

# CEPHALOPODS FROM THE LATE EOCENE HOKO RIVER FORMATION, NORTHWESTERN WASHINGTON

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**ABSTRACT**—Rare specimens of the nautiloids *Nautilus* and *Aturia* and extremely rare specimens of a sepiamorph sepiid are described from the late Eocene Hoko River Formation, northern Olympic Peninsula, Washington. The well-preserved partial phragmocones are from channel-fill clastics deposited on the inner and middle slopes of a submarine-fan system.

The *Nautilus* specimen is allied to *N. cookanum* Whitfield from middle Eocene strata, New Jersey, and is probably conspecific with *Nautilus* sp. (Miller) from late Eocene strata, northwestern Oregon, both of which were previously assigned to *Eutrephoceras*. This is the first record of *Nautilus* in the northeastern Pacific.

The *Aturia* specimen is tentatively identified as *A. cf. A. alabamensis* (Morton), a species previously only known from late Eocene strata in the Atlantic–Gulf Coastal area and northeastern Mexico. *Aturia alabamensis* may be the same as numerous Eocene North American aturiid species.

The two sepiamorph sepiid specimens resemble *Belosepia* Voltz but are probably generically distinct. They are only the second record of sepiids in the Eocene of the northeastern Pacific.

## INTRODUCTION

LATE EOCENE cephalopods are rare in the northeastern Pacific. The occurrence of three genera at a locality in northwestern Washington, therefore, is especially noteworthy. Single specimens of *Nautilus* aff. *N. cookanum* Whitfield and *Aturia* cf. *A. alabamensis* (Morton) and two specimens of a sepiamorph sepiid have been found in the late Eocene Hoko River Formation, northwestern Olympic Peninsula, Washington (Figure 1). The specimens are part of a collection accumulated over many years by James L. Goedert, Marion Berglund, and William Buchanan. The sepiid specimens are extremely rare and represent only the second time Eocene sepiids have ever been found in the northeastern Pacific. The first discovery was reported by Squires (1983, 1984).

The Hoko River Formation conformably overlies the early late Eocene Lyre Formation and underlies the late Eocene through late Oligocene Makah Formation. For a generalized geologic map of the area see Snively et al. (1980). The upper contact of the Hoko River Formation appears to be gradational with the overlying Makah Formation. About 15–20 km east of the study area, however, there is a local unconformity between the two formations (Snively et al., 1978).

The Hoko River Formation consists of 1,500–2,300 m of sedimentary rocks deposited on the inner and middle slopes of a submarine-fan system. In the vicinity of Neah Bay (Figure 1), the formation consists mostly of inner-fan, channel-fill conglomerate interbedded with hemipelagic siltstone (DeChant, 1986). Macrofossils are uncommon in the formation and most occur about 300 m above the base of the formation in the vicinity of Kydikabbit Point (Figure 1) (DeChant, personal commun.).

The *Nautilus* and sepiid specimens were found in a siltstone, and the *Aturia* specimen was found in a granule to large pebble, phyllite and basalt conglomerate at Los Angeles County Museum of Natural History, Invertebrate Paleontology locality LACMIP 6938 in the lower part of the Hoko River Formation. The locality is at a garbage dump at 78 m (260 ft) elevation on a ridge top approximately 675 m south of Kydikabbit Point, NE¼, SW¼, sec. 4, T33N, R15W, Cape Flattery quadrangle (15-minute series, 1957), Washington.

Rau (1964) studied the benthic foraminiferal fauna of the Hoko River Formation (then known as the lower member of the Twin River Formation) and assigned the formation to the northeastern Pacific provincial benthic foraminiferal upper Na-

rizian Stage (late Eocene). He also inferred, based on the benthic foraminifers, that the formation was deposited in relatively cool, moderately shallow ocean waters between lower neritic and uppermost bathyal depths. Snively et al. (1978), who formalized the name "Hoko River Formation," mentioned that crabs present in the formation at Kydikabbit Point are late Eocene in age, and Rathbun (1926) also reported crabs from strata in the vicinity of Kydikabbit Point.

