Upper Cretaceous (Cenomanian–Turonian) bivalves from northern Jordan, Middle East

María del Carmen Perrilliat[1,*], Fayez Ahmad[2], and Francisco J. Vega[1]

[1] Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Coyoacán, 04510 México, D. F., Mexico.
[2] Faculty of Natural Resources and Environment, Department of Earth and Environmental Sciences, The Hashemite University, P. O. Box 150459, 13115 Zarqa, Jordan.
**mariacp@servidor.unam.mx*

ABSTRACT

Twelve species of bivalves are described for the Upper Cretaceous Ajlun Group of northern Jordan. The specimens were collected in three localities of the Fuheis (?middle to late Cenomanian), Hummar (late Cenomanian), and Shuayb (early Turonian) formations. Some of the species here described are reported for the first time in Jordan and confirm Tethyan paleobiogeographic affinities.

Key words: Bivalvia, Upper Cretaceous, northern Jordan, Middle East.

RESUMEN

Se describen e ilustran doce especies de bivalvos procedentes del Cretácico Superior del Grupo Ajlun en el norte de Jordania. Los especímenes fueron recoletados en tres localidades de las formaciones Fuheis (Cenomaniano medio? a tardío), Hummar (Cenomaniano tardío) y Shuayb (Turoniano temprano). Algunas de las especies descritas son reportadas por vez primera para Jordania y confirman una afinidiad paleobiogeográfica con la Provincia del Tethys.

Palabras clave: Bivalvia, Cretácico Superior, norte de Jordania, Medio Oriente.

INTRODUCTION

Upper Cretaceous carbonate rocks cover about two-thirds of Jordan. These rocks are rich in microfossils and invertebrates. During the Cenomanian and Turonian, Jordan was largely covered by shallow, warm seas. In this lapse of time, strata of the Ajlun Group (Naur, Fuheis, Hummar, Shuayb, and Wadi As Sir formations) were deposited. Previous studies of these sediments concentrated mainly on the petrography, microfossils and occasionally macrofossils, *e.g.*, Bandel and Geys (1985), Powell (1989), Abed and Kraishan (1991), Aqrabawi (1993), Nazzal and Mustafa (1993), Shinaq and Bandel (1998), Bandel *et al.* (1999), Neumann (1999), Sabaheen and Mustafa (2000), and Ahmad and Al-Hammad (2002).

The aim of the present work is to study the bivalves from the Upper Cretaceous Fuheis, Hummar, and Shuayb formations, cropping out in Zarqa area (Figure 1). The Fuheis Formation (Table 1) overlies the Naur Formation and is overlain by the Hummar Formation throughout most of north Jordan, with a maximum thickness of 80 m. It is composed of fossiliferous marl and marly limestone, and includes foraminifera, ostracods, gastropods and echinoids (Wetzel and Morton, 1959; Basha, 1978; Dilley, 1985). Bivalves reported from this formation include *Exogyra flabellata*, *E. columba*, *Cardium* sp., *Neithea* sp.,

Figure 1. Location map of study area in northern Jordan. Black square indicates the area shown in Figure 2.

Pholadomya vignesi, *Dosinia delettrei*, *Venus reynesi*, *Arca trigeri*, *Protocardia moabitica* and *Cardium pauli* (Wetzel and Morton, 1959). Oysters assigned to *Rhynchostreon mermeti* (Coquand), and *Amphidonte* (*Ceratostreon*) *flabellatum* reinforced a ?middle to late Cenomanian age for this formation (Aqrabawi, 1993).

The Hummar Formation is overlain by the Shuayb Formation, a prominent cliff-forming carbonate unit thinning rapidly south of Wadi Mujib, Central Jordan. The formation consists of gray limestone, dolomitic limestone and dolomite with a relatively poor macrofossil content. Foraminifera and ostracods are present (Basha, 1978; Dilley, 1985), as well as corals, rudists and echinoids (Powell, 1989). Bivalves reported from this formation include *Exogyra olisiponensis*, *Plicatula auressensis*, *Lucina* sp., and *Protocardia* sp. (Wetzel and Morton, 1959). The micro and macrofauna indicates a late Cenomanian age for this unit (Olexcon, 1966; Basha, 1978; Dilley, 1985; Powell, 1989).

Table 1. Upper Cretaceous stratigraphic units in northern Jordan.

Group	Stage	Formation
Belqa	Coniacian–Santonian	Wadi UmmGhudran Chalk
Ajlun	Turonian	Wadi As-Sir Limestone
	Cenomanian	Shuayb
		Hummar
		Fuheis
		Naur Limestone
	Lower Cretaceous	Kurnub Sandstone

The Shuayb Formation is early Turonian in age (Wetzel and Morton, 1959; Basha, 1978; Dilley, 1985), and is overlain by the Wadi As Sir Formation. It consists of thinly bedded limestone and marly limestone, which is mostly fossiliferous, including ammonites and foraminifera that support the age. Bivalves present in this formation include: *Exogyra columba*, *E. conica*, *E. olisiponensis*, *Plicatula raynesi*, *P. forneli*, *Lucina useilli*, and *Cardium saportae* (Powell, 1989). Other fossil groups present are dasycladacean algae, gastropods, ostracods, and echinoids.

