more difficult at sites far inland such as Tikal and Uaxactun, where the sea could have been of little practical importance. It was noted that the many votive offerings of marine life were probably not chosen for either aesthetic or monetary considerations. The commonest life forms were used, without apparent effort to choose tasteful specimens.

A short examination of the use of shells as ornaments and as raw material in the manufacture of jewelry and artifacts reveals the use of a large assortment of species for these purposes. But the amount of worked material recovered at Dzibilchaltun is so small that such industry cannot be considered a significant factor in the enormous total accumulations of shell at the site. Detailed analysis and comparative study of the worked material have been reserved for our separate publication on Dzibilchaltun artifacts.

Excavation of the briefly inhabited Late Formative kitchen midden on Isla Cancun, Q.R., has given the first clear picture of Maya utilization of the faunal environment. The midden consists mostly of shell and pottery mixed with ash, and the bones of turtle, fish, birds, and animals. We can be quite sure that these remains were of animals actually eaten by the ancients. Table 3 summarizes the molluscan remains, with surprising implications. Virtually all collectible shellfish were eaten—very prominently among them such carrion-eaters as the Melongenas, which according to modern texts are quite inedible. This probably clears up the mystery of large masses of raw shell at Dzibilchaltun, which we were otherwise unable to explain. After the Formative period at the latter site, many molluscs such as *Melongena* seem to have been eliminated from the diet. A decreasing number of *Dinocardium* valves and shells of the larger conchs in Early period and Florescent deposits may well indicate an increasing economic practice of leaving the heavy shells on the beaches where the animals were taken. Freshwater molluscs of several species seem to have replaced marine molluscs as food at the sites farther inland, as they do today.

Plates 1–21

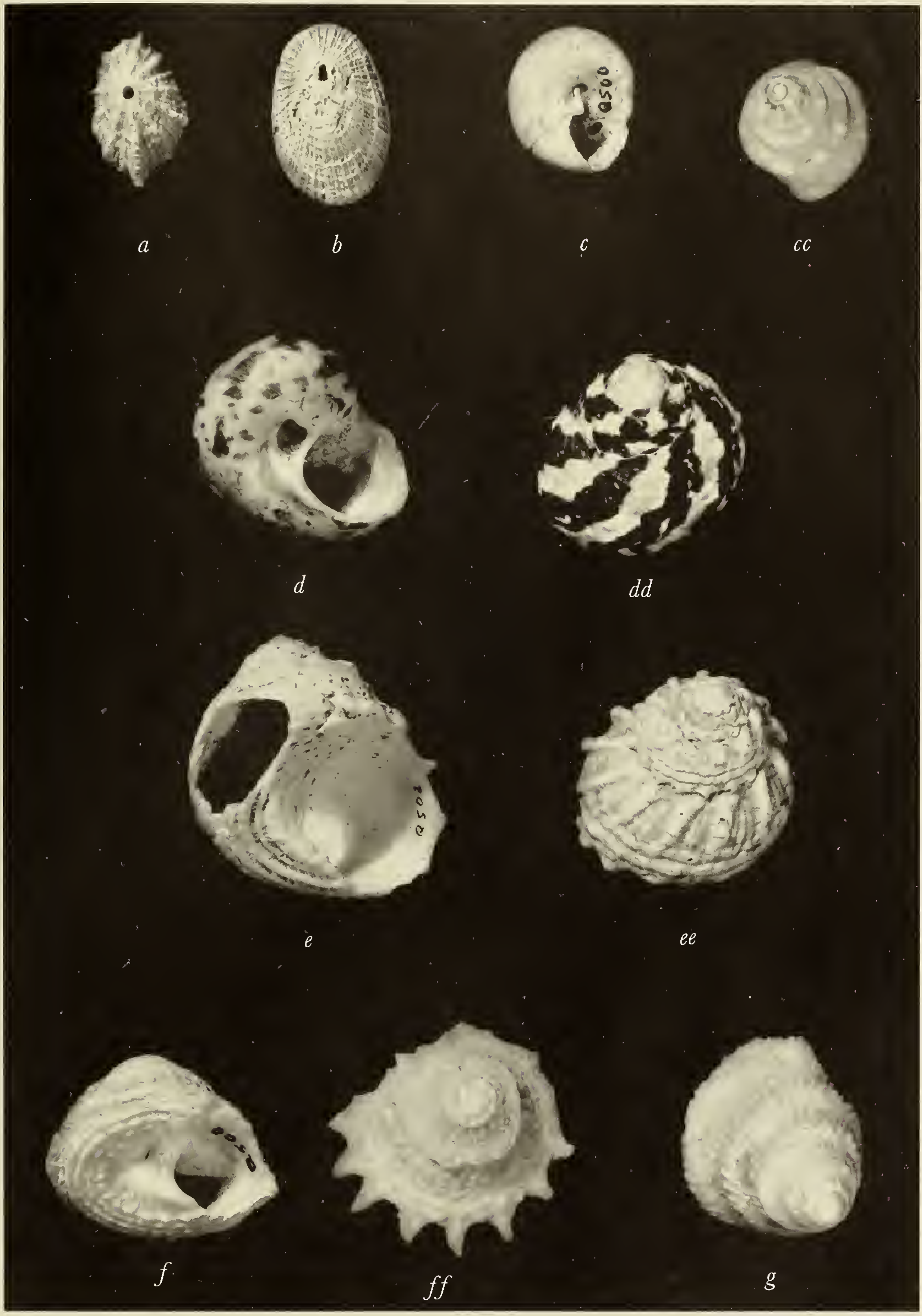
Specimen numbers preceded by M are Dzibilchaltun archaeological lot numbers; those preceded by Q are Isla Cancun archaeological lot numbers; simple numerals are Tulane University catalogue numbers of modern specimens. Precise data on stratigraphical association of archaeological shells and provenience of modern specimens are available at the Middle American Research Institute, Tulane University.

Archaeological shells are designated by single lowercase letters; modern specimens, by double lowercase letters.

PL. 1 — FISSURELLIDAE, TROCHIDAE, TURBINIDAE

a. *Fissurella barbadensis* Gmelin (M–200).
b. *Diodora cayenensis* Lamarck (M–101).
c. *Calliostoma jujubinum* Gmelin (Q–500), cc (2726).
d. *Cittarium pica* Linné (M–567), dd (7286). Both juveniles.
e. *Astraea caelata* Gmelin (Q–502), ee (5044).
f. *Astraea phoebia* Röding (Q–500), ff (2710).
g. *Astraea tecta americana* Gmelin (Q–500).

(Actual size)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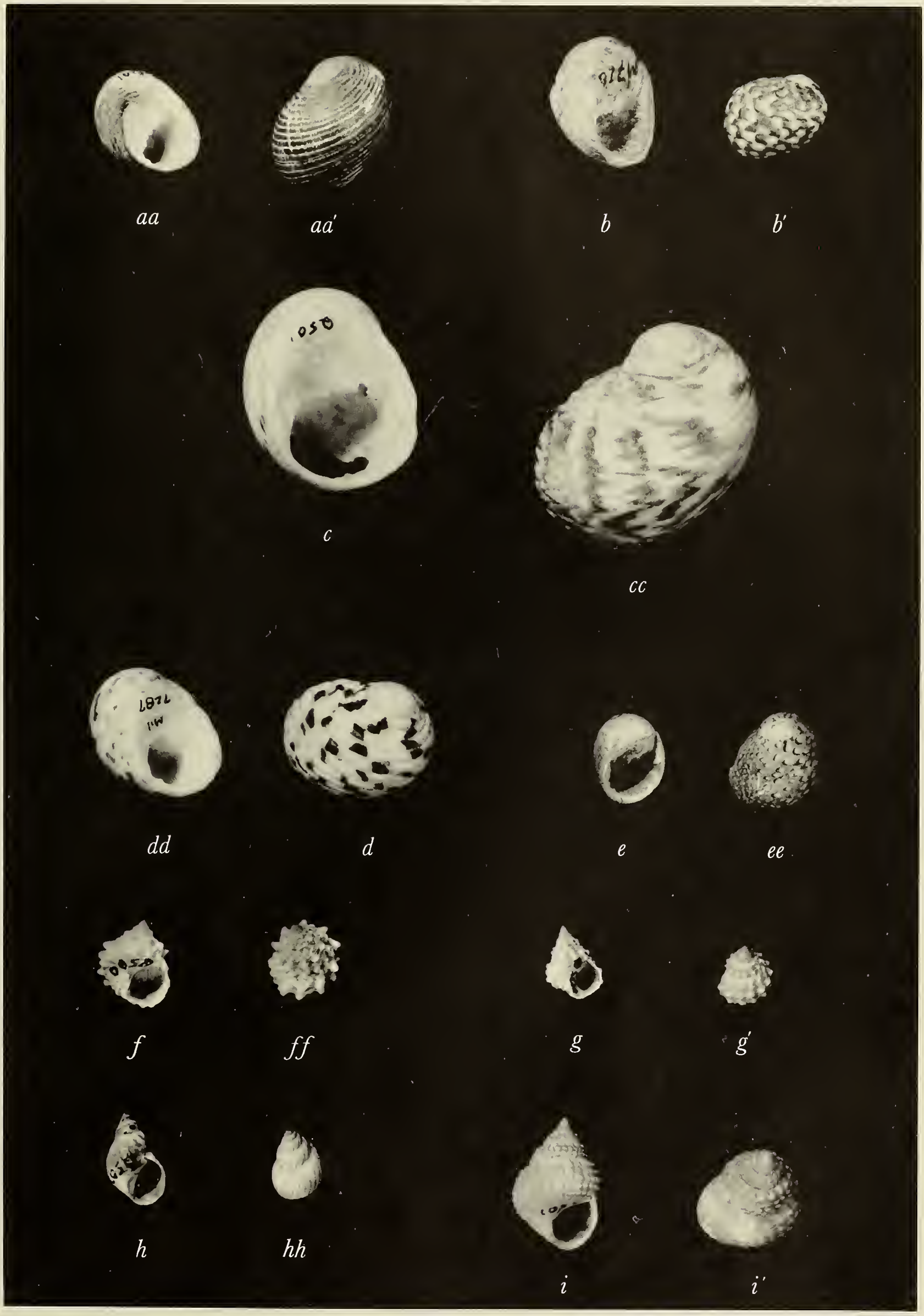
ff
g

PL. 2 — NERITIDAE, LITTORINIDAE

aa,aa′. *Nerita fulgurans* Gmelin (5244, 5277).
b,b′. *Nerita tessellata* Gmelin (M–720, Q–500).
c. *Nerita peloronta* Linné (Q–500), cc (4815).
d. *Nerita versicolor* Gmelin (Q–501), dd (7287).
e. *Neritina virginea* Linné (M–825), ee (4498).
f. *Nodilittorina tuberculata* Gmelin (Q–500), ff (1293).
g,g′. *Echininus nodulosus* Pfeiffer (Q–501).
h. *Littorina ziczac* Gmelin (Q–502), hh (4505).
i,i′. *Tectarius muricatus* Linné (Q–502).