The cephalopod specimens from locality LACMIP 6938 are well-preserved portions of phragmocones, and they occur in concretions. The crabs are well preserved, numerous, and also occur in concretions. Many specimens are complete with chelipeds and legs, and they appear to have been rapidly buried in situ. Most are *Branchioplax washingtoniana* Rathbun (1916, p. 345, text-fig. 1), which, according to Rathbun (1926), ranges from late Eocene through early? Oligocene. Carapaces of raninid crabs are common also. A few gastropods were also found at this locality. They include a single specimen of *Ectinochilus* (*Cowlitzia*) *washingtonensis* (Clark and Palmer, 1923, p. 283–284, Pl. 51, figs. 11–14), which has been reported from the late Eocene Cowlitz Formation of southwestern Washington (Clark and Palmer, 1923; Weaver, 1943), a single specimen of a poorly preserved *Conus* sp. indet., and an internal mold of a naticid. An internal mold of a pitarid bivalve was also found. All molluscs were in concretions.

The cephalopod specimens are deposited in the Los Angeles County Museum of Natural History, Invertebrate Paleontology collections. The technique of Elias (1938) was used in drawing the septal sutures (Figure 2). Whorl-height and whorl-width terminology is the same as that used by Sweet (1964, fig. 8).

## SYSTEMATIC PALEONTOLOGY

Family NAUTILIDAE Blainville, 1825

Genus NAUTILUS Linné, 1758

NAUTILUS aff. *N. COOKANUM* Whitfield, 1892

Figures 2.1, 3.1–3.4

**Description.**—Internal mold of a juvenile phragmocone with 9.5 chambers; nautiliconic, involute with small umbilicus, whorls somewhat flattened laterally; septal suture with a very broad rounded ventral saddle, a broad shallow lateral lobe, a small shallow lateral saddle near umbilical shoulder, a shallow lobe on the umbilical wall, and near the inner umbilical seam a broad saddle that extends to a well-developed, broad, "V"-shaped

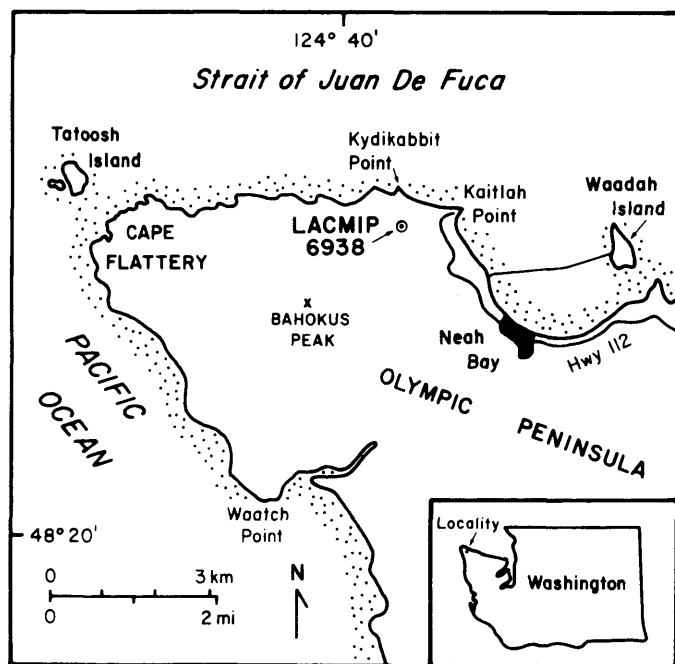


FIGURE 1—Index map of study area in Hoko River Formation, northwestern Olympic Peninsula, Washington.

dorsal lobe (annular lobe) (Figure 2.1); siphuncle near center in early whorls, becoming subcentral and nearer dorsum with growth; where whorl width is about 13.5 mm, the center of the 1 mm thick siphuncle is about 8 mm from venter; maximum whorl height 24 mm; test diameter 42 mm.