In central and southern Jordan, the Hummar Formation is absent, the base of the Shuayb Formation is not traceable, and the formation has been included in the undifferentiated Fuheis / Hummar / Shuayb unit. Powell (1989) assigned an early Turonian age to the Fuheis Formation.

The bivalves were collected at three localities in the area of Zarqua (Figure 2). Locality A (IGM-3513) includes outcrops of the Hummar Formation, and is found 3 km northwest of Urqub As Saqla (As Saqla Cliff), at 32º6'22" Lat N and 36º10'5" Long E. Locality B (IGM-3514) represents the lithology of the Shuayb Formation in outcrops located 1.5 km east of Urqub As Saqla, at 32º5'2" Lat N and 36º15'35" Long E. Locality C (IGM-3515) is found 1 km west of Jabal ar Ruhayd (ar Ruhayd Mountain) and includes outcrops of the Fuheis Formation, at 32º6'19" Lat N, 36º16'5" Long E.

The studied material is deposited in the Colección Nacional de Paleontología, Instituto de Geología, Universidad Nacional Autónoma de México. Types are included in the Type Collection and classified under the acronym IGM. The classification herein follows that of Vaught, 1989.

SYSTEMATIC PALEONTOLOGY

Class Bivalvia Linnaeus, 1758
Order Arcoida Stoliczka, 1871
Superfamily Arcoidea Lamarck, 1809
Family Arcidae Lamarck, 1809
Genus *Arca* Linnaeus, 1758

Type species. (International Commission on Zoological Nomenclature, Opinion 189, 1945): *Arca noae* Linnaeus. Recent. Mediterranean Sea and Eastern Atlantic Ocean.

Subgenus *Eonavicula* Arkell, 1929

Type species. *Arca quadrisulcata* J. de C. Sowerby, 1824.

***Arca (Eonavicula)* sp.**

Figures 3, 4, 5

Description. Shell elongate, trapezoidal; hinge narrow. Anterior margin rounded below, subtruncated above; ventral margin slightly concave centrally; posterior margin sharply

rounded. Sculpture of numerous radial prominent ribs and interspaces of equal width.

Material examined. Nine articulated specimens.

Hypotypes. IGM 8846, length 62.4 mm, height 27.1 mm, diameter 27.9 mm (both valves); IGM 8847, length 55.3 mm, height 28.5 mm, diameter 24.0 mm (both valves); IGM 8848, length 51.1 mm, height 25.5 mm, diameter 21.9 mm (both valves).

Occurrence. Shuayb Formation (early Turonian).

Discussion. The specimens are internal molds similar to *Barbatia* (*Plagiarca*) *carolinensis* Conrad (1875, p. 4, pl. 1, fig. 11) from the upper part of the *Exogyra ponderosa* zone in North Carolina, in shape and sculpture of shell; but the Jordanian specimens are larger in size.

Order Pterioida Newell, 1965
Superfamily Pterioidea Gray, 1847
Family Inoceramidae Giebel, 1852

Genus *Inoceramus* J. Sowerby, 1814

Type species. *Inoceramus cuvieri* J. Sowerby, 1814. Senonian. England.

?*Inoceramus* sp.
Figures 6-8

Description. Shell medium-sized, slightly inequivalve, inequilateral, subovate to subcircular; moderately convex. Left valve slightly more inflated than right one with slightly incurved, prosogyrate beak. Anterior margin nearly straight, ventral margin semi-circular. Sculpture of fine commarginal growth costae with narrow interspaces; faint radial lines.

Material examined. Three articulated specimens.

Hypotypes. IGM 8849, length 41.4 mm, height 35.4 mm, diameter 32.4 mm (both valves); IGM 8850, length 32.0 mm, height 29.4 mm, diameter 16.6 m (one valve).

Occurrence. Fuheis Formation (Cenomanian), and Shuayb Formation (lower Turonian).

