MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA.

Palæontologia Indica,

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF THE GOVERNMENT OF INDIA.

New Series.

Vol. XXII, Memoir No. 2.

PLATES I TO VIII.

FOSSIL MOLLUSCA FROM SOUTHERN PERSIA (IRAN) AND BAHREIN ISLAND.

By

L. R. COX, M.A., F.G.S.

CALCUTTA: Sold at the Central Book Depôt, 8, Hastings Street, and at the Office of the Geological Survey of India, 27, Chowringhee Road.

DELHI: Sold at the Office of the Manager of Publications.

1936.

List of Agents from whom Government of India Publications are available.

ENGLAND.

THE HIGH COMMISSIONER FOR INDIA, INDIA HOUSE, ALDWYCH, LONDON, W. C. 2.

PALESTINE.

Steimatzky, Jerusalem.

INDIA.

(*a*) PROVINCIAL GOVERNMENT BOOK DEPOTS.

MADRAS :- -Superintendent, Government Press, Mount Road, Madras.

BOMBAY.—Superintendent, Government Printing and Stationery, Queen's Road, Bombay.

SIND :—Manager, Sind Governmen t, Book Depot, Karachi (Sadar).

UNITED PROVINCES OF AGRA AND OUDH :—Superintendent of Government Press, United Provinces of Agra and Oudh, Allahabad.

PUNJAB :—Superintendent, Government Printing, Punjab, Lahore.

BURMA :—Superintendent, Government Printing, Burma, Rangoon.

CENTRAL PROVINCES AND BERAR :—Superintendent, Government Printing, Central Provinces, Nagpur.

ASSAM :—Superintendent, Assam Secretariat Press, Shillong.

BIHAR AND ORISSA :—Superintendent, Government Printing, Bihar and Orissa, P. O. Gulzarbagh, Patna.

NORTH-WEST FRONTIER PROVINCE :—Manager, Government Printing and Stationery, Peshawar.

(*b*) PRIVATE BOOK-SELLERS.

Aero Stores, Karachi City.*
Albert Library, Dacca.
Banerjee & Bros., Ranchi, Messrs. G.
Banthiya & Co., Ltd., Station Road, Ajmer.
Bengal Flying Club, Dum Dum Cantt.*
Bhawnani & Sons, New Delhi.
Book Company, Calcutta.
Booklover's Resort, Taikad, Trivandrum, South India.
Burma Book Club, Ltd., Rangoon.
Butterworth & Co. (India), Ltd., Calcutta.
Calcutta Book Agency, 16-1, Shama Charan Dey Street, Calcutta.
Chatterjee & Co., 3, Bacharam Chatterjee Lane, Calcutta.
Chukerverty, Chatterjee & Co., Ltd., 13, College Square, Calcutta.
City Book Co., Madras.
City Book House, Meston Road, Cawnpore.
Commercial Book Co., Lahore.
Das Gupta & Co., 54/3, College Street, Calcutta.
Deccan Bookstall, Poona 4.
Delhi and U. P. Flying Club, Ltd., Delhi.*
English Book Depot, Ferozepore.
English Book Depot, Taj Road, Agra, and Saddar Bazar, Jhansi.
English Book Depot, Bank Road, Ambala Cantt. and Kasauli.
English Bookstall, Karachi.
Fakir Chand Marwah, Peshawar Cantonment.
Fono Book Agency, Simla.
Gaya Prasad & Sons, Agra.
Grantha Mandir, Cuttack.
Higginbothams, Madras.
Hindu Library, 137-F, Balaram De Street, Calcutta.
Hyderabad Book Depot, Chaderghat, Hyderabad (Deccan).
Imperial Book Depot and Press, near Jama Masjid, (Machhliwalan), Delhi.
Indian Army Book Depot, Dayalbagh, Agra.
Indian Army Book Depot, Jullundur City and Daryaganj, Delhi.
Indian Book Shop, Benares City.
Indian School Supply Depot, Central Avenue, South, P. O. Dharamtala, Calcutta.
Insurance Publicity Co., Ltd., Lahore.
International Book Service, Poona 4.
Jaina & Bros., Mori Gate, Delhi and Connaught Place, New Delhi, Messrs. J. M.
James Murray & Co., 12, Govt. Place, Calcutta (for Meteorological publications only).
Kali Charan & Co., Municipal Market, Calcutta.
Kamala Book Depot, 15, College Square, Calcutta.
Kamala Book Stores, Bankipore, Patna.
Karnataka Publishing House, Bangalore City.
Keale & Co., Karachi.
Krishnaswami & Co., Teppakulam P. O., Trichinopoly Fort, Messrs. S.
Lahiri & Co., Calcutta, Messrs. S. K.
Law Printing House, 11, Mount Road, Madras.
Law Publishing Co., Mylapore, Madras.
Lawrence and Mayo, Ltd., Bombay (for Meteorological publications only).
Local Self-Govt. Institute, Bombay.
London Book Co. (India), Arbab Road, Peshawar, Murree, Nowshera and Rawalpindi.
London Book Depot, B. I. Bazaar, Bareilly, U. P.
Malhotra & Co., Post Box No. 94, Lahore, Messrs. U. P.
Modern Book Depot, Bazar Road, Sialkot Cantonment.
Mohanlal Dossabhai Shah, Rajkot.
Motilal Banarsi Das, Oriental Book Depot, Saidmitha Street, Lahore.
Nandkishore & Bros., Chowk, Benares City.
Nateson & Co., Publishers, George Town, Madras, Messrs. G. A.
New Book Co., "Kitab Mahal," 192, Hornby Road, Bombay.
Newman & Co., Ltd., Calcutta, Messrs. W.
North India Christian Tract and Book Society, 18, Clive Road, Allahabad.
Oriental Book Supplying Agency, 15, Shukrawar, Poona City.
Oxford Book and Stationery Company, Delhi, Lahore, Simla, Meerut and Calcutta.
Parikh & Co., Baroda, Messrs. B.
Pioneer Book Supply Co., 20, Shib Narayan Das Lane, Calcutta and 219, Cloth Market, Delhi.
Popular Book Depot, Grant Road, Bombay.
Punjab Religious Book Society, Lahore.
Raghunath Prasad & Sons, Patna City.
Ram Krishna Bros., Opposite Bishrambag, Poona City.
Ram Narain Lal, Katra, Allahabad.
Rama Krishna & Sons, Book-sellers, Anarkali, Lahore.
Ramesh Book Depot, Stationery Mart, Kashmere Gate, Delhi.
Ray & Sons, 43, K. & L. Edwardes Road, Rawalpindi, Murree and Peshawar, Messrs. J.
Ray Chowdhury & Co., 119, Ashutosh Mukherjee Road, Bhawanipur, Calcutta.
Rochouse & Sons, Madras.
Roy Chowdhury & Co., 11, College Square, Calcutta, Messrs. N. M.
Sampson William & Co., 127-B, The Mall, Cawnpore.
Sarcar & Sons, 15, College Square, Calcutta, Messrs. M. C.
Sarkar & Co., Ltd., 18, Shama Charan Dey Street and 8/2, Hastings Street, Calcutta, Messrs. P. C.
Scientific Publishing Co., 9, Taltola Lane, Calcutta.
Seshachalam & Co., Masulipatam, Messrs. M.
Shivji & Co., P. O. Chauliaganj, Cuttack.
Shri Shankar Karnataka Pustaka Bhandara, Malamuddi, Dharwar.
S. P. Bookstall, 21, Budhwar, Poona.
Standard Book Depot, Lahore, Dalhousie and Delhi.
Standard Bookstall, Karachi.
Standard Bookstall, Quetta.
Standard Law Book Society, 5, Hastings Street, Calcutta.
Standard Literature Company, Ltd., Calcutta.
Students' Popular Depot, Kachari Road, Lahore.
Surat and District Trading Society, Surat.
Taraporevala Sons & Co., Bombay, Messrs. D. B.
Thacker & Co., Ltd., Bombay.
Thacker, Spink & Co., Ltd., Calcutta and Simla.
Tripathi & Co., Book-sellers, Princess Street, Kalbadevi Road, Bombay, Messrs. N. M.
Union Stores, Indore City.
University Book Agency, Kachari Road, Lahore.
Upper India Publishing House, Ltd., Literature Palace, Ammuddaula Park, Lucknow.
Varadachary & Co., Madras, Messrs. P.
Venkatasubban, A., Law Book-seller, Vellore.
Wheeler & Co., Allahabad, Calcutta and Bombay, Messrs. A. H.
Young Man & Co., Ajmer and Egerton Road, Delhi.

* Agents for publications on aviation only.

Geological Survey of India.
Central Library.
Acc. No. PER. 14,327
Date 15.6.76

CONTENTS.

	Page.
Introduction	1
Stratigraphical Notes and Lists of Species—	2
(*a*) Jurassic	2
(*b*) Cretaceous	4
(*c*) Tertiary	6
Eocene	7
Oligocene	7
Miocene	8
Pliocene	10
Description of the Species	12
I. Fossils of Jurassic Age—	12
Pseudomelania cf. *procera* (Eudes-Desl.)	12
Modiolus (*Pharomytilus*) *plicatus*, J. Sow.	13
Trigonia signata, Agassiz	14
Trigonia sp.	15
Ostrea (*Catinula*) *sandalina*, Goldfuss	15
Ostrea (*Lopha*) cf. *gregarea*, J. Sow.	16
Chlamys sp.	17
Chlamys (*Radulopecten*) *tipperi*, sp. nov.	18
Variamussium pumilum (Lamarck)	19
Ctenostreon sp.	20
Pleuromya unioides (Roemer)	21
Ceratomya concentrica (J. de C. Sow.)	21
II. Fossils of Cretaceous Age—	22
Nerinea pilgrimi, sp. nov.	22
Nerinea sp.	23
Trochactaeon cf. *giganteus* (J. de C. Sow.)	24
Exogyra conica (J. Sow.)	25
Exogyra flabellata, Goldfuss	25
Durania persica, sp. nov.	26
III. Fossils of Eocene Age—	28
Terebellum carcassense, Leymerie	28
Mytilus cleopatrae, Oppenheim	28
Euphenax jamaicensis (Trechmann)	29
Ostrea turkestanensis, Romanovski	30
Spondylus radula, Lamarck	31
Lucina metableta, Cossmann	32
Lucina (*Loripinus*) *pharaonis*, Bellardi	32
Chama calcarata, Lamarck	33
Corbula (*Bicorbula*) *subexarata*, d'Arch. & Haime	33
IV. Fossils of Oligocene Age—	34
Mytilus persicus, sp. nov.	34
Lithophaga cordata (Lamarck)	35
Ostrea khamirensis, sp. nov.	35
Pecten (*Amussiopecten*) cf. *labadyei* (d'Arch. & Haime)	36
Tellina pilgrimi, sp. nov.	37
V. Fossils of Neogene Age—	38
Turritella angulata, J. de C. Sow.	38
Turritella harrisoni, sp. nov.	39
Nassarius persicus, sp. nov.	40
Rapana mekranica, sp. nov.	40
Clavatula tipperi, sp. nov.	41
Conus (*Dendroconus*) *loroisii*, Kiener	42
Navicula cf. *avellana* (Lamarck)	43
Anadara cf. *antiquata* (Linné)	43
Cucullaea farsensis, sp. nov.	44
Lithophaga lithophaga (Linné)	45
Anomia sp.	46
Ostrea latimarginata, Vredenburg	46
Ostrea digitata, Eichwald	47
Ostrea gryphoides (Schlotheim)	48
Ostrea (*Lopha*) *virleti*, Deshayes	49

PAGE.

V. Fossils of Neogene Age—*contd.*

Pecten pascoei, sp. nov. 50
Pecten nearchi, Vredenburg 52
Pecten pilgrimi, sp. nov. 52
Pecten (*Oopecten*) *gigas* (Schlotheim) 53
Chlamys senatoria (Gmelin) 54
Chlamys pusio (Linné) 55
Spondylus crassicosta, Lamarck 56
Lucina dalikiensis, sp. nov. 57
Apolymetis papyracea (Gmelin) 57
Meretrix persica, sp. nov. 58
Meretrix (*Pitar*) *dalikiensis*, sp. nov. 59
Dosinia sp. 59
Clausinella persica, sp. nov. 60
Antigona granosa (J. de C. Sow.) 61
Clementia papyracea (Gray) 62
Paphia persica, sp. nov. 62
Cardium sp. 63
Cardium sp. 64
Cardium (*Discors*) cf. *triforme*, J. de C. Sow. 64
Mactrinula tryphera, Melvill 66
Lutraria cf. *philippinarum*, Reeve 65
Saxicava sp. 66

Alphabetical index of species 68
Explanation of Plates . . . . . following 70

FOSSIL MOLLUSCA FROM SOUTHERN PERSIA (IRAN) AND BAHREIN ISLAND.

By

L. R. COX, M.A., F.G.S.

(With Plates I to VIII).

INTRODUCTION.

THIS Memoir deals primarily with molluscan fossils from southern Persia and Bahrein Island collected at various times by officers of the Geological Survey of India. The largest of the collections described is that obtained by Dr. G. E. Pilgrim in 1904-5 on a reconnaissance of much of the coastal region of Persia, the islands of the Persian Gulf, the Oman coast of Arabia, southern Iraq, and a part of the Bakhtiari country. The stratigraphical results of this expedition were embodied in a memoir published in 1908[1], in which reference is made to many of the fossils now described. A smaller collection, interesting as including fossils of Jurassic age, is that made by Mr. G. H. Tipper in 1912-13 in a strip of eastern Persia stretching from Chahbar on the coast in a north-westerly direction to beyond Kerman. An account of the geology of this region, with lists of a few of the fossils, was published by Mr. Tipper in 1921[2]. A further collection, from the Bandar Abbas district and several parts of the interior, is that obtained by Dr. Pilgrim in 1917-18 on a reconnaissance described in 1925[3]. The material also includes a few fossils from Bahrein Island collected by Sir E. H. Pascoe in 1918-19. The fossils collected on Dr. Pilgrim's first expedition are registered in the K9 and K10 series of the Geological Survey of India collections and those obtained on his second expedition in the K21 series, while Mr. Tipper's are registered in series K16 and Sir E. H. Pascoe's in K19; these numbers are cited in the descriptions of the fossils and will indicate to which collection they belong. Echinoidea from these collections have already been described by Mr. E. L. G. Clegg[4], while the Cretaceous Rudists from Mr. Tipper's collection have been dealt with by Dr. O. Kühn[5].

During the past few years much detailed work has been done in the region from which these fossils came by members of the geological staff of the Anglo-Persian Oil Company, Limited. From the large collections of fossils obtained

[1] 'The Geology of the Persian Gulf and the adjoining portions of Persia and Arabia.' *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, (1908).

[2] 'The Geology and Mineral Resources of Eastern Persia.' *Rec. Geol. Surv. Ind.*, LIII, pp. 51-80, (1921).

[3] 'The Geology of Parts of the Persian Provinces of Fars, Kirman and Laristan.' *Mem. Geol. Surv. Ind.*, XLVIII, Pt. 2, (1925).

[4] *Pal. Ind.*, N. S., Vol. XXII, Mem. No. 1, (1933).

[5] *Rec. Geol. Surv. Ind.*, LXVI, pp. 151-79; Pls. I, II, (1932).

in the course of this work Dr. J. A. Douglas has described a number of the commoner Upper Tertiary fossils of the Persian Gulf region[1] and also an interesting series of Triassic fossils from the Kerman district of eastern Persia[2], while Dr. O. Kühn has described the Lower Miocene corals of the Isfahan-Saidabad basin[3] and I have given an account of the remarkable Upper Cretaceous Rudist *Trechmannella* (formerly *Polyptychus*)[4].

Except for a few Jurassic forms referred to below, the present memoir has been restricted to species represented in the collections first mentioned. In some cases, however, supplementary information concerning these species has been derived from the more recent collections, and it has been thought desirable to figure a few specimens additional to those from the Geological Survey of India material. Mr. Tipper's material, considered by itself, proved insufficient to establish the age (shown below to be Middle Jurassic) of an interesting fauna from eastern Persia which he was the first to discover. I have therefore included a description of all the material now available from the same horizon, including a number of specimens collected by Messrs. R. C. Jennings and K. Washington Gray, of the Anglo-Persian Oil Company, Limited. I am greatly indebted to Dr. G. M. Lees, the Company's Chief Geologist, for permission to describe these specimens, as well as for helpful information concerning the stratigraphy of the region.

This Memoir has been prepared in my spare time during the years 1933-34 and not as part of my official work at the British Museum (Natural History).

Stratigraphical Notes and Lists of Species.

An account of the stratigraphy of southern Persia, incorporating the results of recent work, was published in 1929 by the late Professor H. de Böckh, Dr. G. M. Lees and Mr. F. D. S. Richardson[5]. There are no mollusca from the Palaeozoic or Trias in the collections studied by me, but the Jurassic, Cretaceous, Eocene, Oligocene, Miocene, and Pliocene are all represented. The following notes indicate the stratigraphical significance of the fossils described.

(*a*) Jurassic.

Marine Jurassic rocks have been recorded by several travellers (C. Grewingk, A. Rodler, C. Bogdanovich, H. Pohlig, A. F. Stahl, J. de Morgan) in northern Persia and their fossils have been described by C. Bogdanovich[6], K. A. Weithofer[7],

[1] Contributions to Persian Palaeontology, I & II, (1927); III, (1928), (published by the Anglo-Persian Oil Company, Limited).

[2] *Quart. Journ. Geol. Soc.*, LXXXV, pp. 624-49; Pls. XLII-XLVI, (1929).

[3] *Palaeontographica*, LXXIX (A), pp. 143-218; Pls. XVII-XIX, (1933).

[4] *Proc. Malac. Soc. London*, XXI, pp. 42-66; Pls. IV-VIII, (1934).

[5] 'Contribution to the Stratigraphy and Tectonics of the Iranian Ranges.' The Structure of Asia (ed. J. W. Gregory), pp. 58-176, (London, Methuen).

[6] Notes sur la géologie de l'Asie centrale. I. Description de quelques dépôts sédimentaires de la contrée transcaspienne et d'une partie de la Perse septentrionale. St. Petersburg (1889). Reprinted in *Verh. russ.-kais. min. Ges.*, ser. 2, XXVI, (1890).

[7] 'Über Jura und Kreide aus dem nordwestlichen Persien.' *Sitzber. Akad. Wiss. Wien*, XCVIII, Pt. 1, pp. 756-773; Pls. I, II, (1890).

G. von dem Borne[1], H. Douvillé[2] and E. Fischer[3]. Mr. G. H. Tipper, in 1912-13, was the first to discover rocks of this age in southern Persia, and the fossils collected by him, which come from the district north of Kerman, are described for the first time in the present Memoir. Other districts from which Jurassic fossils are recorded by de Böckh, Lees and Richardson[4] are near Yezd (Lias), between Kuh-i-Gakum and Fergun, south-west of Kermanshah, north-east of Paitaq, the Aoroman Mountains, and south of Isfahan.

Two horizons with marine Jurassic fossils appear to be represented in Mr. Tipper's collection. The lower, possibly, of these, referred by him to[5] the Upper Lias, has proved to belong to the Bajocian and to contain an ammonite assemblage (to be described by Dr. L. F. Spath) identical with that found at Cape S. Vigilio, in northern Italy[6]. The following are the other mollusca obtained from this horizon (their locality is recorded as ' low hills, 8½ miles S. S. W. of Ravar ') :—

Pseudomelania cf. *procera* (Eudes-Deslongchamps) (p. **12**, Pl. I, fig. 23),
Trigonia sp. (p. **15**, Pl. I, fig. 17),
Modiolus (*Pharomytilus*) *plicatus*, J. Sowerby (p. **13**, Pl. I, fig. 21),
Lima sp. (fragment, not further mentioned),
Pleuromya unioides (Roemer) (p. **21**, Pl. I, fig. 22).

More widespread, apparently, is a second horizon, which has yielded no ammonites, but is characterised by the abundance of a peculiar and easily recognised Pecten, now described as *Chlamys* (*Radulopecten*) *tipperi*, sp. nov. This horizon, recorded as Cretaceous in Mr. Tipper's paper[7] on account of the superficial resemblance of this species to *Neithea quinquecostata* (J. Sowerby), was discovered by him in the ' low hills east of Ravar ' and ' 7 miles north of Rayin, where the Jupar range disappears below the Siwaliks '. A loose block containing *C. tipperi* was also picked up on the ' road to Rehun '. A series of fossils obviously from the same horizon and consisting mainly of *C. tipperi* was also collected by the Rev. H. E. J. Biggs while engaged on missionary work, and presented to the British Museum (Natural History) in 1929. Their locality is recorded as ' east of Kerman, between that town and Gishin '.

Finally, the same beds were discovered by Messrs. R. C. Jennings and K. Washington Gray, of the Anglo-Persian Oil Company, Limited, on their reconnaissance of the same region, and abundant specimens of *C. tipperi* were collected from 'hillocks ¼ mile east of Hauz-i-Panj Caravanseroi ' (south of Ravar). A brief reference to these beds (' Group I ') was made by Dr. J. A. Douglas[8] in his account of the Triassic fossils from Naiband collected on the same expedition,

[1] Der Jura am Ostufer des Urmiasees. Halle, (1891).
[2] ' Mollusques fossiles.' In J. de Morgan, Mission scientifique en Perse, III, Études géologiques, Pt. 4, pp. 191-380; Pls. XXV-L, (1904).
[3] ' Jura- und Kreideversteinerungen aus Persien.' *Beitr. Geol. Pal. Österr.-Ungarns*, XXVII, pp. 207-273; Pls. XIX-XXI, (1915).
[4] *Loc. cit.*, pp. 85, 119, 128, 138, 214, (1929).
[5] *Rec. Geol. Surv. Ind.*, LIII, pp. 57, 59, (1921).
[6] *See* Vacek, M. " Über die Fauna der Oolithe von Cap S. Vigilio." *Abh. k. k. geol. Reichsanst.*, XII, Pt. 3, (1886).
[7] *Loc. cit.*, p. 61, (1921).
[8] *Quart. Journ. Geol. Soc.*, LXXXV, p. 626, (1929).

and the suggestion was made that they are Upper Jurassic in age. A list of fossils now available from this horizon is as follows :—

Ostrea sandalina, Goldfuss (p. 15, Pl. I, figs. 8-13). East of Ravar.

Ostrea (*Lopha*) cf. *gregarea*, J. Sowerby (p. 16, Pl. I, figs. 14-16). East of Ravar ; 7 miles North of Rayin.

Chlamys sp. (p. 17, Pl. I, figs. 6, 7). Hauz-i-Panj.

Chlamys (*Radulopecten*) *tipperi*, sp. nov. (p. 18, Pl. I, figs. 1-5). East of Ravar ; 7 miles North of Rayin ; East of Kerman ; Hauz-i-Panj.

The type-horizon of *O. sandalina* is Bajocian, but the species has been recorded from higher beds. Oysters of the *O. gregarea* type range from the Bajocian upwards, the type-horizon of the species being the Argovian. It seems probable that the *C. tipperi* horizon will prove to be Bajocian or Bathonian and perhaps not very remote from that of the beds with Bajocian ammonites already referred to.

Messrs. Jennings and Washington Gray also met with Middle Jurassic fossils at localities ' about 4 miles south-west of Gujur ' and ' south-west of Hauz-i-Khan ' (south of Naiband). From the former locality was collected a specimen of *Ceratomya concentrica* (J. de C. Sowerby) (p. 21, Pl. I, fig. 19) and, from the latter, one of *Trigonia signata*, Agassiz (p. 14, Pl. I, fig. 20). Both of these species range from the Bajocian to the Bathonian.

A few Jurassic fossils were collected by Mr. Tipper from a locality ' five miles below Badamu '. They include the following mollusca :—

Ostrea sp. indet. (not further mentioned),
Chlamys sp. indet.,
Variamussium pumilum (Lamarck) (p. 19, Pl. I, fig. 18),
Ctenostreon sp. indet. (p. 20).

There are also a few broken belemnites and an indeterminate brachiopod which Dr. H. M. Muir-Wood identifies as ' *Zeilleria* ' sp. and informs me might come from the Lias or Bajocian. The species *Variamussium pumilum* also indicates the same approximate horizon. The *Chlamys* may be a fragment of *C. tipperi*, but is too incomplete for definite determination.

(*b*) Cretaceous.

All horizons of the Cretaceous appear to be represented in southern Persia, and Rudist limestones of Upper Cretaceous age are widely distributed. The Rudists collected by Mr. Tipper have already been described by Dr. O. Kühn,[1] but the collections of the Geological Survey of India examined by me include several more specimens of this group as well as a few other lamellibranchs and some gastropods. These fossils come partly from Khamir, which lies on the coast west of Bandar Abbas, and partly from the Kerman district.

[1] *Rec. Geol. Surv. Ind.*, LXVI, pp. 151-79, Pls. I, II, (1932).

1. KHAMIR.—The Cretaceous sequence at this locality has been described by Pilgrim[1], by R. K. Richardson[2], and by de Böckh, Lees and Richardson[3]. The section given by the latter authors, based on the one in R. K. Richardson's paper, is as follows :—

Eocene conglomerate.
Globigerina marls.
Rudist limestone.
Green and reddish marls.
Sandy limestone with *Knemiceras*, *Holectypus planatus*, Roemer, etc.
Marls with *Orbitolina*.
Limestone with *Caprinula* and *Caprotina*.
Hormuz salt plug.

Five species, listed as ' cf. *Caprinella doublieri*, d'Orb., cf. *Durania laevis*, Douv., cf. *Durania mortoni*, Douv., cf. *Saugavesia praesharpei*, Toucas, and cf. *Sauvagesia nicaisei*, Coquand ', are recorded from the Rudist limestone in Dr. Richardson's paper. All the species with which these provisional identifications have been made are Cenomanian forms, with the exception of the first, which is said to come from the Lower Cretaceous. It is probable, however, that the two Duranias are referable to the new species *D. persica*, mentioned below. *Holectypus planatus*, from the sandy limestone below the Rudist limestone, comes typically from the Washita formation (Upper Albian-Cenomanian) of Texas. The collection now studied includes three specimens of the well-known Cenomanian oyster *Exogyra flabellata*, Goldfuss (p. 25, Pl. III, figs. 4, 5), from the beds immediately below the Rudist limestone of Khamir. Hence the Rudist limestone itself appears to be Cenomanian or, at the latest, Turonian.

All the Rudists from this limestone in the Geological Survey of India material are referable to a new species of *Durania* (*D. persica*, sp. nov., p. 26, Pl. II, figs. 1-3), and this same form is represented by several specimens from Khamir in the Anglo-Persian Oil Company's collection of Rudists, which, through the kindness of Dr. G. M. Lees, has been sent to the British Museum (Natural History) for study[4]. The only other fossil from the Rudist limestone of Khamir in the material examined by me is a remarkable new species of *Nerinea*, now described (p. 22, Pl. III, figs. 1*a*, *b*) as *N. pilgrimi*, sp. nov.

2. KERMAN DISTRICT.—From the Hippurite limestone of Badamu[5], a village about 14 miles west of Kerman, is recorded (p. 24, Pl. IV, figs. 1*a*, *b*) a specimen of *Trochactaeon* cf. *giganteus* (J. de C. Sowerby). This specimen is probably of Senonian age. Several Rudists from this locality are described by Kühn[6] and referred to species whose ages range from Cenomanian to Maestrichtian.

Specimens of the well-known species *Exogyra conica* (J. Sowerby) (p. 25, Pl. III, fig. 3) are recorded from a locality ' 3 miles north of Baghin ', about

[1] *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, p. 103, (1908) ; *ibid.*, XLVIII, Pt. 2, p. 36 ; Pl. XV, (1925).

[2] " Die Geologie und die Salzdome im südwestlichen Teile des persischen Golfes." *Verh. nat. med. Ver. Heidelberg*, N. S., XV, pp. 391-2 ; Pl. XIII, (1927).

[3] *Loc. cit.*, p. 93 ; Pl. VIII, (1929).

[4] The specimens listed in R. K. Richardson's paper and referred to above are not included in this material.

[5] Tipper, G. H., *Rec. Geol. Surv. Ind.*, LIII, p. 58, (1921).

[6] *Rec. Geol. Surv. Ind.*, LXVI, pp. 167-68, (1932).

18 miles west of Kerman. A section of the rocks at this locality is given by Pilgrim[1], who states that white grits, referable to the Jurassic plant-bearing series, are directly overlain by the Cretaceous limestone, from the base of which these fossils came; their age is probably Cenomanian.

The Hippurite limestone of Sink, about 14 miles north-east ot Kerman, is referred to by Tipper[2]. Several specimens of an indeterminate *Nerinea* from this locality are described in the present Memoir (p. 23, Pl. III, fig. 2).

(*c*) Tertiary.

The Tertiary stratigraphy of the Gulf region of southern Persia is complicated by considerable lateral variation in facies. The most recent account, which is illustrated by a number of sections showing this variation, is that given by de Böckh, Lees and Richardson[3].