(Actual size)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aa'
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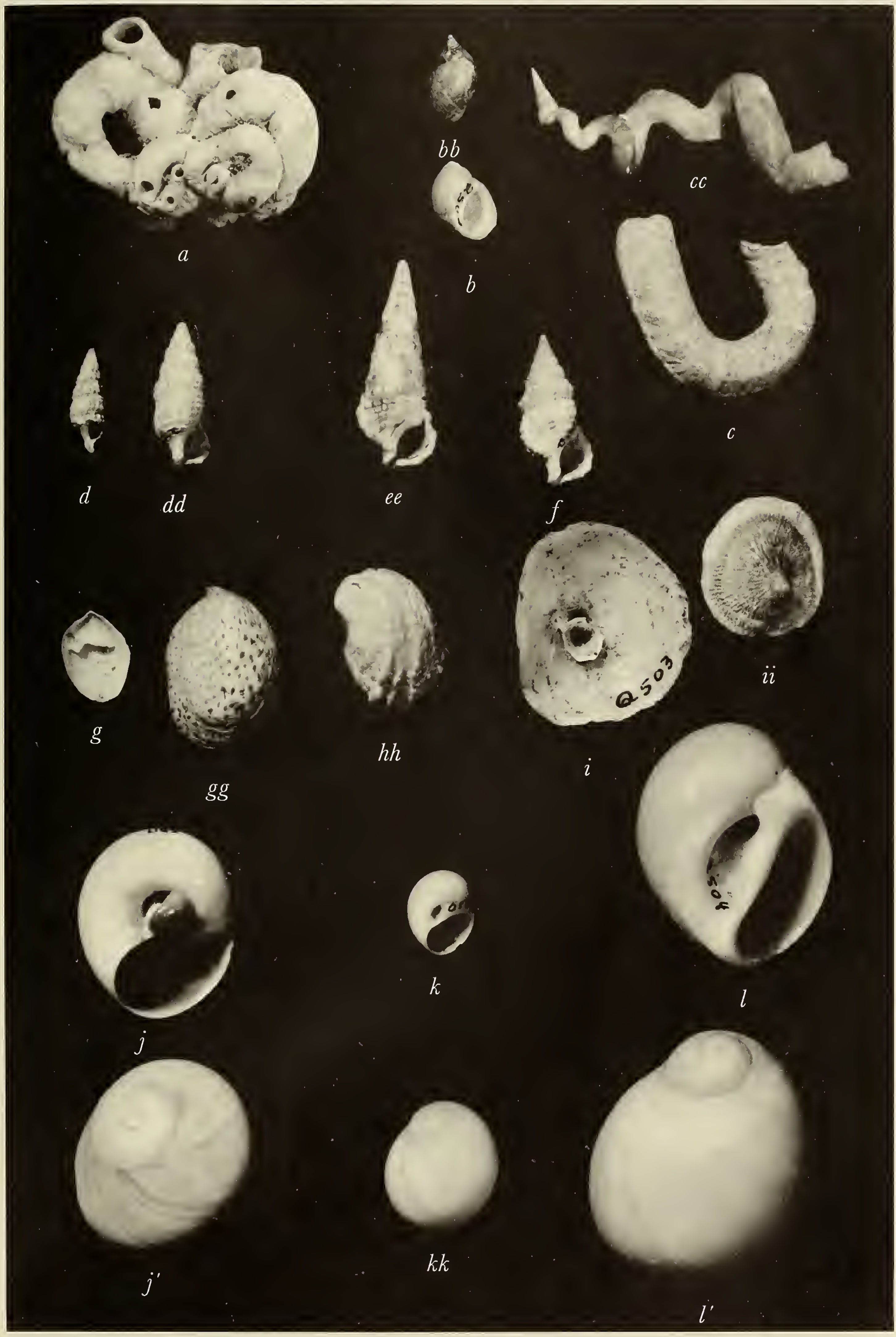
PL. 3 — VERMETIDAE, TURRITELLIDAE, PLANAXIDAE, CERITHIIDAE, CALYPTRAEIDAE, NATICIDAE

a.	*Petaloconchus irregularis* d'Orbigny (Q–500).
b.	*Planaxis nucleus* Bruguière (Q–500), bb (4759).
c.	*Vermicularia spirata* Philippi (M–239–B), cc (2142).
d.	*Cerithium eburneum* Bruguière (M–936), dd (2981).
ee.	*Cerithium floridanum* Mörch (201).
f.	*Cerithium literattum* Born (Q–500).
g.	*Crepidula fornicata* Linné (M–239–B), gg (4068).
hh.	*Crepidula aculeata* Gmelin (7288).
i.	*Crucibulum auriculum* Gmelin (Q–503), ii (929).
j,j′.	*Polinices duplicatus* Say (5812, 5817).
k.	*Polinices lacteus* Guilding (Q–500), kk (6650).
l,l′.	*Polinices hepaticus* Röding (Q–504, Q–500).

(Actual size)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j'
kk
l'

PL. 4 — STROMBIDAE

a. *Strombus gigas* Linné (Q–500), aa (1022).
b. *Strombus costatus* Gmelin (M–239–B).
c. *Strombus pugilis* Linné (Q–500).
d. *Strombus raninus* Gmelin (Q–502).

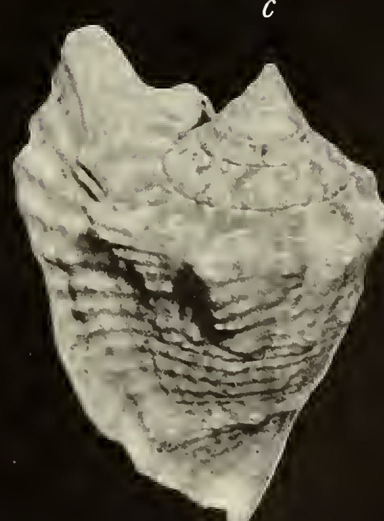
(Scale 1/2)

a

aa

c

b



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PL. 5 — CYPRAEIDAE, OVULIDAE

a. *Cypraea cervus* Linné (M–437), aa (6268).
b. *Cyphoma gibbosum* Linné (Q–500), bb (2673).
c. *Cypraea zebra* Linné (Q–500), cc (6017).
d. *Cypraea cinerea* Gmelin (Q–500), dd (6975).

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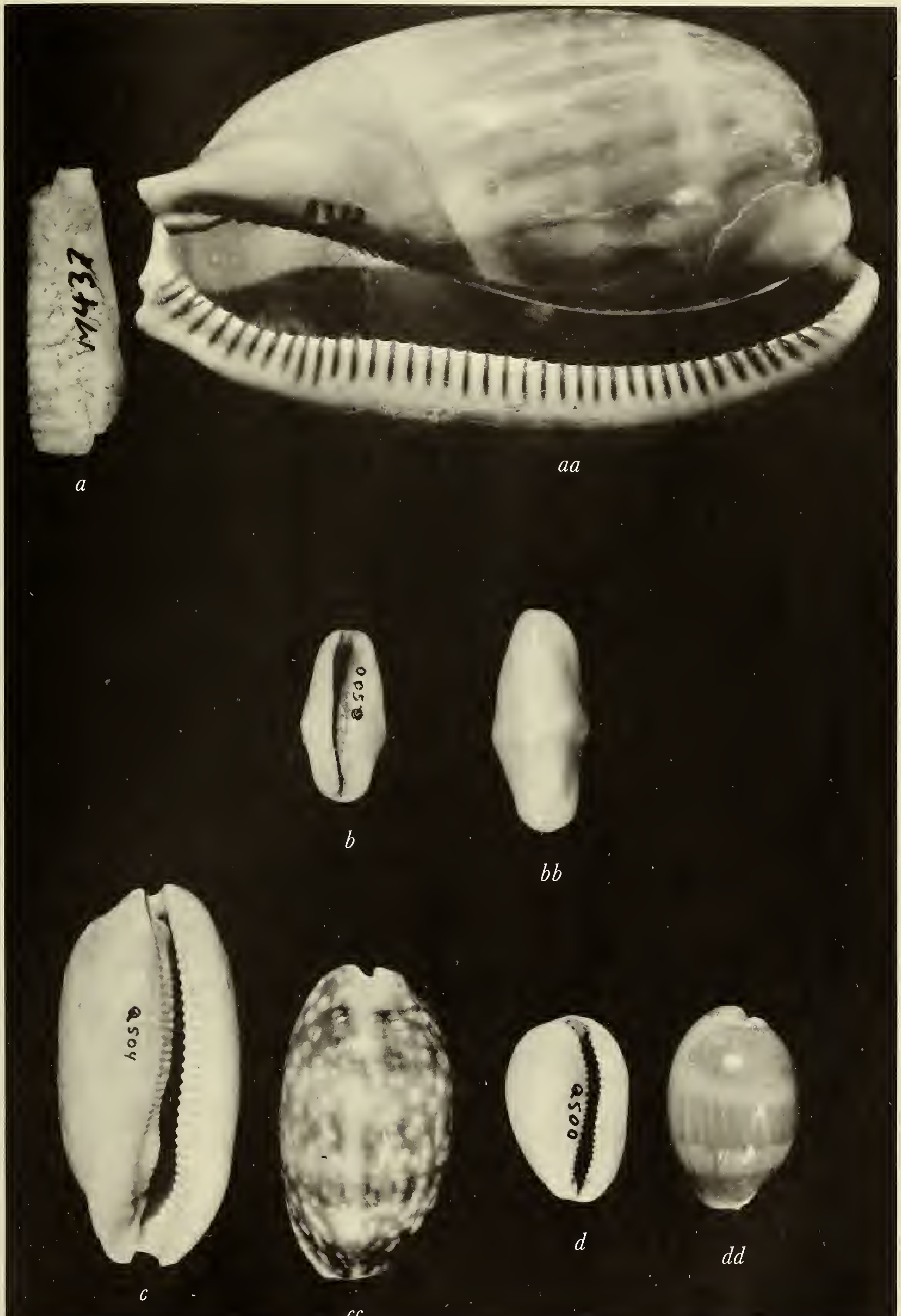
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PL. 6 — CASSIDIDAE AND MISCELLANEOUS SMALL GASTROPODS

a.	*Phalium inflatum* Shaw (M–825), aa (3865).
b.	*Phalium granulatum* Born (Q–504), bb (3700).
c.	*Cypraecassis testiculus* Linné (Q–504), cc (7289).
dd,dd′.	*Morum oniscus* Linné (6982, 4561).
e.	*Columbella mercatoria* Linné (Q–500).
ff.	*Nassarius vibex* Say (696).
g.	*Cantharus auritulus* Link (Q–501).
hh.	*Cancellaria reticulata* Linné (6584).
i.	*Melampus coffeus* Linné (Q–502), ii (7290).
jj.	*Natica canrena* Linné (6283).