**Discussion.**—*Nautilus* aff. *N. cookanum* is similar to *Nautilus cookanum* Whitfield (1892, p. 285–286, Pl. 48, fig. 1, Pl. 49, figs. 4, 5) from the top of the Eocene Shark River Marl, Monmouth County, northeastern New Jersey. Other workers who have described and/or illustrated this species are Stenzel (1940, p. 741, fig. 115(4); 1942, cards 3a–b) and Miller (1947, p. 30–31, Pl. 10, figs. 1, 2, Pl. 11, figs. 1–3, Pl. 12, fig. 1, Pl. 13, figs. 1, 2). The Hoko River specimen especially resembles Miller's (1947, Pl. 11, fig. 3, Pl. 12, fig. 1) illustrations of topotypes of *N. cookanum*. Cooke and Stephenson (1928) reported the age of the Shark River Marl as middle Eocene.

The Hoko River specimen differs from *N. cookanum* in having a shallow lobe on the umbilical wall and a siphuncle halfway between center and dorsum rather than midway between dorsum and the venter. This siphuncle position difference may result from the small size of the Hoko River specimen. The most complete description of *N. cookanum* is given by Miller (1947) and is based on mature specimens between 105 and 208 mm in diameter, 2.5–5 times larger than the Hoko River specimen.

Most workers have assigned Whitfield's species to *Eutrephoceras*, but the suture is closer to the description (Miller, 1947, p. 25, fig. 3; Kummel, 1964, p. 448, figs. 330, 1a–c) of *Nautilus pompilius*, the type species of *Nautilus*, than it is to the description (Meek, 1876, p. 496–498, text-fig. 67, Pl. 27, fig. 1a–e; Whitfield, 1892, p. 243–244, Pl. 37, figs. 1–6, Pl. 38, figs. 1–4; Miller, 1947, p. 27, text-fig. 5, Pl. 6, figs. 4, 5; Kummel, 1964, p. 449) of *Eutrephoceras dekayi* (Morton, 1834), the type species of *Eutrephoceras*. *Nautilus* is gradational with *Eutrephoceras* and presumably evolved from that genus (Miller, 1947). The type species of *Nautilus* has sinuous external sutures, an annular lobe, and a shallow lobe on the umbilical wall. *Nautilus cook-*