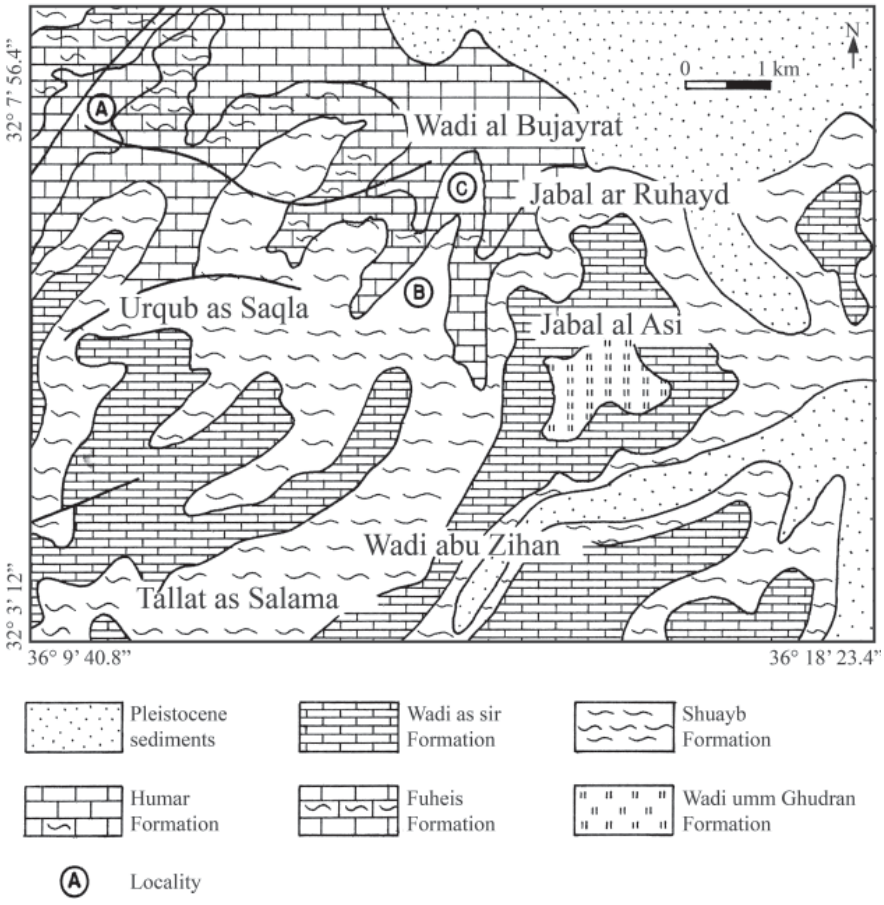


Figure 2. Geologic map of study area. Localities indicated: A, locality IGM-3513, outcrops of the Hummar Formation; B, locality IGM-3514, outcrops of the Shuayb Formation; C, locality IGM-3515, outcrops of the Fuheis Formation.

Discussion. The Jordanian specimens are similar in outline and ornamentation to *Inoceramus virgatus* Schlüter, 1877 described in Elder and Box (1992, p. 13, figs. 9.1, 9.2) from lower-middle Turonian of Alaska.

Genus *Mytiloides* Brongniart, 1822

Type species. *Ostracites labiatus* Schlotheim, 1813. Turonian. England.

?*Mytiloides* sp.
Figure 9

Description. Shell medium-sized, trapezoidal, equivalve, inequilateral, moderately prosocline; slightly convex with poorly differentiated umbo and terminal beak that barely protudes beyond dorsal margin; hinge line short; flanks inclined anteriorly and posteriorly ; margin anterodorsal straight to slightly convex; posterior margin long and broad.

Material examined. Six specimens.

Hypotype. IGM 8851, length 34.0 mm, height 50.0 mm, diameter 17.4 mm.

Occurrence. Shuayb Formation (lower Turonian).

Discussion. All the specimens are molds and deformed, so that further classification is not possible.

Order Ostreoida Férussac, 1822
Superfamily Ostreoidea Rafinesque, 1815
Family Gryphaeidae Vyalov, 1936
Genus *Exogyra* Say, 1820

Type species. *Exogyra costata* Say, 1820. Maastrichtian, United States of America.

Subgenus *Costagyra* Vyalov, 1936

Type species. *Exogyra olisiponensis* Sharpe, 1850. Cenomanian. Portugal.

***Exogyra (Costagyra) olisiponensis* Sharpe, 1850**
Figures 10, 11

Exogyra olisiponensis Sharpe, 1850, p. 185, figs. 1, 2.
Exogyra (*Costagyra*) *olisiponensis* Sharpe. Malchus, 1990, p. 134, pl. 10, figs. 1-6; Aqrabawi, 1993, p. 67, pl. 4, figs. 3-5; pl. 5, figs. 1, 2.

Description. Shell large-sized, inequivalve, inequilateral, subtriangular; ligament area small, umbo helicoidal; sculpture of left valve, seven strong radial ribs and sometimes with remnant of spines, scally growth lamellae in whole surface of shell; interior with oval adductor muscle scar. Right valve subcirclar and with scally growth lamellae.

Material examined. Five specimens.

Hypotype. IGM 8852, length 55.1 mm, height 68.4 mm, diameter 46.0 m (left valve).

Occurrence. Fuheis Formation (late Cenomanian), Hummar Formation (early Turonian), Shuayb Formation (early Turonian).

Discussion. Complete synonymy of this species can be seen in Malchus, 1990, p. 134.