In the northern part of the Gulf region marls and marly limestones of Eocene age, which in the Bakhtiari country pass laterally into nummulitic limestones, are overlain by a limestone of Oligocene and Burdigalian age, the Asmari limestone. About the middle of the Asmari limestone are a few thin beds of gypsum (anhydrite) which possibly represent the top of the Oligocene, while at the base of the limestone, that it, within the Oligocene, is a strong 20 feet-thick anhydrite bed. To the north-east the Asmari limestone becomes marly and finally passes into a series of marls and silts. The Asmari limestone is overlain by a formation termed by Pilgrim the Fars series, consisting of gypsiferous deposits (the Lower Fars) at the base, followed by a series of fossiliferous limestones, marls and calcareous sandstones (the Middle Fars) and then by sandstones, clays and shales (the Upper Fars). The Upper Fars passes up into a series of fluviatile sandstones and conglomerates of Pliocene age known as the Bakhtiari beds.

At the southern end of the Gulf the succession is considerably different. Marls and marly limestones of the Eocene are overlain by a well-developed limestone of Oligocene age (the Khamir limestone). Further inland, the Eocene consists predominantly of massive limestone, with a gypsiferous series at its base, and is overlain by a thin shallow-water development of red sandstones, conglomerates and limestones containing Oligocene nummulites. Overlying the Khamir limestone is a gypsiferous series resembling the Lower Fars of the more northerly region but actually older and probably representing the middle anhydrite zone of the true Asmari limestone. The gypsiferous series of the southerly region is overlain by a limestone series similar in some respects to the upper part of the Asmari limestone, followed by a series of red sandstones and marls, marly limestones and gypsum, and then by a series of limestones with a fauna similar to that of the Middle Fars. The limestones are in turn overlain by a thick series of clays and silts becoming more arenaceous towards the top (the *Pecten vasseli* beds); inland these beds become more conglomeratic and finally pass laterally into non-marine sandstones and massive conglomerates.

[1] *Mem. Geol. Surv. Ind.*, XLVIII, Pt. 2, p. 54, (1925).

[2] *Loc. cit.*, pp. 58, 60, (1921).

[3] The Structure of Asia (ed. J. W. Gregory), pp. 93-118; Pls. X, XI, XIV, (1929). Dr. Lees has very kindly revised the following two paragraphs of the present Memoir.

EOCENE.—The collections examined by me include no determinate Eocene mollusca from Persia, but there are a number of specimens from the Middle Eocene limestone of Bahrein Island[1]. With the exception of the specimens of *Ostrea* and *Euphenax* all these fossils occur as internal casts, and several species represented in the material have proved indeterminate. The following is a list of determinate forms, which are described in the present Memoir :—

Terebellum carcassense, Leymerie (p. 28, Pl. III, figs. 7-9),
Mytilus cleopatrae, Oppenheim (p. 28, Pl. III, fig. 11),
Ostrea turkestanensis, Romanovski (p. 30, Pl. IV, figs. 6-8),
Spondylus radula, Lamarck (p. 31, Pl. III, fig. 10),
Euphenax jamaicensis (Trechmann) (p. 29, Pl. III, figs. 12, 13),
Lucina metableta, Cossmann (p. 32, Pl. IV, fig. 3),
Lucina (*Loripinus*) *pharaonis*, Bellardi (p. 32, Pl. IV, fig. 2),
Chama calcarata, Lamarck (p. 33, Pl. IV, figs. 9, 10),
Corbula (*Bicorbula*) *subexarata*, d'Archiac & Haime (p. 33, Pl. IV, figs. 4, 5).

The majority of these forms occur in the Middle Eocene of north-western India, Somaliland, and Egypt, but the presence of *O. turkestanensis*, which has not yet been found in those regions, also indicates faunal affinity with Central Asia. The *Terebellum*, *Spondylus*, and *Chama* extend into the European Eocene, while the *Euphenax*, although as yet unrecorded from Europe, occurs as far afield as Jamaica.

OLIGOCENE.—Four lamellibranch species of undoubted Oligocene age and one species probably referable to that stage are described in the present Memoir.

The Oligocene limestone of Khamir—a locality already mentioned (page 4) in connection with the Cretaceous fossils described—has been referred to particularly by Pilgrim[2] and by R. K. Richardson[3]. There are about 700 feet of interbedded limestones and sandstones containing *Nummulites intermedius*, d'Arch., both near the top and 500 feet lower down. A list of species from the Khamir limestone, determined by Dr. J. A. Douglas, is given in R. K. Richardson's paper and includes *Nummulites fichteli*, Michelotti, and *N. garansensis*, Leymerie, as well as *N. intermedius*. The lamellibranchs described in the present Memoir include three species from near the top of this formation :—

Lithophaga cordata (Lamarck) (p. 35, Pl. IV, fig. 13),
Ostrea khamirensis, sp. nov. (p. 35, Pl. V, figs. 2-4),
Pecten (*Amussiopecten*) cf. *labadyei*, d'Archiac & Haime (p. 36, Pl. V, fig. 1).

Specimens of *O. khamirensis* were also collected from 600 feet below the top of this formation.

From the Oligocene of Kuh-i-Namak, about 24 miles north of Bandar Abbas[4], is described a new species of *Tellina*, *T. pilgrimi* (p. 37, Pl. IV, figs. 11, 12). The matrix is a soft yellowish limestone containing small nummulites.

[1] Pilgrim, G. E., *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, pp. 21, 113-21, (1908).
[2] *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, pp. 22, 102-3, (1908) ; *ibid.*, XLVIII, Pt. 2, pp. 78, 80, 106-8, (1925).
[3] *Verh. nat. med. Ver. Heidelberg*, N. S., XV, p. 393, (1926).
[4] Pilgrim, G. E., *Mem. Geol. Surv. Ind.*, XLVIII, Pt. 2, pp. 79, 99, (1925).

From near Godar bridge, on the Karun river in the Bakhtiari country[1], comes the large mussel described as *Mytilus persicus*, sp. nov. (p. 34, Pl. V, fig. 5). This specimen is referred to in Pilgrim's memoir, where it is stated that it occurred associated with nummulites, but these, unfortunately, are not included in the material now studied. It is probable that this fossil, which occurs in a white limestone, is of Oligocene age.

MIOCENE.—The material now described includes a small specimen of the well-known Lower Miocene species *Pecten* (*Oopecten*) *gigas* (Schlotheim) (p. 53, Pl. VI, fig. 5), collected by Dr. Pilgrim at Shalil, on the Karun river in the Bakhtiari country[2]. This specimen is stated to come from a limestone underlying the Lower Fars gypsum beds and hence is presumably from the Asmari limestone. It is very similar to a number of specimens of the same species collected by Dr. G. M. Lees from a Burdigalian limestone at Murad Bulaq, 10 miles east of Hamadan, in central Persia. According to Dr. J. A. Douglas[3], another Pecten (*P.* (*Amussiopecten*) *burdigalensis*, Lamarck) also occurs in the Asmari limestone.

Dr. Pilgrim's material includes a good many specimens from the Fars beds of the district north-east of Bushire, where the formation has its typical development. The localities (Chinar Rahdar, Kotel Kamarij, Khaneh Zinian, Daliki bridge, etc.) are referred to in his 1908 memoir.

The basal gypsum beds, or Lower Fars, contain few fossils, the four species from this horizon described in the present Memoir being :—

Anomia sp. (p. 46),

Ostrea latimarginata, Vredenburg (p. 46),

Clausinella persica, sp. nov. (p. 60, Pl. VII, figs. 12, 13),

Cardium sp. (p. 64, Pl. VII, fig. 17).

In India, the species *O. latimarginata* is confined to the Upper Gaj beds, of Burdigalian age, while in Burma also it is confined to the Burdigalian. Even as far afield as Portuguese East Africa it appears to occur at about the same horizon. Thus, although it is impossible to rely much on the evidence of a single species of oyster, it seems probable that the Lower Fars beds should be included in the Burdigalian. They must, however, belong to the very top of that stage, as the underlying Asmari limestone is also partly of Burdigalian age.

The Middle Fars marls and limestones are often rich in fossils, but except for the oysters, Pectens, and allied families these are usually mere casts often crushed and distorted by pressure. Some of the lamellibranch species, such as *Clementia papyracea* and *Antigona granosa*, already known fossil from other regions bordering on the Indian Ocean, can be identified with certainty, while a few forms are sufficiently distinct from any known previously to be describable as new species. Some of the lamellibranch species, however, can only be given qualified specific determinations, while the remainder (only a few of which have

[1] Pilgrim, G. E., *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, p. 85; Pl. XI, (1908).
[2] Pilgrim, G. E., *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, pp. 23, 84, (1908).
[3] Contributions to Persian Palaeontology, III, p. 17, (1928).

appeared to be worth describing) are only generically determinate. The gastropod casts offer even less satisfactory material and none have seemed worth describing.

Since the species definitely determined are all forms known to have had an extended geological range, it is impossible to draw any very accurate conclusions as to the age of the Middle Fars from the molluscan fossils, but from their stratigraphical position it appears certain that these beds must be referable to the Upper Miocene (Vindobonian). This stage of the Miocene is but little represented in the Indian Ocean region, for in East Africa, North-West India, and Burma only the Lower Miocene is known to be present. The beds in northern Ceylon whose fauna was described by Professor A. Morley Davies[1] may, however, be approximately contemporaneous with the Middle Fars, or perhaps slightly older.

The following is a list of species from the Middle Fars of the district north-east of Busheir described in the present Memoir :—

Navicula cf. *avellana* (Lamarck) (p. 43, Pl. V, fig. 7),
Anadara cf. *antiquata* (Linné) (p. 43, Pl. V, fig. 8),
Cucullaea farsensis, sp. nov. (p. 44, Pl. V, figs. 6*a*, *b*),
Lithophaga lithophaga (Linné) (p. 45, Pl. V, figs. 14-17),
Ostrea digitata, Eichwald (p. 47),
Ostrea (*Lopha*) *virleti*, Deshayes (p. 49, Pl. VII, fig. 2),
Chlamys pusio (Linné) (p. 55, Pl. VI, fig. 1),
Chlamys senatoria (Gmelin) (p. 54),
Lucina dalikiensis, sp. nov. (p. 57, Pl. V, figs. 9-13),
Meretrix persica, sp. nov. (p. 58, Pl. VII, figs. 9*a*, *b*),
Meretrix (*Pitar*) *dalikiensis*, sp. nov. (p. 59, Pl. VIII, fig. 2),
Dosinia sp. (p. 59, Pl. VII, figs. 3*a*, *b*),
Antigona granosa (J. de C. Sowerby) (p. 61, Pl. VII, figs. 4-8),
Paphia persica, sp. nov. (p. 62, Pl. VII, figs. 10, 11),
Clementia papyracea (Gray) (p. 62, Pl. VIII, fig. 8),
Cardium sp. (p. 63, Pl. VII, fig. 15),
Cardium (*Discors*) cf. *triforme*, J. de C. Sowerby (p. 64, Pl. VII, fig. 16),
Lutraria cf. *philippinarum*, Reeve (p. 65, Pl. VIII, fig. 1),
Saxicava sp. (p. 66, Pl. VII, fig. 14).

It will be seen that this fauna differs considerably from that of contemporaneous beds in the Mediterranean region, only forms such as *Lithophaga lithophaga*, *Ostrea digitata* and *O. virleti*, which originated in Lower Miocene times, being common to the two areas.

The material described also includes a number of specimens collected by Dr. Pilgrim from the district west of Bandar Abbas and referred to by him in 1925[2]. Further details of the section at Latidun, the chief locality represented, have since been published by de Böckh, Lees and Richardson[3]. According to Dr. Pilgrim's account, most of the fossils came from not far (100-200 feet) above

[1] *Quart. Journ. Geol. Soc.*, LXXIX, pp. 584-602; Pl. XXVIII, XXIX, (1923).
[2] *Mem. Geol. Surv. Ind.*, XLVIII, Pt. 2, pp. 89, 95.
[3] The Structure of Asia (ed. J. W. Gregory), Pl. X, (1929).

a gypsum horizon which he regarded as contemporaneous with the Lower Fars gypsum of the Busheir district. As already explained, however, it is now known that the main gypsiferous series in the Bandar Abbas district belongs to a lower horizon. It is thus probable that Dr. Pilgrim's fossils came from beds rather older than the Lower Fars of the typearea and equivalent to some part of the Asmari limestone. They comprise the following species :—

Anadara cf. *antiquata* (Linné),
Ostrea digitata, Eichwald (p. 47, Pl. VII, fig. 1),
Ostrea (*Lopha*) *virleti*, Deshayes,
Chlamys pusio (Linné)
Chlamys senatoria (Gmelin) (p. 54, Pl. V, fig. 18 ; Pl. VI, fig. 9),
Spondylus crassicosta, Lamarck (p. 56, Pl. VI, figs. 6-8),
Antigona granosa (J. de C. Sowerby),
Clementia papyracea (Gray) (p. 62, Pl. VIII, fig. 7).

These are species found in the typical Middle Fars[1], but are all known, from their occurrences in other regions, to have had an extended stratigraphical range.

From a higher limestone group in the same district (7 miles north-east of Latidun and Ab-i-Mar hills) were collected specimens of *Ostrea* (*Lopha*) *virleti*, Deshayes, and *Chlamys senatoria* (Gmelin). The horizon is probably equivalent to the Middle Fars.

Pliocene.—Several species from the *Pecten vasseli* beds of the southern part of the Gulf region are recorded in Dr. Pilgrim's first memoir[2], but unfortunately only a few of the specimens on which this list was based have been included in the material sent to me. The *P. vasseli* beds, which are confined to the coast and adjacent islands, are marine equivalents of the Upper Fars and Bakhtiari beds, the lateral transition from a freshwater to a marine facies being well shown in the district round Bandar Abbas[3]. *P. vasseli* itself is not represented in the material now described, but its distribution has been discussed by me[4] in several recent papers and it has been considered by me to be a typical Pliocene species.

The occurrence of this together with such species as *Chlamys* (*Aequipecten*) *lessepsii* (Fuchs) and *Ostrea tridacnaeformis*, Cox[5], point to the correlation of the *Pecten vasseli* beds with the Pliocene beds of the Mekran, Red Sea, and East African littorals.

In the present Memoir the following forms are described from the *P. vasseli* beds of Henjam Island [6]:—

Lithophaga lithophaga (Linné),
Apolymetis papyracea (Gmelin) (p. 57, Pl. VIII, fig. 3),

[1] *Spondylus crassicosta* was not collected by Dr. Pilgrim in the Fars of the type-area, but is present in the Anglo-Persian Oil Company's collections from that horizon.

[2] *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, pp. 41-51, (1908).

[3] De Böckh, Lees and Richardson, 'The Structure of Asia' (ed. J. W. Gregory), p. 115, (1929).

[4] Report on the Palaeontology of the Zanzibar Protectorate, p. 72, (1927).
"Notes on the Post-Miocene Ostreidae and Pectinidae of the Red Sea Region." *Proc. Malac. Soc. London*, XVIII, p. 187, (1929).
"Reports on Geological Collections from the Coastlands of Kenya Colony." *Mon. Geol. Dept. Hunterian Museum, Glasgow Univ.*, IV, p. 122, (1930).

[5] Represented in the Anglo-Persian Oil Company's collections from the *P. vasseli* beds near Bardistan, on the Persian Gulf, although not in Dr. Pilgrim's material.

[6] Pilgrim, G. E., *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, pp. 134-5, (1908).

Antigona sp. (cast, not further mentioned),
Cardium (*Trachycardium*) sp. (cast, not further mentioned).

From the same horizon in Qishm Island and also on the mainland between Khanu Sukh and Bostanah is described the species *Pecten pascoei*, sp. nov. (p. 50, Pl. VIII, figs. 9-11). This form is also represented in the Anglo-Persian Oil Company's collections from the Mekran beds near Ishtak. A specimen of *Mactrinula tryphera*, Melvill (p. 66, Pl. VIII, fig. 6), from Henjam Island probably comes from just below the *P. vasseli* horizon.

There are also a few specimens from Kharag Island, at the northern end of the Gulf; these include *Chlamys senatoria* (Gmelin), *Pecten pilgrimi*, sp. nov. (p. 50, Pl. VIII, figs. 4, 5), and some small plicated oysters. Dr. Pilgrim referred the beds from which these fossils were obtained to the *P. vasseli* beds, but that species has not been found in this island. De Böckh, Lees and Richardson[1] refer the marine beds here to the Pleistocene, and state that they overlie the Bakhtiari beds unconformably. It is possible that these marine beds may be equivalent to part of the Bakhtiari beds of the mainland, and it is thus uncertain whether they should be referred to the Pliocene or Pleistocene.

The molluscan fauna of the Neogene deposits of the Mekran coast has already been largely described by Vredenburg[2], who adopts Blanford's term 'Mekran Series'. This series is subdivided by him into the Talar stage, referred to the Pontian, and the Gwadar stage, referred to the Pliocene. In lithological characters the beds of the Mekran series differ completely from the contemporaneous beds of the Persian Gulf region, and they are now considered to be of the nature of Flysch deposits formed during the Iranian orogeny. Dr. Pilgrim[3] was of the opinion that the faunal differences between the two areas would prove to be considerable, and that the areas were separated, at least intermittently, by a land barrier situated on the site of the present Strait of Hormuz. Certain very characteristic Pectens and oysters (*P. vasseli*, Fuchs, *P. pascoei*, sp. nov., *Ostrea tridacnaeformis*, Cox)[4], however, are known to be common to the two areas, and there is no doubt that it is an Indian Ocean fauna that is found in the *P. vasseli* beds of the Gulf region. It is impossible to estimate to what extent the faunas of the two areas do differ until the fauna of the beds of the Gulf region has been more fully investigated. If, however, there are appreciable differences, it is probable that these are to be attributed to difference in facies rather than to geographical separation.

The beds of the Mekran series extend nearly as far west as to Bandar Abbas, and a few fossils collected from them in the Chahbar district by Mr. G. H. Tipper are included in the material examined by me. A provisional list of these forms, determined by Vredenburg, has already been published in Mr. Tipper's paper[5].

[1] The Structure of Asia (ed. J. W. Gregory), p. 118, (1929).
[2] *Mem. Geol. Surv. Ind.*, L, Pt. 1, (1925); *ibid.*, Pt. 2, (1928).
[3] *Mem. Geol. Surv. Ind.*, XLVIII, Pt. 2, p. 86, (1925).
[4] Not mentioned in Vredenburg's monograph on the Mekran fauna, but represented by a specimen collected by Drs. B. K. N. Wyllie and J. V. Harrison from the Gwadar stage of Zirkuh, 16 miles N. W. of Jask, now in the British Museum.
[5] *Rec. Geol. Surv. Ind.*, LIII, p. 66, (1921).

The following is a revised list of species, excluding several indeterminate forms :—

Turritella angulata, J. de C. Sowerby (p. 38, Pl. VIII, figs. 20-24),
Turritella harrisoni, sp. nov. (p. 39, Pl. VIII, figs. 25-29),
Nassarius persicus, sp. nov. (p. 40, Pl. VIII, figs. 19*a*, *b*),
Rapana mekranica, sp. nov. (p. 40, Pl. VIII, figs. 17, 18),
Conus (*Dendroconus*) *loroisii*, Kiener (p. 42, Pl. VIII, figs. 14, 15),
Clavatula tipperi, sp. nov. (p. 41, Pl. VIII, fig. 16),
Ostrea (*Crassostrea*) *gryphoides* (Schlotheim) (p. 48),
Pecten nearchi, Vredenburg (p. 52).

A collection made by Drs. B. K. N. Wyllie and J. V. Harrison, of the Anglo-Persian Oil Company; Limited, from beds of the same series in the neighbourhood of Jask is in the British Museum and includes most of the species in the above list, together with several others. These fossils are undoubtedly from the Gwadar stage, of Pliocene age.

DESCRIPTION OF THE SPECIES.

I.—FOSSILS OF JURASSIC AGE.

Class : **GASTROPODA**.

Family : *PSEUDOMELANIIDAE*.

Genus : PSEUDOMELANIA, Pictet & Caompiche, 1862.

PSEUDOMELANIA cf. PROCERA (J. A. Eudes-Deslongchamps).

(Plate I, fig. 23).

References to descriptions of *Ps. procera* are as follows :—

1842. *Melania procera*, J. A. Eudes-Deslongchamps, *Mém. Soc. Linn. Normand.*, VII, p. 222 ; Pl. XII, figs. 5, 6.

1851. *Chemnitzia procera*, d'Orbigny, Paléont. française, terrains jurass., II, p. 41 ; Pl. CCXXXIX, figs. 2, 3 (*C. turris* on Plate).

1874. *Chemnitzia procera*, Dumortier, Études paléont. sur les dépots jurass. du bassin du Rhone, IV, Lias supérieur, p. 127 ; Pl. XXXIV, figs. 1, 2.

1892. *Pseudomelania procera*, Hudleston, Gastropoda of the Inferior Oolite, p. 237 ; Pl. XVII, fig. 9 ; Pl. XVIII, figs. 1, 2 ; Pl. XXI, fig. 1.

? 1909. *Chemnitzia coarctata*, Brösamlen, *Palaeontographica*, LVI, p. 282 ; Pl. XXI, fig. 13.

Material.—One specimen (K16/868).

Description.—A smooth, acuminate, flat-sided shell which was about 27 mm. in height when complete (its apex is now missing) ; it attains a diameter of 9·0 mm. Its whorls, which are fairly high in proportion to their diameter, are at first very feebly convex, but on the last whorl a posterior swelling appears adjacent to the suture, producing a slight concavity of the profile. The growth-lines are arched with a pronounced forward-facing concavity. The aperture is not preserved.

Remarks.—This specimen belongs to the group of species which includes *Pseudomelania lineata* (J. Sowerby)[1], *Ps. coarctata*, Eudes-Deslongchamps[2], and *Ps. procera*. It differs from the first-named in the development of a definite posterior swelling of the whorls, but is not sufficiently advanced in growth for it to be possible to say if it is identical with either of the other forms. According to the original figures given by Eudes-Deslongchamps, *Ps. procera* is slightly more acute than *Ps. coarctata* and its whorls are higher in proportion to their diameter. The sub-sutural swelling becomes more prominent in *Ps. coarctata* than in *Ps. procera*, producing a definite turreting of the later whorls. The figures given by Hudleston show that the differences in acuteness and whorl-height are not constant, the turreting of the later whorls of *Ps. coarctata* being its chief distinctive feature. Brösamlen, on the other hand, refers a specimen with turreted whorls to *Ps. procera*[3] and one with straight sides to *Ps. coarctata*, apparently basing his distinction between the species on the acuteness of the spire[4]. It seems possible that the two forms will eventually prove to be conspecific. Provisionally, I have associated the name *procera* with the Persian specimen now recorded. In Europe *Ps. procera* ranges from the Toarcian to the Bajocian.

Locality and Horizon.—Low hills 8½ miles S. S. W. of Ravar, eastern Persia. Bajocian.

Class: **LAMELLIBRANCHIATA.**

Family: *MYTILIDAE.*

Genus: MODIOLUS, Lamarck, 1799.

Subgenus: PHAROMYTILUS, Rollier, 1914.

MODIOLUS (PHAROMYTILUS) PLICATUS, J. Sowerby.

(Plate I, fig. 21.)

1819. *Modiola plicata*, J. Sowerby, Mineral Conchology, III, p. 87; Pl. CCXLVIII, fig. 1.

1833. *Modiola plicata*, Zieten, Versteinerungen Württembergs, p. 79; Pl. LIX, fig. 7.

1837. *Mytilus plicatus*, Goldfuss, Petrefacta Germaniae, II, p. 175; Pl. CXXX, fig. 12.

1850. *Mytilus sowerbianus*, d'Orbigny, Prodrome, I, p. 282.

1853. *Mytilus sowerbianus*, Morris and Lycett, Mollusca from the Great Oolite, p. 36; Pl. IV, fig. 1.

1905. *Modiola plicata*, Benecke, *Abh. geol. Spezialk. Elsass-Lothringen*, N. S., VI, p. 168; Pl. IX, fig. 6.

1932. *Modiola plicata*, Staesche, Trinkler'schen Zentralasien Exped., II, p. 148; Pl. XXII, fig. 36.

Material.—One specimen (K16/867).

Description and Remarks.—Although merely a fragment, this specimen clearly shows the character of the sculpture. The coarse ribs which cross the area

[1] Mineral Conchology, III, Pl. CCXVIII, fig. 1, (1818). Hudleston, *loc. cit.*, p. 241; Pl. XVIII, figs. 7*a*, *b*, (1892).

[2] *Loc. cit.*, p. 226; Pl. XII, figs. 11, 12, (1842). Hudleston, *loc. cit.*, p. 242; Pl. XVIII, figs. 9*a-c*; Pl. XIX, figs. 1*a*, *b*, (1892).

[3] *Loc. cit.*, p. 282; Pl. XXI, fig. 14, (1909).

[4] In his description, nevertheless, Brösamlen states that the specimen referred to *coarctata* has turreted whorls and that the one referred to *procera* is flat-sided. It is possible that his figures may be inaccurate.

adjacent to the dorsal margin of each valve mostly bifurcate half-way between that margin and the diagonal carina, beyond which the surface is smooth except for fine growth-lines. In Sowerby's type of *M. plicatus* and in most specimens from the Middle Jurassic each of the coarse dorsal ribs splits up into several fine ones before reaching the diagonal carina, and simple bifurcation of the ribs has been considered to be characteristic of the Upper Jurassic form, *M. perplicatus* (Étallon).[1] The presence of ribbing of this latter type in the Bajocian specimen now described shows it to be an exception to this rule and casts doubt on the value of the specific distinction drawn between *M. plicatus* and *M. perplicatus*.

Locality and Horizon.—Low hills 8½ miles S. S. W. of Ravar, eastern Persia. Bajocian.

Family : *TRIGONIIDAE.*

Genus : TRIGONIA, Bruguière, 1789.

TRIGONIA SIGNATA, Agassiz.

(Plate I, fig. 20.)

1833. *Trigonia clavellata*, Zieten, Versteinerungen Württembergs, p. 78; Pl. LVIII, figs. 3 *a-c* (*non* Parkinson).
1841. *Trigonia signata*, Agassiz, Études critiques sur les mollusques fossiles. Mémoire sur les Trigonies, p. 18; Pl. III, fig. 8 and Pl. IX, fig. 5.
1850. *Trigonia clavo-costata*, Lycett, *Ann. Mag. Nat. Hist.*, [2], VI, p. 425.
1853. *Trigonia signata*, Chapuis and Dewalque, *Mém. cour. Acad. roy. Belgique*, XXV, p. 172; Pl. XXVI, fig. 1.
1853. *Trigonia decorata*, Lycett, *Ann. Mag. Nat. Hist.*, [2], XII, p. 233; Pl. XI, fig. 1.
1853. *Trigonia clavo-costata*, Lycett, *loc. cit.*, p. 235; Pl. XI, fig. 6.
1872. *Trigonia signata*, Lycett, British Fossil Trigoniae, p. 29; Pl. II, figs. 1-3.
1877. *Trigonia signata*, Lycett, *op. cit.*, p. 204.
1883. *Trigonia signata* vars. *zietenii*, *rugulosa*, *stutterdi*, *decurtata*, Lycett, *op. cit.*, Suppl. 2, pp. 5-10; Pl. I, figs. 1-5, 16, 17, Pl. II, figs. 1-3, 9-11 and Pl. IV, figs. 1-7.
1899. *Trigonia signata*, Greppin, *Mém. Soc. pal. suisse*, XXVI, p. 94; Pl. IX, figs. 11, 12 and Pl. X, fig. 1.
1899. *Trigonia zieteni*, Greppin, *loc. cit.*, p. 96; Pl. X, fig. 2.
1915. *Trigonia zieteni*, Fischer, *Beitr. Pal. Österr.-Ungarns*, XXVII, p. 212.
1932. *Clavotrigonia signata*, Lebküchner, *Palaeontographica*, LXXVII, p. 57; Pl. III, figs. 3-7, Pl. IV, figs. 3, 4 and Pl. V, figs. 1-5.

Material.—One specimen (A. P. O. C. Coll., J-G/ZE/1174, now British Museum, L. 63153).

Remarks.—While Lycett (1877) considered the form represented in the above-cited figures of Zieten's (also cited by Agassiz) as the typical *T. signata*, Greppin (1899) proposed to restrict *T. signata* to the form represented in Agassiz's Pl.

[1] Cf. de Loriol, "Monographie paléontologique des étages supérieurs de la formation jurassique du département de la Haute-Marne," *Mém. Soc. Linn. Normandie*, XVI, p. 348, (1872).

IX, fig. 5, and gave the name *T. zieteni* to Zieten's form, including in the synonymy of this the English form described as *T. signata* by Lycett in 1872. Since, however, specimens of this English form had already been described by Lycett under the names *T. clavo-costata* and *T. decorata*, it was unnecessary for Greppin to introduce the name *zieteni*.