(Actual size)


aa
bb
cc
a
b
c
dd
dd'
e
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g
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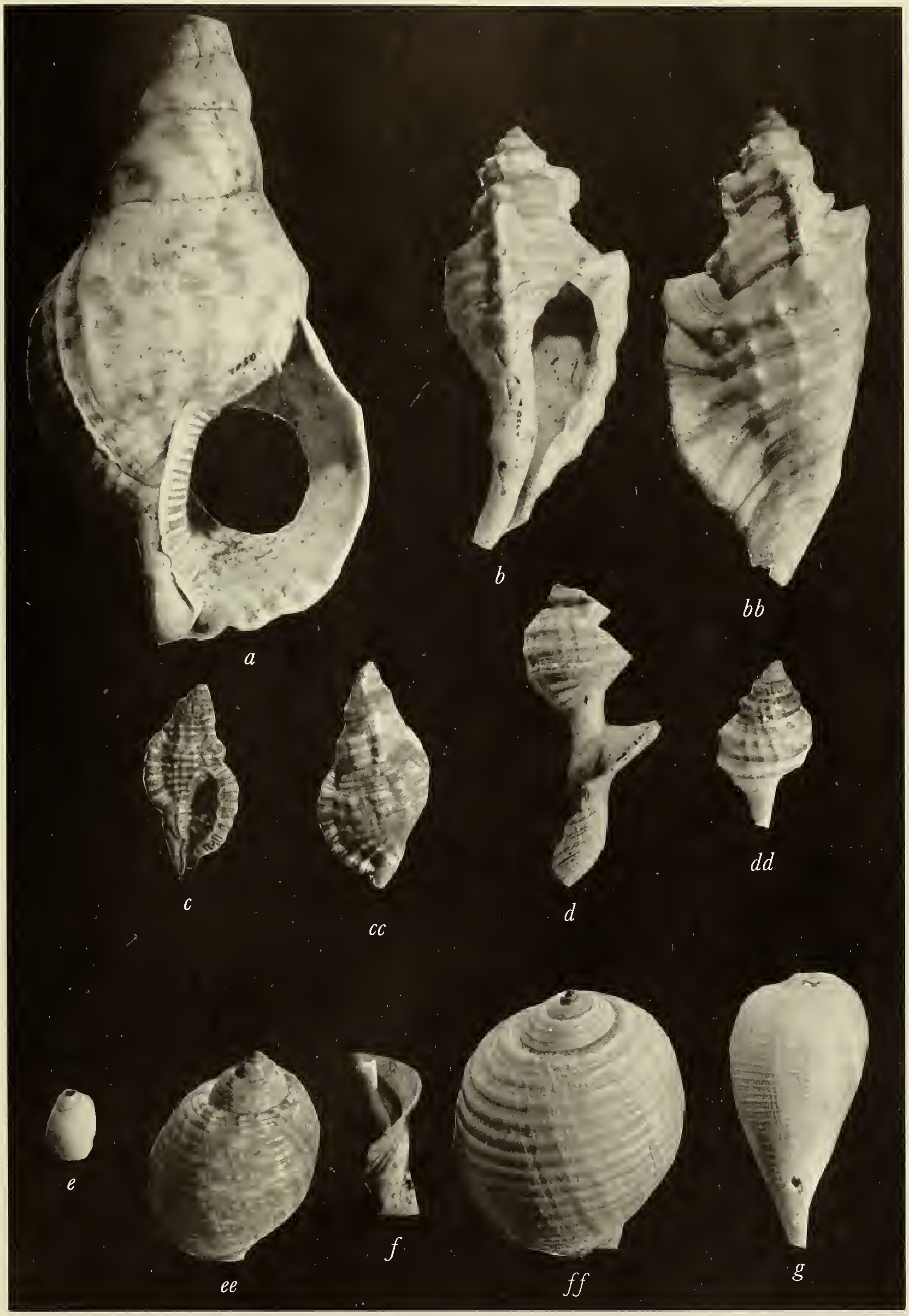
i
ii
jj

Pl. 7 — CYMATIIDAE, TONNIDAE, FICIDAE

a. *Charonia variegata* Lamarck (Q–502).
b. *Cymatium femorale* Linné (Q–504), bb (4573).
c. *Cymatium parthenopeum* von Salis (M–101), cc (6571).
d. *Cymatium pileare* Linné (Q–504), dd (4573).
e. *Tonna maculosa* Dillwyn (Q–501), ee (6099).
f. *Tonna galea* Linné (M–615), ff (3601).
g. *Ficus communis* Röding (M–825).

(Scale 1/2)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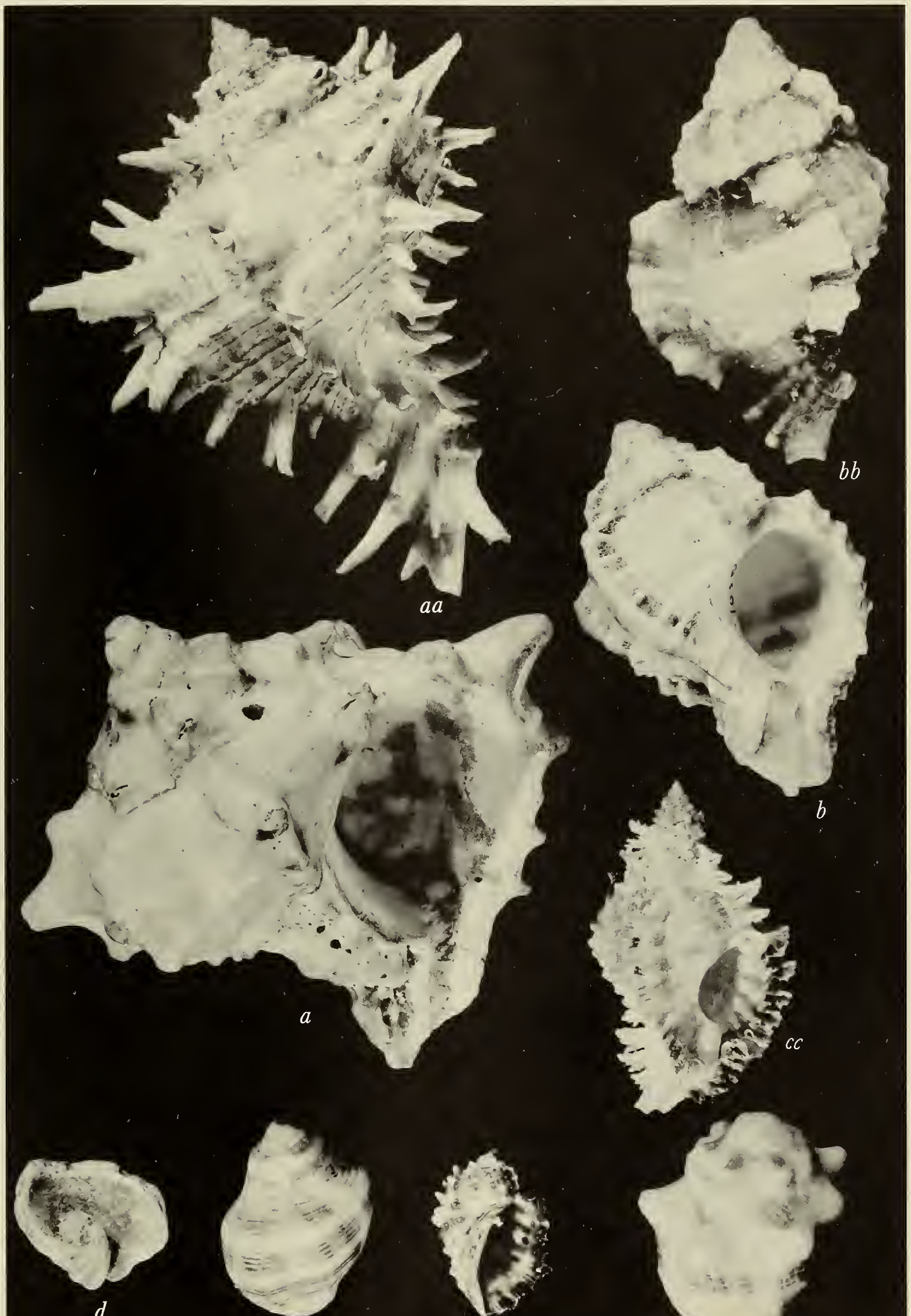
PL. 8 — MURICIDAE

a. *Murex fulvescens* Sowerby (Chichen Itza), aa modern, Florida, U.S.A.
b. *Murex pomum* Gmelin (Q–501), bb (7015).
cc. *Murex dilectus* A. Adams (3897).
d. *Thais rustica* Lamarck (Q–501), dd (3633).
e. *Purpura patula* Linné (Q–500).
ff. *Thais deltoidea* Lamarck (6683).

(Actual size)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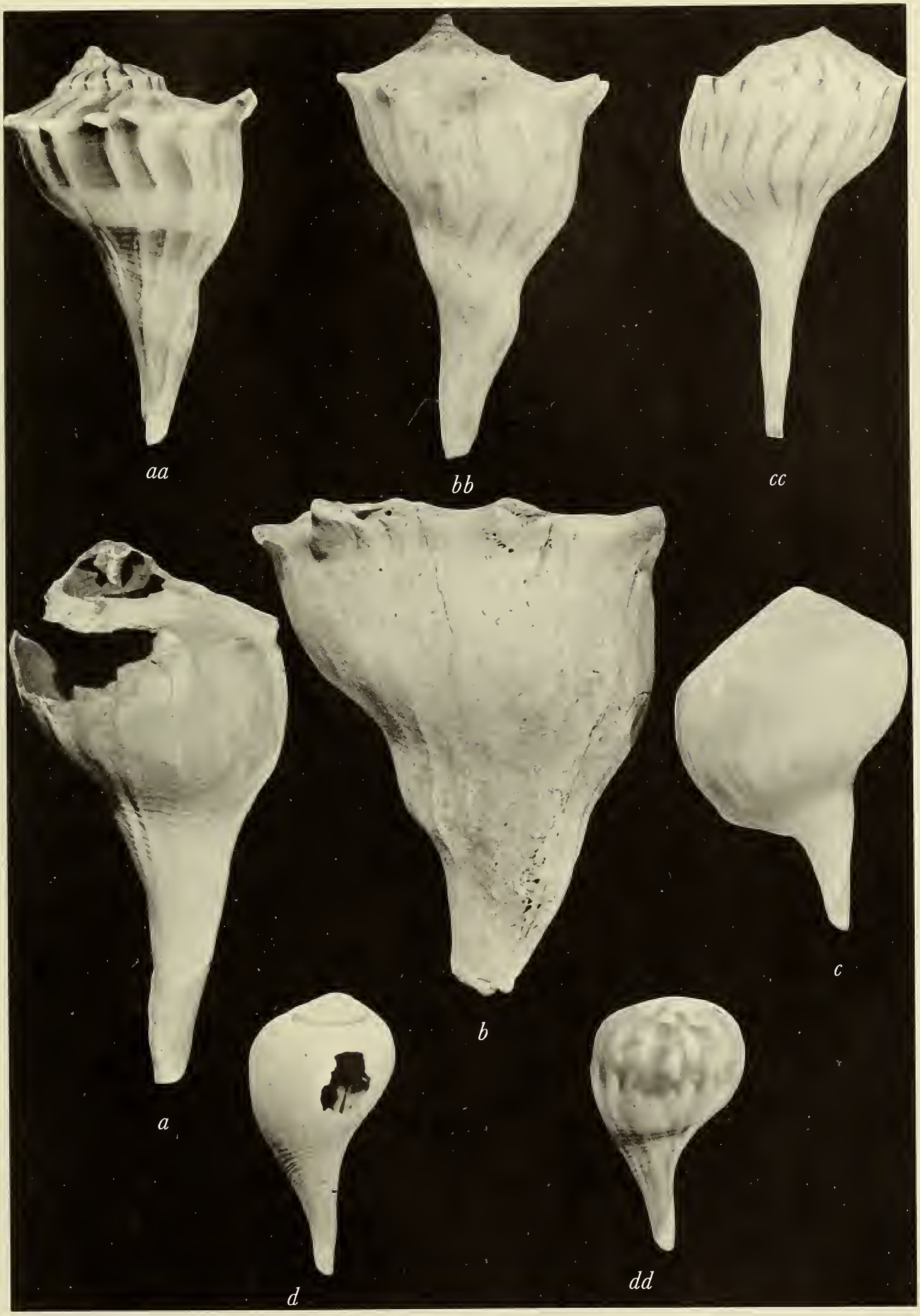
PL. 9 — MELONGENIDAE