Superfamily Plicatuloidea Watson, 1930
Family Plicatulidae Watson, 1930
Genus *Plicatula* Lamarck, 1801

Type species. *Spondylus plicatus* Linnaeus, 1758, by subsequent designation Schmidt, 1818. Recent. Indo-Pacific.

***Plicatula* cf. *ferryi* Coquand, 1862**
Figures 12, 13

Description. Shell medium-sized, subtrigonal, inequivalve; badly preserved umbonal area; fairly developed auricles; right valve evenly convex; sculpture of numerous subnodose closely spaced radial ribs.

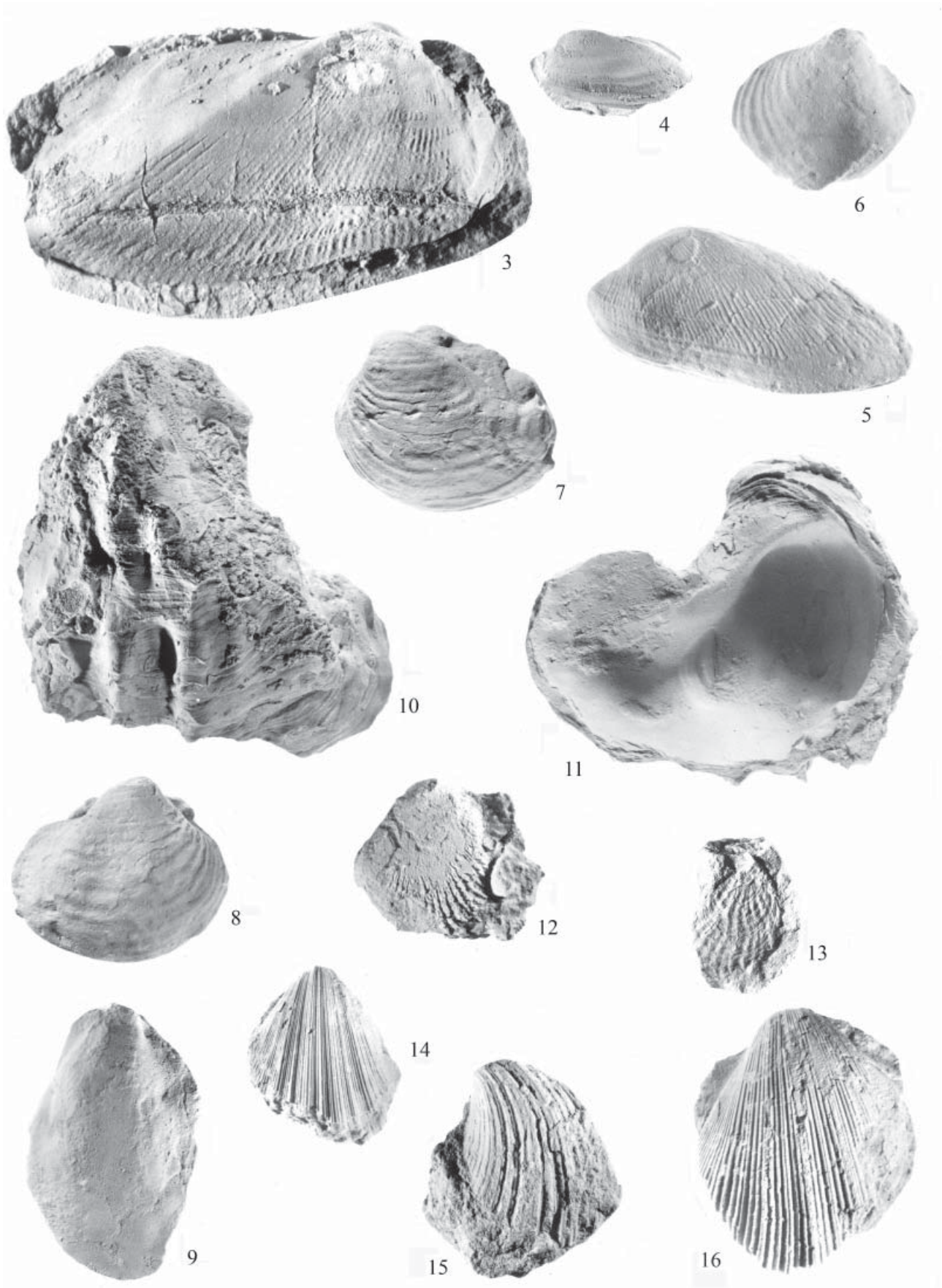
Material examined. Four specimens.

Hypotypes. IGM 8853, length 24.6 mm, height 27.1 mm; IGM 8854, length 15.3 mm, height 22.1 mm.

Occurrence. Fuheis Formation (late Cenomanian), Hummar Formation (early Turonian) and Shuayb Formation (early Turonian).