I have examined a number of specimens from the English Inferior Oolite, and find that there is complete intergradation between those with wide-spaced rows of tubercles, corresponding to *T. signata* as restricted by Greppin, and those with more closely spaced rows similar to the form represented in Zieten's figure. The angle between the carina and the posterior rows of tubercles also varies considerably and does not form a satisfactory basis for specific discrimination. It therefore seems desirable to reunite the forms separated by Greppin under the names *T. signata* and *T. zieteni*. Lebküchner (*loc. cit.*) is of the same opinion.

The specimen now recorded is not fully grown, but its ribbing agrees exactly with that of specimens of *T. signata* at the same stage of growth and it may be definitely referred to that species. This is a widespread Bajocian form, but there are a few records of its occurrence in the Bathonian (*see* Lebküchner, *loc. cit.*). It has already been recorded from northern Persia by Fischer (as *T. zieteni*).

Locality and Horizon.—4 miles south-west of Hauz-i-Khan, south of Naiband, eastern Persia. Bajocian-Bathonian.

Trigonia sp.

(Plate I, fig. 17).

Material.—A fragment of an external mould (K16/867).

Description and Remarks.—This mould is of a small portion of the surface of the shell lying on either side of the marginal carina. The posterior area is crossed transversely by prominent, irregular threads. The main surface is crossed obliquely by closely spaced, tuberculate ribs. This fragment is not identifiable, but appears to belong to a species comparable to *T. formosa*, Lycett[1], of the Bajocian.

Locality and Horizon.—Low hills 8½ miles S. S. W. of Ravar, eastern Persia. Bajocian.

Family: *OSTREIDAE.*

Genus: Ostrea, Linné, 1758.

Sub-genus: Catinula, Rollier, 1911.

Ostrea (Catinula) sandalina, Goldfuss.

(Plate I, figs. 8-13).

1833. *Ostrea sandalina*, Goldfuss, Petrefacta Germaniae, II, p. 21; Pl. LXXIX, figs. 9 *a*, *b*, *f-i* (non *c*, *d*, *e*).

? 1851. *Ostrea sandalina*, Bayle and Coquand, *Mém. Soc. géol. France*. [2], IV, p. 25; Pl. I; figs. 9, 10.

[1] British Fossil Trigoniae, p. 35; Pl. V, figs. 4-6, (1872).

1853. *Ostrea sandalina*, Chapuis and Dewalque, *Mém. cour. Acad. roy. Belgique*, XXV, p. 226; Pl. XXX, fig. 7.

? 1882. *Ostrea sandalina*, Roeder, Terrain à Chailles und seine Zweischaler, p. 32; Pl. I, figs. 2 *a-c*.

1900. *Ostrea sandalina*, Greppin, *Mém. Soc. pal. suisse*, XXVII, p. 154.

1912. *Ostrea sandalina*, Lissajous, Jurassique maconnais. Fossiles caractéristiques, p. 61; Pl. VIII of Atlas, fig. 4.

1917. *Ostrea sandalina*, Rollier, *Mém. Soc. pal. suisse*, XLII, p. 579.

1923. *Ostrea (Catinulus ?) sandalina*, Lissajous, *Trav. Lab. géol. Lyon*, Mém. 3, p. 140.

? 1923. *Ostrea sandalina*, Hummel, *Palaeontographica*, Supp. IV, Abt. 3, p. 164.

1927. *Ostrea sandalina*, Pcelincev, *Mém. Com. géol.*, N. S., Livr. 172, p. 37.

1927. *Ostrea sandalina*, Pcelincev, *Bull. Com. géol.*, XLVI, p. 1149.

Material.—Numerous specimens (K16/856).

Description and Remarks.—A small, smooth, gregarious oyster with a large attachment-area and a cylindrical shape, the lower valve deepening continuously but increasing only slightly in diameter during growth. The upper valve is flat and lid-like. The specimens agree very well with Goldfuss's original figures of the species.

With the exception of some not very typical specimens from the Upper Jurassic (figs. *c*, *d*, *e*), which later authors have excluded from the species, Goldfuss's types came from the Inferior Oolite, and it is from the same horizon that the species has been recorded by Chapuis and Dewalque, Pcelincev, and others. Lissajous (1912) gives its range as Bajocian to Oxfordian and in a later work (1923) records it from the Bathonian. Roeder figures Oxfordian specimens as this species. Hummel records it from the Oxfordian of the East Indies, and Bayle and Coquand from the Middle Jurassic of South America. It is, of course, possible that some of these records may be based on misidentifications. Pcelincev's records are from Armenia and the Crimea.

Dr. W. J. Arkell[1] has discussed the polyphyletic subgenus *Catinula*, to which oysters with a large attachment-area and a cylindrical growth-habit may be referred.

Locality and Horizon.—Low hills east of Ravar, eastern Persia. Bajocian-Bathonian.

Sub-genus: Lopha, Bolten, 1798.

Ostrea (Lopha) cf. gregarea, J. Sowerby.

(Plate I, figs. 14-16).

The following are references to descriptions of typical *O. gregarea*:—

1816. *Ostrea gregarea*, J. Sowerby, Mineral Conchology, II, p. 19; Pl. CXI, figs. 1, 3.

1933. *Lopha gregarea*, Arkell, A Monograph of British Corallian Lamellibranchia, p. 183; Pl. XXII, figs. 5, 6 and Pl. XXIII, figs. 1-4.

[1] *Proc. Cotteswold Nat. Field Club*, XXV, p. 36, etc., (1933).

The synonymy of the form now described is :—

1853. *Ostrea gregarea*, var., Morris and Lycett, Mollusca from the Great Oolite, Bivalves, p. 4; Pl. I, fig. 2.

1900. *Alectryonia* cf. *rastellaris*, Münst.; Greppin, *Mém. Soc. pal. suisse*, XXVII, p. 149; Pl. XVI, fig. 8.

1904. *Alectryonia greppini*, Riche, *Ann. Univ. Lyon*, N. S., XIV, p. 200; Pl. VIII, figs. 9 *a-c*.

1926. *Alectryonia* cf. *gregarea*, Schmidtill, *Palaeontographica*, LXVIII, p. 26.

Material.—Several specimens (K16/857, K16/862).

Description and Remarks.—A small, sharply plicated oyster with a large attachment-surface, growing in clusters. The upper valve is feebly convex, with occasionally divaricating radial plications. These specimens are closely comparable to specimens of *O. gregarea* from the British Corallian. Similar plicated, gregarious oysters are, however, known from the Bajocian onwards. References to some of these forms, from the Bajocian and Bathonian, are given above; a synonymy of *O. gregarea* restricted to Upper Jurassic occurrences is given in Dr. Arkell's monograph.

Locality and Horizon.—Low hills east of Ravar, eastern Persia; 7 miles north of Rayin, eastern Persia, where the Jupar range disappears below the Siwaliks. Bajocian-Bathonian.

Family : *PECTINIDAE*.

Genus : CHLAMYS, Bolten, 1798.

CHLAMYS sp.

(Plate I, figs. 6, 7).

Material.—Two specimens (A. P. O. C. Coll., J-G/ZE/1106 and 1108, now British Museum, L. 63154-5); also one specimen (British Museum, L. 53461, collected by the Rev. H. E. J. Biggs), showing only an eroded interior of the shell.

Description.—An equivalve, orbicular species, about as long as high and slightly inequilateral; the dorsal margins of its body diverge at a slightly obtuse angle; the inflation is slight. In both of the specimens which show anything of the exterior the actual shell is only preserved near the margins, where it is smooth except for rather pronounced growth-rugae. Of the auricles, only the posterior ones are preserved; each is characterised by an elongate, horizontal dorsal margin and an acute-angled shape, due to a well-marked sinus between it and the body of the shell. The auricles are smooth except for growth-lines. The largest specimen is about 38 mm. in diameter.

Remarks.—This species is distinguished from representatives of *Camptonectes* and *Entolium* by the shape of its auricles. The only comparable described Jurassic species appears to be *Pecten griesbachi*, Lycett[1], from the English

[1] Supplementary Monograph on the Mollusca from the Stonesfield Slate, Great Oolite, etc., p. 31; Pl. XXXIII, figs. 6, 6 *a*, (1863).

Bathonian. That species is described as having delicate radial costae which fade away on the lower part of the valve. It is unfortunate that so little of the shell is preserved in the specimens now described, making detailed comparison impossible.

Locality and Horizon.—Hauz-i-Panj, south of Ravar, eastern Persia. Bajocian-Bathonian.

Sub-genus: RADULOPECTEN, Rollier, 1911.

CHLAMYS (RADULOPECTEN) TIPPERI, sp. nov.

(Plate I, figs. 1-5).

Material.—Several broken specimens (K16/855, K16/858, K16/861, ?K16/877) in the G. S. I. Coll. The holotype (L. 63156, figs. 2 *a*, *b*, *ex* A. P. O. C. Coll., J-G/ZE/1091) and a figured paratype (L. 63157, fig. 3, *ex* A. P. O. C. Coll., J-G/ZE/1083), collected by Messrs. R. C. Jennings and K. Washington Gray, also several specimens (L. 53456-8, L. 53463, L. 53465-70) collected by the Rev. H. E. J. Biggs, in the British Museum Coll. There are several further specimens in the A. P. O. C. Coll.

Specific Characters.—Height approximately equal to or slightly exceeding length; inflation slight, valves almost equal in convexity but differing considerably in ornamentation.

Left valve ornamented with radial ribs five of which, symmetrically distributed, stand out more prominently than the others, the middle one being especially thick and conspicuous; these five are rounded in cross-section and, except near the ventral margin, bear rather irregularly distributed squamae. Of the four interspaces between these primary ribs, the middle two are usually occupied by three and the outer two by two subequal and symmetrically arranged, obscurely squamose ribs of secondary strength; these are at first obtusely angular, and later depressed-rounded. Sometimes, however, additional and still weaker ribs are intercalated and the arrangement is less symmetrical. The outermost primary ribs are separated from the margins by either one or two ribs of secondary strength. Very fine, downward-arched growth-threads occupy the interspaces.

Right valve with a conspicuous deep median radial sulcus, corresponding to the thick median rib of the other valve, and with 8-9 rather irregularly distributed, depressed, rounded ribs on either side of it; the widest interspaces between these correspond to the other four conspicuous ribs of the other valve. The outermost ribs may be squamose, and both ribs and interspaces are crossed by fine growth-threads, arched upwards where they cross the ribs and downwards in the interspaces.

Auricles fairly large, ornamented with pronounced growth-ridges. The right anterior auricle is narrow and parallel-sided, with a deep sinus beneath it; there is a shallow sinus beneath the left anterior auricle. The posterior auricles are right- or slightly obtuse-angled in shape.

Dimensions.—The measurements of the holotype are as follows :—

Length	60·0 mm.
Height	65·8 mm.
Inflation	26·0 mm.

Remarks.—The ornamentation of the left valve of this species is rather similar to that of right valves of the genus *Neithea*, and this species was recorded by its original collector[1] as a variety of the well-known Cretaceous species *N. quinquecostata* (Sow.) and assigned to a Cretaceous horizon in consequence. This resemblance, however, is purely superficial, and the species has proved to belong to an entirely different group of the Pectinidae, confined to Jurassic rocks.

The group in question is the one named *Radulopecten* by L. Rollier[2] and recently discussed by W. J. Arkell[3]. The type-species is *Pecten hemicostatus*, Morris and Lycett[4], from the Bathonian, while other representatives are *P. anisopleurus*, Buvignier[5], and *P. biplex*, Buvignier[6], from the Oxfordian, and *P. inaequicostatus*, Phillips[7], and *P. laurae*, Étallon[8], from the Corallian. Of these forms, *P. laurae* is most closely comparable to the species now described.

The most characteristic feature of *Radulopecten* is the presence of five more or less symmetrically arranged, squamose ribs of primary strength in the left valve, with corresponding radial sulci in the right. Usually radial ribs are absent or only weakly and irregularly developed in the interspaces between the primary ribs of the left valve, and the strength and regular arrangement of these interstitial ribs in the species now described form its most distinctive character. Dr. Arkell has pointed out that in the right valve of species of this group there is a tendency for the radial ribs to be grouped in pairs. This tendency is observable towards the middle of the shell in the species now described.

Localities and Horizon.—Low hills east of Ravar (G. S. I. Coll.); 7 miles north of Rayin, where the Jupar range disappears below the Siwaliks (G. S. I. Coll.); Hauz-i-Panj, south of Ravar (A. P. O. C. Coll.); east of Kerman, between that town and Gishin (Biggs Coll., British Museum). Bajocian-Bathonian.

Genus : Variamussium, Sacco, 1897.

Variamussium pumilum (Lamarck).

(Plate I, fig. 18).

1819. *Pecten pumilus*, Lamarck, Histoire naturelle des animaux sans vertèbres, VI, Pt. 1, p. 183.

1825. *Pecten incrustatus*, Defrance, Dictionnaire des sciences naturelles, XXXVIII, p. 253.

[1] G. H. Tipper, *Rec. Geol. Surv. Ind.*, LIII, p. 61, (1921).
[2] Les faciès du Dogger, p. 158, (1911).
[3] A Monograph of British Corallian Lamellibranchia, p. 116, (1931).
[4] Mollusca from the Great Oolite, Bivalves, p. 10 ; Pl. I, fig. 16, (1853).
[5] Statistique géologique, etc., du département de la Meuse, Atlas, p. 23 ; Pl. XIX, figs. 31-35, (1852).
[6] *Loc. cit.*, p. 23 ; Pl. XIX, figs. 1-6, (1852).
[7] Arkell, W. J. *loc. cit.*, p. 118 ; Pl. VIII, figs. 4-7, (1930-1).
[8] J. Thurmann and A. Étallon, Lethea Bruntrutana, p. 253 ; Pl. XXXV, fig. 6, (1862). Also P. de Loriol, *Mém. Soc. pal. suisse*, XXI, p. 47 ; Pl. V, figs. 5, 5 *a*, *b* and Pl. VI, figs. 3, 3 *a*, *b*, (1894).

1833. *Pecten personatus*, Zieten, Versteinerungen Württembergs, p. 68; Pl. LII, figs. 2 *a*, *b*.

1836. *Pecten paradoxus*, Goldfuss, Petrefacta Germaniae, II, p. 75; Pl. XCIX, figs. 4 *a-c*.

1836. *Pecten personatus*, Goldfuss, *loc. cit.*, p. 75; Pl. XCIX, fig. 5.

1899. *Pecten* (*Amusium*) *pumilus*, Greppin, *Mém. Soc. pal. suisse*, XXVI, p. 123; Pl. XIV, figs. 6, 7.

1900. *Pecten* (*Variamussium*) *personatus*, Philippi, *Zeitschr. deutsch. geol. Ges.*, LII, p. 110, figs. 24 *a-c*.

1905. *Pecten* (*Variamussium*) *pumilus*, Benecke, *Abh. geol. Spezialk. Elsass-Lothringen*, N. S., VI, p. 112; Pl. III, figs. 20-22.

1915. *Pecten* (*Variamussium*) *incrustatum*, Fischer, *Beitr. Pal. Österr.-Ungarns*, XXVII, p. 211.

1926. *Variamussium pumilum*, Staesche, *Geol. pal. Abhandl.*, N. S., XV, p. 84 (with fuller synonymy).

Material.—One specimen (K16/870).

Description and Remarks.—A smooth but somewhat eroded left (?) valve, measuring about 10·7 mm. in height and length, and showing traces of 11 or 12 internal ribs. The anterior (?) auricle is acute-angled with a sinus separating it from the body of the shell; the exact shape of the posterior (?) auricle cannot be clearly seen. The dorsal margins of the auricles are almost in alignment and do not meet in an obtuse angle like that illustrated, for example, in Philippi's figures of the species.

Stahl[1] and Fischer (*loc. cit.*) have already recorded this species from a number of localities in Persia. It has a world wide distribution in rocks of Upper Liassic and Inferior Oolite age.

Locality and Horizon.—Hills east of Badamu, eastern Persia. Bajocian ?

Family : *LIMIDAE.*

Genus : Ctenostreon, Eichwald, 1867.

Ctenostreon sp.

Material.—One fragment (K16/870).

Description and Remarks.—This fragment consists of part of the ventral region of the shell; it is about 70 mm. in length and bears eight unequal, irregular, rounded ribs. It undoubtedly belongs to the genus *Ctenostreon*, and in view of its geological horizon should probably be referred to the species *Ct. pectiniforme* (Schlotheim), if this is considered specifically distinct from *Ct. rugosum* (Smith), of the Bathonian.

Locality and Horizon.—Hills east of Badamu, eastern Persia. Bajocian ?

[1] "Zur Geologie von Persien," *Petermanns Mitteilungen*, Ergänzungsheft 122, pp. 6, 10, 24, 69, (1897).

Family : *PLEUR OMYIDAE.*

Genus : PLEUROMYA, Agassiz, 1845.

PLEUROMYA UNIOIDES (Roemer).

(Plate I, fig. 22).

1836. *Venus unioides*, Roemer, Versteinerungen des norddeutschen Oolithengebirges, p. 109 ; Pl. VIII, fig. 6.

1840. *Lutraria unioides*, Goldfuss, Petrefacta Germaniae, II, p. 256 ; Pl. CLII, figs. 12 *a*, *b*.

1845. *Pleuromya unioides*, Agassiz, Monographie des Myes, p. 236 ; Pl. XXVII, figs. 9-13.

1905. *Pleuromya unioides*, Benecke, *Abh. geol. Spezialk. Elsass-Lothringen*, N. S., VI, p. 278 ; Pl. XXIV, figs. 3, 3 *a*.

? 1915. *Pleuromya unioides*, Fischer, *Beitr. Pal. Österr.-Ungarns*, XXVII, p. 217 ; Pl. XIX, fig. 6.

? 1932. *Pleuromya unioides*, Staesche, Trinkler'schen Zentralasien Exped., II, p. 152 ; Pl. XXII, fig. 48.

Material.—Five specimens (K16/867).

Description and Remarks.—Specimens of an elongate, concentrically ribbed *Pleuromya* with fairly prominent umbones, placed at about the anterior quarter of the length. The anterior extremity is low and subrostrate. The largest specimen measures 52 mm. in length and 30 mm. in height.

These agree well in size and shape with Roemer's original figure of this species. The specimens from northern Persia and Kashmir referred by Fischer and Staesche to this species are small and not very characteristic.

Locality and Horizon.—Low hills $8\frac{1}{2}$ miles S. S. W. of Ravar, eastern Persia. Bajocian.

Family : *CERATOMYIDAE.*

Genus : CERATOMYA, P. Fischer, 1887.

CERATOMYA CONCENTRICA (J. de C. Sowerby).

(Plate I, fig. 19).

1825. *Isocardia concentrica*, J. de C. Sowerby, Mineral Conchology, V, p. 147 ; Pl. CCCCXCI, fig. 1.

1854. *Ceromya concentrica*, Morris and Lycett, Mollusca from the Great Oolite, Bivalves, p. 108 ; Pl. X, figs, 3 *a*, *b* [*non* Pl. XV, figs. 2 *a*, *b*].

1916. *Ceromya concentrica*, Douvillé, *Mém. Acad. Sci. Paris*, [2], LIV, p. 56 ; Pl. IV, fig. 4.

Material.—One specimen (A. P. O. C. Coll., J-G/ZE/1413, now British Museum, L. 63158).

Description and Remarks.—The specimen is a cast somewhat broken at its posterior end and rather flattened by pressure, like specimens found in the Collyweston slate (Inferior Oolite) of Northamptonshire. It is subquadrate in shape its length (36 mm.) being very little in excess of its height (34 mm.). The

anterior end of the shell projects very slightly beyond the umbo, which scarcely rises above the postero-dorsal margin. The ornamentation consists of concentric ridges, some of which bifurcate on approaching the postero-dorsal margin.

This specimen agrees very well in shape with specimens of *C. concentrica* from the type-horizon, the British Cornbrash (Bathonian), and it seems unnecessary to qualify its specific determination. The species, which first appears in the Inferior Oolite, does not range above the Bathonian.

Locality and Horizon.—About 4 miles south-west of Gujur, eastern Persia. Bajocian-Bathonian.

II.—FOSSILS OF CRETACEOUS AGE.

Class: **GASTROPODA.**

Family: *NERINEIDAE.*

Genus: NERINEA, Deshayes, 1827.

NERINEA PILGRIMI, sp. nov.

(Plate III, figs. 1 *a*, *b*).

Material.—The holotype only (K21/300), a specimen with its apical whorls missing.

Specific Characters.—Attaining considerable dimensions; spire angle about 18° and thus fairly wide for the genus. Whorls low smooth, concave in profile; sutures linear, unimpressed. Axial section revealing an extremely wide umbilicus, occupying about one-half of the total diameter, and narrow whorls constricted by one fold on the middle of the columella, a second occupying the angle between the columella and the parietal wall, and a third on the outer wall. Aperture unknown.

Dimensions of Holotype—

Height (original, estimated)	270 mm.
Diameter	83 mm.

Remarks.—Secondary calcite crystallisation, accompanied to some extent by solution of the original shell, has obliterated the internal structure of some of the whorls, but the internal folds can be seen clearly in the second whorl preserved and less clearly in two other whorls. The wide, matrix-infilled umbilicus can be seen very clearly.

The researches of C. D. Sherborn[1] have shown that the generic name *Nerinea* was first published in its Latin form by Deshayes in 1827[2]. Only one species, *N. mosae*, Deshayes, is cited under the genus[3], and must therefore be accepted

[1] Index Animalium, Pt. 17, p. 4297, (1928). The spelling '*Nerinaea*' given in this reference is a mistake.

[2] Dictionnaire classique d'histoire naturelle, XI, p. 534.

[3] The generic name is spelt '*Nerina*' in the species heading but I do not think that this obvious misprint invalidates the species as genotype of *Nerinea*.

as genotype. It is a broad, umbilicate form with two folds on the columella, one on the parietal wall, and two on the outer wall. Sharpe, in his subgeneric classification of *Nerinea*[1], places it in group Bc of *Nerinea* s. str.; Cossmann[2] refers it to Sharpe's genus *Ptygmatis*, while his synonymy shows that Zittel and de Loriol had included it in the genus *Itieria*. It is not, in fact, a very characteristic species of any of the genera and subgenera into which *Nerinea* has now been split up, but occupies a more or less intermediate position. Hence it will not be easy to decide which group shall take the name *Nerinea* s. str.

Its extraordinarily wide umbilicus distinguishes the Persian species now described from any described previously. The Neocomian species *N. renauxiana*, d'Orbigny[3], has the same number of internal folds, placed in similar positions, and also has a moderately wide umbilicus. The folds are rather less complex in these forms than in the genotype, but the difference is not sufficient to warrant subgeneric separation; hence they may be referred to *Nerinea* s. str. It is not obvious into which subgeneric group of Cossmann's classification[4] they would fall.

Locality and Horizon.—Khamir, southern Persia; half a mile north of sulphur mine. From the Rudist limestone, of Cenomanian or Turonian age.

Nerinea sp.

(Plate III, fig. 2).

Material.—Several blocks of rock (K16/851) enclosing a number of eroded specimens.

Description.—A moderately large and stout *Nerinea*, complete specimens of which attained a height of about 150 mm. and a diameter of about 30 mm. The whorls are narrow and strongly excavated in the middle, but details of the surface ornamentation are obliterated. Axial sections show that the columella is thick and imperforate, occupying about one-third of the total diameter. There are two folds on the columella, a wide and prominent fold on the parietal wall, and a prominent fold on the outer wall, at or slightly below its middle.

Remarks.—This species is probably new, but it seems undesirable to name it owing to the eroded condition of the specimens. Cretaceous species with the same number of internal folds are *N. pailletteana*, d'Orbigny[5], which is a stouter shell with a thicker columella, and *N. requieniana*, d'Orbigny[6], which is also stouter and has flat-sided whorls. According to their original describer both of these species come from the Cenomanian.

Locality and Horizon.—Sink, about 14 miles north-east of Kerman, eastern Persia. From the Rudist limestone, exact age uncertain.

[1] *Quart. Journ. Geol. Soc.*, VI, p. 106, (1850).
[2] *Mém. Soc. géol. France* (Pal.), No. 19, p. 81, (1898).
[3] Paléontologie française, terrains crétacés, II, p. 76; Pl. CLVII, (1842).
[4] Essais de paléoconchologie comparée, II, pp. 23-46, (1896). The most recent classification of the Nerineidae is that of Pcelincev (*Trav. Soc. Nat. Leningrad*, LVII, Pt. 4, pp. 3-20, (1927), but this is in Russian and unintelligible to me.
[5] Paléontologie française, terrains crétacés, II, p. 88; Pl. CLXI, figs. 1-3, (1842).
[6] *Loc. cit.*, p. 94; Pl. CLXIII, figs. 1-3, (1842).

Family : *ACTEONIDAE.*

Genus : TROCHACTAEON, Meek, 1863.

TROCHACTAEON cf. GIGANTEUS (J. de C. Sowerby).

(Plate IV, figs. 1 *a*, *b*).

The following are references to descriptions of the type-form :—

1833. *Tornatella gigantea*, J. de C. Sowerby, *Trans. Geol. Soc.* [2], III, Pl. XXXVIII, fig. 9.

1852. *Actaeonella gigantea*, Zekeli, *Abh. k. k. geol. Reichsanst.*, I, Pt. 3, p. 39 ; Pl. V, figs. 8 *a-c.*

Material.—One incomplete specimen (K16/850).

Description.—Large, globose, thick-shelled, the height (originally about 110 mm.) slightly exceeding the diameter (originally about 97 mm.). Spire gradate, occupying about one-sixth of the total height. The penultimate whorl is oviform, attaining its greatest diameter at about two-thirds of its height, thence tapering anteriorly, with a slight but definite constriction at about one-third of its height, producing a concavity in its profile. Only a portion of the last whorl is preserved.

Remarks.—If we accept the interpretation of *T. giganteus* given by such authors as Stoliczka[1] and Choffat[2], this would appear to be a highly variable species from which the specimen now recorded could not be excluded. The holotype, which is preserved in the British Museum (Natural History), has its apical whorls eroded, but its spire appears to have been low and the whorls not at all shouldered. The specimen figured by Zekeli as *Actaeonella gigantea* is closely comparable, while the one figured by the same author[3] as *A. lamarcki* is slightly more globose, but otherwise inseparable. The specimen from the Toulon district figured as *A. gigantea* by d'Orbigny[4] is less globose than the holotype and has a more salient, gradate spire. The spire is still more prominent in the specimen from Wiener Neustadt figured by Goldfuss[5], as also in those figured by Choffat[6] as varieties of this species. Hojnos[7] has discussed *Trochactaeon* and has divided its species into two groups, the first consisting of low-spired forms and the second of high-spired ones ; hence the varieties of *T. giganteus* recognised by Choffat fall partly into each group. *T. giganteus* var. *ventricosus*, Hojnos[8], is closely comparable to the specimen now recorded. In the distinct concavity of the side of its last preserved whorl this specimen resembles those referred by Zekeli[9] to *Actaeonella renauxana*, d'Orbigny, but these are also included in the synonymy of *T. giganteus* by Stoliczka and Choffat.

T. giganteus has a wide distribution in rocks of Senonian age, most frequently occurring in association with Rudists.

[1] 'Revision der Gastropoden der Gosauschichten,' *Sitzber. Akad. Wiss. Wien*, LII, Pt. 1, p. 139, (1866).
[2] Receuil d'études paléontologiques sur la faune crétacique du Portugal, I, Pt. 3, p. 113, (1902).
[3] *Abh. k. k. geol. Reichsanst.*, I, Pt. 3, Pl. VI, figs. 2, 3, (1852).
[4] Paléontologie française, terrains crétacés, II, p. 109 ; Pl. CLXV, fig. 1, (1843).
[5] Petrefacta Germaniae, III, p. 48 ; Pl. CLXXVII, fig. 12, (1844).
[6] *Loc. cit.*, Pl. I, figs. 16-21, (1902).
[7] *Foldtani Közlöny*, XLIX, p. 95, (1919).
[8] *Loc. cit.*, p. 95 ; Pl. I, fig. 2, (1919).
[9] *Loc. cit.*, Pl. VII, figs. 1-5, (1852).

Locality and Horizon.—Badamu, 14 miles west of Kerman, eastern Persia. Rudists from this locality are stated by O. Kühn[1] to range in age from Cenomanian to Maestrichtian. The *Trochactaeon* probably comes from some stage of the Senonian.

Class: **LAMELLIBRANCHIATA.**

Family: *OSTREIDAE.*

Genus: EXOGYRA, Say, 1820.

EXOGYRA CONICA (J. Sowerby).

(Plate III, fig. 3).

1813. *Chama conica*, J. Sowerby, Mineral Conchology, I, p. 69; Pl. XXVI, fig. 3.

1913. *Exogyra conica*, Woods, Cretaceous Lamellibranchia of England, II, p. 407, text-figs. 215-242.

Material.—Three specimens (K21/288).

Remarks.—The best preserved of these specimens agrees well with specimens of this species from the English Upper Greensand. The only other comparable form is *E. suborbiculata* (Lamarck)[2], in which the left valve is less distinctly carinate and the umbonal region more coiled.