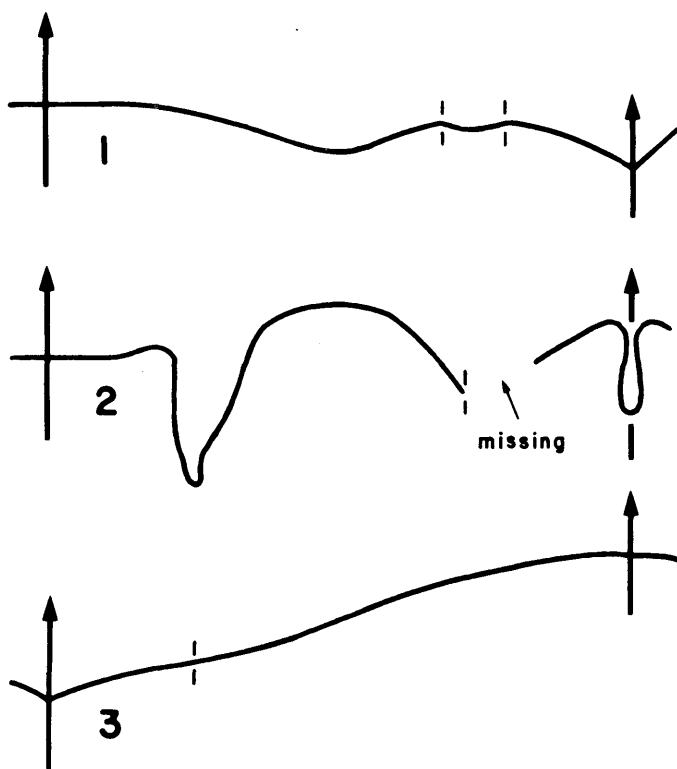
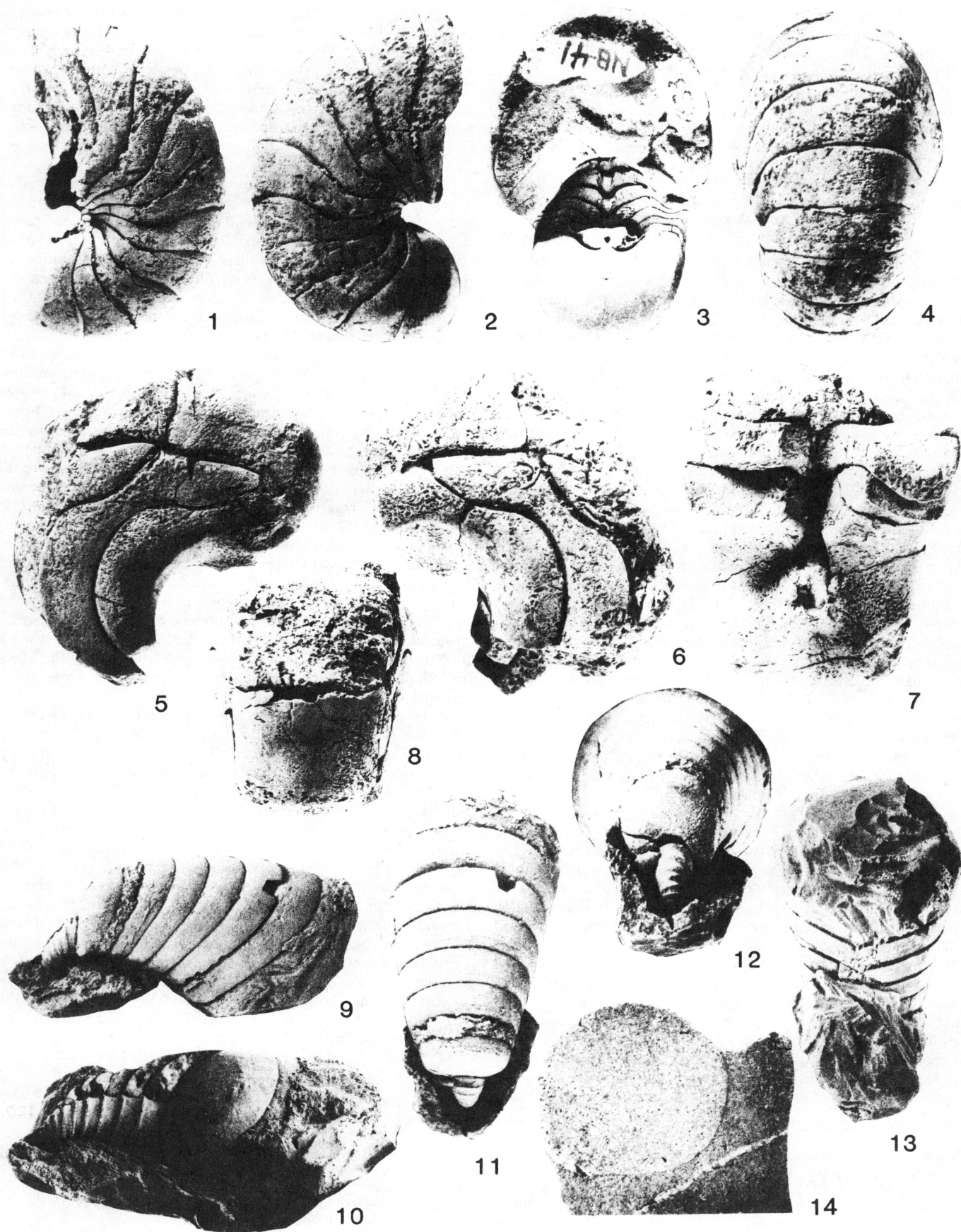


FIGURE 2—Septal sutures of the Hoko River Formation cephalopods. 1, *Nautilus* aff. *N. cookanum* Whitfield, LACMIP 7197, at whorl height of 20 mm,  $\times 2$ . 2, *Aturia* cf. *A. alabamensis* (Morton), LACMIP 7198, at whorl height of 70 mm,  $\times 0.7$ . 3, sepiamorph sepiid, LACMIP 7580, at chamber height of 13 mm,  $\times 3.7$ .

*anum* has the first two of these features. *Nautilus* aff. *N. cookanum* has all three. The type species of *Eutrephoceras* has only slightly sinuous external sutures and does not have an annular lobe. Based on the suture-line drawing (Kummel, 1964, fig. 330, 2c) of *Eutrephoceras* aff. *E. dekayi*, apparently *E. dekayi* also does not have a shallow lobe on the umbilical wall, but instead has a saddle there.