Discussion. Although they are poorly preserved specimens are comparable in shape and sculpture to *Plicatula ferryi* Coquand (1862, p. 221, pl. 16, figs. 7-9) from the Santonian of North Africa. Some other authors have recorded this species from Coniacian-Santonian strata in many localities (El-Hedeny *et al.*, 2001, p. 299). Barber (1958) described this species from the Turonian of Nigeria, and Cobban (1977) from the middle-upper Cenomanian of West Central New Mexico.

Superfamily Pectinoidea Rafinesque, 1815
Family Pectinidae Rafinesque, 1815
Genus *Neithea* Drouet, 1824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Type species. *Pecten aequicostatus* Lamarck, 1819. Recent. Mans, Sarthe, France.

Subgenus *Neithea* s. s.

***Neithea* (*Neithea*) *dutrugei* (Coquand, 1862)**
Figures 14-16

Janira Dutrugei Coquand, 1862, p. 219, pl. 13, figs. 1, 2; Stefano, 1901, p. 58 ; Michalet, 1901, p. 582.
Janira aequicostata non *Neithea aequicostata* (Lamarck). Choffat, 1885, p. 62-67.
Vola Dutrugei Coquand. Blanckenhorn, 1890, p. 78, 79, pl. 4, figs. 8, 9.
Janira Dutrugei Coquand. Choffat, 1900, p. 155, 162.
Vola Dutrugei Coquand var. *Beirensis* Choffat, 1902, p. 150, 151, pl. 2, figs. 1, 2.
Pecten Dutrugei Coquand. Fourtau, 1903, p. 317, 318; Daguin, 1935, p. 293.
Janira duplicicosta Roemer. Frech, 1916, p. 270-271, pl. 14, figs. 1a-c.
Pecten (*Vola*) *Dutrugei* Coquand. Blanckenhorn, 1934, p. 194, pl. 9, fig. 25.
Pecten (*Vola*) *zakarjensis* Blanckenhorn, 1934, p. 194, pl. 9, figs. 26a, b.
Neithea cf. *Dutrugei* Coquand. Marchetti, 1935, p. 26.
Neithea Dutrugei (Coquand). Tavani, 1942, p. 9, 10, pl. 1, fig. 4.
Neithea sp. aff. *N. Dutrugei* Coquand. Tavani, 1948, p. 95.
Pecten cfr. *Dutrugei* Coquand. Farag, 1955, p. 156.
Neithea (*Neithea*?) *dutrugei* (H. Coquand, 1862). Dhondt, 1973, p. 59, 60, pl. 4, fig. 3 ; pl. 5, figs. 4a, 4b.

Description. Shell medium-sized, inequivalve. Sculpture of six primary radial ribs, interspaces with four secondary radial ribs being the medial one slightly stronger. No auricles preserved.

Material examined. Numerous specimens.

Hypotypes. IGM 8855, length 29.0 mm, height 35.0 mm; IGM 8856, length 29.5 mm, height 36.8 mm; IGM 8857, length 31.3 mm, height 35.0 mm; IGM 8858, length 26.2 mm, height 24.9 mm.

Occurrence. Hummar Formation (early Turonian), and Shuayb Formation (early Turonian).

Discussion. This species has been reported from the Albian-Cenomanian in Europe, Africa, and Middle East. See Dhondt, 1973, p. 60.

Order Trigonioida Dall, 1889
Superfamily Trigonioidea Lamarck, 1819
Family Trigoniidae Lamarck, 1819
Genus *Rutitrigonia* Van Hoepen, 1929

Type species. *Rutitrigonia peregrina* Van Hoepen, 1929. Lower Cretaceous. South Africa.

?*Rutitrigonia* sp.
Figures 17, 18

Description. Shell medium-sized; ovate; umbo ill defined; anterior part with thin, flexuous concentric ribs.

Material examined. Two specimens.

Hypotypes. IGM 8859, length 33.4 mm, height 36.2 mm, diameter 23.1 mm; IGM 8860, length 34.0 mm.

Occurrence. Fuheis Formation (late Cenomanian).

Discussion. The specimens are tentatively assigned to *Rutitrigonia* because they are badly preserved.

Order Veneroida Adams and Adams, 1856
Superfamily Cardioidea Lamarck, 1809
Family Cardiidae Lamarck, 1809
Genus *Granocardium* Gabb, 1869

Type species. *Cardium carolinum* d'Orbigny, 1844. Upper Cretaceous. France.