a. *Busycon contrarium* Conrad (Q–500), aa (5080).
b. *Busycon perversum* Linné (M–720), bb (5835).
c. *Busycon coarctatum* Sowerby (Q–500), cc (2281).
d. *Busycon spiratum* Lamarck (M–1567–A–9), dd (2086).

(Scale 1/2)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Pl. 10 — MELONGENIDAE, FASCIOLARIIDAE

a,a′. *Melongena melongena* Linné (M–1002, M–824).
b,b′. *Melongena corona* Gmelin (Q–501, M–999).
c. *Fasciolaria hunteria* Perry (Q–504), cc (6578).
d. *Fasciolaria tulipa* Linné (M–544), dd (4208).

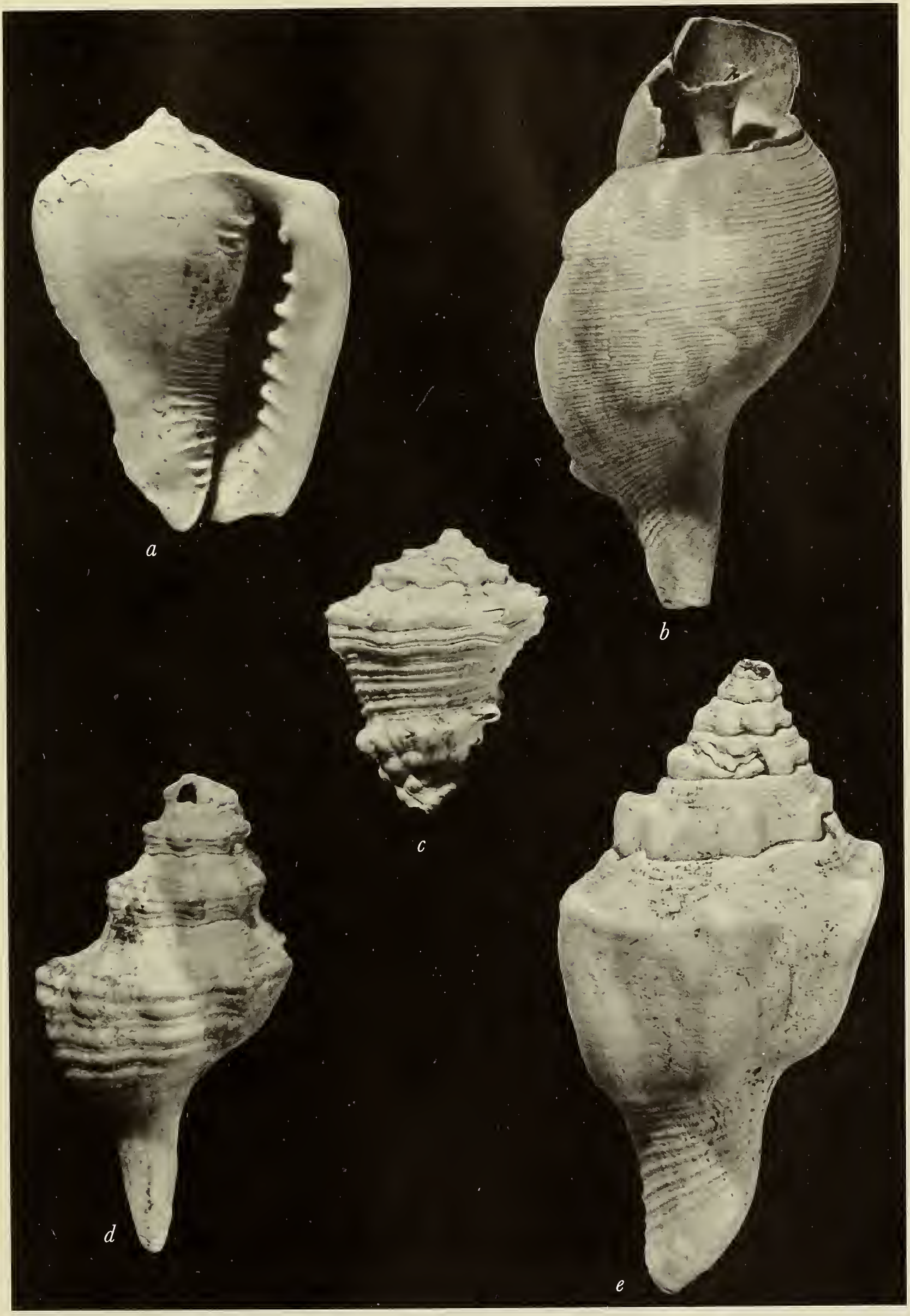
(Actual size)


a
b
a′
b′
c
cc
d
dd

PL. 11 — MISCELLANEOUS LARGE GASTROPODS

a. *Cassis tuberosa* Linné, immature specimen (Q–504).
b. *Fasciolaria tulipa* Linné, unusually large, specimens average less than half this size (Q–500).
c. *Vasum muricatum* Born (Q–504).
d. *Pleuroploca gigantea* Kiener, half-grown specimen (Q–500).
e. *Turbinella angulata* Solander, half-grown specimen (Q–500).

(Scale 1/2)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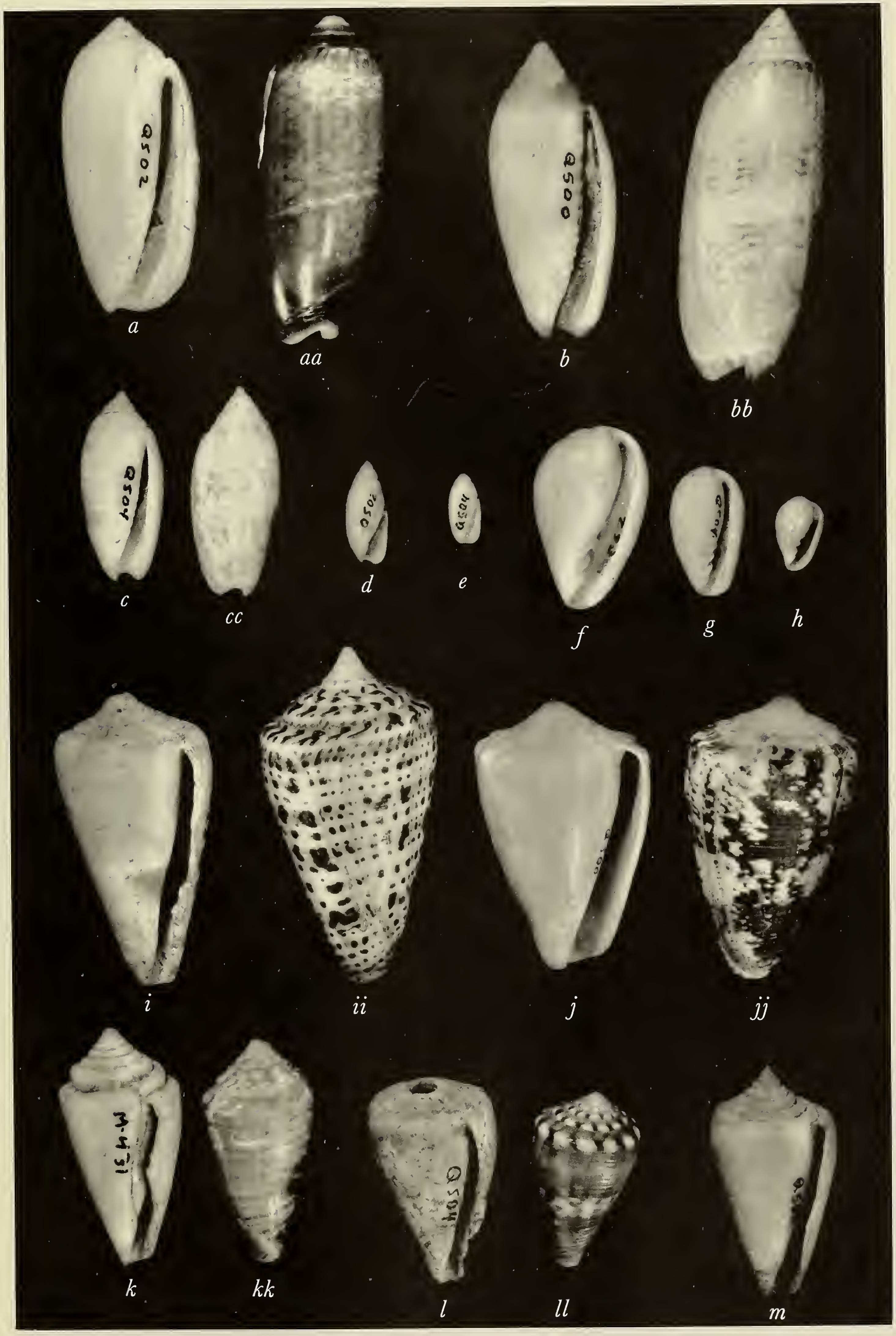
PL. 12 — OLIVIDAE, CONIDAE

a. *Oliva caribaeensis* Dall and Simpson (Q–502), aa (3693).
b. *Oliva sayana* Ravenel (Q–500), bb (5625).
c. *Oliva reticularis* Lamarck (Q–504), cc (3480).
d. *Olivella nivea* Gmelin (Q–502).
e. *Olivella dealbata* Reeve (Q–504).
f. *Prunum labiatum* Valenciennes (M–562).
g. *Prunum guttatum* Dillwyn (Q–504).
h. *Prunum apicinum virgineum* Jousseaume (M–105).
i. *Conus spurius atlanticus* Clench (M–720), ii (6827).
j. *Conus regius* Gmelin (Q–500), jj (7228).
k. *Conus floridanus* Gabb (M–431), kk (6597).
l. *Conus mus* Hwass (Q–504), ll (2960).
m. *Conus sozoni* Bartsch (Q–500).