Locality and Horizon.—Three miles north of Baghin, 18 miles west of Kerman, eastern Persia, from a limestone in contact with white Jurassic grits; horizon probably Cenomanian.

EXOGYRA FLABELLATA, Goldfuss.

(Plate III, figs. 4, 5).

1833. *Exogyra flabellata*, Goldfuss, Petrefacta Germaniae, II, p. 38; Pl. LXXXVII, figs. 6 *a*, *b*.

1869. *Ostrea flabellata*, Coquand, Monographie du genre *Ostrea*, p. 126; Pl. XLIX, figs. 1, 2; Pl. L, fig. 1; Pl. LII, figs. 1-6, 8, 9 (*non* 7).

1912. *Exogyra flabellata*, Pervinquière, Études de paléontologie tunisienne, II, Gastropodes et Lamellibranches des terrains crétacés, p. 189; Pl. XIII, figs. 6-8.

Material.—Three specimens [K21/273 (1), K21/276 (2)].

Remarks.—These agree well with specimens of this species from Tunis, Egypt, and Palestine, where it occurs in great abundance in the Cenomanian but does not appear to range up into the Turonian. A closely comparable species, E. *matheroniana* (d'Orbigny), occurs in the Upper Senonian, and has been recorded by Douvillé[3] from Persia; its main distinctive feature appears to be its sharply carinate upper valve.

Localities and Horizon.—Khamir, southern Persia; half a mile north of the sulphur mine, on spur below main Rudist limestone containing *Durania persica*; also one mile south-west of sulphur mine. Horizon probably Cenomanian.

[1] *Rec. Geol. Surv. Ind.*, LXVI, pp. 167-8, (1932).

[2] *See* Woods, *loc. cit.*, p. 413, text-figs. 243-248, where it is described under Lamarck's later name *E. columba*.

[3] *In* de Morgan, Mission scientifique en Perse, III, Pt. 4, Mollusques fossiles, p. 279; Pl. XXXVI, figs. 17-21, (1904).

Family : *RADIOLITIDAE.*

Genus : DURANIA, H. Douvillé, 1908.

DURANIA PERSICA, sp. nov.

(Plate II, figs. 1-3 ; Plate III, fig. 6).

Material.—Five specimens (four numbered K21/299 and one numbered K10/63) in the G. S. I. collection and about fifteen specimens in the Anglo-Persian Oil Company's collection. An isolated individual with an upper valve in the G. S. I. collection (Plate II, figs. 1*a*, *b*) is selected as holotype. Of the remaining specimens in this collection, one consists of a group of three individuals growing in contact, but unfortunately broken away at both ends, while another is an eroded group of seven individuals.

Specific Characters.—Conico-cylindrical, elongate, attaining considerable dimensions ; growing either isolated or in colonies. Shell-wall very thick, especially on the dorsal side. Exterior of lower valve ornamented with numerous longitudinal ribs crossed by growth-rugae ; at fairly regular intervals, about 20 mm. or rather less apart, the growth-layers frequently imbricate upwards. On the anterior side of the siphonal band E the growth-stages are frequently festooned (Plate III, fig. 6). Siphonal bands smooth or with weak longitudinal ribs ; E is considerably wider than S ; they may be either concave or flat, and in the latter case may project above the general level of the surface. Interband ornamented with longitudinal ribs similar to those on the main part of the surface ; it is convex except when E and S project, in which case it is almost flat. Lip usually corrugated radially, the corrugations increasing towards the periphery by intercalation ; occasionally, however, they may be absent. The lip is also crossed by narrow, shallow, bifurcating radial channels, which are quite independent of the corrugations. No ligamental ridge.

Upper valve smooth, elevated, cap-shaped, with a rounded apex placed at about one-third of the distance from the dorsal to the ventral margin.

Dimensions.—The most complete specimens are about 220 mm. long and attain a diameter of 80 mm. Other specimens, now broken, must have been much longer when complete ; the maximum diameter attained is about 140 mm.

Remarks.—All the specimens referred to this species agree in the ornamentation of their surface and in the relative widths of their siphonal bands. The relative prominence of the bands and interband, however, varies considerably, while the bands may either be smooth or costate. The degree of crenulation of the lip also varies. It certainly does not appear possible to separate these specimens into different species according to the ornamentation of the siphonal bands. The latter are most clearly preserved in a specimen from Kuh-i-Khormuj (Plate III, fig. 6), in which both are quite smooth ; E is flat and S concave, the interband being slightly convex. This is the only specimen in which the lip is smooth, and in other respects it does not appear to differ from those from Khamir, the type-locality. In one of these latter specimens E and S are both concave

and ribbed, while the interband projects strongly. In another specimen E is concave and S flat, both being smooth. In two others both E and S are flat, although they project above the general level of the surface; in one of these specimens the bands are smooth, while in the other they are costate. In two of the specimens there are two prominent longitudinal dorsal swellings.

The single upper valve examined (Plate II, figs. 1*a*, *b*) occupies a tilted position on top of one of the lower valves. I have assumed that it belongs to the same species, although it seems doubtful if it belonged to this particular specimen on account of its size. In the British Museum collection there is an undescribed species of *Durania* from Greece with a similar elevated upper valve, with an eccentric apex. In very few of the species of this genus, however, is the upper valve known.

O. Kühn[1] records three species of *Durania* from Persia. Of these, *D. laevis*, Douvillé[2], is readily distinguished from the form now described by the smoothness of its entire surface. *D. inermis*, Douvillé[3], is a much smaller form, not closely comparable. *D. major*, Kühn[4], is inadequately described and figured, but appears to differ from the form now described in the thinness of its shell-wall.

An indeterminate fragment of a *Durania* from Persia has been referred by Douvillé[5] to the species *D. austinensis* (Roemer). Specimens of that species from Texas, its type-locality, have not been adequately described, but a form occurring in the English Senonian is usually identified with it.[6] In this form the surface is less rugose than in the Persian species now described, while E and S always bear numerous longitudinal ribs and E is exceptionally wide; the lip is never crenulated, but is much more conspicuously channelled than in the species now described.

D. mortoni (Mantell), of the English Cenomanian and Turonian, is similarly distinguished by its strongly ribbed siphonal bands and by the absence of lip crenulations. *D. affilanensis* (Parona)[7], from the Turonian of Italy appears to be particularly close to the species now described. Its external ornamentation is very similar, while E and S are both smooth. These bands, however, are approximately equal in width, a fact which probably indicates that this Italian form is distinct from the Persian one now described.

Localities and Horizon.—Khamir, southern Persia; at and half a mile north of the sulphur mine (G. S. I. collection). Khamir, at horizons 120 ft., 140 ft., 160 ft. and 220 ft. above the base of the upper Rudist limestone, and also from unrecorded horizons (A. P. O. C. collection). Tang-i-Shirineh, Kuh-i-Khormuj, south-western Persia (A. P. O. C. collection). Horizon, Cenomanian or Turonian.

[1] 'Rudistae from Eastern Persia,' *Rec. Geol. Surv. Ind.*, LXVI, pp. 162-3, (1932).
[2] *Mém. Soc. géol. France*, Pal., No. 41, p. 75; Pl. V, figs. 1, 2, (1910).
[3] *Mém. Inst. Égypt.*, VI, p. 255; Pl. XVI, figs. 6, 7, (1912).
[4] *Loc. cit.*, p. 163, text-figs. 4, 5, (1932).
[5] *In* J. de Morgan, Mission scientifique en Perse, III, Pt. 4, Mollusques fossiles, p. 257; Pl. XXXIX, fig. 2, (1904).
[6] Woods, H. Cretaceous Lamellibranchia of England, II, p. 422, (1913).
[7] *Boll. Soc. geol. ital.*, XXVII, p. 309; Pl. IX, figs. 4*a*, *b*, (1908).

III.—FOSSILS OF EOCENE AGE.

Class : **GASTROPODA.**

Family : *STROMBIDAE.*

Genus : TEREBELLUM, Bolten, 1798.

TEREBELLUM CARCASSENSE, Leymerie.

(Plate III, figs. 7-9).

1846. *Terebellum carcassense*, Leymerie, *Mém. Soc. géol. France*, [2], I, p. 365 ; Pl. XVI, figs. 9*a*, *b*.

1854. *Terebellum obtusum*, d'Archiac & Haime, Animaux fossiles du groupe nummulitique de l'Inde, p. 333 (*partim*) ; Pl. XXXII, fig. 20 (*non* fig. 21). (*Non* J. de C. Sowerby, 1840.)

1863. *Terebellum clava*, Schafhäutl, Süd-Bayerns Lethaea Geognostica, p. 209 ; Pl. XLVII, fig. 14.

1905. *Terebellum obtusum*, Doncieux, *Ann. Univ. Lyon*, N. S., fasc. 17, p. 44 ; Pl. II, fig. 4.

1905. *Terebellum carcassense*, Doncieux, *loc. cit.*, p. 45 ; Pl. II, fig. 2.

1925. *Terebellum* cf. *carcasense*, Schlosser, *Abh. bayer. Akad. Wiss.*, XXX, Pt. 7, p. 103 ; Pl. III, fig. 27.

1931. *Terebellum carcassense*, Cox, *Trans. R. Soc. Edin.*, LVII, Pt. 1, p. 51 ; Pl. I, fig. 21.

Material.—Eleven specimens [K9/768(1), K9/781(7), K9/795(3)].

Remarks.—These are internal moulds agreeing well with those from India described by me previously. One of them retains the mould of the posterior apertural canal, not observed in the Indian material. Nothing else can be added to my former notes on this species. Its relationship to *T. sopitum* (Solander) needs further investigation.

Locality and Horizon.—Hisai Jebel, 3 miles east of Rifaa. Bahrein Island. Middle Eocene.

Class : **LAMELLIBRANCHIATA.**

Family : *MYTILIDAE.*

Genus : MYTILUS, Linné, 1758.

MYTILUS CLEOPATRAE, Oppenheim.

(Plate III, fig. 11).

1903. *Mytilus cleopatrae*, Oppenheim, *Palaeontographica*, XXX, Pt. 3, p. 77 ; Pl. VII, figs. 2, 2*a*.

?1903. *Mytilus antonii*, Oppenheim, *loc. cit.*, p. 78 ; Pl. VII, figs. 1, 1*a*, 1*b*.

Material.—One specimen (K9/767).

Remarks.—The umbo of this specimen is broken, but otherwise it agrees well with Oppenheim's figures of *M. cleopatrae*, from the Upper Mokattam beds

of Egypt. It seems very doubtful if this species and *M. antonii* are distinct. *M. nummuliticus*, d'Archiac & Haime[1], from the Laki beds of India, is more gibbose.

Locality and Horizon.—Hisai Jebel, 3 miles east of Rifaa, Bahrein Island. Middle Eocene.

Family : *VUSELLIDAE.*

Genus : EUPHENAX, Cox, 1931.

EUPHENAX JAMAICENSIS (Trechmann).

(Plate III, figs. 12, 13).

1923. *Pseudoheligmus* (?) *jamaicensis*, Trechmann, *Geol. Mag.*, LX, p. 358; Pl. XVIII, figs. 1-3.

1931. *Euphenax jamaicensis*, Cox, *Proc. Malac. Soc. London*, XIX, p. 178; Pl. XX, figs. 1-8; Pl. XXI, figs. 1, 2, 4.

1931. *Euphenax jamaicensis*, Cox, *Trans. R. Soc. Edin.*, LVII, Pt. 1, p. 62.

Material.—Five specimens [K9/761 (4), K9/770 (1)].

Remarks.—The main characters of this remarkable species, the only known representative of its genus, may be most conveniently summarized by quoting my original generic diagnosis.—

'A Vulsellid highly variable in outline and inflation, more or less ovate, sub-equivalve to pronouncedly inequivalve, entirely closed, without gape or marginal fissures, without an internal platform for the adductor muscle, and characterized by a peculiar shell-structure, consisting of a thick but fragile outer layer, composed of radially elongate, prismatic, thin-walled, hollow cells, weakly joined, by thin concentric laminae, to a more compact inner layer, which is itself chambered near the umbones, and may support a number of thin-walled chambers on its inner side.'

Erosion of the shell readily removes its cellular outer layer, revealing the concentric, wavy laminae of the surface of the inner layer, which would be readily mistaken for the actual surface of a concentrically ornamented shell by an observer not familiar with the species. Very frequently the species has been determined as a *Chama* on preliminary examination.

Such is the condition of the fragmentary specimens now recorded. Only a small portion of the outer layer of the shell remains, and the cellular structure of this has been largely obliterated in fossilization. The jagged, concentric laminae of the surface of the inner layer are, however, clearly preserved.

Since I described this genus, Dr. C. T. Trechmann has kindly sent me the Jamaican specimens on which its type-species was founded. These agree in every particular with those from Somaliland and India described by me, and there can be no doubt as to the specific identity of the specimens from the two regions. So far as is known, this species is confined to the Middle Eocene.

Locality and Horizon.—Cliff North-West of Rifaa, Bahrein Island. Middle Eocene, 'below the flint-bearing bed'.

[1]Animaux fossiles du groupe nummulitique de l'Inde, p. 269; Pl. XXIII, fig. 12, (1854).

Family : *OSTREIDAE.*

Genus : OSTREA, Linné, 1758.

OSTREA TURKESTANENSIS, Romanovski.

(Plate IV, figs. 6-8).

1880. *Ostrea turkestanensis*, Romanovski, Materialien zur Geologie von Turkestan, I, p. 95 ; Pl. X, figs. 2*a-c* ; Pl. XI, figs. 3*a*, *b* ; Pl. XII, figs. 2, 2*a*, 3.

1880. *Gryphaea kaufmannii*, Romanovski, *loc. cit.*, p. 92 (*partim*) ; Pl. X, figs. 1*a-c* ; Pl. XI, figs. 1*a*, *b*, 2. (*Non* Mayer-Eymar, 1877.)

1884. *Gryphaea kaufmannii*, var., Romanovski, *ibid.*, II, p. 56 ; Pl. III *bis*, fig. 6 ; Pl. XIV, fig. 4.

1899. *Ostrea baissunensis*, G. Böhm, *Zeitschr. deutsch. geol. Ges.*, LI, p. 466 ; Pl. XXX, figs. 1*a-c*, 2, 3.

1903. *Ostrea turkestanensis*, J. Böhm, in Futterer, Durch Asien, III, Pt. 1, p. 99.

1930. *Ostrea multicostata*, Yang Kieh, *Bull. Soc. géol. France*, [4], XXX, p. 89 (*partim*) ; Pl. VI, figs. 8, 9 ; Pl. VII, fig. 1.

1930. *Ostrea multicostata*, var. *strictiplicata*, Yang Kieh, *loc. cit.*, Pl. VII, figs. 2, 3, 4.

Material—Numerous specimens (K9/853, K9/854, K9/855, K9/856, K9/807, K19/568, K19/569).

Description.—Both valves are thick-shelled. The left valve is trigonally ovate in outline and usually very tumid ; it may have an ill-defined posterior lobe. The umbonal region is usually acute. The umbones may or may not be incurved ; they frequently point in a posterior direction, but are not coiled as in *Exogyra*. The sculpture consists of rather depressed, occasionally dichotomizing radial ribs, which may fade away near the ventral margin ; they are crossed at irregular intervals by imbricating lamellae of growth. The ligamental area, which may or may not be slightly undercut, is acutely triangular and elongated, and is frequently bent apically in a posterior direction. On either side of it the shell margin bears a series of shallow indentations. The adductor scar is comparatively small and is placed in a rather posterior position. The right valve is moderately convex, and has no ornamentation other than the growth-lamellae.

Dimensions.—The measurements of a typical left valve are :—

Length	42·0 mm.
Height	49·0 mm.
Inflation	20·0 mm.

Remarks.—Yang Kieh (*loc. cit.*) has recently discussed the Eocene oysters of this group, and considers that the species *O. multicostata*, Deshayes, should be interpreted in a very wide sense, and should include in its synonymy *O. turkestanensis* and certain larger gryphaeate forms found in the Eocene of Central Asia, as well as certain exogyrate forms from northern Africa.[1] All 'Mesogean' or Tethyan forms of this group are included by him in the variety *O. multicostata*

[1] Yang Kieh does not refer to P. Oppenheim's monograph of the mollusca of the Egyptian Eocene (*Palaeontographica*, XXX, Pt. 3, 1903 and 1906), although he gives outline drawings of Egyptian specimens. He would presumably include *O. elegans*, Deshayes, var. *exogyroides*, Oppenheim (*loc. cit.*, p. 19 ; Pl. I, figs. 6, 7 ; Pl. XVII, figs. 2, 6) and *O. fraasi*, Mayer-Eymar (Oppenheim, *loc. cit.*, p. 21 ; Pl. II, fig. 21 ; Pl. V, fig. 2) in the synonymy of *O. multicostata*.

var. *strictiplicata*, Raulin & Delbos, five types being distinguished—a normal type with straight umbones, a gryphaeate type, an exogyrate type, a giant type, and a type with coarse plications. It is not obvious why he retains the variety *strictiplicata*, distinguished from the type-form by unimportant differences in costation, while otherwise he is so sweeping in his synonymy. Since, as he points out, the gryphaeate forms are particularly characteristic of Asia and the exogyrate ones of northern Africa, it seems desirable to distinguish them by name, whether they be regarded merely as varieties or races of *O. multicostata*, or as distinct species. I prefer to follow J. Böhm (*loc. cit.*) in using Romanovski's specific name *O. turkestanensis* for the smaller gryphaeate form which occurs in the Asiatic Eocene, and to which the specimens now described undoubtedly belong.

The larger gryphaeate form from Central Asia upon which the species *Gryphaea kaufmanni*, Romanovski, was mainly based has been renamed *G. romanowskii* by J. Böhm[1], while an equally large but more expanded form from the same region has been considered by Suess[2] and later authors (including J. Böhm and Yang Kieh) to be identical with *G. esterhazyi*, Pavay, originally described from the Middle Eocene of Transylvania. These large forms are not represented in the collections now described.

Localities and Horizon.—Bahrein Island :—E. S. E. of Jebel Dukhan ; cliff between Jan and Ain el Qar ; Rifaa ; 3 miles west of Rifaa. Middle Eocene.

Family : *SPONDYLIDAE*.

Genus : SPONDYLUS, Linné, 1758.

SPONDYLUS RADULA, Lamarck.

(Plate III, fig. 10).

1806. *Spondylus radula*, Lamarck, *Ann. Mus. Hist. nat. Paris*, VIII, p. 351.
1810. *Spondylus radula*, Lamarck, *ibid.*, XIV, Pl. XXIII, fig. 5.
1824. *Spondylus radula*, Deshayes, Description des coquilles fossiles des environs de Paris, I, p. 320 ; Pl. XLVI, figs. 1-5.
1898. *Spondylus aegyptiacus*, Newton, *Geol. Mag.* [4], V, p. 536 ; Pl. XX, figs. 4-6.
1903. *Spondylus radula*, Oppenheim, *Palaeontographica*, XXX, Pt. 3, p. 62.
1903. *Spondylus aegyptiacus*, Oppenheim, *loc. cit.*, p. 63 ; Pl. III, figs. 1, 2.
1931. *Spondylus radula*, Cox, *Trans. R. Soc. Edin.*, LVII, Pt. 1, p. 68 (with further synonymy) ; Pl. III, figs. 23*a*, *b*.

Material.—Seven specimens [K9/762 (3), K9/763 (1), K9/769 (1), K9/773 (2)].

Remarks.—These are mostly internal moulds, but one specimen is a mould of the exterior of the shell clearly reproducing the ornamentation. This consists of numerous unequal, fine radial riblets, some of which bear short spines ; the most conspicuously spinose ones are distributed at nearly equal intervals apart. This ornamentation is closely comparable to that of Paris Basin specimens of *S. radula*.

[1] *Loc. cit.*, p. 104, (1903).
[2] 'Zur Stratigraphie Central-Asiens.' *Denkschr. Akad. Wiss. Wien*, LXI, p. 465, (1894).

Localities and Horizon.—Bahrein Island :—3 miles east of Rifaa; plateau in the south of the island; Hisai Jebel. Middle Eocene.

Family : *LUCINIDAE.*

Genus : LUCINA, Bruguière, 1797.

LUCINA METABLETA, Cossmann.

(Plate IV, fig. 3).

1901. *Lucina metableta*, Cossmann, *Bull. Inst. Égypt.*, [4], I, p. 195 ; Pl. III, figs. 11-13.
1903. *Lucina metableta*, Oppenheim, *Palaeontographica*, XXX, Pt. 3, p. 133 ; Pl. XIII, figs. 9-11.
1931. *Lucina metableta*, Cox, *Trans. R. Soc. Edin.*, LVII, Pt. 1, p. 72 ; Pl. IV, fig. 2.

Material.—One specimen (K9/775).

Remarks.—This specimen, an internal mould, agrees well with published figures of *L. metableta*—particularly with Oppenheim's fig. 10—and with numerous specimens from the Eocene of Somaliland which I have examined.

Locality and Horizon.—3 miles north of Rifaa, Bahrein Island. Middle Eocene.

Sub-genus : LORIPINUS, Monterosato, 1883.

LUCINA (LORIPINUS) PHARAONIS, Bellardi.

(Plate IV, fig. 2).

1854. *Lucina pharaonis*, Bellardi, *Mem. Accad. Sci. Torino*, [2], XV, p. 190 ; Pl. II, fig. 12.
1854. *Lucina bialata*, Bellardi, *loc. cit.*, p. 191 ; Pl. II, fig. 7.
1854. *Lucina aegypthiaca*, Bellardi, *loc. cit.*, p. 191 ; Pl. II, fig. 8.
1854. *Lucina cycloidea*, Bellardi, *loc. cit.*, p. 192 ; Pl. III, fig. 3.
1854. *Lucina inflata*, Bellardi, *loc. cit.*, p. 192 ; Pl. II, fig. 11.
1854. *Lucina pharaonis*, d'Archiac & Haime, Animaux fossiles du groupe nummulitique de l'Inde, p. 354.
1854. *Lucina vicaryi*, d'Archiac & Haime, *loc. cit.*, p. 240 ; Pl. XVII, figs. 5, 5*a*.
1854. *Lucina subvicaryi*, d'Archiac & Haime, *loc. cit.*, p. 241 ; Pl. XVII, figs. 6, 6*a*.
1854. *Corbis ? elliptica*, d'Archiac & Haime, *loc. cit.*, p. 237 ; Pl. XVI, figs. 13, 13*a*.
1854. *Corbis ? subelliptica*, d'Archiac & Haime, *loc. cit.*, p. 238 ; Pl. XVI, figs. 14, 14*a*.
1862. *Lucina moevusi*, Coquand, Géologie et paléontologie de la région sud de la province de Constantine, p. 269 ; Pl. XXX, figs. 17, 18.
1883. *Lucina pomum*, Mayer-Eymar, *Palaeontographica*, XXX, Pt. 2, p. 70 ; Pl. XXIII, figs. 19 (?), 20, 21. (*Non* Dujardin.)
1901. *Lucina libyca*, Cossmann, *Bull. Inst. Égypt.*, [4], I, p. 195 ; Pl. III, figs. 16, 19.
1903. *Lucina pharaonis*, Oppenheim, *Palaeontographica*, XXX, Pt. 3, p. 124 ; Pl. XIII, figs. 1, 2 ; Pl. XV, fig. 6.
1903. *Diplodonta cycloidea*, Oppenheim, *loc. cit.*, p. 147 (*partim*) ; Pl. XIII, figs. 4, 7 (?) ; Pl. XVI, figs. 1, 1*a*, 7, 7*a*.
1903. *Diplodonta inflata*, Oppenheim, *loc. cit.*, p. 149 ; Pl. XVI, figs. 2, 3.
1910. *Lucina pharaonum*, Dareste de la Chavanne, *Mat. Carte géol. Algérie*, [1], No. 4, pp. 4, 40 ; Pl. I, figs. 2*a-c* ; Pl. V, fig. 7.

1921. *Lucina pharaonis*, Stefanini, *Pal. Ital.*, XXVII, p. 112; Pl. XVI, fig. 4.

1931. *Lucina (Loripinus) pharaonis*, Cox, *Trans. R. Soc. Edin.*, LVII, Pt. 1, p. 72; Pl. IV, fig. 8.

Material.—Four internal moulds [K9/767 (1), K9/770 (1), K9/800 (2)].

Remarks.—My reasons for proposing the above somewhat sweeping synonymy for this species were fully discussed in my previous paper. The specimens now recorded agree well with those from Egypt, Somaliland and India examined by me.

Localities and Horizon.—Bahrein Island:—Hisai Jebel; Rifaa; north-west of Rifaa. Middle Eocene.

Family: *CHAMIDAE.*

Genus: CHAMA, Linné, 1758.

CHAMA CALCARATA, Lamarck.

(Plate IV, figs. 9, 10).

1806. *Chama calcarata*, Lamarck, *Ann. Mus. Hist. nat. Paris*, VIII, p. 349.

1810. *Chama calcarata* Lamarck, *ibid.*, XIV, Pl. XXIII, figs. 4*a*, *b*.

1824. *Chama calcarata*, Deshayes, Description des coquilles fossiles des environs de Paris, I, p. 246; Pl. XXXVIII, figs. 5-7.

1886. *Chama calcarata*, Frauscher, *Denkschr. Akad. Wiss. Wien*, LI, p. 157.

1903. *Chama calcarata*, Oppenheim, *Palaeontographica*, XXX, Pt. 3, p. 119.

1911. *Chama calcarata*, Boussac, Études paléont. sur le Nummulitique alpin, p. 251.

Material.—Part of an external mould (K9/767); also an internal mould (K9/785), probably referable to this species.

Remarks.—The external mould clearly preserves the impression of the ornamentation characteristic of this species, consisting of erect, jagged, concentric laminae with irregularly spaced radial riblets crossing their interspaces. This is the most widespread species of *Chama* in the Middle and Upper Eocene of Europe; it also occurs in the Mokattam beds of Egypt.

Locality and Horizon.—Hisai Jebel, Bahrein Island. Middle Eocene.

Family: *CORBULIDAE.*

Genus: CORBULA, Bruguière, 1792.

Sub-genus: BICORBULA, P. Fischer, 1887.

CORBULA (BICORBULA) SUBEXARATA, d'Archiac & Haime.

(Plate IV, figs. 4, 5).

1854. *Corbula subexarata*, d'Archiac & Haime, Animaux fossiles du groupe nummulitique de l'Inde, p. 235; Pl. XVI, figs. 10, 10*a* (?), 11.

1906. *Corbula harpaeformis*, Oppenheim, *Palaeontographica*, XXX, Pt. 3, p. 193; Pl. XVIII, figs. 7-10.

1931. *Corbula (Bicorbula) subexarata*, Cox, *Trans. R. Soc. Edin.*, LVII, Pt. 1, p. 84; Pl. IV, figs. 14*a*, *b*.

Material.—Six internal moulds of right valves and one mould of the exterior of a left valve [K9/760 (1), K9/775 (2), K9/791 (3), K9/800 (1)].

Remarks.—As explained in my previous paper, the differences between this species and *C. exarata*, Lamarck, of the Middle Eocene of Europe, are that the umbones are placed in a more median position, the posterior end of the shell tapers more, and the left valve is strongly ribbed instead of smooth. The internal moulds of right valves in the material now described do not bear any impression of the ornamentation of the exterior of the shell, but agree very well in shape with Indian specimens of *C. subexarata*. The mould of the exterior of a left valve, on which the impression of the ornamentation is most fortunately clearly preserved, shows strong concentric ribbing, confirming the specific identification of the specimens.

Localities and Horizon.—Bahrein Island :—Rifaa ; 3 miles east of Rifaa ; Hisai Jebel. Middle Eocene.

IV.—FOSSILS OF OLIGOCENE AGE.

Class : LAMELLIBRANCHIATA.

Family : *MYTILIDAE.*

Genus : Mytilus, Linné, 1758.

Mytilus persicus, sp. nov.

(Plate V, fig. 5).

Material.—The holotype only (K9/977).

Specific Characters.—Shell large, gibbose, tall and narrow, elongated in a direction making an angle of about 60° with the hinge-margin ; hinge-margin short, occupying less than one-half of total length. Postero-dorsal and ventral margins straight, parallel ; ' buccal ' region not at all convex ; umbones terminal. The valves are strongly swollen diagonally, but are not carinate. Growth-rugae pronounced.

Dimensions—

Length (parallel to hinge-margin)	75 mm.
Height (perpendicular to hinge-margin)	105 mm.
Inflation	49 mm.

Remarks.—No *Mytilus* comparable in size and shape has been described from the Eocene or Oligocene previously. The Middle Fars species described by Douglas[1] as *M. plenus* resembles this species in its parallel-sided shape and is almost as large, but is much broader.

Locality and Horizon.—Just below Godar bridge (God-i-Balutek), Karun river, Bakhtiari country. From the Nummulitic limestone, probably of Oligocene age.

[1] Contributions to Persian Palaeontology, III, p. 10 ; Pl. XII, (1928).

Genus : LITHOPHAGA, Bolten, 1798.

LITHOPHAGA CORDATA (Lamarck).