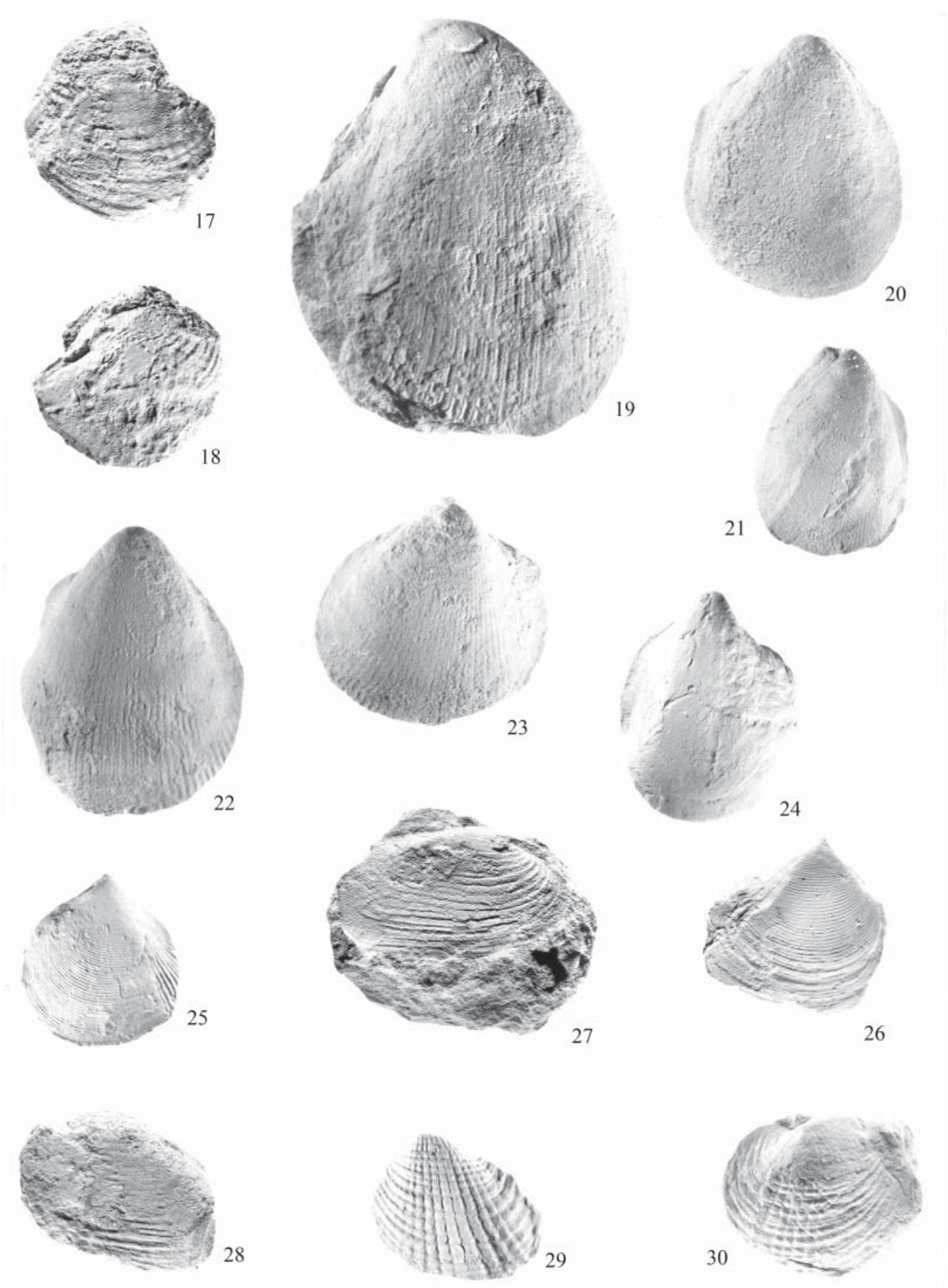
Subgenus *Criocardium* Conrad, 1870

Type species. *Cardium dumosum* Conrad, 1870, subsequent designation Stoliczka, 1871. Santonian. Haddonfiel, New Jersey.

***Granocardium* (*Criocardium*?) sp.**
Figures 19-24

Description. Shell medium to large sized, equivalve, inequilateral, oval, elongated; strongly inflated, inflation increas-

Figures 3 to 16. Figures 3–5: *Arca* (*Eonavicula*) sp. 3, hypotype IGM 8846, X1.4; 4, hypotype IGM 8848, X0.6; 5, hypotype IGM 8847, X1.1. Figures 6–8: ?*Inoceramus* sp., 6, hypotype IGM 8850, X1.0; 7, 8, hypotype IGM 8849, X1.0. Figure 9: ?*Mytiloides* sp., hypotype IGM 8851, X1.0. Figures 10, 11: *Exogyra* (*Costagyra*) *olisiponensis* Sharpe, 1850, hypotype IGM 8852, X1.1. Figures 12, 13: *Plicatula* cf. *ferryi* Coquand, 1862. 12, hypotype IGM 8853, X1.1; 13, hypotype IGM 8854, X1.1. Figures 14–16: *Neithea* (*Neithea*) *dutrugei* (Coquand, 1862). 14, hypotype IGM 8857, X1.0; 15, hypotype IGM 8855, X1.05; 16, hypotype IGM 8856, X1.2. Specimens 3, 4, 6, 7, 10, 13, 16 are from the Shuayb Formation; 5, 8, 9 are from the Fuheis Formation; 11, 12, 14, 15 are from the Hummar Formation.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ing toward umbonal region; umbones relatively broad and incurved protruding beyond hinge line; beaks prosogyrate; anterior, posterior, and ventral margins rounded; posterodorsal margin broad, straight; sculpture of relatively broad, flat, bifid ribs with narrow interspaces, with pores.