(Actual size)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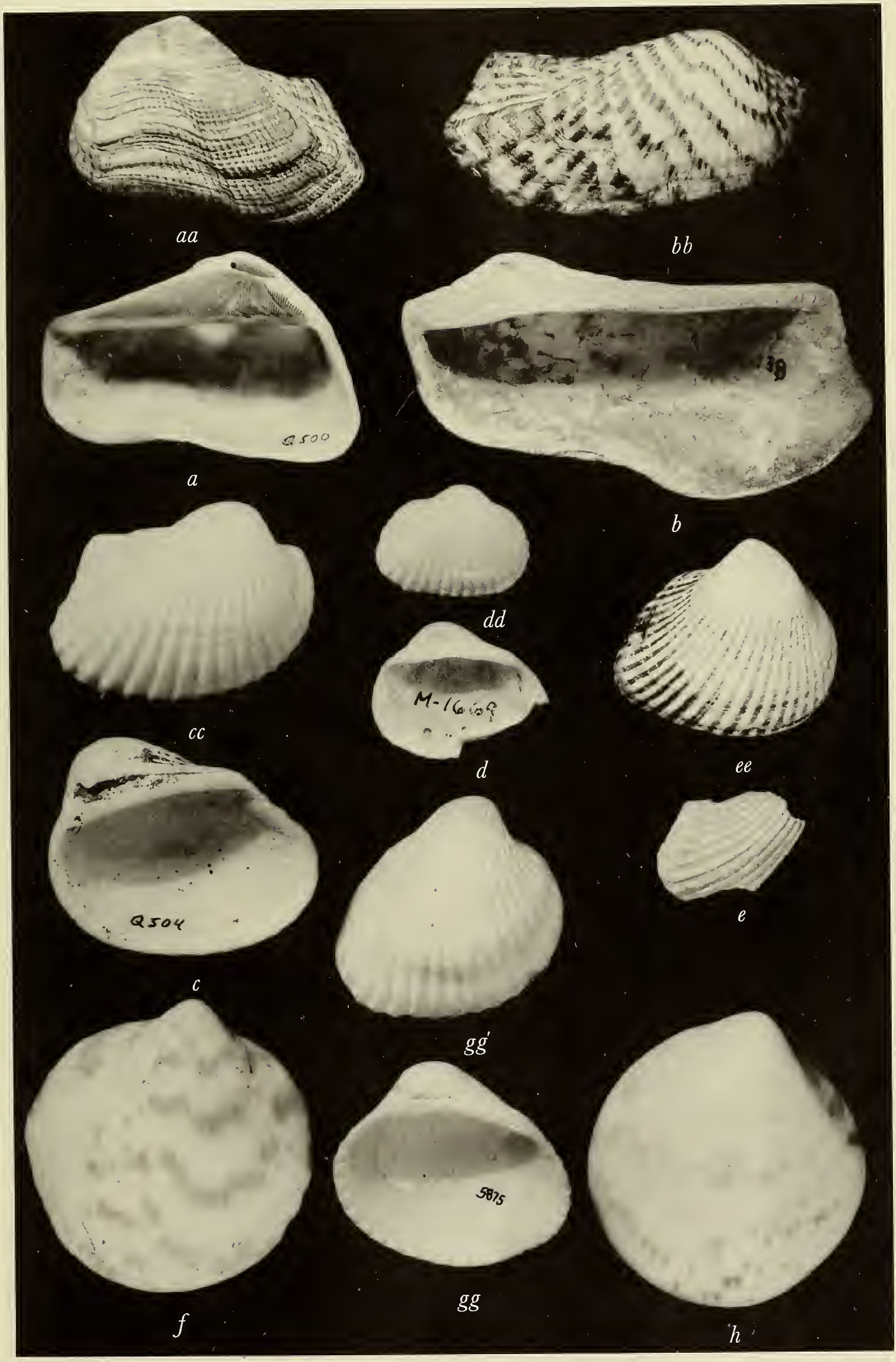
Pl. 13 — ARCIDAE, GLYCYMERIDAE

a. *Arca imbricata* Bruguière (Q–500), aa (7291).
b. *Arca zebra* Swainson (M–138), bb (7292).
c. *Anadara notabilis* Röding (Q–500), cc (6603).
d. *Anadara transversa* Say (M–1669), dd (6604).
e. *Noetia ponderosa* Say (M–720), ee (5876).
f. *Glycymeris decussata* Linné (Q–503).
gg,gg'. *Lunarca ovalis* Bruguière (5464, 5875).
h. *Glycymeris undata* Linné (Q–504).

(Actual size)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PL. 14 — MYTILIDAE, ISOGNOMONIDAE, PTERIIDAE

a. *Modiolus demissus granosissimus* Sowerby (M–720), aa (3966).
b. *Brachidontes exustus* Linné (M–239–B), bb (3015).
c. *Isognomon alatus* Gmelin (M–539), cc (4279).
d. *Isognomon radiatus* Anton (Q–500), dd (4421).
e. *Pinctada radiata* Leach (M–204), ee (2657).
f. *Pteria colymbus* Röding (M–571), ff (1812).

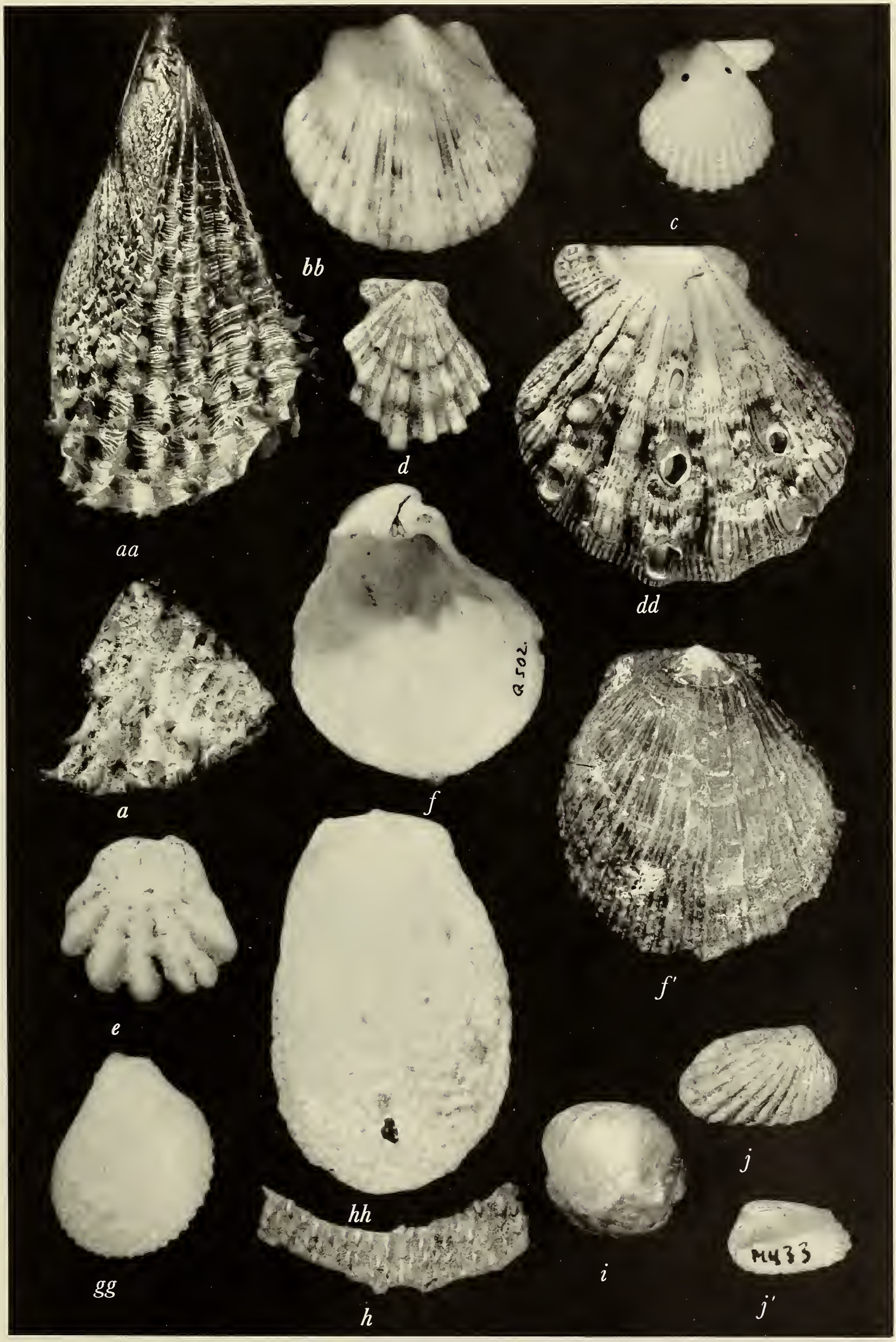
(Actual size)


a
aa
bb
b
cc
dd
c
d
e
ee
f
ff

PL. 15 — PINNIDAE, PLICATULIDAE, PECTINIDAE, SPONDYLIDAE, LIMIDAE, ANOMIIDAE, CARDITIDAE

a.	*Atrina seminuda* Lamarck (M–720), aa (7293).
bb.	*Aequipecten gibbus* Linné (6932).
c.	*Aequipecten muscosus* Wood (M–2007).
d.	*Lyropecten nodosus* Linné, juvenile, (Q–502), dd (6314).
e.	*Plicatula gibbosa* Lamarck (M–101).
f,f'.	*Spondylus americanus* Hermann (both Q–502).
gg.	*Lima lima* Linné (2628).
h.	*Lima scabra* Born (Q–501), hh (7294).
i.	*Anomia simplex* d'Orbigny (M–310).
j,j'.	*Carditamera floridana* Conrad (M–433, M–624).