(Plate IV. fig. 13).

1807. *Modiola cordata*, Lamarck, *Ann. Mus. Hist. nat. Paris*, IX, p. 237 ; Pl. XVIII, fig. 2.
1824. *Modiola cordata*, Deshayes, Description des coquilles fossiles des environs de Paris, I, p. 268 ; Pl. XXXIX, figs. 17—19.
1870. *Lithodomus cordatus*, Fuchs, *Denkschr. Akad. Wiss. Wien*, XXX, p. 168.
1886. *Lithophagus cordatus*, Frauscher, *Denkschr. Akad. Wiss. Wien*, LI, p. 118 ; Pl. VI, figs. 11*a*, *b*.
1922. *Lithodomus* (*Botula*) *cordata*, Cossmann, *Mém. Soc. géol. France*, (Pal.), No. 55, p. 155 ; Pl. IX, figs. 13-15.

Material.—One specimen (K21/239).

Remarks.—This specimen agrees very closely with Cossmann's figure (*loc. cit.*) of a specimen of *L. cordata* from the Middle Eocene of Aquitaine. It measures 31 mm. in length and thus is about twice as long as specimens from the Paris Basin (the type-locality), but of the same length as Cossmann's specimen from Aquitaine and the largest specimens from the Alpine Eocene recorded by Frauscher (*loc. cit.*).

L. cordata is typically a Middle Eocene species, but Fuchs (*loc. cit.*) has recorded it from the Middle Oligocene of Monte Grumi, near Verona. Oppenheim[1], however, states that he has seen only one specimen at all like this species from the Oligocene of Venetia, while Sacco and Rovereto do not record it from the Ligurian Oligocene. A Priabonian specimen figured by Oppenheim[2] under the name *Lithodomus hortensis*, Vinassa de Regny, may belong to *L. cordata*. A Lower Miocene descendant of this species bears d'Orbigny's name *L. subcordata*. According to Cossmann and Peyrot[3], who figure specimens from the Aquitanian of Aquitaine, there are certain slight differences in shape between this form and *L. cordata*, but these differences appear inappreciable to me and I think that the two forms should probably be regarded as synonymous.

Localities and Horizon.—Kishar Bala, Khamir, southern Persia, '600 ft. below gypsum bed'. Oligocene.

Family : *OSTREIDAE*.

Genus : OSTREA, Linné, 1758.

OSTREA KHAMIRENSIS, sp. nov.

(Plate V, figs. 2-4).

Material.—Nine left valves [K21/237 (2), K21/243 (3), K21/252 (4)], of which the one represented in figs. 3*a*, *b*, (K21/237) is selected as holotype.

Specific Characters.—Of medium size, ovate, with the height usually slightly exceeding the length, and sometimes with a well-developed posterior lobe. Left

[1] *Zeitschr. deutsch. geol. Ges.*, LII, p. 264, (1900).
[2] *Palaeontographica*, XLVII, p. 147 ; Pl. XVI, fig. 9, (1901).
[3] *Actes Soc. Linn. Bordeaux*, LXVIII, p. 22 ; Pl. XVI, figs. 15-19, (1914).

valve very thick-shelled, strongly and fairly evenly convex; attachment-area fairly small; surface of valve ornamented with a few depressed, rounded radial ribs, in the spaces between which obscure, narrow riblets sometimes occur; growth-stages well marked, sometimes imbricating at irregular intervals, especially on the ribs. Marginal region of interior delicately frilled, the frilling being most conspicuous on the anterior side; ligamental area small, scarcely undercut, with the ligamental groove strongly concave; adductor scar orbicular, very deeply impressed. Right valve unknown.

Dimensions.—The measurements of the holotype are as follows:—

Length	53·7 mm.
Height	64·0 mm.
Inflation	27·0 mm.

The largest specimen, which is much eroded, is 91·5 mm. in height.

Remarks.—The delicate frilling of the internal marginal region serves to distinguish this species from *O. protoimbricata*, Vredenburg[1], from the Oligocene of Sind, and the species from the Aquitanian (?) of Central Persia described by Fuchs[2] as *O. virleti*, Deshayes; *O. protoimbricata*, moreover, appears to be a comparatively thin-shelled form. Fuchs's form may be identical with *O. praevirleti*, Douglas[3], the type-specimen of which is much less strongly convex than the form now described.

Locality and Horizon.—Khamir, southern Persia. Oligocene.

Family: *PECTINIDAE.*

Genus: PECTEN, Müller, 1776.

Sub-genus: AMUSSIOPECTEN, Sacco, 1897.

PECTEN AMUSSIOPECTEN cf. LABADYEI, d'Archiac & Haime.

(Plate V, fig. 1).

The following are references to descriptions of the type-form:—

1854. *Pecten labadyei*, d'Archiac & Haime, Animaux fossiles du groupe nummulitique de l'Inde, p. 271; Pl. XXIV, fig. 2.

1928. *Pecten* (*Amussiopecten*) *labadyei*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 430 (*partim*).

Material.—One specimen (K21/238).

Description.—This is a broken valve (probably a right one), flabelliform in shape, somewhat longer than high, and very feebly convex; when complete, its height was about 45 mm. It is ornamented with depressed radial ribs separated by interspaces of about their own width; the total number of ribs on the complete valve was about 18. In uneroded places it can be seen that ribs and interspaces are crossed transversely by very fine, regularly spaced threads. There is no tendency for the ribs to become effaced near the ventral margin.

[1] *Mem. Geol. Surv. Ind.*, L, p. 425; Pl. XXIII, figs. 3-7, (1928).
[2] *Denkschr. Akad. Wiss. Wien*, XLI, p. 106; Pl. IV, figs. 1-9, (1879).
[3] Contributions to Persian Palaeontology, III, p. 14, Pl. XIV, figs. 3, 4, (1928).

Remarks.—This shell is more flabelliform than the holotype of *P. labadyei*, from the Oligocene of India. Hence the ribs are somewhat more divergent, although their number is about the same as in that species. The type of *P. labadyei* has a similar ornamentation of fine transverse threads.

I think that Vredenburg (*loc. cit.*) is probably wrong in referring one of the type-specimens of *P. hopkinsi*, d'Archiac & Haime[1], to *P. labadyei*. The specimen in question has 21 ribs, excluding some faint ones near the auricular margins, so that its ribs are much more closely spaced than in *P. labadyei*. Vredenburg also unites *P. pasinii*, Meneghini[2], from the Lower Miocene of Sardinia, with *P. labadyei*. Both *P. pasinii* and the form from the Schio beds of Monte Brione referred to it by Schaffer[3], but referred to *P. vinassai*, Ugolini, by Depéret & Roman[4], are closely comparable to *P. labadyei*, and have their ribs similarly ornamented with fine transverse threads. They have, however, only 14—15 ribs, and their identity with the Indian form appears questionable.

Locality and Horizon.—Kishar Bala, Khamir, southern Persia, '600 ft. below gypsum bed'. Oligocene.

Family : *TELLINIDAE.*

Genus : TELLINA, Linné, 1758.

TELLINA PILGRIMI, sp. nov.

(Plate IV, figs. 11, 12*a*, *b*).

Material.—Two specimens (K21/263), both internal casts; the original of figs. 12*a*, *b*, is selected as holotype.

Specific Characters.—Trigonally ovate, not tapering much towards its extremities, evenly rounded anteriorly, obliquely truncated posteriorly; not very gibbose. Umbones obtusely angular, submedian. In the middle the ventral margin is deflected towards the left side of the shell and at its posterior end it is strongly deflected to the right. A deep but narrow sulcus runs in the left valve from behind the umbo to the postero-ventral corner of the shell, and a corresponding ridge is present in the right valve.

Dimensions.—The measurements of the holotype are as follows:—

Length	42·7 mm.
Height	31·1 mm.
Inflation	13·4 mm.

Remarks.—This species may belong to the genus *Apolymetis*, Salisbury [*Metis*, H. & A. Adams]. It does not closely resemble any Oligocene form hitherto described.

Locality and Horizon.—Kuh-i-Namek (about 24 miles N. of Bandar Abbas), Oligocene (*Nummulites fichteli*, Michelotti[5], extracted from matrix).

[1] *Loc. cit.*, p. 271; Pl. XXIV, fig. 3, *non* fig. 4, (1854).
[2] Paléontologie de l'ile de Sardaigne, p. 511; Pl. H, fig. 13, (1857).
[3] *Jahrb. k. k. geol. Reichsanst.*, XLIX, p. 661; Pl. XVII, figs. 1-3, (1900).
[4] *Mém. Soc. géol. France* (Pal.), No. 26, p. 157, (1912).
[5] I am indebted to my colleague Dr. H. D. Thomas for this determination.

V.—FOSSILS OF NEOGENE AGE.

Class: GASTROPODA.

Family: *TURRITELLIDAE.*

Genus: TURRITELLA, Lamarck, 1799.

TURRITELLA ANGULATA, J. de C. Sowerby.

(Plate VIII, figs. 20-24).

1840. *Turritella angulata*, J. de C. Sowerby, *Trans. Geol. Soc.*, [2], V, Pl. XXVI, fig. 7.
1840. *Turritella assimilis*, J. de C. Sowerby, *loc. cit.*, Pl. XXVI, fig. 8.
1928. *Turritella angulata*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 378.
1928. *Turritella assimilis*, Vredenburg, *loc. cit.*, p. 377.

Material.—Numerous specimens (K16/846, K16/487, K16/848) in the G. S. I. Coll. and two (G. 36956-7, collected by Drs. B. K. N. Wyllie and J. V. Harrison) in the British Museum Coll.

Remarks.—Vredenburg, in his description of the Turritellas of the Mekran beds, gives a long synonymy for *T. angulata*, but considers *T. assimilis* (already placed in its synonymy by d'Archiac & Haime) to be distinct. After studying the series of specimens now described I have come to the conclusion that it is as impossible to separate this form from *T. angulata* as it is the other forms placed by Vredenburg in its synonymy.

The ornamentation of *T. angulata* originates on its early whorls with three primary spirals, to which a fourth is soon added adjacent to the anterior suture. In the form *assimilis* these four remain of equal strength on the later whorls and very weak spiral threads become intercalated between them—in the case of its holotype, one between the posterior suture and the first carina and a second between the first and second carinae. The arrangement of the spirals is closely comparable in the form which Martin[1] figures as *T. duplicata*, Lamarck, but later[2] includes in his *T. djadjariensis*, and this is one of the forms which Vredenburg includes in the synonymy of *T. angulata*.

Many of the specimens numbered K16/846 and now described are quadricarinate forms closely comparable to the holotype of *T. assimilis*. In others, however, the third (most anterior) primary spiral becomes much stronger than the other two and the whorls become subangular. Finally, specimens in which the secondary threads on the posterior part of the whorl are of the same strength as the two primary ones, and in which the third primary spiral forms a well-defined angle, are identical with typical *T. angulata*.

In other specimens the whorl remains convex and several secondary spirals attain almost the same strength as the primary ones. This variety appears to be identical with the form from Java described by Martin[3] as *T. bandongensis*, although it is probable that the form from the Mekran beds recorded by

[1] Die Tertiärschichten auf Java, p. 69; Pl. XI, fig. 13, (1879).
[2] *Samml. geol. Reichs-Mus. Leiden*, N. S., I. p. 228; Pl. XXXIV, figs. 532-8, (1905).
[3] Die Tertiärschichten auf Java, p. 68; Pl. XI, figs. 12, 12*a*, (1879).

Vredenburg under that name is the distinct species described below as *T. harrisoni*. *T. bantamensis*, Martin[1], is another form in which the spirals have essentially the same arrangement, and I doubt if its more acute shape justifies its specific separation from *T. angulata*. Vredenburg, however, regards it as distinct and records it from the Mekran beds.

The two specimens (G. 36956-7) have two spiral carinae and are closely comparable to specimens from Java figured by Martin[2] as *T. acuticarinata*, Dunker; this is one of the forms included by Vredenburg in the synonymy of *T. angulata*.

Localities and Horizon.—Pozug, eastern Persia; Chah Bashua plain, eastern Persia (G. S. I. Coll.). Hushdan, 12 miles north-east of Jask (British Museum). Pliocene (Mekran beds).

TURRITELLA HARRISONI, sp. nov.

(Plate VIII, figs. 25-29).

Material.—Several specimens (K16/838) in the G. S. I. Coll., of which the one represented in fig. 26 is selected as holotype. Three specimens (G. 36938, G. 36958-9, collected by Drs. B. K. N. Wyllie and J. V. Harrison) in the British Museum Coll.

Specific Characters.—Shell acute, apical angle about 11°. Whorls convex, sometimes with an anterior angularity in their profile, and ornamented with rather depressed spiral cords, five of which are present on the earliest preserved whorls, increasing in number to a varying extent on later whorls by the intercalation of secondary threads. Each suture is bordered by a comparatively wide band on which spiral ornamentation is absent or confined to weak threads. Of the five primary spirals, the three more posterior ones are weaker than the other two, the posterior of which may be the stronger, forming the angle in the whorl profile; usually one of the secondary threads becomes as strong as the three more posterior primary ones, with which it remains associated. The later whorls thus usually have six conspicuous spiral cords rather crowded towards the central part of the whorl, with weaker spirals above, between, and below them; but the weaker spirals are occasionally absent. The growth-lines meet the posterior suture at a very acute angle, and sweep round so as to meet the anterior suture nearly at right angles.

Dimensions.—The measurements of the largest specimen (G. 36938) are:

Height (original, estimated)	60 mm.
Diameter	18 mm.

Remarks.—Its greater acuteness and its more numerous primary spirals distinguish this species from round-whorled varieties of *T. angulata*. This may, however, be the species from the Mekran beds which Vredenburg[3] refers to *T. bandongensis*, Martin, but does not figure. As stated above (p. 38), the original *T. bandongensis*, from Java, appears to me to be a variety of *T. angulata*;

[1] *Samml. geol. Reichs-Mus. Leiden.* N. S., I, p. 230; Pl. XXXV, figs. 539-45, (1905).
[2] Die Tertiärschichten auf. Java, p. 69; Pl. XII, figs. 4, 4*a*, (1879).
[3] *Mem. Geol. Surv. Ind.*, L, p. 377, (1928).

it is, however, unfortunate that its early whorls are unknown. The species now described differs from the Recent form *T. terebra*, Lamarck, in its less strongly convex and wider whorls and in the more numerous spirals which ornament its later whorls. It may conceivably be identical with the species from the Upper Miocene of Java which Martin[1] figures as '*T. terebra* var.'; its whorls appear, however, to be slightly less convex.

Localities and Horizon.—Nur Mohammadi, eastern Persia (G. S. I. Coll.); Hushdan, 12 miles north-east of Jask (British Museum). Pliocene (Mekran beds).

Family: *NASSARIIDAE.*

Genus: NASSARIUS, Duméril in Froriep, 1806.

NASSARIUS PERSICUS, sp. nov.

(Plate VIII, figs. 19*a*, *b*).

Material.—Two specimens (K16/843); the figured one is selected as holotype.

Specific Characters.—Biconical, with an acute spire occupying one-half of the total height. Spire whorls very feebly convex; last whorl at first with evenly convex sides, subsequently becoming flattened laterally and developing a distinct shoulder just before the aperture. Sculpture consisting of slightly sinuous, rounded axial costae which are slightly procurrent with respect to the posterior suture; their spacing varies considerably, but on the greater part of the surface they are separated by interspaces slightly wider than themselves; fine spiral threads ornament the interspaces. The base of the shell is ornamented with spiral threads which alternate in strength and cross the thinning lower ends of the axial costae. A conspicuous siphonal fasciole corresponds to the deep basal notch of the aperture.

Dimensions.—The measurements of the holotype are as follows:

Height	17·0 mm.
Diameter	10·0 mm.

Remarks.—This species is quite distinct from those representatives of its genus recorded by Vredenburg from the Mekran beds. *N. costatus* (A. Adams), from Burias I., is the most closely comparable Recent species, but is distinguished by the tubercles which crown its axial costae.

Locality and Horizon.—Nur Mohammadi, eastern Persia. Pliocene (Mekran beds).

Family: *MURICIDAE.*

Genus: RAPANA, Schumacher, 1817.

RAPANA MEKRANICA, sp. nov.

(Plate VIII, figs. 17, 18*a*, *b*).

Material.—One imperfect specimen (K16/841) and one internal cast (K16/842) in the G. S. I. Coll. Six more complete specimens (G. 36939-41, G. 36962,

[1] *Samml. geol. Reichs-Mus. Leiden*, N. S., I. p. 232; Pl. XXXV, fig. 548, (1905).

G. 36967, G. 36973, collected by Drs. B. K. N. Wyllie and J. V. Harrison) in the British Museum; G. 36940 (figs. 18*a*, *b*) is selected as holotype.

Specific Characters.—Stoutly piriform, with the spire occupying about one-quarter of the total height. Spire whorls with low, flat, vertical sides separated by a marked angle, at which tubercles or short spines are developed, from a wide, flat or feebly convex, gently sloping shoulder; sutures simple. Anterior to the shoulder angle (which may have become less well defined than on the spire whorls) the profile of the last whorl is at first obtusely angular or strongly convex, but more anteriorly is well excavated at the origin of a short, stout stem, in which a wide false umbilicus is included between the reflected inner lip and a rugose siphonal fasciole. The obtuse angle in the profile, which in most specimens corresponds to the anterior limit of the rather narrow vertical part of the whorl, occupies a position slightly anterior to a line producing the last suture, and may bear very obscure tubercles. Two obscure spiral ridges may be developed still more anteriorly, on the lower slope of the whorl. The finer ornament consists of fine, inequidistant, incised spiral lines, which extend over the entire surface and are even perceptible on the siphonal fasciole; about 8-10 of these are present on the whorl shoulder and about 30 on the remainder of the surface of the last whorl. Growth-layers of the shell imbricate appreciably only on the latter part of the last whorl of the largest specimen.

The apertural characters are not clearly visible, but appear similar to those of other species of the genus. The anterior canal has a deep basal notch.

Dimensions.—The dimensions of the holotype and largest paratype (G. 36973, fig. 17) are as follows:

	Holotype.	Paratype.
Height	37·5	53·5 mm.
Diameter	35·0	54·0 mm.

Remarks.—This species closely resembles the living Indo-Pacific form *R. bezoar* (Lamarck), but differs in the details of its spiral sculpture, while the shoulder of its last whorl lacks the crenulated imbricating shell-laminae which characterise that species. *R. bulbosa* (Solander), another living Indo-Pacific species, is distinguished by its deeply channelled sutures and by differences in spiral sculpture; Vredenburg[1] refers a single specimen from the Mekran beds to this species, and it would be interesting to check his determination.

Localities and Horizon.—Nur Mohammadi, eastern Persia (G. S. I. Coll.). Kargoskhi, near Jask; Hangar near Jargin R., 26 miles E. N. E. of Jask; Hushdan, 12 miles north-east of Jask (British Museum). Pliocene (Mekran beds).

Family: *TURRIDAE.*

Genus: CLAVATULA, Lamarck, 1801.

CLAVATULA TIPPERI, sp. nov.

(Plate VIII, fig. 16).

Material.—The holotype only (K16/843), consisting of the greater part of the last three whorls of the shell.

[1] *Mem. Geol. Surv. Ind.*, L, p. 233, (1925).

Specific Characters.—Spire whorls rather high-embracing, with a fairly prominent, convex, slightly puckered sutural band occupying the posterior quarter of their width, a concave anal fasciole occupying the next quarter, and a strongly convex, axially ribbed band occupying their anterior half. The sutural band bears three linear grooves; the anal fasciole, on which the growth-lines are deeply sinuate, also bears three linear grooves, which are more obscure than those on the sutural band. The ribs on the convex anterior part of the whorls are very prominent, slightly retrocurrent with respect to the posterior suture, and separated by interspaces of approximately their own width; these interspaces bear five linear spiral grooves, which are obscurely visible on the ribs also. On the last whorl the anal fasciole becomes appreciably wider at the expense of the axially ribbed part of the whorl, but at the same time the axial ribs become very prominent, especially at their posterior ends. The part of this whorl anterior to a line producing the final suture bears three fairly strong, tuberculate spiral bands, while several other, less prominent, spirals ornament the stem of the shell. The anterior canal and outer lip are broken away in the holotype.

Dimensions.—The original height of the holotype may be estimated very roughly as 30 mm.; its maximum diameter is 11 mm.

Remarks.—Vredenburg[1] refers a shell from the Mekran beds to the Recent West African species *Clavatula sacerdos* (Reeve), but does not figure it. He states that its characters are identical with those shown in the figure given by Reeve except that the sutural band is not puckered. I have compared the shell now described with Reeve's type and find that it is more slender, while its sutural band is more prominent and its axial ribs are much more elongate. It therefore appears to be distinct from the form recorded by Vredenburg. The most similar species in the Recent fauna is *C. pyramidata* (Kiener), also from West Africa, but in that form the axial costae are more delicate and more numerous. The Burmese Oligocene and Aquitanian species *C. protonodifera*, Noetling[2], is also comparable.

Locality and Horizon.—Nur Mohammadi, eastern Persia. Pliocene (Mekran beds).

Family: *CONIDAE.*

Genus: CONUS, Linné, 1758.

Subgenus: DENDROCONUS, Swainson, 1840.

CONUS (DENDROCONUS) LOROISII, Kiener.

(Plate VIII, figs. 14, 15).

1847. *Conus loroisii*, Kiener, Iconographie des coquilles vivantes, Genre Cône, p. 91; Pl. LXV, fig. 1.

1925. *Conus (Dendroconus) loroisii*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 93.

Material.—Three specimens [K16/839 (1), K16/840 (2)] in the G. S. I. Coll. and one specimen (G. 36943, collected by Drs. B. K. N. Wyllie and J. V. Harrison) in the British Museum Coll.

[1] *Mem. Geol. Surv. Ind.*, L, p. 29, (1925).

[2] *Pal. Ind.*, N. S., I, p. 350; Pl. XXIII, figs. 3, 4, (1901). I am indebted to Mr. F. E. Eames for information as to the horizons of the Burmese species described by Noetling.

Remarks.—I accept Vredenburg's determination for this species of the Mekran beds. *C. loroisii* is often regarded as a variety of *C. figulinus*, Linné.

Localities and Horizon.—Nur Mohammadi, eastern Persia (G. S. I. Coll.); Hushdan, 12 miles north-east of Jask (British Museum). Pliocene (Mekran beds).

Class: LAMELLIBRANCHIATA.

Family: *ARCIDAE.*

Genus: NAVICULA, Blainville, 1825.

NAVICULA cf. AVELLANA (Lamarck).

(Plate V, fig. 7).

The following are references to descriptions of *N. avellana*:—

1819. *Arca avellana*, Lamarck, Histoire naturelle des animaux sans vertèbres, VI, Pt. 1, p. 38.
1844. *Arca maculata*, Reeve, Conch. Icon., II, *Arca* sp. 71.
1844. *Arca imbricata*, Reeve, *loc. cit.*, *Arca* sp. 73. (*Non* Bruguière.)
1844. *Arca cunealis*, Reeve, *loc. cit.*, *Arca* sp. 87.
1844. *Arca volucris*, Reeve, *loc. cit.*, *Arca* sp. 109.
1849. *Arca kraussii*, Krauss, Südafrikanischen Mollusken, p. 14; Pl. I, fig. 13.
1907. *Arca imbricata* var. *avellana*, Lamy, *Journ. de Conch.*, LV, p. 28.
1932. *Arca* (*Navicula*) *avellana*, Prashad, *Siboga-Exped. Monogr.*, LIIIc, p. 32 (with complete synonymy).

Material.—One specimen (K9/895).

Remarks.—The genus *Navicula* (the posteriorly carinate, inequilateral group of the Arcidae typified by *A. noae*, Linné) is represented by a cast 25·5 mm. in length and closely comparable to Recent specimens of this widespread Indo-Pacific species.

Locality and Horizon.—Daliki bridge, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Genus: ANADARA, Gray, 1847.

ANADARA cf. ANTIQUATA (Linné).

(Plate V, fig. 8).

The following are references to recent discussions of *A. antiquata*:

1927. *Anadara antiquata*, Cox, Report on the Palaeontology of the Zanzibar Protectorate, p. 94.
1930. *Anadara antiquata*, Cox, *Mon. Geol. Dept. Hunterian Museum, Glasgow Univ.*, IV, pp. 121, 150.
1932. *Arca* (*Anadara*) *antiquata*, Prashad, *Siboga Exped. Monogr.*, LIIIc, p. 35.

Material.—Two specimens (K9/952, K21/215) in the G. S. I. Coll. and two (L. 39716, L. 39855, collected by Drs. B. K. N. Wyllie and J. V. Harrison) in the British Museum Coll.

Description and Remarks.—The specimens in the Geological Survey of India material are crushed moulds of single valves of an ovate *Anadara* about 65 mm.

in length and 44 mm. in height, with broad, obtuse, and not very prominent umbones placed between the anterior quarter and third of the length. The total number of ribs may be estimated at about 34. The British Museum specimens are uncrushed moulds of bivalve specimens with about the same number of ribs. These specimens agree well with *A. antiquata* in shape and are most probably referable to that species. As recorded in my previous papers, its known range is from Miocene to Recent.

Localities and Horizons.—Close to Latidun, west of Bandar Abbas (G. S. I. Coll.). Burdigalian.

Near Chinar Rahdar, south-western Persia (G. S. I. Coll.). Dasht-i-Qil (Qashgai district) and Jamal-i-Kar, both south-western Persia (British Museum). Vindobonian (Middle Fars or *O. virleti* beds).

Genus: CUCULLAEA, Lamarck, 1801.

CUCULLAEA FARSENSIS, sp. nov.

(Plate V, figs. 6*a*, *b*).

Material.—The holotype (K9/955) in the G. S. I. Coll. Also three specimens (L. 39734, L. 39857, L. 39923, collected by Drs. B. K. N. Wyllie and J. V. Harrison) in the British Museum Coll.

Specific Characters.—Shell trapeziform, not very elongate, moderately gibbose, most inflated just in front of the posterior carina. Umbones moderately prominent, slightly acute, not greatly separated, slightly anterior to median; posterior carina persistent right to the umbones. Posterior margin nearly straight, oblique, making an angle of about 120° with the hinge-margin; ventral margin straight, converging with the hinge-margin in an anterior direction; anterior margin evenly convex. Posterior area slightly concave. Sculpture (as seen by the traces preserved) consisting of radial striae cancellated near the umbones by concentric ones. Ventral margins apparently not crenulated.

Dimensions.—The measurements of the holotype are as follows:—

Length	53·0 mm.
Height	43·2 mm.
Inflation	38·0 mm.

Remarks.—The specimens on which this species is founded closely resemble the two species of the genus now living in the Indian Ocean, namely, *C. concamera* (Bruguière) and *C. granulosa*, Jonas; they are, however, considerably smaller than full-grown specimens of these forms. The main differences between the living species themselves are as follows:—*C. granulosa* is less elongate than *C. concamera* and has slightly less prominent umbones; its posterior margin and posterior area are convex, whereas the former is usually and the latter always concave in *concamera;* its posterior carina disappears near the umbo, whereas in *concamera* it is persistent; its most inflated region is just in front of the carina, whereas in *concamera*, which is more flattened laterally, it is considerably anterior to this; it is slightly inequivalve, whereas *concamera* is equivalve; it also differs in its more granulose sculpture and in the more dis-

tinct and regular crenulation of its ventral margin. The form now described agrees with *concamera* in the concavity of its posterior area and in the persistence of its posterior carina as far as the umbones, but it is less flattened laterally than that species and its most inflated region is nearer the carina; in this latter character it resembles *granulosa*. The holotype appears, like *granulosa*, to be slightly inequivalve, but this feature is not apparent in the other specimens. This Fars form is undoubtedly best regarded as a new species distinct from the living forms. It is quite different from the forms described from the Miocene of Burma and the East Indies.

Localities and Horizon.—Near Chinar Rahdar, south-western Persia (G. S. I. Coll.). Tang-i-Astaki, near Amiri; Kurruk, near Bikarz; Jamal-i-Kar [all south-western Persia] (British Museum). Vindobonian (Middle Fars or *O. virleti* beds).

Genus: LITHOPHAGA, Bolten, 1798.

LITHOPHAGA LITHOPHAGA (Linné).

(Plate V, figs. 14-17).

1758. *Mytilus lithophagus*, Linné, Systema Naturae, edit. 10, p. 705.

1867. *Lithodomus avitensis*, Mayer; Hoernes, *Abh. k. k. geol. Reichsanst.*, IV, p. 354; Pl. XLV, figs. 12*a-c*.

1898. *Lithophagus lithophagus*, Sacco, Molluschi dei terreni tertiarii del Piemonte e della Liguria, Part 25, p. 45; Pl. XII, figs. 11-14.

1914. *Lithodomus avitensis*, Cossmann & Peyrot, *Actes Soc. Linn. Bordeaux*, LXVIII, p. 18; Pl. XI, figs. 27-30.

1920. *Lithophagus lithophagus*, Dollfus & Dautzenberg, *Mém. Soc. géol. France* (Paléont.) No. 27, p. 390; Pl. XXXIV, figs. 13-18.