Miller (1947), Miller and Downs (1950), and Palmer (1961, 1965) discussed and illustrated the known northeastern Pacific Paleogene nautiloids as *Eutrephoceras* (i.e., they did not recognize *Nautilus* except as a Recent genus). In comparison with these particular taxa, *Nautilus* aff. *N. cookanum* has more sinuous external sutures, except for *Eutrephoceras* sp. Miller, 1947, and possibly *E. oregonense* Miller, 1947. *Eutrephoceras* sp. Miller (1947, p. 37–38, Pl. 22, figs. 3, 4) is from latest Eocene (or possibly earliest Oligocene) strata, northwestern Oregon. It is known only from a single small specimen that is too fragmentary to allow its specific affinities to be positively determined, but the partial suture pattern that is preserved is very close to that of the Hoko River specimen. The two specimens, which are very likely conspecific, also have the same position of the siphuncle in the same sized chamber. *Eutrephoceras oregonense* Miller (1947, p. 34, Pl. 21, figs. 1, 2) is from Oligocene strata in northern Oregon. It is known only from two very large specimens (215–250 mm in diameter). The suture pattern in these specimens is sinuous enough to cause Miller (1947) to suggest a relationship to *Nautilus*, but the sinuosity is less than that in the suture pattern of the Hoko River specimen. This difference may result from the small size of the Hoko River specimen.

Kummel (1964) and Davies (1971) reported the geologic range



of *Nautilus* as Oligocene to Recent and did not report any North American occurrences. *Nautilus cookanum* and *N. aff. N. cookanum* represent the first records of *Nautilus* in the northwestern Atlantic and northeastern Pacific, respectively.

*Material.*—A single juvenile phragmocone.

*Type.*—Hypotype, LACMIP 7197.

*Occurrence.*—LACMIP locality 6938, 300 m above the base of the late Eocene Hoko River Formation, northwestern Washington, near Kydikabbit Point, Neah Bay area.

Family ATURIIDAE Hyatt, 1894

Genus ATURIA Bronn, 1838

ATURIA cf. *A. ALABAMENSIS* (Morton, 1834)

Figures 2.2, 3.5–3.8

*Description.*—Adult partial phragmocone of 2.5 chambers; lateral sides of test flattened and ventrally convergent; venter broadly rounded, median area obscured; septal suture with a shallow ventral lobe along shoulder of venter, a square-shouldered ventral saddle, a narrow pointed lateral lobe with a hook-like constriction, and a broadly rounded lateral saddle; sutural portion from umbilical border to vicinity of dorsal lobe missing; fairly deep dorsal lobe (Figure 2.2); chamber area between the lateral lobe and lateral saddle is pinched-in; siphuncle moderate in size, marginal, and located in an infundibuliform dorsal adapical flexure of the suture; whorl height (almost complete) 70 mm.

*Discussion.*—*Aturia* cf. *A. alabamensis* cannot be positively identified as to species because of the incomplete nature of the test. It closely resembles *Aturia alabamensis* (Morton, 1834, p. 33, Pl. 18, fig. 3) from late Eocene Jackson Group strata in the Atlantic–Gulf Coastal area (North Carolina through Louisiana) and from late Eocene strata in Nuevo Leon and Tamaulipas, northeastern Mexico (Miller, 1947; Kummel, 1956). Kummel (1964) also reported this species from late Eocene strata in Africa. Miller (1947) provided numerous photographs of *A. alabamensis*. Miller (1947, text-fig. 7f), Kummel (1964, fig. 337, 1c), and Miller and Furnish (1938, fig. 1f) provided suture-line drawings.