Material examined. Numerous specimens.

Hypotypes. IGM 8861, length 56.0 mm, height 77.0 mm; IGM 8862, length 38.7 mm, height 45.1 mm, diameter 28.6 mm; IGM 8863, length 41.9 mm, height 42.5 mm, diameter 35.0 mm; IGM 8864, length 39.0 mm, height 51.0 mm, diameter 40.8 mm; IGM 8865, length 27.4 mm, height 36.9 mm, diameter 21.0 mm; IGM 8866, length 33.2 mm, height 41.7 mm, diameter 27.2 mm.

Occurrence. Hummar Formation (early Turonian), and Shuayb Formation (lower Turonian).

Discussion. With better material these specimens could be described as a new species; at present they are similar to *Granocardium conradi* (Stephenson) (1923, p. 296, pl. 72, figs. 1-4) from the Black Creek Formation (upper part of *Exogyra ponderosa* zone) in North Carolina in the relatively broad, flat bifid ribs with narrow interspaces characteristic of this species, but the Jordanian specimens are larger and, because they are molds, the spines are not preserved, also this species is from a different age.

Genus *Protocardia* von Beyrich, 1845

Type species. *Cardium hillanum* J. de C. Sowerby, 1813, subsequent designation by Herrmannsen, 1847, p. 366. Lower Cretaceous. England.

***Protocardia multistriata* (Shumard, 1854)**
Figure 25

Cardium hillanum Sowerby, Roemer, 1849, p. 406; 1852, p. 49, pl. 6, fig. 12.
Cardium multistriatum Shumard, 1854, p. 194, pl. 4, fig. 2.
Cardium (*Protocardia*) *multistriata* Shumard. Conrad, 1857, p. 149, pl. 6, fig. 4a-c.
Cardium (*Protocardia*) *granuliferum* Gabb, 1869, p. 267-268, pl. 36, fig. 15.
Cardium (*Protocardia*) *hillanum* Sowerby. Böse, 1910, p. 129-131, pl. 27, fig. 5 ; pl. 28, figs. 1-3; Adkins, 1928, p.159.
Protocardia texana (Conrad). Adkins and Winton, 1920, p. 15, 75, pl. 18, fig. 7; Adkins, 1928, p. 159, pl. 2, fig. 5; pl. 16, fig. 2; Perkins, 1961, p. 73-74, pl. 21, figs. 1-8.
Protocardia multistriata (Shumard). Perkins, 1961, p. 72, pl. 20, fig. 7; Scott, 1975, p. 113-117, pl. 1, figs. 4-6; Scott, 1986, p. 1193-1196, figs. 12.1-12.7.

Description. Shell medium-sized, ovate, equilateral, equivalve; beaks subcentral, projecting moderately beyond hingeline, prosocline. Dorsal margin slope moderately away from the beak, anterior and ventral margins smoothly and broadly curved, posterior margin curved, sloping dorsally. Surface sculpture of low rounded concentric ribs separated by rounded interspaces as wide as ribs; 15 symmetrically rounded radial ribs on posterior one fourth of valve.

Material examined. Numerous specimens.

Hypotype. IGM 8867, length 30.0 mm, height 32.5 mm, diameter 15.3 mm.

Occurrence. Shuayb Formation (early Turonian).

?*Protocardia* sp.
Figure 26

Description. Shell medium-sized, subcircular in outline, equivalve, inequilateral, moderatey inflated; umbones prominent, slightly curved. Anterior margin well rounded, posterior margin truncated, ventral margin straight. Sculpture of low rounded concentric ribs separated by wide interspaces; posterior area with radial ribs, separated by interspaces of equal width.

Material examined. Numerous specimens.

Hypotype. IGM 8868, length 30.7 mm, height 30.0 mm, diameter 15.1 mm.

Occurrence. Shuayb Formation (early Turonian).

Discussion. The Jordanian specimens are poorly preserved and cannot be identified at species level.