(Actual size)


aa
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c
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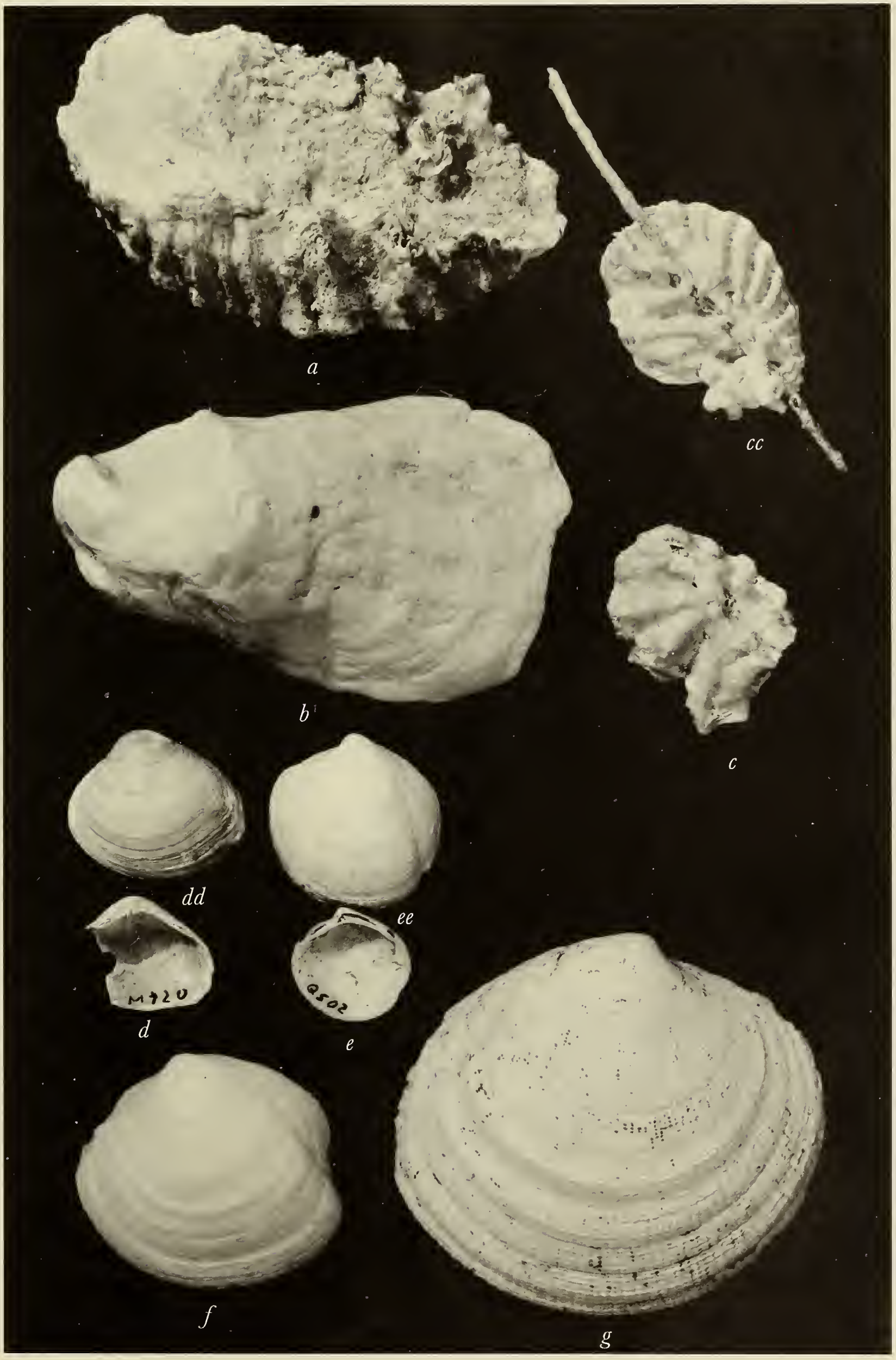
dd
a
f
Q 502.
f'
e
j
gg
hh
i
h
j'
M433

Pl. 16 — OSTREIDAE, CORBICULIIDAE, LUCINIDAE

a. *Ostrea equestris* Say (Q–500).
bb. *Crassostrea virginica* Gmelin (5033).
c. *Ostrea frons* Linné (Q–504), cc (7295).
d. *Pseudocyrena floridana* Conrad (M–720), dd (150).
e. *Lucina pensylvanica* Linné (Q–502), ee (6124).
f. *Phacoides pectinatus* Gmelin (Q–504).
g. *Codakia orbicularis* Linné (Q–504).

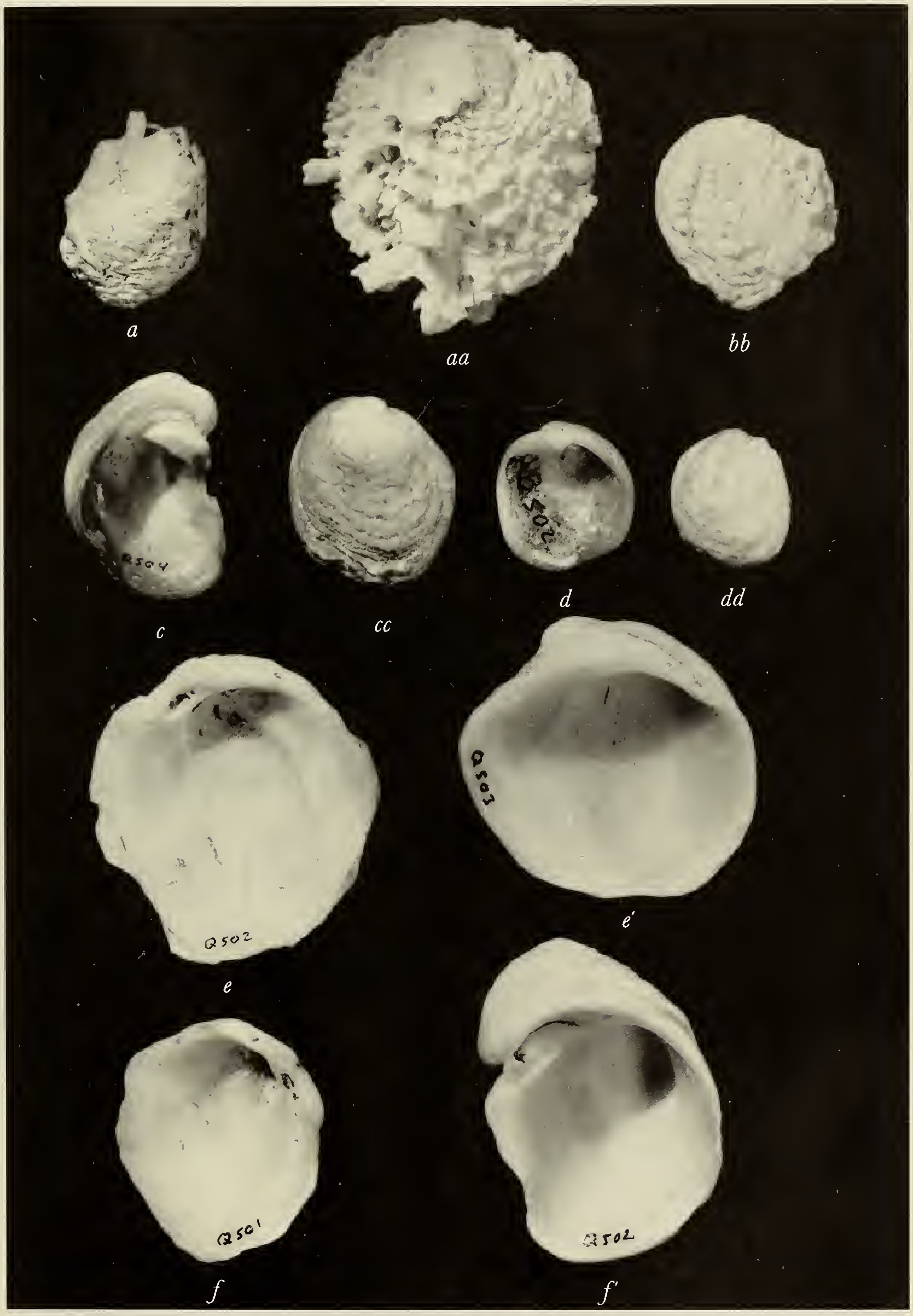
(Actual size)


a
cc
b
c
dd
ee
M420
Q502
d
e
f
g

PL. 17 — CHAMIDAE

a. *Chama macerophylla* Gmelin (Q–501), aa (2427).
bb. *Chama congregata* Conrad (4978).
c. *Chama sarda* Reeve (Q–502), cc (6133).
d. *Chama florida* Lamarck (Q–502), dd (6132).
e,e′. *Chama sinuosa* Broderip (Q–502, Q–503). Both specimens illustrated are upper valves.
f,f′. *Pseudochama radians* Lamarck (Q–501, Q–502).

(Actual size)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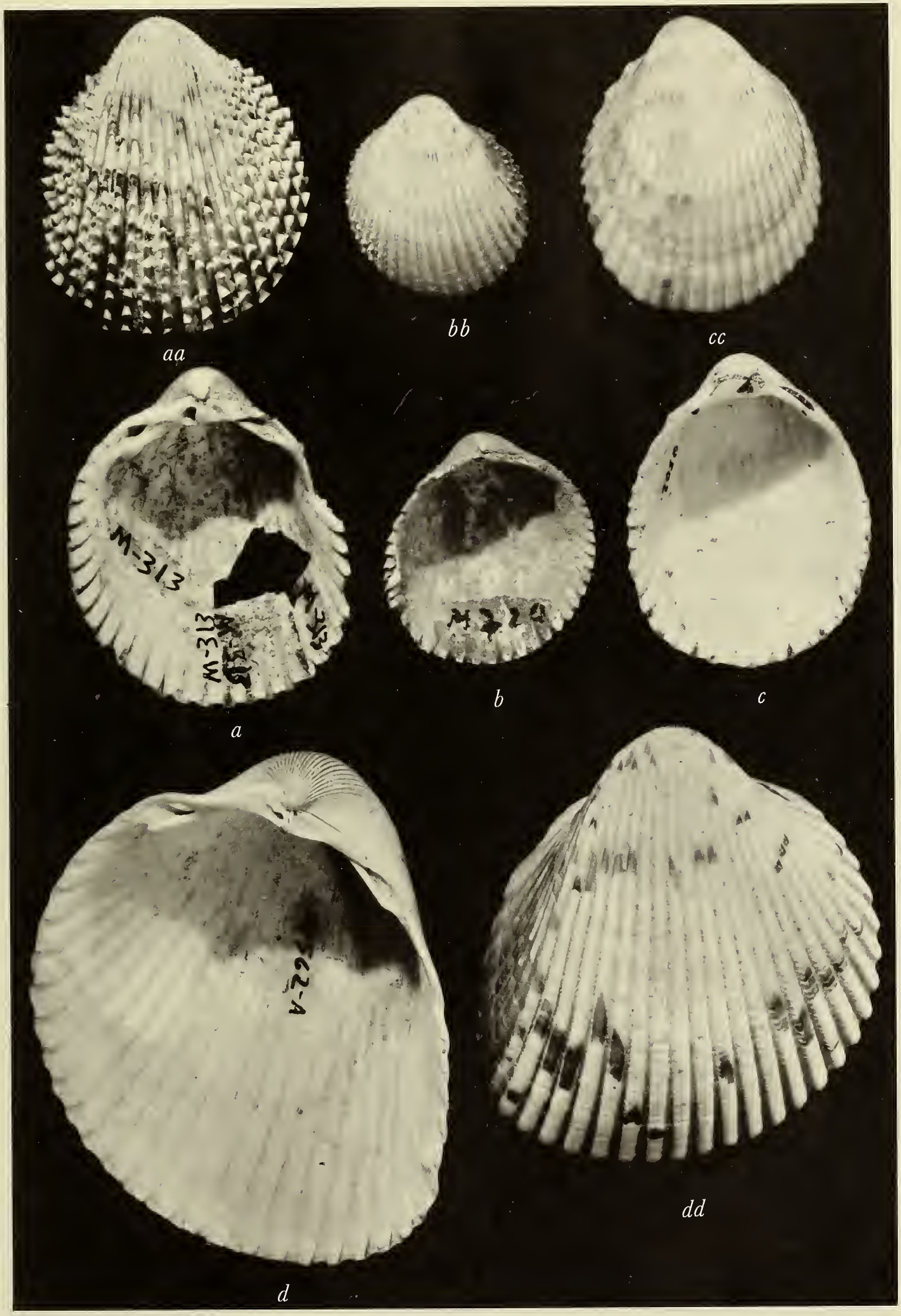
Q504
c
cc
Q502
d
dd
Q503
e'
Q502
e
Q501
f
Q502
f'