Miller (1947) advocated that several other Eocene aturiids may be the same as *A. alabamensis*. They are *A. kerniana* Anderson and G D. Hanna, 1925, *A. peruviana* Olsson, 1930, *A. triangula* Stenzel, 1935, *A. laticlavia* Stenzel, 1935, *A. brazoensis* Stenzel, 1935, *A. garretti* Stenzel, 1940, and *A. panamensis* Miller, 1947. Schenck (1931), furthermore, noted that *A. kerniana* may be the same as *A. myrlae* M. A. Hanna, 1927. Synonymies and illustrations of all of these aturiids are in Miller (1947). *Aturia laticlavia* and *A. garretti* are known only from single specimens. The Japanese late Eocene–early Oligocene *A. yokoyamai* Nagao, 1926 (in the strict sense of Kobayashi, 1957), also resembles *A. alabamensis*, as also noted by Sastry and Mathur (1968).

Comparison of the external suture lines (umbilical areas usually not known) of the above-mentioned aturiids does reveal their remarkable similarity, especially if one takes into account that any minor differences in the shapes of the lateral lobes can be due to amount of removal of the original outer shell layer and/or due to the stage of maturity of the specimen. Schenck (1931) also noted the importance of these two factors in the study of cephalopod sutures. These aturiids also have the same

spacing of septa, the same pinched-in chamber area between the lateral lobe and lateral saddle, and in all the forms the point of each lateral lobe touches or nearly touches the preceding septum. It is conceivable, therefore, that all of the above-mentioned aturiids are actually just a single species that had widespread distribution during the Eocene when equatorial circulation of surface waters was largely unrestricted worldwide, and included a seaway across southern Central America or northwestern South America (Woodring, 1966; Givens, 1978, 1979; Zinsmeister, 1983; Squires, 1984, 1986, 1987).

A complete understanding of all Eocene aturiids, however, is necessary before a formalized equivalency of various forms can be made. Such a thorough revisionary study is beyond the scope of this paper. Complete suture-line drawings of each form at various stages of maturity will be necessary. To date, most of the sutures of the named species of *Aturia* have not been described or illustrated adequately. The umbilical portions of the sutures are critical in distinguishing the middle Oligocene through Miocene northeastern Pacific *A. angustata* and *A. curvilineata* from the Eocene species (Miller, 1947, p. 94). It remains to be seen how distinctive this feature will be for the Eocene species.

*Aturia myrlae* and *A. kerniana* are the only previously known Eocene forms of *Aturia* from the northeastern Pacific, and they do not differ significantly from *A. alabamensis*. *Aturia myrlae* occurs in southern California in the earliest middle Eocene portion of the Lajas Formation and in the middle Eocene Ardath Shale, as well as in central California in the middle Eocene Domingine Formation (M. A. Hanna, 1927; Schenck, 1931; Vokes, 1939; Miller, 1947; Squires, 1984). Vokes' (1939) report of a specimen of *A. myrlae* in the early Eocene Arroyo Hondo Formation in central California was questioned by Miller and Downs (1950), who identified the specimen as *A. cf. A. myrlae*. *Aturia kerniana* was reported from 137 m (450 ft) above the base of the Tejon Formation, Liveoak Canyon, San Emigdio Mountains, southern California (Miller, 1947). Based on work by Nilsen (1973), this locality would probably plot in the Liveoak Shale Member of middle or late Eocene age. Only a few specimens have been found.

Miller and Downs (1950) reported two other Eocene aturiids from the northeastern Pacific; namely, *Aturia* sp. Miller and Downs (1950, p. 15, Pl. 3, figs. 1, 2) from the Capay Formation (early Eocene) of north-central California and *Aturia* sp. Miller and Downs (1950, p. 16, Pl. 1, fig. 9) from the Eocene Crescent Formation in a sea cliff near Port Crescent, Clallam County, Washington. According to Rau (1964, 1981), the Crescent Formation is early early Eocene through early middle Eocene in age. The *Aturia* cf. *A. alabamensis* of this present report differs from the Capay Formation *Aturia* in that the lateral lobes more nearly contact the preceding septum and the chamber area between the lateral lobe and lateral saddle is more pinched-in. The *Aturia* from the Crescent Formation is too poorly preserved for comparison with the *Aturia* of this report.

If the Hoko River Formation specimen is *Aturia alabamensis*, it would extend the geographic range of this species from the Atlantic–Gulf Coastal, northeastern Mexico, and African area into northwestern Washington.

*Material.*—A single partial phragmocone of an adult.

*Type.*—Hypotype, LACMIP 7198.