Material.—Numerous specimens (K9/887, K9/899, K9/914, K10/67).

Remarks.—These specimens are very similar to those from the Miocene of the Loire basin figured by Dollfus and Dautzenberg, who give a long synonymy of the species. I have also compared them with all the Recent representatives of the genus preserved in the British Museum (Natural History) and consider them to be inseparable from *L. lithophaga*. Transverse threads are well developed on the ventral portion of the shell except at its anterior and posterior extremities, but are absent from the dorsal half of the surface. The growth-corrugations are usually pronounced. The largest specimens are about 45 mm. in length.

This species first appears in the Aquitanian of south-western France, becoming very widespread in the Mediterranean region from the Middle Miocene onwards and remaining quite common in the Mediterranean at the present day. According to Dollfus and Dautzenberg it is also now living in the Indian Ocean and off New Caledonia and Japan. They include in its synonymy the species *L. nicobaricus* (Preston), from the Nicobar Islands, and it seems probable that the *L. robusta*, Jousseaume, MS., described by Lamy[1] from the Red Sea is another synonym.

[1] *Bull. Mus. Nat. Hist. Nat. Paris.* XXV, p. 253, (1919).

L. avitensis, a Miocene fossil form also to be included in its synonymy, was recorded by R. B. Newton[1] from the Pliocene or Pleistocene deposits of the Red Sea coast, but, as I have already recorded[2], the specimens examined by him belong to the more elongate and cylindrical species *L. teres* (Philippi). There are no other previous records of the occurrence of *L. lithophaga* fossil in the Indian Ocean region.

Localities and Horizons.—Between Daliki bridge and Konar Takhta; three miles south-west of Khaneh Zinian [both south-western Persia]. Vindobonian (Middle Fars or *O. virleti* beds).

Henjam I. Pliocene (*P. vasseli* beds).

Family: *ANOMIIDAE.*

Genus: ANOMIA, Linné, 1758.

ANOMIA sp.

Material.—Five specimens [K9/945 (3), K9/946 (2)].

Description.—An orbicular *Anomia*, moderately inflated and attaining a diameter of about 40 mm. Faint bifurcating radial ribs are visible in one specimen; they are less numerous and fainter than in the Recent Indian Ocean species *A. achaeus*, Gray. In all the specimens the greater part of the surface is missing owing to exfoliation; hence they cannot be considered specifically determinate.

Locality and Horizon.—Near Kotel Kamarij, south-western Persia. Upper Burdigalian ? (Lower Fars).

Family: *OSTREIDAE.*

Genus: OSTREA, Linné, 1758.

OSTREA LATIMARGINATA, Vredenburg.

1840. *Ostrea flabellulum*,, J. de C. Sowerby, *Trans. Geol. Soc.*, [2], V, Pl. XXV, fig. 18 (*non* Lamarck).

1908. *Ostrea latimarginata*, Vredenburg, *Rec. Geol. Surv. Ind.*, XXXVI, p. 317.

1909. *Ostrea latimarginata*, Vredenburg & Stuart, *Rec. Geol. Surv. Ind.*, XXXVIII, p. 127.

1927. *Ostrea latimarginata*, Douglas, Contributions to Persian Palaeontology, I, p. 3 (*partim*); Pl. I, figs. 1, 2.

1928. *Ostrea latimarginata*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 423; Pl. XXIV, fig. 2; Pl. XXIV*a*, fig. 1.

Material.—Broken specimens, represented partly by their impressions, and preserved in hard limestone (K9/941, K9/942, K9/944).

Remarks.—Of the two species of *Ostrea* from the Miocene of Kachh described by J. de C. Sowerby in 1840, his *O. angulata* must take the name *O. subangulata* d'Orbigny[3], while his '*O. flabellula* Lam.' is the form renamed *O.*

[1] *Geol. Mag.*, Decade iv, Vol. VII, p. 548, (1900).

[2] *Geol. Mag.*, LXVIII, p. 9, (1931).

[3] *See* Cox, *Mon. Geol. Dept. Hunterian Museum, Glasgow Univ.*, IV, p. 110, (1930).

latimarginata by Vredenburg and now recorded from Persia. The species recorded as '*O. multicostata*, Desh., var.' by d'Archiac & Haime[1] and renamed *O. blandfordiana* by Noetling[2] was considered by Vredenburg to be identical with Sowerby's *O. angulata*, but is included by Dr. J. A. Douglas in the synonymy of *O. latimarginata*. Vredenburg's interpretation is here accepted.

These forms, which belong to the group of *Ostrea* s. str., characterised by a ribbed lower valve and a smooth upper valve, both have an exceptionally wide, flattened border surrounding the relatively small visceral cavity in the lower valve. In *O. latimarginata* the ribs are narrower, more sinuous and branching, and weaker than in *O. subangulata*, and have a distinct tendency to fade away.

Pilgrim[3] states that, so far as the Fars series is concerned, this species is confined to the basal gypsum beds, and does not apparently pass up into the Plateau series (*O. virleti* beds). Douglas also states that in Persia its range 'does not encroach on that of the oysters which characterise the succeeding Middle Fars deposits (*O. virleti*, *O. digitata*, etc.)'. In India, according to Vredenburg, *O. latimarginata* characterises the Upper Gaj beds, which he refers to the Burdigalian. In Burma also it is confined to the Burdigalian.[4] Abundant specimens have recently been collected by Mr. H. St. J. B. Philby in Arabia, in the district south of the Gulf of Bahrein, while it is also represented in a collection from Portuguese East Africa which I have for study.

Localities and Horizon.—Near Chinar Rahdar; near Kotel Kamarij [both south-western Persia]. Upper Burdigalian? (Lower Fars).

OSTREA DIGITATA, Eichwald.

(Plate VII, fig. 1).

1830. *Ostrea digitata*, Eichwald, Naturhistorische Skizze von Lithauen, etc., p. 213.
1853. *Ostrea digitalina* (with vars. *ovalis* and *foveolata*), Eichwald, Lethaea Rossica, III, p. 58; Pl. III, figs. 14-17.
1870. *Ostrea digitalina*, Hoernes, *Abh. k. k. geol. Reichsanst.*, IV, p. 447; Pl. LXXIII, figs. 1-9.
1879. *Ostrea rholfsii*, Fuchs, *Denkschr. k. k. Akad. Wiss.*, XLI, p. 106; Pl. VI, figs. 5-8.
1883. *Ostrea digitalina* var. *rholfsi*, Fuchs, Palaeontographica, XXX, Pt. 2, pp. 44, 61; Pl. VII, figs. 3-6 & Pl. XVII, figs. 1, 3.
1901. *Ostrea promensis*, Noetling, *Pal. Ind.*, N. S., I, p. 109; Pl. II, fig. 3 & Pl. III, figs. 1, 2.
1909. *Ostrea promensis*, Martin, *Samml. geol. Reichs-Mus. Leiden*, N. S., I, p. 335; Pl. XLVI, figs. 7, 7*a*.
1911. *Ostrea digitalina* var. *rholfsii*, Vredenburg, *Rec. Geol. Surv. Ind.*, XLI, p. 38; Pl. VI, figs. 1-4.

[1] Animaux fossiles du groupe nummulitique de l'Inde, p. 273; Pl. XXIV, figs. 14, 14*a*, (1854).
[2] *Pal. Ind.*, N. S., Vol. I, p. 110, (1901).
[3] *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, p. 32, (1908).
[4] Mr. F. E. Eames informs me that the Pyalo and Kama stages of the Burmese Tertiary, in both of which this oyster occurs, are now known to be approximately contemporaneous.

1914. *Ostrea digitalina*, Cossmann & Peyrot, *Actes Soc. Linn. Bordeaux*, LXVIII, p. 181; Pl. XX, figs. 1-4.

1927. *Ostrea digitata*, Douglas, Contributions to Persian Palaeontology, I, p. 9; Pl. III, figs. 1, 2 & Pl. IV, figs. 2, 3.

1928. *Ostrea digitalina* var. *rholfsii*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 424.

1931. *Ostrea* (*Euostrea*) *digitalina*, Vialov, *Bull. Geol. Prosp. Serv. U. S. S. R.*, L, p. 669; Pl. I, figs. 2-5, Pl. II, fig. 3 & Pl. III, fig. 9.

Material.—A fragment of a lower valve (K9/921) and three upper valves (K21/213, K21/230, K21/234).

Remarks.—Although Eichwald's original description of *O. digitata* was unaccompanied by a figure, it may be assumed that the specimens from the type-locality figured under the emended name *O. digitalina* in his 'Lethaea Rossica' belong to the same species, since a reference is given to the original description; they may even be the original types. Although most authors, including Eichwald himself, have regarded the form figured by du Bois de Montpéreux[1] as *O. digitalina* as the same species as *O. digitata*, this is by no means certain, as Dr. J. A. Douglas has pointed out. The radial ribs appear to be much less persistent than in *O. digitata* and the imbricating lamellae more distant and more prominent. It is possible that the figures are misleading or the specimen chosen for illustration an abnormal one; but we need not trouble about its identity if we abandon the name *O. digitalina* in favour of *O. digitata* and base our conception of that species on the 'Lethaea Rossica' figures, which undoubtedly represent the *O. digitalina* of authors.

The Lower Miocene form from Burma described by Noetling as *O. promensis* has been shown by Vredenburg to be identical with *O. digitata*, while Dr. J. A. Douglas has already described and figured specimens of this species from the Middle Fars of Persia. Vredenburg also records the species from the Talar stage of the Mekran beds, so that it is obviously one of long range, valueless for dating the beds in which it occurs.

The specimens now recorded are too few for it to be possible to add anything to the description of the species given by Dr. Douglas.

Localities and Horizons.—8 miles W. S. W. of Latidun, 100 ft. above gypsum; close to Latidun; Tang Khah gorge, north of Kishar Bala [all west of Bandar Abbas]. Burdigalian. 2 miles from camp at Rahdar on Shahpur River, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Sub-genus: Crassostrea, Sacco, 1897.

Ostrea (Crassostrea) gryphoides (Schlotheim).

1813. *Ostracites gryphoides*, Schlotheim, Leonhard's *Taschenbuch*, VII, p. 52.

1813. *Ostracites gingensis*, Schlotheim, *loc. cit.*, p. 72.

1920. *Ostrea* (*Crassostrea*) *gryphoides*, Dollfus & Dautzenberg, *Mém. Soc. géol. France* (Pal.), no. 27, p. 465; Pl. XLIX, figs. 1-5 & Pl. L, figs. 1-5.

1927. *Ostrea gryphoides*, Cox, Report on the Palaeontology of the Zanzibar Protectorate, p. 36; Pl. III, fig. 4 & Pl. V, figs. 7, 8.

[1] Conchologie fossile des formations du plateau Wolhyni-Podolien, p. 74; Pl. VIII, figs. 13, 14, (1831).

1928. *Ostrea gingensis*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 427.
1928. *Ostrea pseudocrassissima* Fuchs; Vredenburg, *loc. cit.*, p. 427.

Material.—Several specimens (K16/836).

Remarks.—These specimens attain a length of 21 cm., while their thickness may be as much as 8 cm. Frequently the ligamental area is very long in proportion to the length of the specimen, attaining a length of 8 cm. or more. It has apparently continued to increase regularly in length after the stage when continued growth of the shell itself has been marked mainly by increase in its thickness. In such specimens the muscle scar is very near the ventral margin, which is rather wide and flattened.

Locality and Horizon.—Tiz, eastern Persia. Pliocene (Mekran beds).

Sub-genus: LOPHA, Bolten, 1798.

OSTREA (LOPHA) VIRLETI, Deshayes.

(Plate VII, fig. 2).

1833. *Ostrea virleti*, Deshayes, Expédition scient. Morée, III, Pt. 1, p. 123; Pl. XXI, figs. 1, 2.
1901. *Ostrea peguensis*, Noetling, *Pal. Ind.*, N. S., I, Pt. 3, p. 107; Pl. II, figs. 1, 2.
1901. *Ostrea hyotiformis*, E. Philippi, *Zeitschr. deutsch. geol. Ges.*, LIII, p. 305, text-fig. 3.
1927. *Ostrea virleti*, Cox, Report on the Palaeontology of the Zanzibar Protectorate, p. 66; Pl. XI & Pl. XVI, fig. 1.
1927. *Ostrea hyotiformis*, Cox, *loc. cit.*, p. 69; Pls. XIII, XIV & Pl. XV, fig. 4.
1927. *Ostrea* (*Alectryonia*) *virleti* (with var. *persica*), Douglas, Contributions to Persian Palaeontology, I, pp. 6, 8; Pl. I, fig. 3 & Pl. II, figs. 1, 2.
1928. *Ostrea virleti*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 426.
1929. *Ostrea virleti*, Cox, *Proc. Malac. Soc. London*, XVIII, p. 177.
1930. *Ostrea virleti*, Cox, *Mon. Geol. Dept. Hunterian Mus., Glasgow Univ.*, IV, pp. 127, 155; Pl. XV, figs. 9, 10.

Material.—Numerous specimens (K9/900, K9/903, K9/904, K9/905, K9/915, K9/921, K9/927, K9/936, K9/938, K21/212, K21/214, K21/234, K21/247, K21/255, K21/268).

Remarks.—When discussing the Zanzibar specimens in 1927, I pointed out that Deshayes' original figure of *O. virleti* represents a specimen with a deep, thick, plicated lower valve and an almost flat and unplicated upper valve, the typical *O. virleti* being thus identical with the form later described by G. B. Sowerby as *O. crassicostata*. In the Miocene of Egypt the commonest variety of the species is a form in which both valves have eight or more deep and occasionally bifurcating, subspinose plications. Dr. J. A. Douglas has proposed to distinguish this variety, which also occurs in Persia, East Africa, Burma, and elsewhere, by the name *O. virleti* var. *persica*, but Noetling's prior name *peguensis* might have been used instead as the varietal name; that is, if we exclude from consideration the West Indian fossil forms which appear identical with it (*see* Cox, 1927, p. 69).

When describing the Zanzibar fossils I accepted *O. hyotiformis*, E. Philippi, characterised by its saddle-like shape, as a species distinct from *O. virleti*, and referred to its presence in the Persian Miocene. Judging by the specimens in Dr. Pilgrim's collection, now described, this appears to be the commonest form from Persia which has been recorded as *O. virleti*, and one of the specimens figured by Dr. Douglas (*loc. cit.*, Plate I, fig. 3) under that name is referable to it. This form apparently intergrades with the 'var. *persica*' and must therefore be included in the species *O. virleti*, but it is certainly well enough characterised to rank as a definite variety. The specimens from a presumably Burdigalian horizon in the Bandar Abbas district are closely comparable to those from the Vindobonian (Middle Fars) of the Bushire district, and include the var. *hyotiformis*.

The relationship of these forms to the living Indo-Pacific species O. *hyotis* (Linné) has also been discussed by me previously, and I have shown that specimens inseparable from *O. virleti* occur in the Pleistocene of East Africa. The only difference which I thought could be established between *O. hyotis* and *O. virleti* was that the latter is a thicker-shelled form. Dr. B. Prashad[1] states, however, that old shells of *O. hyotis* 'often have, for their size, a remarkably thick shell, and the tubiferous spines on the ridges are also absent'. *O. virleti* would appear to be inseparable from such specimens, while the saddle-like shape of its var. *hyotiformis* can be matched among numerous specimens of the Recent form. It therefore seems not improbable that it will eventually prove necessary to include *O. virleti* and its varieties in the specific synonymy of *O. hyotis*, thus reverting to the determination of the fossil form made by some of the earlier workers.

Localities and Horizons.—Close to Latidun (west of Bandar Abbas); 8 miles W. S. W. of Latidun, 100 ft. above gypsum horizon. Burdigalian.

Seven miles north-east of Latidun, going towards Tang Saubat; Ab-i-Mar hills, close to station [both west of Bandar Abbas]. Vindobonian.

Daliki bridge; Kotel Kamarij; two miles, also three miles, down the Shahpur river from Rahdar camp; 3 miles south-west of Khaneh Zinian [all south-western Persia]. Vindobonian (Middle Fars or *O. virleti* beds).

Family: *PECTINIDAE.*

Genus: PECTEN, Müller, 1776.

PECTEN PASCOEI, sp. nov.

(Plate VIII, figs. 9-13).

Material.—Three right valves (K10/65, K10/66, K21/265) and five left valves (K21/265) in the G. S. I. Coll. Two right and six left valves (NM 206) in the A. P. O. C. Coll. The right valve K10/65 (figs. 9*a*, *b*) is selected as holotype.

Specific Characters.—Shell of medium size, orbicular, slightly inequilateral, very inequivalve; right valve moderately to strongly and evenly convex, left valve very feebly convex, flattened towards the ventral margin. Right valve

[1] *Siboga Exped. Monogr.*, LIIIc, p. 130, (1932).

ornamented with a variable number (25-40) of very depressed, smooth ribs, separated by very narrow, almost linear, smooth interspaces; the ribs are somewhat unequal in width and in some specimens a few may become divided by a median groove. Right anterior auricle elongate, narrow, widening distally, with a deep subauricular sinus in which a ctenolium is developed, and ornamented with about five feebly squamose, depressed radial threads; right posterior auricle of moderate size, almost right-angled, and bearing a few faint radial threads. Left valve ornamented with numerous narrow, smooth, rounded radial riblets, four of which, diverging at nearly equal angles, are usually slightly more prominent than any others, and the remainder of which usually alternate in strength; the riblets of secondary strength, together with the four most conspicuous ones, usually total from 25-40; in some specimens the riblets of tertiary strength are very obscure or absent. Auricles of left valve large, ornamented with radial threads; the anterior one concave, with a right or slightly acute distal angle, the posterior one nearly flat, slightly obtuse-angled.

Dimensions.—The measurements of the holotype are as follows:

Length	34·5 mm.
Height	34·5 mm.
Inflation (right valve)	11·0 mm.

Most of the specimens are smaller than tnis, but one right valve unfortunately broken, measures 53 mm. in length.

Remarks.—There is no specimen with the two valves of the same shell associated together, and the locality of the two right valves in the G. S. I. material is not the same as that of the left valves; a single right valve was found with the latter, but it is small and eroded, and not obviously conspecific with the other two. It is fortunate, therefore, that the A. P. O. C. Coll. includes good specimens of both valves found associated in the same bed, so that there can be little doubt that they belong to the same species. These have been sent to me for study through the kindness of Drs. G. M. Lees and J. A. Douglas.

The deep anterior subauricular sinus and ctenolium in the right valve, taken in conjunction with the slightly inequilateral shape, suggest at first that this valve belongs to a somewhat gibbose *Aequipecten* (or *Plagioctenium*, if that group is considered distinct). Hence it is not surprising that this species was originally listed[1] as *Pecten* (*Plagioctenium*) n. sp., aff. *ventricosus*, Sow. The inequality and different ornamentation of the two valves indicate, however, that the species should be grouped with *Pecten* s. str. No closely comparable form seems to have been described previously.

Localities and Horizon.—West end of Qishm Island. Between Khanu Sukh and Bostanah (near Lingeh), close to Hormuz inlier. Pliocene (*P. vasseli* beds). Ishtak, Mekran coast (A. P. O. C. Coll.). Pliocene (Mekran beds).

[1] Pilgrim, G. E., *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, p. 44, (1908).

PECTEN NEARCHI, Vredenburg.

1928. *Pecten nearchi*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 437; Pl. XXV, figs. 5, 13.

Material.—Two specimens (K16/837).

Locality and Horizon.—Chahbar, eastern Persia. Pliocene (Mekran beds).

PECTEN PILGRIMI, sp. nov.

(Plate VIII, figs. 4, 5).

Material.—One right and one left valve (K21/292); the former is selected as holotype.

Specific Characters.—Shell of medium size, highly inequivalve; right valve strongly convex, with the umbonal region rising above the hinge-margin, left valve slightly concave. Right valve ornamented with 16 smooth, depressed, flat-topped, square-cut ribs, separated by flat-bottomed interspaces of about half their width; all the ribs except the very narrow ones near the auricular margins are bipartite, with a shallow median groove, while each half of the ribs in the middle of the shell may itself be divided by a very obscure groove; delicate concentric threads are visible in the interspaces. Right anterior auricle fairly large, with three obscure radial threads; subauricular sinus shallow; right posterior auricle unknown complete. Left valve ornamented with 15 moderately prominent, smooth, flat-topped, square-cut ribs, separated by slightly wider, flat-bottomed interspaces in which delicate concentric threads are visible. Auricles of left valve fairly large, concave, nearly right-angled, almost smooth.

Dimensions.—The measurements of the holotype, a rather broken right valve are:

Length	ca. 50 mm.
Height	49·8 mm.
Inflation	20·0 mm.

Remarks.—The sculpture of the right valve is closely comparable to that of *P. reghiensis*, Sequenza[1], from the Mediterranean Pliocene. Its ribs, however, are more square-cut, while its umbonal region rises more prominently above the hinge-margin. Compared with the Recent Persian Gulf form, *P. dorotheae*, Melvill[2] (which may be a race of *P. erythraeensis*, G. B. Sowerby), the right valve has wider and deeper intercostal spaces, while the median sulcus of each costa is much more pronounced; its umbonal region, moreover, is more prominent.

Locality and Horizon.—Kharag I., Persian Gulf. Pliocene or Pleistocene.

[1] Depéret & Roman, F., *Mém. Soc. géol. France* (Pal.), No. 26, pp. 24, 85; Pl. II figs. 6, 6*a*, Pl. X, figs. 1, 1*a*, (1902 & 1905).

[2] *Proc. Zool. Soc. London*, 1906, Pt. 2. p. 810; Pl. LIV, fig. 1, (1907).

Sub-genus : OOPECTEN, Sacco, 1897.

PECTEN (OOPECTEN) GIGAS (Schlotheim).

(Plate VI, figs. 2-5).

1813. *Pectinites gigas*, Schlotheim, Leonhard's *Taschenbuch*, VII, p. 92.

1819. *Pecten solarium*, Lamarck, Histoire naturelle des animaux sans vertèbres, VI, Pt. 1, p. 179 (*partim*).

1833. *Pecten solarium*, Goldfuss, Petrefacta Germaniae, II, p. 65; Pl. XCVI, figs. 7*a*, *b*.

1867. *Pecten solarium*, Hoernes, *Abh. k. k. geol. Reichsanst.*, IV, p. 403; Pls. LX, LXI.

1910. *Amussiopecten gigas* (and var. *plana*), Schaffer, *Abh. k. k. geol. Reichsanst.*, XXII, p. 42; Pl. XXI, figs. 1, 2 & Pl. XXII, figs. 1, 2.

1920. *Pecten* (*Oopecten*) *gigas*, Dollfus & Dautzenberg, *Mém. Soc. géol. France* (Pal.), no. 27, p. 408; Pl. XXXIX, figs. 1, 2 & Pl. XL, figs. 1, 2.

1922. *Amussiopecten gigas*, Teppner, Fossilium Catalogus, Animalia, Pt. 15, p. 238 (with further synonymy).

Material.—Two left valves (K9/970) in the G. S. I. Coll. and nine specimens (L. 43495-503, collected by Dr. G. M. Lees) in the British Museum Coll.

Description.—The specimens are rather feebly inflated, with the right valve more convex than the left, which is flat in early stages of growth; the largest is about 93 mm. in length. The shell is fan-shaped, with the obtusely divergent dorsal margins of its body strongly concave and forming shoulder-like angles with the anterior and posterior margins; the length exceeds the height. The hinge-margin is straight and elongate, the auricles long and narrow. Each valve has 14-15 depressed, flat-topped radial costae separated by interspaces which are usually of about the same width; in the largest specimens these costae become very depressed near the margin of the shell, but they do not completely fade away. Near the dorsal margins of the body the costae are very faint and these margins are usually bordered by smooth areas. Very fine, regularly spaced concentric threads cross both ribs and interspaces.

Internally a pair of very prominent, narrow ribs, which are pointed and converge somewhat at the margin, correspond to each intercostal space of the exterior; these fade away some distance from the margin. The auricular crura are very strong, forming prominent tubercles.

Remarks.—In both external and internal characters these specimens agree well with specimens of *P. gigas* from the European Miocene. Hoernes and Teppner place *P. planocostatus*, Abich[1], from the Miocene of Armenia, in the synonymy of *P. gigas* [*P. solarium* in Hoernes], but the species in question appears to be more equivalve and more inflated, with less square-cut costae. This synonymy cannot be accepted.

P. gigas appears to be closely related to *P. rotundatus*, Lamarck, the genotype of *Oopecten*, and so may be referred to that subgenus. A specimen from the Lower Miocene of the Urmi district of Persia described and figured by

[1] *Mém. Acad. Sci. St. Pétersb.*, [6], IX, p. 117; Pl. I, fig. 7, (1858). *Also* Geologie des armenischen Hochlandes, p. 214; Pl. I, figs. 3-5 & Pl. II, figs. 5, 8, (1882).

Newton[1] as *P. rotundatus* appears closely comparable to those now recorded but is too imperfect for exact comparison to be made. Its less orbicular shape, larger auricles, straight hinge-margin, and persistent radial costae distinguish it from species of *Amussiopecten*, in which subgenus it is placed by Schaffer and Teppner.

Localities and Horizons.—Shalil, Bakhtiari Mts. (G. S. I. Coll). Burdigalian (Asmari limestone).

Murad Bulaq, 10 miles east of Hamadan, Central Persia (British Museum). Lower Miocene, probably Burdigalian.

Genus : CHLAMYS, Bolten, 1798.

CHLAMYS SENATORIA (Gmelin).

(Plate V, fig. 18 ; Plate VI, fig. 9).

1791. *Ostrea senatoria*, Gmelin, Systema Naturae, edit. 13, p. 3327.
1791. *Ostrea porphyrea*, Gmelin, *loc. cit.*, p. 3328.
1840. *Pecten somrowensis*, J. de C. Sowerby, *Trans. Geol. Soc.*, [2], V, Pl. XXV, fig. 14.
1840. *Pecten articulatus*, J. de C. Sowerby, *loc. cit.*, Pl. XXV, fig. 15.
1854. *Pecten bouei*, d'Archiac & Haime, Animaux fossiles du groupe nummulitique de l'Inde, p. 269 ; Pl. XXIV, fig. 1.
1854. *Pecten favrei*, d'Archiac & Haime, *loc. cit.*, p. 270 ; Pl. XXIV, fig. 5.
1927. *Chlamys senatoria*, Cox, Report on the Palaeontology of the Zanzibar Protectorate, p. 45 ; Pl. VII, figs. 1-3 ; p. 75 ; Pl. XV, fig. 3 ; Pl. XXVII, fig. 10.
1928. *Pecten (Chlamys) articulatus*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 434.
1928. *Pecten (Chlamys) senatoria* var. *soomrowensis*, Vredenburg, *loc. cit.*, p. 434.
1928. *Chlamys senatoria*, Douglas, Contributions to Persian Palaeontology, III, p. 2; Pl. VIII, figs. 3-5.
1929. *Chlamys senatoria*, Cox, *Proc. Malac. Soc. London*, XVIII, p. 191.
1930. *Chlamys senatoria*, Cox, *Mon. Geol. Dept. Hunterian Mus., Glasgow Univ.*, IV, p. 108 ; Pl. XIII, fig. 21 ; pp. 122, 152.

Material.—Numerous specimens (K9/893, K9/894, K9/907, K9/923, K9/926, K9/928, K9/929, K9/930, K9/932, K9/934, K9/935, K9/943, K9/951, K21/218, K21/234, K21/248, K21/256, K21/290, K21/291, K21/293).

Description and Remarks.—This species has been fully discussed in previous papers by myself and also by Dr. J. A. Douglas (*loc. cit.*). In the material from both Burdigalian and Vindobonian horizons two main varieties are distinguishable. These appear to be the two 'mutations' mentioned by Dr. Douglas, but are not characteristic of different horizons. In the first variety (Plate VI, fig. 9) the shell is suborbicular, with the height only slightly in excess of the length. There are about 24 wide, depressed ribs which become tripartite near the ventral margin. Fine, closely spaced, undulating squamae extend across each interspace from the sides of adjacent ribs, while slightly more distant squamae ornament the middle and widest division of each rib. Compared with the holotype of *P. somrowensis*, from the Miocene of Kachh, these specimens are rather more orbicular and their ribs are more depressed. Their average height is about 65 mm.

[1] *Journ. Linn. Soc.* (*Zool.*), XXVII, p. 443 ; Pl. XXIX, fig. 1, (1900).

In the second variety (Plate V, fig. 18) the shell is taller, with a more acute umbonal angle, and there are 23-24 ribs which are narrower and more prominent than those of the first variety, and remain undivided. The ribs bear evenly spaced squamae which are more distant than those on the ribs of the first variety. This is the variety described by Sowerby from India as *P. articulatus* and by d'Archiac & Haime as *P. bouei*. I do not agree with Vredenburg in regarding it as a distinct species, as it is represented also among Recent specimens which are considered inseparable from *C. senatoria*. The specimens of this variety are slightly smaller than those of the first.