PL. 18 — CARDIIDAE

a. *Trachycardium isocardia* Linné (M–313), aa (4150).
b. *Trachycardium muricatum* Linné (M–220), bb (7203).
c. *Trachycardium magnum* Linné (Q–502), cc (4985).
d. *Dinocardium robustum vanhyningi* Clench and Smith (M–562–A), dd (7296).

(Actual size)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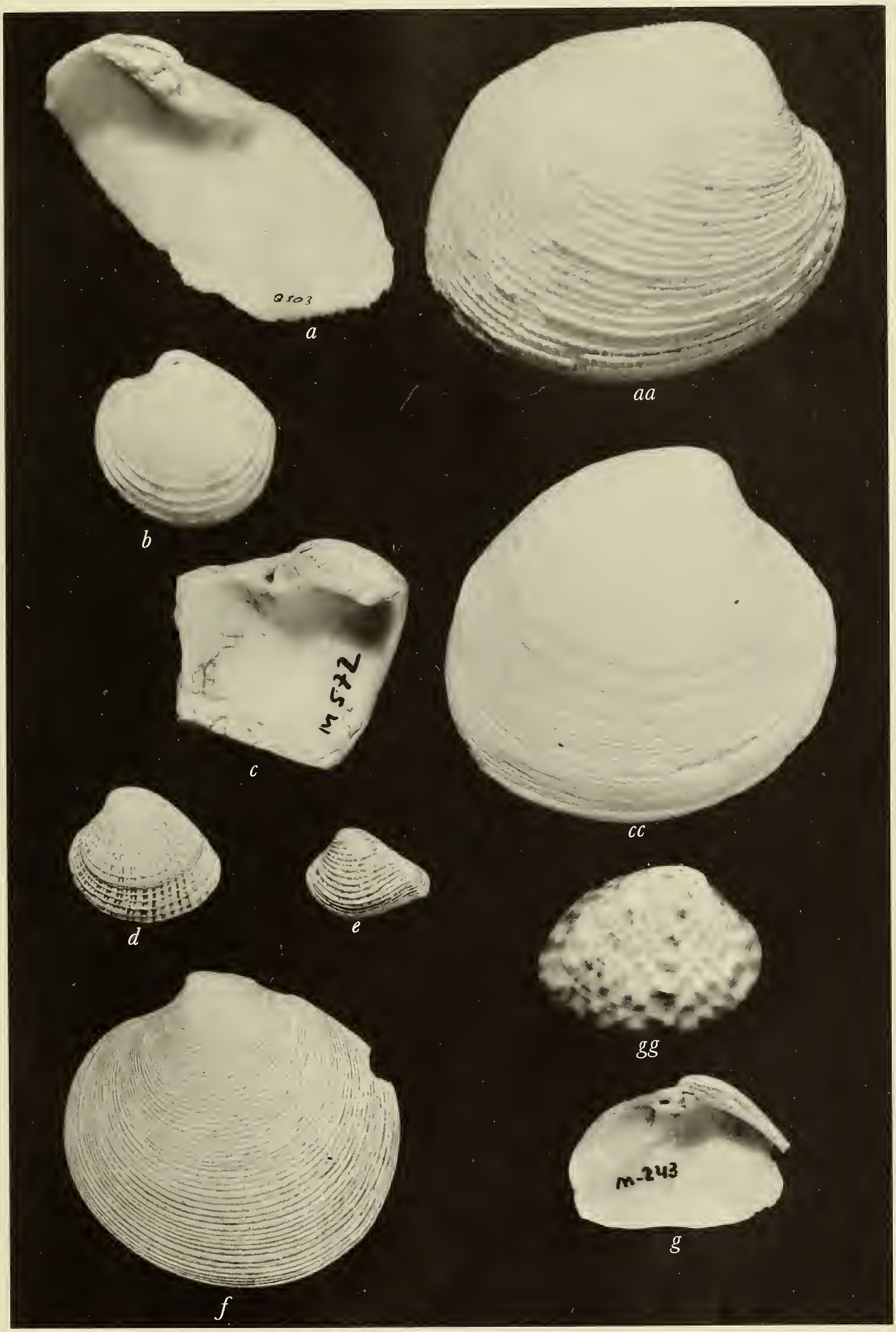
PL. 19 — VENERIDAE

a. *Antigona listeri* Gray (Q–503), aa (979).
b. *Antigona rigida* Dillwyn (Q–500).
c. *Mercenaria campechiensis* Gmelin (M–572), cc (5957).
d. *Chione cancellata* Linné (M–101).
e. *Anomalocardia cuneimeris* Conrad (M–825).
f. *Dosinia elegans* Conrad (M–332).
g. *Macrocallista maculata* Linné (M–243), gg (1374).

(Actual size)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g

Pl. 20 — TELLINIDAE, MACTRIDAE

a. *Tellina radiata* Linné (Q–503), aa (7297).
b,b′. *Tellina listeri* Röding (Q–500, Q–503).
c. *Tellina lineata* Turton (M–720), cc (6951).
d. *Arcopagia fàusta* Pulteney (Q–501), dd (6391).
ee. *Apolymetis intastriata* Say (4734).
ff,ff′. *Mulinia lateralis* Say (5525, 7298).

(Actual size)


aa
b'
a
b
cc
dd
c
d
ee
ff
ff'

PL. 21 — MISCELLANEOUS GASTROPODS AND PELECYPODS

aa. *Diodora listeri* d'Orbigny (1569).
b. *Mitra florida* Gould (Q–501), bb (7594).
c. *Pecten laurenti* Gmelin (Q–504), cc (6434).
dd. *Murex rubidus* Baker (6572).
ee. *Modulus modulus* Linné (6460).
ff. *Bulla occidentalis* C. B. Adams (1502).
g. *Nephronaias* aff. *calamitarum* Morelet (M–720).
h. *Pomacea flagellata arata* Crosse and Fischer.
(Actual size)


aa
b
bb
cc
dd
ee
ff
c
g
h

Archaeological Occurrences of Other Marine Invertebrates

At Dzibilchaltun and elsewhere, a number of other forms of marine life have been found in some abundance. These are listed below, with comments. Abbreviations of references are those used in the checklist.

CORAL

DZIBILCHALTUN: Corals were kindly identified by Dr. Donald F. Squires, of the Smithsonian Institution, who also determined which of our specimens were "modern" and which were fossil. Limestone at the site is frequently very rich in fossil corals. Fossil specimens encountered were normally entirely removed from their matrix. They were probably obtained in the course of breaking up the enormous amount of stone used as architectural fill. The following species were found:

Colpophyllia sp.: 1, modern, in Cenote Xlacah.

Montastrea sp.: 4, fossil, three in Formative fill, one in Late Early period fill.

Porites, probably *P. astreoides*: 1, modern, in Late Early period fill.

Solenastrea hyades: 4 fossil, three in Formative, one in Copo Complex fill; 15, modern, nine in Formative, three in Late Early period and one Copo Complex fill; two on surface.

Solenastrea bournoni: 2, one fossil in Formative, one modern in Copo Complex fill.

Solenastrea sp.: 2, fossil, one in Formative, one in Late Early period fill; 4, modern, two in Formative, one in Late Early period fill, one in Pure Florescent cache.

MAYAPAN: 6 pieces "in tombs or in association with objects of a ceremonial nature," Decadent period (P, p. 387, fig. 44,*k*).

SAN JOSE: "Coral or Bryozoa. Several fragments . . ." in S.J. II or possibly III cache (T, p. 181).

HATZCAP CEEL: 2 pieces in two Classic caches (Thompson, 1931, pp. 273–74, pl. XXXI, 16).

CARACOL: 1 piece, in cache (Satterthwaite, quoted by Coe, 1959, p. 60).

COPAN: 2 lumps in Full Classic stela cache (Longyear, 1952, p. 51).

TIKAL: Moholy-Nagy (M–MS) lists over 200 fragments of coral not yet identified by species or arranged by age or context. However, it is clear from her earlier paper that the context was largely ceremonial.

UAXACTUN: 16 specimens, one in Tzakol cache, eleven in two Tepeu caches, four in Tepeu fill (K, p. 66; RR, p. 159, pl. 68,*d*).

PIEDRAS NEGRAS: 3 fragments, two in two Classic caches, one of unknown exact provenience (C, p. 60, fig. 52,*d*).

COMMENT: Dr. Squires writes of the Dzibilchaltun material:

"Several things struck me as I completed the listings: (1) many of the older, possibly fossilized coralla I had called *Montastrea,* rather than *Solenastrea*, which is the common coral in this collection. The difference between these two corals is slight, but important as I shall explain. In *Montastrea* the peritheca between the calices is solid, while in *Solenastrea* it is vesicular. This is a difference which is easily obscured in the process of recrystallization occurring as a part of fossilization. Hence, I am moved to question all of the occurrences of *Montastrea* without the time-consuming operation of preparation of thin-sections."

"(2) All of the corals noted here with the exception of *Porites astreoides* have been found floating in the Gulf of Mexico, and even that species is potentially capable of floating. I enclose a separate of a paper on this subject by Dr. Louis Kornicker and me [Kornicker and Squires, 1962]. This is a remarkable thing, as is the consistent selection of *Solenastrea* from a potentially larger selection.