*Occurrence.*—LACMIP locality 6938, 300 m above the base  
= *Quacicut local* 120.

FIGURE 3—1–4, *Nautilus* aff. *N. cookanum* Whitfield, juvenile phragmocone, hypotype, LACMIP 7197, locality LACMIP 6938, lateral, lateral, apertural, and ventral views respectively,  $\times 1.4$ . 5–8, *Aturia* cf. *A. alabamensis* (Morton), adult partial phragmocone, hypotype, LACMIP 7198, locality LACMIP 6938. 5, lateral view,  $\times 0.8$ ; 6, lateral view,  $\times 0.8$ ; 7, apertural view,  $\times 0.8$ ; 8, ventral view,  $\times 0.6$ . 9–14, sepiamorph sepiid, locality LACMIP 6938,  $\times 2.5$ . 9–12, hypotype, LACMIP 7580; 9, lateral view; 10, lateral internal view of siphuncle with the six posteriormost septa removed; 11, dorsal view; 12, adapical view; 13, ventral view; 14, hypotype, LACMIP 7581, oral view.

of the late Eocene Hoko River Formation, northwestern Washington, near Kydikabbit Point, Neah Bay area.

Family BELOSEPIIDAE Naef, 1921a

SEPIAMORPH SEPIID

Figures 2.3, 3.9–3.14

*Description.*—Partial phragmocone of 7–8 chambers; incurved and strongly tapered adapically; ventral surface flattened and dorsal surface broadly rounded; living chamber and rostrum missing; cross-sectional shape of phragmocone elliptical and hoof-like; height/width ratio of chambers approximately 1:1; diameter of each chamber increases in size by 12 percent relative to preceding younger chamber.

Septal suture with a moderately broad but distinct ventral lobe; a very weak lateral lobe raises addorsally, forming a broad and rounded dorsal saddle (Figure 2.3); sutures strongly oblique in relation to phragmocone's axis.

Rapidly adorally expanding siphuncle on ventral side of phragmocone; siphuncle diameter size increases at rate of 12 percent with each successive chamber; siphuncle width at oral end comprises approximately half (48 percent) of diameter of corresponding chamber; siphuncle in apical portion of phragmocone with a strong endogastric curvature of at least one-half of a turn; phragmocone length, 20 mm; maximum height, 14.7 mm.

*Discussion.*—In hypotype LACMIP 7580, the siphuncle was exposed for nearly the entire length of the phragmocone by means of an accidental fracturing during cleaning. Figure 3.10 shows this internal view, photographed prior to gluing the specimen together again. In hypotype LACMIP 7581, the oral cross-sectional shape (Figure 3.14) was exposed by making a cut parallel to the anterior end of the oldest chamber and then grinding the surface flat. Unfortunately, the siphuncle was not present, presumably due to pre-burial destruction.

Donovan (1977) divided the Tertiary "sepiids" of authors into two groups. The first group consists of *Sepia*-like forms with strongly oblique sutures and includes *Belosepia*, *Sepia*, and one or two other genera (Jeletzky, 1969, p. 107). The second group consists of forms transitional between belemnites and *Spirula* (i.e., *Spirulirostra*, *Spirulirostrella*, and a number of others) with sutures of conventional form, making a less oblique angle with the phragmocone. In this paper, the informal terms "sepiamorph" and "spirulimorph" are used for these two groups, respectively. Stolley (1919, p. 58) and Reitner and Engesser (1982) treated them as separate orders, whereas Naef (1921a, p. 47–48; 1922, p. 299) placed them in the same suborder. Jeletzky (1966, p. 107) placed them in the same order Sepiida. Formal classification of these two groups is currently undergoing revision, and Jeletzky (personal commun.) plans to treat them as separate suborders of the order Sepiida.