The specimens from Kharag I. are not well preserved, but belong to a large, tall variety of the species with about 24 wide, depressed, laterally partite ribs. Except for their rather fewer ribs, they agree with *P. alexandri*, Vredenburg[1], which I have already suggested[2] should be regarded as a variety of *C. senatoria*.

Localities and Horizons.—Close to Latidun (west of Bandar Abbas); 8 miles W. S. W. of Latidun, 100 ft. and 200 ft. above gypsum beds. Burdigalian.

Seven miles north-east of Latidun, going towards Tang Saubat. Vindobonian.

Kotel Kamarij; near Chinar Rahdar; Rahdar; two miles and three miles from camp at Rahdar on Shahpur river; Daliki bridge [all south-western Persia]. Vindobonian (Middle Fars or *O. virleti* beds).

Kharag I., Persian Gulf. Pliocene or Pleistocene.

Chlamys pusio (Linné, emend. Gmelin).

(Plate VI, fig. 1).

1758. *Ostrea pusio*, Linné, Systema Naturae, edit. 10, p. 698 (*partim*).
1791. *Ostrea pusio*, Gmelin, Systema Naturae, edit. 13, p. 3324.
1796. *Ostrea multistriata*, Poli, Testacea Siciliae, II, p. 164; Pl. XXVIII, fig. 14.
1897. *Chlamys multistriata*, Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, XXIV, p. 6; Pl. I, figs. 12-19.
1920. *Pecten (Chlamys) multistriatus*, Dollfus & Dautzenberg, *Mém. Soc. géol. France* (Pal.), XXII, p. 417; Pl. XXXV, figs. 32-43.
1927. *Chlamys pusio*, Cox, Report on the Palaeontology of the Zanzibar Protectorate, pp. 42, 96; Pl. VII, fig. 6.
1927. *Chlamys tenuisculpta*, Cox, *loc. cit.*, p. 43; Pl. VII, figs. 5*a*, *b*.
1928. *Chlamys multistriata*, Douglas, Contributions to Persian Palaeontology, III, p. 4; Pl. VIII, fig. 1.
1930. *Chlamys pusio*, Cox, *Mon. Geol. Dept. Hunterian Mus., Glasgow Univ.*, IV, pp. 107, 122, 152; Pl. XIV, fig. 9.

Material.—Seven specimens [K9/906(1), K9/931(5), K21/234(1)].

Remarks.—This well-known species, which is still living in the Mediterranean and eastern Atlantic as well as off South Africa, has been discussed by me when describing fossil specimens from East Africa, where it occurs in Lower Miocene, Pliocene, and Pleistocene rocks. The Persian specimens attain a larger size than those recorded from that region, the largest (now broken) having

[1] *Mem. Geol. Surv. Ind.*, L, p. 435; Pl. XXVI and Pl. XXVIII, figs. 1, 3, (1928).
[2] *Proc. Malac. Soc. London*, XVIII, p. 191, (1929).

been originally 40-45 mm. in height. Specimens of a comparable size occur, however, in the European Miocene.

Linné may originally have included other species besides this in his *Ostrea pusio*, but this is undoubtedly the form to which the name was restricted by Gmelin in 1791.

Localities and Horizons.—Eight miles W. S. W. of Latidun, west of Bandar Abbas. Burdigalian (100 ft. above gypsum horizon).

Daliki bridge; Kotel Kamarij [both south-western Persia]. Vindobonian (Middle Fars or *O. virleti* beds).

Family: *SPONDYLIDAE*.

Genus: Spondylus, Linné, 1758.

Spondylus crassicosta, Lamarck.

(Plate VI, figs. 6-8).

1819. *Spondylus crassicosta*, Lamarck, Histoire naturelle des animaux sans vertèbres, VI, Pt. 1, p. 193.

1867. *Spondylus crassicosta*, Hoernes, *Abh. k. k. geol. Reichsanst.*, IV, p. 429; Pl. LXVII, figs. 7*a-d*.

1898. *Spondylus crassicosta* (with vars. *ornatulina, persquamosa, dertonensis, taurinensis*), Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, XXV, p. 5; Pl. I, fig. 17, Pl. II, figs. 1-4, Pl. III, figs. 1-3.

1920. *Spondylus crassicosta*, Dollfus & Dautzenberg, *Mém. Soc. géol. France* (Paléont.), no. 27, p. 452; Pl. XLVI, figs. 1-4.

Material.—Ten specimens (K21/219).

Description.—A gibbose, subequivalve or very slightly inequivalve *Spondylus*, the largest specimen of which, now broken, was about 110 mm. in height. In the lower valve there are five primary ribs which usually bear moderately long spines at intervals of about 20 mm. The middle of each primary interspace is occupied by a spinose rib of secondary strength, which in some specimens becomes nearly as strong as the primary ribs near the ventral margin. The remainder of the surface is ornamented with numerous closely spaced, denticulate or subspinose threads, which may alternate in strength. The upper valve, which may be slightly smaller and less gibbose than the lower one, has six primary ribs, the spines on which are rather shorter than on those of the other valve. The interspaces bear secondary ribs and minor radial threads similar to those of the other valve.

Remarks.—These specimens agree very closely with certain varieties of *S. crassicosta*, for example, the var. *ornatulina*, Sacco (*loc. cit.*, Pl. II, figs. 3*a*, *b*), and are undoubtedly referable to that species. *S. crassicosta* first makes its appearance in the Aquitanian of the Bordelais, and in the Mediterranean region generally is very widespread in the Upper Miocene and Pliocene, but does not persist into the Pleistocene. Its discovery in Persia raises the question of the identity of the Pliocene form from East Africa which I[1] described under the name

[1] Report on the Palaeontology of the Zanzibar Protectorate, p. 80; Pl. XVI, fig. 4, (1927).

Spondylus insularis. The number and distribution of the primary ribs is about the same in the East African specimens as in those from Persia, but the spines on the ribs are much more prominent; the ornamentation of the interspaces is closely comparable. It is thus possible that *S. insularis* is a race of *S. crassicosta* which persisted in the Indian Ocean after its final separation from the Mediterranean.

Locality and Horizon.—Close to Latidun, west of Bandar Abbas. Burdigalian.

Family : *LUCINIDAE.*

Genus : LUCINA, Bruguière, 1792.

LUCINA DALIKIENSIS, sp. nov.

(Plate V, figs. 9-13).

Material.—Numerous specimens (K9/867, K9/898, K9/909). The one represented in fig. 9 (K9/867) is selected as holotype.

Specific Characters.—Shell suborbicular, moderately inflated, with a prominent, pointed umbo placed at or slightly posterior to the middle of the length; usually more or less obliquely produced in an antero-ventral direction and frequently with a subangular anterior end; a narrow, compressed postero-dorsal region is limited by the umbonal ridge in each valve; lunule very small. Postero-dorsal margin nearly straight, sloping slightly, and meeting the subvertical posterior margin in a slightly obtuse or, occasionally, a right angle; posterior margin with a more or less pronounced sinus at its ventral end; antero-dorsal margin slightly convex, sloping steeply; ventral margin strongly convex. Surface ornamented with raised concentric threads. Dentition unknown.

Dimensions.—Holotype: length 21·0 mm., height 18·4 mm., inflation 9·8 mm.

Remarks.—No comparable species has been described from the Upper Tertiary of India, Burma or East Africa, but three rather similar forms have been described from the Lower Miocene of Java. *L. djunggranganensis* Martin[1] and *L. kemedjingensis* Martin[2] appear to differ in their smaller size, while *L. tjibodasiana* Martin[3] is slightly larger and more gibbose. The new species appears to be quite distinct from any form known from the Mediterranean region.

Locality and Horizon.—Daliki bridge, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Family : *TELLINIDAE.*

Genus : APOLYMETIS, Salisbury, 1929.

APOLYMETIS PAPYRACEA (Gmelin).

(Plate VIII, fig. 3).

1782. *Tellina lacunosa testa alba*, etc., Chemnitz, Conch. Cab., VI, p. 92; Pl. IX, fig. 78.

1791. *Tellina papyracea*, Gemlin, Systema Naturae, edit. 13, p. 3231.

[1] *Samml. geol. Reichs-Mus. Leiden*, n. F., II, p. 274; Pl. V, figs. 133*a*, *b*, (1917).

[2] *Loc. cit.*, p. 274; Pl. V, figs. 134-6, (1917).

[3] *Ibid.*, n. F. I, p. 489; Pl. LXI, figs. 120, 121, (1922).

1859. *Tellina lacunosa*, Hoernes, *Abh. k. k. geol. Reichsanst.*, IV, p. 91 ; Pl. IX, figs. 1*a-c.*

1901. *Capsa lacunosa* (and vars.), Sacco, Molluschi dei terreni tertiarii del Piemonte e della Liguria, Part 29, p. 117 ; Pl. XXV, figs. 17-24.

1916. *Tellina lacunosa*, Fourtau, in Hume, Report on the Oilfields Region of Egypt, *Egypt Survey Dept.*, p. 93 ; Pl. VI*a*, fig. 2.

1918. *Tellina* (*Metis*) *coarctata*, Philippi ; Lamy, *Bull. Mus. Hist. nat. Paris*, XXIV, p. 168.

1931. *Apolymetis papyracea*, Cox, *Geol. Mag.*, LXVIII, p. 11.

Material.—One specimen (K10/40).

Remarks.—This specimen is an internal mould preserved in a pinkish marl, and is closely comparable to the moulds recorded by me (*loc. cit.*) from a deposit of probably Pliocene age in the Farsan Islands, off the Red Sea coast of Arabia, and also to those found in the Pliocene of the oilfields region of Egypt. *A. papyracea* is well known as a Miocene and Pliocene fossil in the Mediterranean region, but is now extinct there, lingering on, however, off the coast of Guinea. It has also survived in the Indian Ocean, but Recent specimens from that region are usually cited by Philippi's specific name *coarctata.*

Locality and Horizon.—Henjam I. Pliocene (*P. vasseli* beds).

Family : *VENERIDAE.*

Genus : MERETRIX, Lamarck, 1799.

'MERETRIX' PERSICA, sp. nov.

(Plate VII, figs. 9*a, b*).

Material.—The holotype (K9/908). A second, but much smaller, specimen (K9/898) is doubtfully referred to the same species.

Specific Characters.—Shell oviform, with its height equal to about two-thirds of its length, very gibbose, most inflated mesially ; extremities rather pointed. Umbones obtusely rounded, not very prominent, placed at the anterior two-fifths of the length. Postero-dorsal profile feebly convex, sloping gently ; antero-dorsal profile slightly excavated ; ventral margin strongly and symmetrically convex.

Dimensions.—The measurements of the holotype are as follows :—

Length	33·3 mm.
Height	24·1 mm.
Inflation	22·9 mm.

Remarks.—The holotype is merely an internal cast, but its shape is sufficiently characteristic to justify its description as a new species. Its very inflated, oviform shape suggests affinity with *Marcia opima* (Gmelin), made by me[1] the type of a subgenus *Levimarcia*, which, however, is a synonym of *Eumarcia*, Iredale[2]. In *M. opima*, however, the anterior end of the shell is not so pointed and projecting. It also recalls some Recent species of *Meretrix, e.g., M. casta* (Gmelin) and *M. ovum* (Hanley), and is provisionally assigned to that genus. No closely comparable fossil form appears to have been described.

[1] Report on the Palaeontology of the Zanzibar Protectorate, p. 52, (1927).

[2] *Proc. Linn. Soc. N. S. W.*, XLIX, p. 211, (1924).

Locality and Horizon.—Daliki bridge, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Subgenus : PITAR, Roemer, 1857.

MERETRIX (PITAR) DALIKIENSIS, sp. nov.

(Plate VIII, fig. 2).

Material.—The holotype only (K9/871).

Specific Characters.—Shell trigonally ovate, slightly inequilateral, low and rather pointed anteriorly; height equal to about four-fifths of length; fairly gibbose, most inflated at the posterior third of the length. Umbo prominent, placed at the anterior third of the length, and rising well above the straight, steeply sloping antero-dorsal margin. Postero-dorsal profile convex and fairly steeply sloping, joining the feebly convex posterior margin in an even curve; ventral margin moderately convex. Posterior slope with an obscure, obtuse ridge. Surface ornamented with closely spaced concentric ribs.

Dimensions.

Length	32·0 mm.
Height	25·2 mm.
Inflation (single valve)	9·5 mm.

Remarks.—The prominent umbo and obscurely carinate posterior slope of this species distinguish it from any living form. It does not compare at all closely with any fossil species described from the Indo-Pacific region.

Locality and Horizon.—Daliki bridge, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Genus : DOSINIA, Scopoli, 1777.

DOSINIA, sp.

(Plate VII, figs. 3*a*, *b*).

Material.—One specimen (K9/896).

Description.—Well inflated for the genus, orbicular, with prominent umbones and a well excavated antero-dorsal region; ventral margin somewhat flattened. The details of the lunule and escutcheon are obliterated. Concentric threads ornament the surface.

Dimensions.

Length	27·3 mm.
Height	26·8 mm.
Inflation	18·2 mm.

Remarks.—This species is quite distinct from any living Indian Ocean form and from the Upper Tertiary species from north-western India and Baluchistan described by Vredenburg. The one available specimen is not well enough preserved to name.

Locality and Horizon.—Daliki bridge, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Genus : CLAUSINELLA, Gray, 1851.

CLAUSINELLA PERSICA, sp. nov.

(Plate VII, figs. 12, 13).

Material.—A limestone block (K9/963) crowded with individuals, some standing out from the surface.

Specific Characters.—Shell small, trigonally ovate, moderately inflated, slightly longer than high. Umbonal region prominent, well inflated; umbones prosogyrous, slightly anterior to median. Postero-dorsal profile strongly convex, sloping to meet the strongly convex ventral margin in a rounded-off angle; antero-dorsal profile only slightly excavated; anterior margin evenly convex. A long, narrow, smooth escutcheon is limited by a well-defined ridge. Excavation of lunule (apparently) slight; (whether the lunule is circumscribed or not cannot be ascertained). Surface of shell usually with pronounced concentric folds, but occasionally smooth; no trace of radial sculpture.

Dentition of left valve consisting of a thin, elongate posterior cardinal fused with the nymph, a fairly thick, posteriorly sloping, triangular median cardinal, and a thin, subvertical, rather curved anterior cardinal, separated by a triangular recess from the lunular margin. Right valve with a thin anterior cardinal adjacent to the lunular margin, a triangular, forward sloping median cardinal, and a thin, elongate posterior cardinal.

Dimensions.—In the block with the type-specimens the length attained is about 13 mm. The average size appears to vary in different bands.

Remarks.—Limestone bands crowded with this species are so characteristic of the Lower Fars that it seems desirable to supply it with a definite name. By Dr. Pilgrim[1] it was provisionally identified with the Italian Neogene species recorded by Sacco[2] as *Clausinella amidei*, Meneghini, and its hinge-structure certainly appears to agree with that of Recent specimens of *Clausinella*. In view of the state of preservation, however, it is impossible to determine how close is the relationship between the Persian form and the Italian one. In any case it seems doubtful if Sacco was correct in identifying his specimens from Piedmont with *Venus amidei*, Meneghini MS., de Stefani, the type-specimens of which came from the Pliocene of S. Miniato, in Tuscany. The original figures of this species[3] indicate a shell with radial ornamentation, which produces denticulations on the concentric ridges, while Sacco's specimens, like those now described, appear to be devoid of radial ornamentation. Thus it appears preferable to describe the Persian form as a new species.

Locality and Horizon.—north-west of Chinar Rahdar, south-western Persia. Upper Burdigalian ? (Lower Fars).

[1] *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, p. 31, (1908).

[2] Molluschi dei terreni terziarii del Piemonte e della Liguria, Pt. 28, p. 42; Pl. X, figs. 1—14 (1900).

[3] *Bull. Soc. malac. ital.*, I, p. 75; Pl. I, figs. 1*a-d*, (1875).

Genus : ANTIGONA, Schumacher, 1817.

ANTIGONA GRANOSA (J. de C. Sowerby).

(Plate VII, figs. 4-8).

1840. *Venus granosa*, J. de C. Sowerby, *Trans. Geol. Soc.*, [2], V, p. 327 ; Pl. XXV, fig. 7.

1840. *Venus cancellata*, J. de C. Sowerby, *loc. cit.*, p. 327 ; Pl. XXV, fig. 7*a*. (*Non* Linné.)

1852. *Venus pseudo-cancellata*, d'Orbigny, Prodrome, III, p. 109.

1927. *Antigona granosa*, Cox, Report on the Palaeontology of the Zanzibar Protectorate, p. 56 ; Pl. III, fig. 2.

1928. *Venus* (*Omphaloclathrum*) *puerpera* Linn. var. *granosa*, Vredenburg, *Mem. Geol. Surv. Ind.*, L. p. 453.

1928. *Antigona cancellata*, Douglas, Contributions to Persian Palaeontology, III, p. 9 ; Pl. VIII, fig. 6.

1930. *Antigona granosa*, Cox, *Mon. Geol. Dept. Hunterian Museum, Glasgow Univ.*, IV, p. 111.

Material.—Numerous specimens (K9/868, K9/870, K9/871, K9/873, K9/874, K9/880, K9/885, K9/889, K9/896, K9/908, K9/914, K9/958, K21/217, K21/234).

Remarks.—The numerous specimens of this species now recorded are all of about the same size as the holotypes of *Venus granosa* and *V. cancellata*, or smaller. Thus the size distinction between the Indian Ocean Miocene form and the Recent species *A. puerpera*, Linné, of the same region, to which I drew attention when discussing this species in 1927, seems to be a constant one. In the Vienna Basin, however, the Lower Miocene representative of the genus figured by Hoernes[1] and Schaffer[2] attained as large a size as the Recent form.

The Persian specimens show considerable variation in shape, but the various forms all intergrade. In view of this variability there can be no doubt that Vredenburg was correct in placing Sowerby's two species *V. granosa* and *V. cancellata* in synonymy. Many of the Persian specimens differ from Sowerby's two types in their more angular outline. A common variety (fig. 6) is trapeziform, with terminal umbones and a high, obliquely truncate posterior end. At the other extreme we have a very elongate variety (fig. 4) in which the umbones are remote from the end of the shell. These specimens come from a later stage of the Miocene than the Indian ones described by Sowerby, but I think that they must be considered conspecific with them. Their ornamentation, although somewhat indistinctly preserved, appears to be closely comparable. Specimens of similar size and showing a comparable range of variation occur in the Miocene of Ceylon.

It is, however, very difficult to decide whether this Miocene species should be considered distinct from the Oligocene form *A. aglaurae* (Brongniart), which Vredenburg treats as another variety of *A. puerpera*. There is no constant difference in size or shape, but in the specimens of *A. aglaurae* figured by Brongniart[3] and Sacco[4], as also (according to Vredenburg) in most specimens from the

[1] *Abh. k.k. geol. Reichsanst.*, IV, p. 122 ; Pl. XIV, figs. 1-4, (1861).

[2] *Ibid.*, XXII, p. 84 ; Pl. XXXIX, figs. 5-7 and Pl. XL, fig. 1, (1910).

[3] Mémoire sur les terrains....du Vicentin, p. 80 ; Pl. V, fig. 5, (1823).

[4] Molluschi dei terreni terziarii del Piemonte e della Liguria, XXVIII, p. 26 ; Pl. VII, fig. 6, (1900).

Indian Oligocene, the concentric frills are more closely spaced and thicker. On the whole it seems best to retain the name *A. granosa* for the Indian Ocean Miocene form. The Italian Miocene species figured by Sacco[1] as *Omphaloclathrum miocenicum* (Michelotti) does not appear to be separable from this species, but the large Vienna Basin form already referred to is best regarded as distinct; the specific name *haueri* Hoernes, adopted by Schaffer, is available for it.

Localities and Horizons.—8 miles W. S. W. of Latidun (west of Bandar Abbas), 100 feet above gypsum; also 'close to Latidun'. Burdigalian.

Daliki bridge; near Chinar Rahdar; 3 miles S. W. of Khaneh Zinian, [all south-western Persia]. Vindobonian (Middle Fars or *O. virleti* beds).

Genus: CLEMENTIA, Gray, 1847.

CLEMENTIA PAPYRACEA (Gray)

(Plate VIII, figs. 7, 8.)

1825. *Venus ? papyracea*, Gray, *Ann. Philosophy*, XXV, p. 137.
1840. *Venus non-scripta*, J. de C. Sowerby, *Trans. Geol. Soc.*, [2], V, Pl. XXV, fig. 8.
1927. *Clementia papyracea*, Cox, Report on the Palaeontology of the Zanzibar Protectorate, p. 54; Pl. IV, figs. 3, 4.
1928. *Clementia papyracea*, Douglas, Contributions to Persian Palaeontology, III, p. 10; Pl. XIII, fig. 10.
1928. *Venus (Clementia) papyracea*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 455; Pl. XXXII, fig. 3.
1930. *Clementia papyracea*, Cox, *Mon. Geol. Dept. Hunterian Museum, Glasgow Univ.*, IV, pp. 130, 158; Pl. XV, fig. 4.
1932. *Clementia papyracea*, Prashad, *Siboga-Exped. Monogr.*, LIIIc, p. 262.

Material.—Numerous specimens (K9/897, K9/908, K9/957, K21/216, K21/257).

Remarks.—This variable but easily recognised species has been fully discussed in the works cited above.

Localities and Horizons.—Close to Latidun; Puhal, 2 miles west of village [both west of Bandar Abbas]. Burdigalian.

Daliki bridge; near Chinar Rahdar [both south-western Persia]. Vindobonian (Middle Fars or *O. virleti* beds).

Genus: PAPHIA, Bolten, 1798.

PAPHIA PERSICA, sp. nov.

(Plate VII, figs. 10, 11).

Material.—Three casts (K9/954); the one represented in fig. 11 is selected as holotype.

Specific Characters.—Elongate-ovate, about twice as long as high, subequilateral, evenly rounded posteriorly, but with the anterior end a little upturned.

[1] *Loc. cit.*, p. 26; Pl. VII, figs. 1-5, (1900).

Umbonal region obtusely rounded, moderately prominent and inflated, submedian; umbones prosogyrous. Antero-dorsal profile moderately excavated, antero-dorsal margin subhorizontal at its extremity; postero-dorsal profile feebly convex, ventral margin moderately and nearly symmetrically convex. Pallial sinus reaching to about the posterior third of the length of the shell.

Dimensions.—The measurements of the holotype are as follows:—

Length	39·9 mm.
Height	21·0 mm.

Owing to crushing, the inflation of the specimens is indeterminate.

Remarks.—The subequilateral shape and general outline of this species at first suggest its reference to the Mactridae, but its umbonal region is more inflated and its umbones more strongly prosogyrous than in comparable species of that genus, *e.g.*, *Mactra* (*Pseudoxyperas*) *proaspersa*, Sacco[1], from the Miocene and Pliocene of Italy and France. Its pallial sinus, moreover, is much shorter than in the Mactridae, but agrees very well with that of Recent species of *Paphia*. *P. textile* (Gmelin), now living in the Indian Ocean, may be cited as a comparable form, but is more inequilateral.

Locality and Horizon.—Near Chinar Rahdar, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Family: *CARDIIDAE*.

Genus: Cardium, Linné, 1758.

Cardium, sp.

(Plate VII, fig. 15).

Material.—Two specimens (K9/889).

Description.—Shell fairly large, gibbose, inequilateral, oblique, with the posterior slope traversed by an obtuse ridge, obliquely truncated posteriorly; length and height approximately equal. Umbonal region prominent, acutely rounded; umbones placed at about the anterior third of the length. The anterior and ventral margins form an uninterrupted curve which meets the nearly straight posterior margin in a fairly well defined angle. The sculpture consists of radial ribs the total number of which was probably about 35.

Dimensions.—The measurements of the larger and more complete specimen are:—

Length	60·0 mm.
Height	63·0 mm.
Inflation	47·5 mm.

Remarks.—It does not seem advisable to name this species until more material is available, as even the more complete of the two specimens is somewhat broken away ventrally. The only comparable species among the Recent Cardiidae is *C. robustum* (Solander), from the Caribbean region, the type of the subgenus

[1] Molluschi dei terreni terziarii del Piemonte e della Liguria, Pt. 29, p. 27; Pl. VI, figs. 16-25, (1901).

Dinocardium, Dall. No comparable form is known either living or fossil from the Indo-Pacific region.

Locality and Horizon.—Daliki bridge, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

Cardium sp.

(Plate VII, fig. 17).

Material.—One specimen (K9/950).

Description.—A small, ovate, equilateral *Cardium*, the height of which (15·0 mm.) considerably exceeds the length (12·2 mm.). The sculpture consists of about 40 fine radial ribs. *C. maculosum*, Wood, may be cited as the most closely comparable Recent species.

Locality and Horizon.—South-west of Khaneh Zinian, south-western Persia. Upper Burdigalian ? (Lower Fars, gypsum beds).

Subgenus : Discors, Deshayes, 1858.

Cardium (Discors) cf. triforme, J. de C. Sowerby.

(Plate VII, fig. 16).

The following are references to descriptions of *C. triforme* :—

1840. *Cardium triforme*, J. de C. Sowerby, *Trans. Geol. Soc.*, [2], V, Pl. XXV, fig. 11 and explan.

1928. *Cardium (Discors) triforme*, Vredenburg, *Mem. Geol. Surv. Ind.*, L, p. 444.

Material.—One specimen (K9/896) in the G. S. I. Coll. and two (L. 39738, L. 39741, collected by Drs. B. K. N. Wyllie and J. V. Harrison) in the British Museum.

Description.—The specimens are casts of an equilateral, gibbose, almost perfectly orbicular *Cardium*. The valves are evenly and symmetrically convex in profile when viewed from above the umbones, which are well inflated and moderately prominent; there are no umbonal ridges. The ornamentation, which is faintly preserved, consists of sinuous, oblique lirae occupying the anterior two-fifths of the surface, the remainder of which is ornamented with small radial riblets.

Dimensions.—The measurements of the better preserved specimen (K9/896) are as follows :—

Length	28·0 mm.
Height	27·3 mm.
Inflation	22·3 mm.

Remarks.—These specimens are slightly smaller than the holotype of *C. (D.) triforme*, from the Gaj Beds of Kachh, but agree very well with that specimen in shape. It is necessary to qualify their determination since one of the most important characters of that species is the cancellate ornamentation of the posterior part of its surface and such details cannot be seen in the Persian specimens owing to their imperfect preservation. Vredenburg unites the European Lower Miocene species *C. anomale*, Matheron, with *C. triforme*, but

this synonymy cannot be considered established until actual specimens have been compared. Their strongly convex posterior margin and even inflation distinguish the Persian specimens now described from the European Miocene form *C.* (*D.*) *discrepans*, Basterot, in which the posterior margin is flattened or even slightly sinuate.

The Javanese Lower Miocene form *C.* (*D.*) *kelirense*, Martin[1], is probably synonymous with *C.* (*D.*) *triforme*. In the Recent species *C.* (*D.*) *lyratum*, G. B. Sowerby, the oblique lirae on the anterior part of the shell extend over slightly more than one-half of the surface, while the posterior radial ribs are fewer and more prominent than in the fossil forms now discussed. The specimen from the Miocene of Ceylon recorded by Professor A. Morley Davies[2] as *Laevicardium* aff. *lyratum* is certainly distinct from the living form and appears to belong to the species now recorded from Persia.

Localities and Horizon.—Daliki bridge, south-western Persia (G. S. I. Coll.); Tang-i-Astaki, near Amiri, Lirawi district, south-western Persia (British Museum). Vindobonian (Middle Fars or *O. virleti* beds).

Family : *LUTRARIIDAE*.

Genus : LUTRARIA, Lamarck, 1799.

LUTRARIA cf. PHILIPPINARUM, Reeve.

(Plate VIII, fig. 1).

The following are references to descriptions of *L. philippinarum* :—

1854. *Lutraria philippinarum*, Deshayes; Reeve, Conch. Icon., VIII, *Lutraria* sp. 4.
1928. *Lutraria philippinarum*, Melvill, *Proc. Malac. Soc. London*, XVIII, p. 116.
1932. *Lutraria philippinarum*, Prashad, *Siboga-Exped. Monogr.*, LIIIc, p. 211 (with synonymy).

Material.—Two specimens (K9/877, K9/956).

Description and Remarks.—The specimens are ill-preserved casts of a compressed, elongate-ovate, somewhat arcuate form closely comparable in shape to Recent specimens from the Philippine Islands in the British Museum determined as *L. philippinarum*. Some of the specimens from Western Australia determined as *L. rhynchaena*, Jonas, are also very similar in outline, but appear to have a wider posterior gape. The Mediterranean form *L. lutraria* (Linné), which occurs fossil from the Miocene onwards, is less elongate and arcuate, while its umbones are less anterior.

Melvill (*loc. cit.*) has recorded a Recent specimen of *L. philippinarum* from the Gulf of Oman.

Localities and Horizon.—Daliki bridge; near Chinar Rahdar [both south-western Persia]. Vindobonian (Middle Fars or *O. virleti* beds).