"All of the corals occur in the West Indies. *Solenastrea* is tolerably common on reefs there. But other species of corals are more common.

"There are known occurrences of windrows of corals which Kornicker and I believe are accumulations of floating corals. It might be that your ancients were collecting from such a selection, and not from a real reef suite. There are obviously many other possibilities."

As was the case with Mollusca, coral from Dzibilchaltun seems to have been collected from the immediately adjacent coast rather than the more distant reef areas, where strikingly beautiful specimens could be found. Again, as with molluscs, no care seems to have been taken to choose attractive material, even though it was locally available.

At Dzibilchaltun, coral occurred among other marine offerings in the Cenote Xlacah and in one cache, never in tombs. In all other cases it was found loose in fill or refuse. We would be inclined to search for some other reason for its collection but have none to suggest. At other sites its ceremonial association is more clear. At Mayapan, Hatzcap Ceel, Caracol, Copan, and Piedras Negras it is found only in tombs and caches. At Uaxactun it is found in three caches as well as in fill. At Tikal it occurs in great abundance in tombs and caches of the Early Classic period, then markedly diminishes during the Late Classic. Classification and analysis of this very large body of material should prove most informative.

BRYOZOA

DZIBILCHALTUN: Specimens identified by Dr. R. J. Scolaro, of Tulane University: 16 multilaminated colonies of *Schizoporella floridana* Osburn were found, six in two Late Early period caches, nine in one Pure Florescent cache, and one in Florescent or later midden. On one of these was found a small colony of *Hippaliosina rostrigera* Smitt. Dr. Scolaro writes that these are common shallow-water species found in Gulf and Atlantic waters. These gray, bleached specimens would seem an unattractive addition to ceremonial offerings, but he adds that when living they were strikingly colored.

TIKAL: Very large numbers of Bryozoa were found. They have not yet been classified or analyzed in terms of context.

PORIFERA

TIKAL: Moholy-Nagy (M–MS) lists a considerable number of soft sponge fragments, not yet classified. At least some were epiphytic on other marine life.

GORGONIANS

DZIBILCHALTUN: 14 examples found in Cenote Xlacah, obviously as offerings. After storms, beautiful specimens of the sea fan are found on nearby beaches.

TIKAL: Numerous. At least one placed under skull in burial. Others were epiphytic to uncleaned molluscs.

COMMENT: Dr. Frederick M. Bayer, of the University of Miami, wrote (personal communication) that such gorgonians as would be found in a cenote would have lost so many essential characteristics that any classification would be highly conjectural, even to generic or often family determination.

PEARLS

Pearls, nacreous concretions found about foreign particles inside the shells of a variety of molluscs, were highly valued in ancient times as they are today. As they are extremely vulnerable to the alternate desiccation and saturation of the tropics, they were probably much commoner than recorded archaeological frequency would indicate, and it is probable that archaeologists have often failed to recognize their remains. They have been reported from five sites in the Maya lowlands:

CHICHEN ITZA: 1, pierced in offering at Caracol, Pure Florescent (Ruppert, 1935, p. 36, fig. 37). 2, pierced, in fill of High Priest's Grave; probably Modified Florescent (E. H. Thompson, 1938, p. 53).

COPAN: 11, pierced and unpierced, in one cache, and two tombs, all Full Classic (Longyear, 1952, pp. 43, 111; figs. 94,*d*; 109,*i*). One was in a jewel box made of a pair of *Spondylus* valves, similar to that described by Gruning from Pusilha which contained cut "blisters" of pearls removed from valve (1930, p. 483, pl. XXI, fig. 1). 4 were used in a necklace from a tomb in Mound 4, illustrated by Maudslay (1889–1902, vol. 1, pl. 21).

SAN JOSE: 3, pierced, in a tomb, Transitional S.J. III–IV. 1 in cache, S.J. V or close of IV. (T, p. 182).

TIKAL: Pearls were found in considerable quantities, apparently in large part as beads or pendants in burial jewelry (M–MS).

UAXACTUN: 2, perforated as pendants in Tzakol burial; 2 perforated as beads in Tepeu cache; 1, unperforated, in Tzakol burial. A fragment of "blister" from which disks had been cut, probably for mosaic, was found discarded in Tzakol fill (K, p. 66).

Comment: Pearls come from a number of molluscs and vary tremendously in quality. Most archaeological specimens would be classified as baroques (irregular in form rather than purely spherical), which would bring little or no price on the modern market, but which nevertheless made attractive nacreous ornaments and were valued as such in ancient times. They are actually produced by a number of molluscs, afflicted by the intrusion of grains of extraneous material into the mantel (the shell-producing organ) of the animal. The molluscs which produce the most perfect pearls in the area under discussion are the so-called pearl oysters; in the Gulf of Mexico and Caribbean, these are *Pteria colymbus* and *Pinctada radiata*; in the Pacific, these are replaced by their cousins, *Pteria sterna* and *Pinctada mazatlanica*. In the Gulf of California, the latter species have been depleted by pearl fishing (Keen, 1958, p. 58). Many other genera produce pearls of inferior quality. Among these are *Strombus* (*S. gigas*, the largest conch in this part of the Atlantic littoral, produces attractive but irregular pink pearls), *Turbinella*, and other gastropods. And among the bivalves are the giant *Tridacna*, several of the common edible oysters and clams and members of the family Pinnidae (the "Sea Pens," see p. 24 above).

Boekelman (1935, pp. 261–62), in evaluating Oviedo's description of a pearl fishery in Nicaragua, reaches some provocative conclusions:

"A rather amusing point is brought out by Oviedo, on page 617, regarding the sale or barter of the pearls secured from these Pinna molluscs. It is a well-known fact that the pearls produced by this shell by no means can compare in their water to those of the true pearl mollusc Meleagrina margaritifera. Oviedo explains that the natives (who apparently fished for these shells primarily for food purposes) did not discard the pearls found, and even though their quality was not of the best . . . but as pearls, according to Oviedo, at this time (1535) were sold and bartered here by weight . . . they mixed these inferior Pinna pearls with the better ones, and obliged the purchaser to accept them, whereupon the purchaser did the same when selling in turn to the regular merchants.

"While Oviedo exclaims on the apparent trickiness of the natives as well as the Spanish purchasers, I wonder if he is entirely right in drawing such conclusions, at least insofar as the Indians are concerned. To mind comes the statement made by so many chroniclers of how disappointed the early explorers were upon finding the pearls spoiled by the action of fire which was used to open the shells. However it would appear these specimens had the same value as the undamaged ones in the mind of the natives. Could it not be quite probable, therefore, that in the eyes of the natives of Nicaragua, pearls from the Pinna shells held as great a value as those from M. margaritifera, and that the distinction was made by the Spaniards?* If so, Oviedo would have accused the natives unfairly. The same could not be said of the Spaniards who bought from them and knowingly sold them by weight to the next Spanish purchaser."

CIRRIPEDIA

DZIBILCHALTUN: 32 barnacles, not identified by a specialist, probably of the genus *Balanus*, were found in a single Late Early period cache. Certainly some (which could be fitted into scars) and probably all of these were removed from two large *Strombus costatus* included in the cache, but they were scattered throughout the cache material. The large conchs were stripped of these and epiphytes before interment.

TIKAL: Moholy-Nagy's preliminary summary (M--MS) lists more than 200 *Balanus*. It will be interesting to see if these were also epiphytic to larger Mollusca in ceremonial offerings.

ECHINODERMS

BARTON RAMIE: "About fifty tiny tubular beads were made from either *Dentalium* shell or echinoderm spines (fig. 309,*k*). . . . They have been cut at both ends" (W, p. 509).

TIKAL: 1 echinoderm fragment, 2 "sand dollars," context not yet specified (M–MS).

* Boekelman's footnote, a point well-taken: "If the reader will bear in mind the vital psychological difference between the Caucasian's viewpoint on pearls, and the more primitive-minded civilizations, this point becomes clearer. To the more civilized races pearls have a purely monetary and aesthetic value, whereas the others value them primarily from a religious standpoint. This applies to shells in general. The greatest market for pearls is not the United States, as might be supposed from the great concentration of wealth in this country, but in China, India, and Asiatic countries, and to a lesser degree in Europe. In the East pearls still maintain their religious symbolism, in Europe less so, and in the United States probably they have none."

MISCELLANEOUS MARINE MATERIALS

Apparently as part of the same ritual context, various nonorganic materials of obvious marine origin were included in the panoply of offerings. Moholy-Nagy's manuscript mentions frequent inclusions of coquina (composed largely of shells) and various unidentified "fibrous" materials at Tikal. A chunk of pumice with striations possibly indicating use as a honing instrument was found in Formative debris at Dzibilchaltun. At San Jose, a S.J. II or possibly III cache contained 8 pieces of pumice, mixed with corals or Bryozoa (T, p. 181). Pumice, normally lighter than water, is formed by the interaction of water and lava. Although not necessarily of marine origin, the pumice blocks, which are widely used as an abrasive by the present-day Maya, are collected on the sea beaches, where occasionally pumice floats ashore in considerable quantities during storms and hence its apparent ritual connection with the sea.

Mention of fish has been purposely avoided in this appendix. Description of vertebrate remains at Dzibilchaltun and the Cancun Midden will be published separately. In this category, however, two items are closely associated with votive offerings, and should be mentioned. Spines of the stingray and of the spiny boxfish have been found at a number of sites, as well as copies of the former in bone, often elaborately and beautifully engraved. These are clearly related to the penitential bloodletting rites of the ancients, in which they must have played a very significant part. Functionally they could much more simply have been replaced with the great variety of thorns arming so much of the local flora against visitors. The fact that they were chosen, despite the difficulty of collection and importation, bespeaks some fundamental identification between the practices and the sea.

SUMMARY

The molluscs described in the previous pages are, with a few exceptions, of ambiguous cultural import, although certain aspects of usage are clear. But most of the items listed in this appendix lacked any aesthetic or economic value. Many of the molluscs were edible or of value as raw material for the manufacture of jewelry and artifacts. But lumps of coral or coquinas, colonies of Bryozoa, or fronds of Gorgonia had no such uses. They reflect a "Cult of the Sea" which must clearly have been of great ceremonial import and which we may never properly understand. From the Formative to the Decadent period, the Maya added such objects to their offertory caches and their tombs. Non-molluscan forms are found in much greater abundance at far inland Tikal than at Dzibilchaltun, which is close to the sea. However, Moholy-Nagy points out that the bulk of such offerings at Tikal date to the Early Classic, and that they became less and less common in the Late Classic. Dzibilchaltun, between its climax phases in the middle Formative and the Late Early period and Pure Florescent, was apparently a site of little importance. We found only one stone-walled (unvaulted) structure datable to the first phase of the Early period, and our stratigraphic sample is correspondingly tiny. So this may well be the reason for the apparent discrepancy.

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Index of Molluscan Species