The bulky, rapidly expanding siphuncle and the strongly oblique sutures of the Hoko River specimens resemble those of *Belosepia* Voltz, 1830 (cf. Edwards, 1849, Pl. 1, figs. 1h, 5, 6; Abel, 1916, fig. 64; Naef, 1922, figs. 32a, 33a–c; 1923, figs. 283a, 286b; Termier and Termier, 1960, fig. 2 763). Naef's drawings are mostly based on the old drawings of Edwards. The ventral lobes, the ventral flattening of the phragmocone, and the hoof-like cross section of the Hoko River specimens also are present in *Belosepia*, and these features help characterize this genus according to Jeletzky (1969, p. 26–27). The Hoko River specimens differ from *Belosepia* in that the chambers are relatively higher and the sutures lack the lateral saddles that are well developed in *Belosepia* (cf. Edwards, 1849, Pl. 1, figs. 5, 6; Naef, 1922, fig. 33b, c). The two are at least generically distinct, but it is doubtful that one should erect a new genus for the Hoko

River specimens because of the fragmentary and otherwise poor preservation (Jeletzky, personal commun.).

*Belosepia* is similar to *Sepia* Linné, 1758, in a number of taxonomically important features. The two were placed in the family Sepiidae by Naef (1921a, 1921b, 1922, 1923) and by Jeletzky (1966). Newton and Harris (1894), Palmer (1937), and Davies (1971) placed *Belosepia* in the family Belosepiidae. Jeletzky (1966, p. 107) placed *Belosepia* in the subfamily Belosepiinae of the family Sepiidae Keferstein, 1866. In 1969, Jeletzky raised this subfamily to the full familial rank. *Belosepia* ranges from late Paleocene to late Eocene and is the only sufficiently well known representative of family Belosepiidae (Jeletzky, 1969, p. 26–27; Davies, 1971, p. 476). The sutures of the Hoko River sepiid are also of the same pronouncedly oblique type as *Sepia* (cf. Naef, 1922, figs. 30e, 32b, c); however, in the latter they are much more closely spaced and the chambers are crossed by supplementary septal elements (i.e., "Pfeiler" and "Zwischensepten" of Naef, 1922, p. 80, explanation of figs. 32b, c). The Hoko River sepiid also differs from *Sepia* in the possession of a normal, fully developed coleoid siphuncle. In contrast, the whole ventral side of the *Sepia* siphuncle is transformed into an abbreviated, pit-like cavity and a so-called fork. Only its dorsal part still exhibits strongly modified septa (cf. Naef, 1923, fig. 309).

The suture lines of all sufficiently well known spirulimorph sepiids are, in contrast to the Hoko River specimens, either slightly or only moderately inclined (i.e., addorsally raising) (cf. Naef, 1922, figs. 12, 13c, 14a, 16b, 17b, 20c, d, 21b, 21e, 23a, 24B2, 29b, c; Jeletzky, 1966, Pl. 20, fig. 1A; 1969, Pl. 1, fig. 1B, text-fig. 3, Pl. 3, fig. 1b, c; Traub, 1982, fig. 1a; Squires, 1983, fig. 2K).

The Hoko River specimens, therefore, show sepiamorph characteristics and are most closely allied to *Belosepia* but appear to be at least generically new. The Hoko River specimens also are situated near the separation of true Sepiidae (i.e., *Archaeosepia* Szörényi, 1933, and *Sepia*) from Belosepiidae. Jeletzky (1969) mentioned that this separation occurred in the middle Eocene and not in the early Paleocene as indicated by Naef (1922, fig. 101; 1923, fig. 471). In middle Eocene (Lutetian) beds of the Paris Basin there are belosepiid-like specimens of *Sepia vera* Deshayes (1866, Pl. 106, figs. 11, 12; Roger, 1952, fig. 82 1–3) that consist of peculiar, very wide guards. Jeletzky (1969) considered them as transitional between *Belosepia* and true Sepiidae and placed them, as did Naef (1923, p. 768), in *Pseudosepia* Naef, 1923. As noted by Jeletzky (1969), the first true Sepiidae (i.e., *Archaeosepia*) is middle to late Eocene in age (Lörentz, 1898; Szörényi, 1933; Wagner, 1938).

*Material.*—Two partial phragmocones.

*Type.*—Hypotypes, LACMIP 7580, 7581.

*Occurrence.*—LACMIP locality 6938, 300 m above the base of the late Eocene Hoko River Formation, northwestern Washington, near Kydikabbit Point, Neah Bay area.

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also arranged for the photography of this specimen shown in Figure 3.10.

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