Figures 17 to 30. Figure 17, 18: ?*Rutitrigonia* sp. 17, hypotype IGM 8859, X1.0; 18, hypotype IGM 8860, X1.1. Figures 19–24: *Granocardium* (*Criocardium*?) sp. 19, hypotype IGM 8861, X1.0; 20, hypotype IGM 8862, X1.0; 21, hypotype IGM 8865, X1.0; 22, hypotype IGM 8864, X1.0; 23, hypotype IGM 8863, X1.0; 24 hypotype IGM 8866, X1.0. Figure 25: *Protocardia multistriata* (Shumard, 1854), hypotype IGM 8867, X1.0. Figure 26: ?*Protocardia* sp., hypotype IGM 8868, X1.0. Figures 27, 28: *Panopea* sp., 27, hypotype IGM 8869, X1.0; 28, hypotype IGM 8870, X1.1. Figures 29, 30: ?*Pholadomya* sp. 29, hypotype IGM 8871, X1.1; 30, hypotype IGM 8872, X1.2. Specimens 17, 18 are from Fuheis Formation; 19, 20, 23, 26, 28 are from Hummar Formation; 21, 22 24, 25, 27, 29, 30 are from Shuayb Formation.

Order Myoida Stoliczka, 1870
Superfamily Hiatelloidea Gray, 1824
Family Hiatellidae Gray, 1824
Genus *Panopea* Ménard, 1807

Type species. *Panopea faujasi* Ménard de la Groye, 1807. Pliocene. Belgium.

***Panopea* sp.**
Figures 27, 28

Description. Shell medium-sized, subquadrate, inequilateral, equivalve; beaks situated about one-third of shell length from the anterior margin. Anterior margin rounded, posterior margin elongated, straight, ventral margin straight. Sculpture of shell with concentric rounded ribs separated by wide interspaces.

Material examined. Two specimens.

Hypotypes. IGM 8869, length 46.0 mm, height 28.7 mm; IGM 8870, length 33.6 mm, height 24.2 mm, diameter 12.5 mm.

Occurrence. Hummar Formation (early Turonian).

Discussion. The specimens are poorly preserved and are similar to *Panopea astieriana* d'Orbigny (1844, p. 342, pl. 359, figs. 3, 4) from the lower Turonian of Var, Sarthre, France in general shape, but the posterior slope is not so pronounced in the Jordanian specimens.

Order Pholadomyoida Newell, 1965
Superfamily Pholadomyoidea Gray, 1847
Family Pholadomyidae Gray, 1847
Genus *Pholadomya* G. B. Sowerby, 1823

Type species. *Lutraria ambigua* Sowerby, 1819. Early Jurassic. England.

? *Pholadomya* sp.
Figures 29, 30

Description. Shell medium-sized, elongate-ovate, inequilateral, equivalve; broadly rounded umbonal region; valves gaping posteriorly; ventral margin rounded; sculpture of broad concentric ribs in the whole surface separated by narrow interspaces; 10 radial ribs extending from umbo to ventral margin in central part of shell.

Material examined. Four specimens.

Hypotypes. IGM 8871, length 28.1 mm, height 23.5 mm; IGM 8872, length 28.0 mm, height 23.1 mm, diameter 17.2 mm; IGM 8873, length 32.1 mm, height 29.9 mm, diameter 21.5 mm.

Occurrence. Shuayb Formation (lower Turonian).

CONCLUSIONS

Late Cretaceous bivalve genera reported for the first time in the Fuheis, Hummar and Shuayb formations of Jordan include *Arca* (*Eonavicula*), *Mytiloides*, *Rutitrigonia*, *Panopea* and *Pholadomya*.

Plicatula cf. *ferryi* has been described from Coniacian-Santonian strata in many localities in the Middle East; Turonian of Nigeria and middle-upper Cenomanian of West Central New Mexico. It is reported for the first time in the Fuheis, Hummar and Shuayb formations.

Neithea (*Neithea*) *dutrugei* has been described from Albian-Cenomanian strata in Iraq; Cenomanian of Argelia, Jordan, Israel, and Tunisia; Senonian of Syria; Upper Cretaceous of Egypt, Iraq, Nigeria, Portugal and it is reported for the first time in the Hummar and Shuayb formations.

Exogyra (*Costagyra*) *olisiponensis* has been described in the Cenomanian of Egypt and Sinai; Turonian of North and South America, central Asia, West Africa and New Mexico. It is found for the first time in the Fuheis, Hummar and Shuayb formations.

Protocardia multistriata has been reported from the Albian of Texas and Sonora. It is reported for the first time in the Shuayb Formation.

Paleobiogeography of the fauna described is based on distribution of the following genera: *Arca* (*Eonavicula*) from Middle Jurassic to Recent of Western Europe; *Inoceramus* from Lower Jurassic (Lias) to Upper Cretaceous, Cosmpolitan; *Mytiloides* from Lower Jurassic to Upper Cretaceous, Cosmopolitan; *Rutitrigonia* from Upper Jurassic (Tithonian) to Upper Cretaceous, Cosmopolitan; *Granocardium* (*Criocardium*?) from Upper Cretaceous of North America and Europe; *Panopea* from ?Triassic to Upper Cretaceous, Recent of Europe, North America, South America; ?*Pholadomya* from Upper Triassic to Recent, Cosmopolitan.

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