[1] *Samml. geol. Reichs.-Mus. Leiden*, N. S., II, p. 268; Pl. IV, figs. 114-5, (1917).
[2] *Quart. Journ. Geol. Soc.*, LXXIX, p. 587, (1923).

Family : *MACTRIDAE*.

Genus : MACTRINULA, Gray, 1853.

MACTRINULA TRYPHERA, Melvill.

(Plate VIII, fig. 6.)

1899. *Mactrinula tryphera*, Melvill, *Ann. Mag. Nat. Hist.*, [7], IV, p. 97 ; Pl. II, fig. 7.
1906. *Mactrinula tryphera*, Smith, *Ann. Mag. Nat. Hist.*, [7], XVIII, p. 260.
1907. *Mactrinula tryphera*, Melvill, *Proc. Zool. Soc.* (1906), p. 828.
1928. *Mactrinula tryphera*, Melvill, *Proc. Malac. Soc. London*, XVIII, p. 116.

Material.—One specimen (K25/287).

Description and Remarks.—The specimen is a cast of a small, trigonally ovate, elongate, subequilateral, feebly inflated shell, 17 mm. in length and originally about 11·5 mm. in height ; its ventral marginal region, however, has been broken away. The umbo is very prominent and sharply pointed ; a sharp umbonal ridge delimits a very narrow posterior area. The postero-dorsal margin is slightly convex, and slopes at a fairly steep angle to the low and rather pointed posterior extremity of the shell. The antero-dorsal region is very slightly excavated, its margin sloping at a more gentle angle to meet the semicircular anterior margin. The ventral margin is flattened mesially. The sculpture consists of regular concentric ribs.

This specimen agrees very closely with Recent specimens of this species in the British Museum (Natural History). So far the species has been found living only in the Persian Gulf and off the Mekran coast, and has been dredged at depths varying from 15 to 40 fathoms. Pilgrim[1] records it from the Pliocene of the Mekran coast.

Locality and Horizon.—Henjam, about 1 mile south-east of station. ? Pliocene.

Family : *SAXICAVIDAE*.

Genus : SAXICAVA, Fleuriau, 1802.

SAXICAVA sp.

(Plate VII, fig. 14).

Material.—One specimen (K9/899) ; its posterior end has been crushed in.

Description.—Small, gibbose, modioliform, curved, highest at its posterior end ; umbones nearly terminal. Postero-dorsal profile slightly convex ; ventral margin strongly concave, the contour of the shell showing a well-marked projection where this margin meets the anterior margin. The posterior slope is very swollen, but not definitely ridged. The surface is devoid of radial ornament, but concentric growth-corrugations are well marked near the ventral margin.

Dimensions.

Length (original, estimated)	7·0 mm.
Height	5·5 mm.
Inflation	5·7 mm.

[1] *Mem. Geol. Surv. Ind.*, XXXIV, Pt. 4, p. 45, (1908).

Remarks.—Owing to extreme variability, specific characters are not easily defined in this genus, and it is not possible to say if the single specimen now recorded should be referred to a new species or not. *S. similis*, Deshayes, now living in the Indian Ocean, differs in possessing radial striations. Only one species, *S. aegypto-indica*, Tesch[1], from the Pliocene of Timor and Pleistocene (?) of the Red Sea coast of Egypt, has previously been recorded fossil from the Indo-Pacific region; it is similar in shape to the specimen now described, but much larger. The Italian Miocene form figured by Sacco[2] as *S. rugosa* var. *miocenica*, Michelotti, is something like the specimen now recorded, but its umbones are less anterior.

Locality and Horizon.—Between Daliki bridge and Konar Takhta, south-western Persia. Vindobonian (Middle Fars or *O. virleti* beds).

[1] *Paläont. von Timor*, Lief. VIII, p. 107; Pl. CXL, figs. 288-9, (1920).
[2] Molluschi dei terreni terziarii del Piemonte e della Liguria, Pt. 29, p. 49; Pl. XIII, fig. 17, (1901).

ALPHABETICAL INDEX OF SPECIES.

	Page.
Anadara cf. *antiquata* (Linné)	43
Anomia sp.	46
Antigona granosa (J. de C. Sow.)	61
Apolymetis papyracea (Gmelin)	57
Cardium sp.	63
Cardium sp.	64
Cardium (*Discors*) cf. *triforme*, J. de C. Sow.	64
Ceratomya concentrica (J. de C. Sow.)	21
Chama calcarata, Lamarck	33
Chlamys pusio (Linné)	55
Chlamys senatoria (Gmelin)	54
Chlamys sp.	17
Chlamys (*Radulopecten*) *tipperi*, sp. nov.	18
Clausinella persica, sp. nov.	60
Clavatula tipperi, sp. nov.	41
Clementia papyracea (Gray)	62
Conus (*Dendroconus*) *loroisii*, Kiener	42
Corbula (*Bicorbula*) *subexarata*, d'Arch. & Haime	33
Ctenostreon sp.	20
Cucullaea farsensis, sp. nov.	44
Dosinia sp.	59
Durania persica, sp. nov.	26
Euphenax jamaicensis (Trechmann)	29
Exogyra conica (J. Sow.)	25
Exogyra flabellata, Goldfuss.	25
Lithophaga cordata (Lamarck)	35
Lithophaga lithophaga (Linné)	45
Lucina dalikiensis, sp. nov.	57
Lucina metableta, Cossmann	32
Lucina (*Loripinus*) *pharaonis*, Bellardi	32
Lutraria cf. *philippinarum*, Reeve	65
Mactrinula tryphera, Melvill	66
Meretrix persica, sp. nov.	58
Meretrix (*Pitar*) *dalikiensis*, sp. nov.	59
Modiolus (*Pharomytilus*) *plicatus*, J. Sow.	13
Mytilus cleopatrae, Oppenheim	28
Mytilus persicus, sp. nov.	34
Nassarius persicus, sp. nov.	40
Navicula cf. *avellana* (Lamarck)	43
Nerinea pilgrimi, sp. nov.	22
Nerinea sp.	23
Ostrea digitata, Eichwald	47
Ostrea khamirensis, sp. nov.	35
Ostrea latimarginata, Vredenburg	46

PAGE.

Ostrea turkestanensis, Romanovski 30
Ostrea (*Catinula*) *sandalina*, Goldfuss 15
Ostrea (*Crassostrea*) *gryphoides* (Schlotheim) 48
Ostrea (*Lopha*) cf. *gregarea*, J. Sow. 16
Ostrea (*Lopha*) *virleti*, Deshayes 49
Paphia persica, sp. nov. 62
Pecten nearchi, Vredenburg 52
Pecten pascoei, sp. nov. 50
Pecten pilgrimi, sp. nov. 52
Pecten (*Amussiopecten*) cf. *labadyei*, d'Arch. & Haime 36
Pecten (*Oopecten*) *gigas* (Schlotheim) 53
Pleuromya unioides (Roemer) 21
Pseudomelania cf. *procera* (Eudes-Desl.) 12
Rapana mekranica, sp. nov. 40
Saxicava sp. 66
Spondylus crassicosta, Lamarck 56
Spondylus radula, Lamarck 31
Tellina pilgrimi, sp. nov. 37
Terebellum carcassense, Leymerie 28
Trigonia signata, Agassiz 14
Trigonia sp. 15
Trochactaeon cf. *giganteus* (J. de C. Sow.). 24
Turritella angulata, J. de C. Sow. 38
Turritella harrisoni, sp. nov. 39
Variamussium pumilum (Lamarck) 19

MGIPC—M—VIII-4-8—15-7-36—425.

PLATE I.

MIDDLE JURASSIC MOLLUSCA.

FIG. 1. *Chlamys* (*Radulopecten*) *tipperi*, sp. nov. Interior of a slightly distorted left valve, showing shape of auricles. East of Kerman; Bajocian-Bathonian. (Brit. Mus., L. 53466). (Page 18).

FIGS. 2*a*, *b*. *Chlamys* (*Radulopecten*) *tipperi*, sp. nov. Holotype, (*a*) left valve, (*b*) right valve. Hauz-i-Panj, south of Ravar; Bajocian-Bathonian. (Brit. Mus., L. 63156).

FIG. 3. *Chlamys* (*Radulopecten*) *tipperi*, sp. nov. Left valve. Hauz-i-Panj, south of Ravar; Bajocian-Bathonian. (Brit. Mus., L. 63157).

FIG. 4. *Chlamys* (*Radulopecten*) *tipperi*, sp. nov. Left valve. Low hills east of Ravar; Bajocian-Bathonian. (G. S. I., K16/855).

FIG. 5. *Chlamys* (*Radulopecten*) *tipperi*, sp. nov. Right valve, showing narrow anterior auricle. Low hills east of Ravar; Bajocian-Bathonian. (G. S. I., K16/858).

FIG. 6. *Chlamys* sp. Left valve, mainly an internal mould, but with the posterior auricle preserved. Hauz-i-Panj, south of Ravar; Bajocian-Bathonian. (Brit. Mus., L. 63154). (Page 17).

FIG. 7. *Chlamys* sp. Right valve, mainly an internal mould, but with the posterior auricle preserved. Hauz-i-Panj, south of Ravar; Bajocian-Bathonian. (Brit. Mus., L. 63155).

FIG. 8. *Ostrea* (*Catinula*) *sandalina*, Goldfuss. Cluster of individuals. Low hills east of Ravar; Bajocian-Bathonian. (G. S. I. K16/856). (Page 15).

FIGS. 9, 10. *Ostrea* (*Catinula*) *sandalina*, Goldfuss. Interior and exterior of upper valves. Low hills east of Ravar; Bajocian-Bathonian. (G. S. I., K16/856).

FIGS. 11-13. *Ostrea* (*Catinula*) *sandalina*, Goldfuss. Lower valves. Low hills east of Ravar; Bajocian-Bathonian. (G. S. I., K16/856).

FIG. 14. *Ostrea* (*Lopha*) cf. *gregarea*, J. Sowerby. Cluster of individuals. Low hills east of Ravar; Bajocian-Bathonian. (G. S. I., K16/857). (Page 16).

FIGS. 15*a*, *b*. *Ostrea* (*Lopha*) cf. *gregarea*, J. Sowerby. Upper valve, (*a*) exterior, (*b*) interior. Low hills east of Ravar. Bajocian-Bathonian. (G. S. I., K16/857).

FIG. 16. *Ostrea* (*Lopha*) cf. *gregarea*, J. Sowerby. ? Upper valve. Low hills east of Ravar; Bajocian-Bathonian. (G. S. I., K16/857).

FIG. 17. *Trigonia* sp. Rubber impression made from natural mould. Low hills 8½ miles S. S. W. of Ravar; Bajocian. (G. S. I., K16/867). (Page 15).

FIG. 18. *Variamussium pumilum* (Lamarck). Hills east of Badamu; ? Bajocian. (G. S. I., K16/870). (Page 19).

FIG. 19. *Ceratomya concentrica* (J. de C. Sowerby). Somewhat crushed specimen. About four miles south-west of Gujur; Bajocian-Bathonian. (Brit. Mus., L. 63158.) (Page 21).

FIG. 20. *Trigonia signata*, Agassiz. Immature specimen. About 4 miles south-west of Hauz-i-Khan; Bajocian-Bathonian. (Brit. Mus., L. 63153). (Page 14).

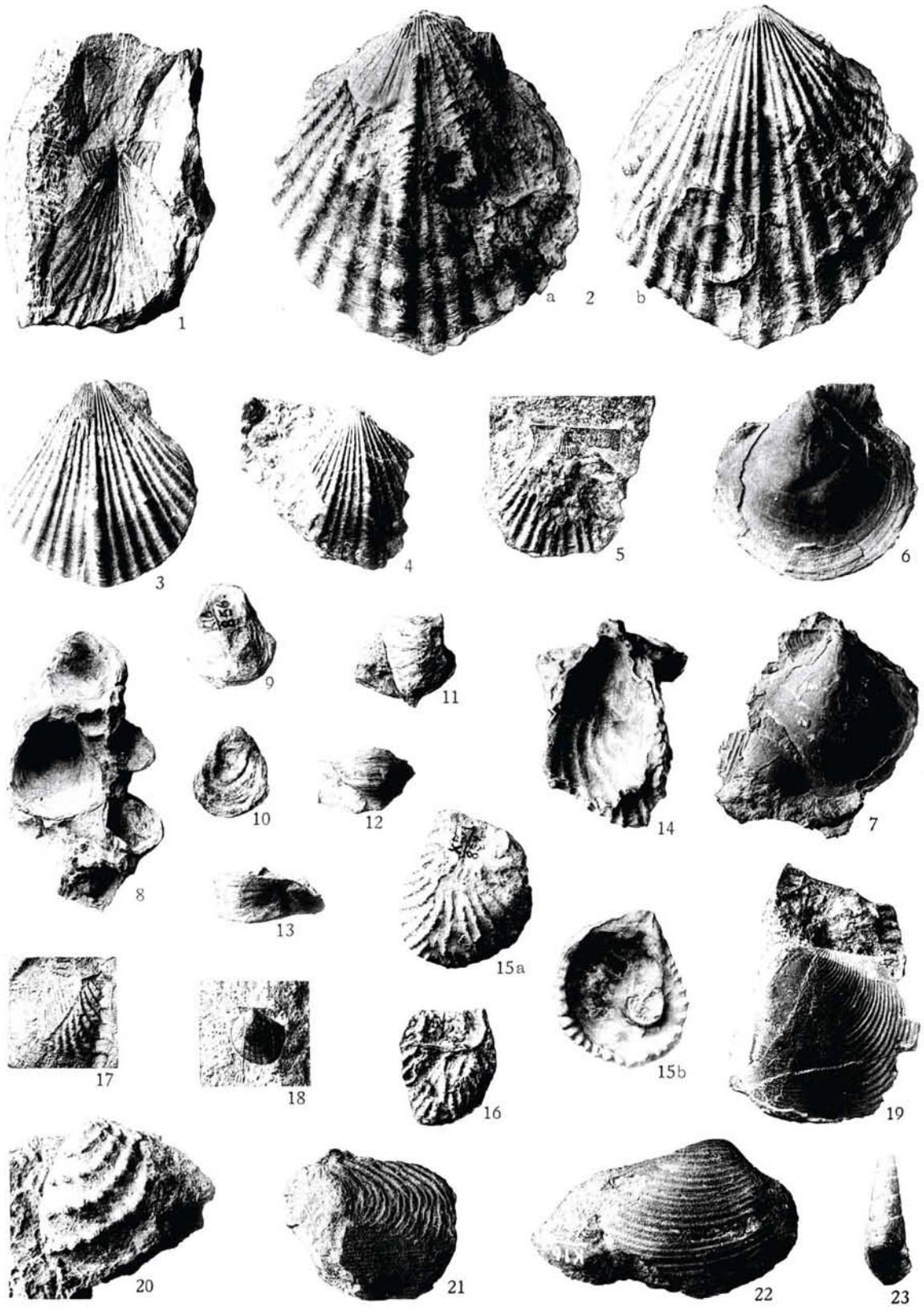
FIG. 21. *Modiolus* (*Pharomytilus*) *plicatus*, J. Sowerby. Fragment. Low hills 8½ miles S. S. W. of Ravar; Bajocian. (G. S. I., K16/867). (Page 13).

FIG. 22. *Pleuromya unioides* (Roemer). Low hills 8½ miles S. S. W. of Ravar; Bajocian. (G. S. I., K16/867.) (Page 21.)

FIG. 23. *Pseudomelania* cf. *procera* (Eudes-Deslongchamps). Low hills 8½ miles S. S. W. of Ravar; Bajocian. (G. S. I., K16/868). (Page 12).

Fossil Mollusca from Southern Persia (Iran) and Bahrein Island.

Geol. Surv. of India. Plate I.



L. R. Cox, photo. Zinco-Collotype Co., Edinburgh.

PLATE II.

CRETACEOUS MOLLUSCA.

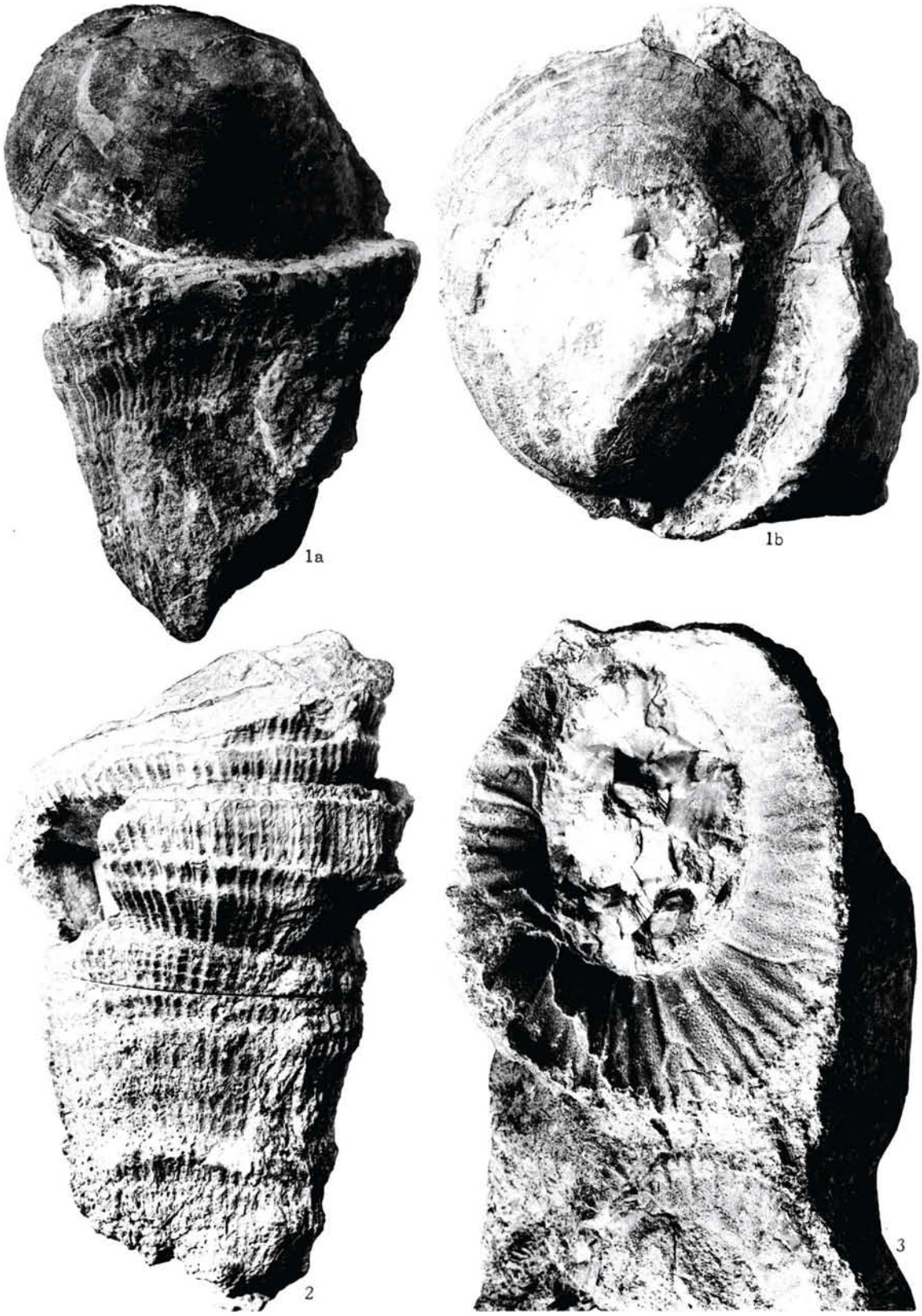
FIGS. 1*a*, *b*. *Durania persica*, sp. nov. Holotype (lower valve) and a tilted upper valve, possibly derived from another individual. Khamir, half a mile north of the sulphur mine; Cenomanian-Turonian. (G. S. I., K21/299). (Page 26).

FIG. 2. *Durania persica*, sp. nov. Lower valve, with the rather ill-defined siphonal band S and the narrow projecting interband visible on the left. Khamir; Cenomanian-Turonian, 120 ft. above base of upper Rudist limestone. (Brit. Mus., L. 63162).

FIG. 3. *Durania persica*, sp. nov. Lip of lower valve, showing radial corrugations and channels. Khamir; Cenomanian-Turonian. (Brit. Mus., L. 63163).

FOSSIL MOLLUSCA FROM SOUTHERN PERSIA (IRAN) AND BAHREIN ISLAND.

Geol. Surv. of India. Plate II.



L. R. Cox, photo. Zinco-Collotype Co., Edinburgh.

PLATE III.

CRETACEOUS AND EOCENE MOLLUSCA.

FIGS. 1*a*, *b*. *Nerinea pilgrimi*, sp. nov. Holotype, (*a*) exterior, (*b*) axial section, with the cross-section of the shell pencilled in where traceable. Khamir; from the Rudist limestone, Cenomanian-Turonian. (G. S. I., K21/300). (Page 22).

FIG. 2. *Nerinea* sp. Axial section. Sink, 14 miles north-east of Kerman; from the Rudist limestone, age uncertain. (G. S. I., K16/851). (Page 23).

FIG. 3. *Exogyra conica* (J. Sowerby). Lower valve. 3 miles north of Baghin, 18 miles west of Kerman; from the basal Cretaceous limestone, probably Cenomanian. (G. S. I., K21/288). (Page 25).

FIG. 4. *Exogyra flabellata*, Goldfuss. Lower valve. Khamir, half a mile north of the sulphur mine, on spur below main Rudist limestone; Cenomanian. (G. S. I., K21/276). (Page 25).

FIG. 5. *Exogyra flabellata*, Goldfuss. Upper valve. Khamir, half a mile north of the sulphur mine, on spur below main Rudist limestone; Cenomanian. (G. S. I., K21/276). (Page 25).

FIG. 6. *Durania persica*, sp. nov. Specimen with smooth siphonal bands S and E. Tang-i-Shirineh, Kuh-i-Khormuj; Cenomanian-Turonian. (Brit. Mus., L. 63161). (Page 26).

FIGS. 7*a*, *b*. *Terebellum carcassense*, Leymerie. Internal cast. 3 miles east of Rifaa, Bahrein I.; Middle Eocene. (G. S. I., K9/781). (Page 28).

FIG. 8. *Terebellum carcassense*, Leymerie. Internal cast. 3 miles east of Rifaa, Bahrein I.; Middle Eocene. (G. S. I., K9/781).

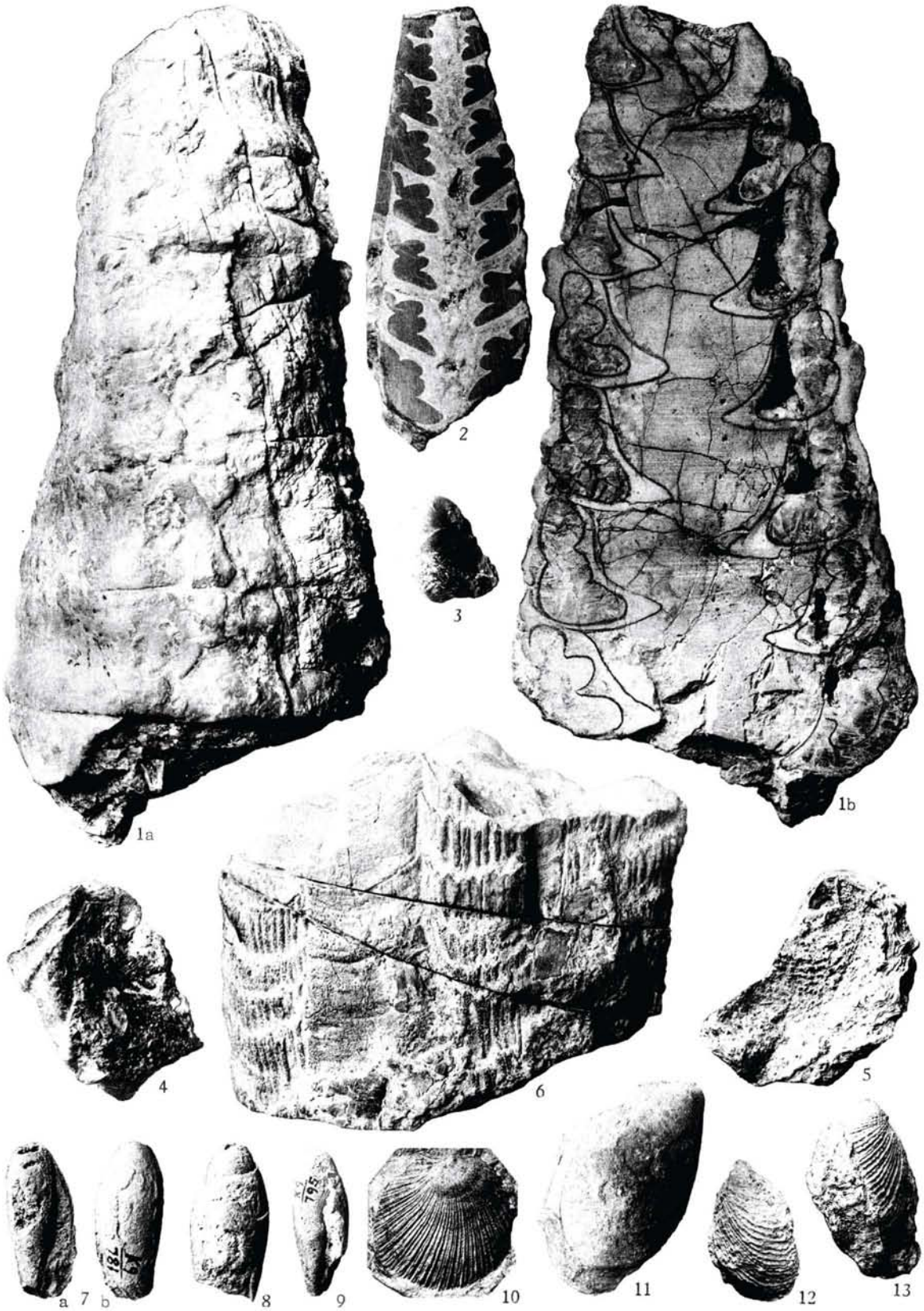
FIG. 9. *Terebellum carcassense*, Leymerie. Internal cast. Hisai Jebel, Bahrein I.; Middle Eocene. (G. S. I., K9/795).

FIG. 10. *Spondylus radula*, Lamarck. Rubber impression made from natural mould, × $1\frac{3}{4}$. Hisai Jebel, Bahrein I.; Middle Eocene. (G. S. I., K9/763). (Page 31).

FIG. 11. *Mytilus cleopatrae*, Oppenheim. Hisai Jebel, Bahrein I.; Middle Eocene. (G. S. I., K9/767). (Page 28).

FIGS. 12, 13. *Euphenax jamaicensis* (Trechmann). Cliff north-west of Rifaa, Bahrein I.; Middle Eocene. (G. S. I., K9/761). (Page 29).

Geol. Surv. of India. Plate III.



L. R. Cox, photo. Zinco-Collotype Co., Edinburgh.

PLATE IV.

CRETACEOUS, EOCENE AND OLIGOCENE MOLLUSCA.

FIGS. 1*a*, *b*. *Trochactaeon* cf. *giganteus* (J. de C. Sowerby). Badamu, 14 miles west of Kerman ; Senonian ? (G. S. I., K16/850). (Page 24).

FIG. 2. *Lucina* (*Loripinus*) *pharaonis*, Bellardi. Internal cast. Hisai Jebel, Bahrein I. ; Middle Eocene. (G. S. I., K9/767). (Page 32).

FIG. 3. *Lucina metableta*, Cossmann. Internal cast. 3 miles north of Rifaa, Bahrein I. ; Middle Eocene. (G. S. I., K9/775). (Page 32).

FIG. 4. *Corbula subexarata*, d'Archiac & Haime. Rubber impression made from natural mould. Rifaa, Bahrein I. ; Middle Eocene. (G. S. I., K9/800). (Page 33).

FIG. 5. *Corbula subexarata*, d'Archiac & Haime. Internal cast. Hisai Jebel, Bahrein I. ; Middle Eocene. (G. S. I., K9/791).

FIGS. 6*a*, *b*. *Ostrea turkestanensis*, Romanovski. Left valve. E. S. E. of Jebel Dukhan, Bahrein I. ; Middle Eocene. (G. S. I., K19/568). (Page 30).

FIGS. 7*a*, *b*. *Ostrea turkestanensis*, Romanovski. Left valve. Rifaa, Bahrein I. ; Middle Eocene. (G. S. I., K9/856).

FIG. 8. *Ostrea turkestanensis*, Romanovski. Right valve. Rifaa, Bahrein I. ; Middle Eocene. (G. S. I., K19/569).

FIG. 9. *Chama calcarata*, Lamarck. Internal cast. Hisai Jebel, Bahrein I. ; Middle Eocene. (G. S. I., K9/785). (Page 33).

FIG. 10. *Chama calcarata*, Lamarck. Rubber impression made from natural mould. Hisai Jebel, Bahrein I. ; Middle Eocene. (G. S. I., K9/767).

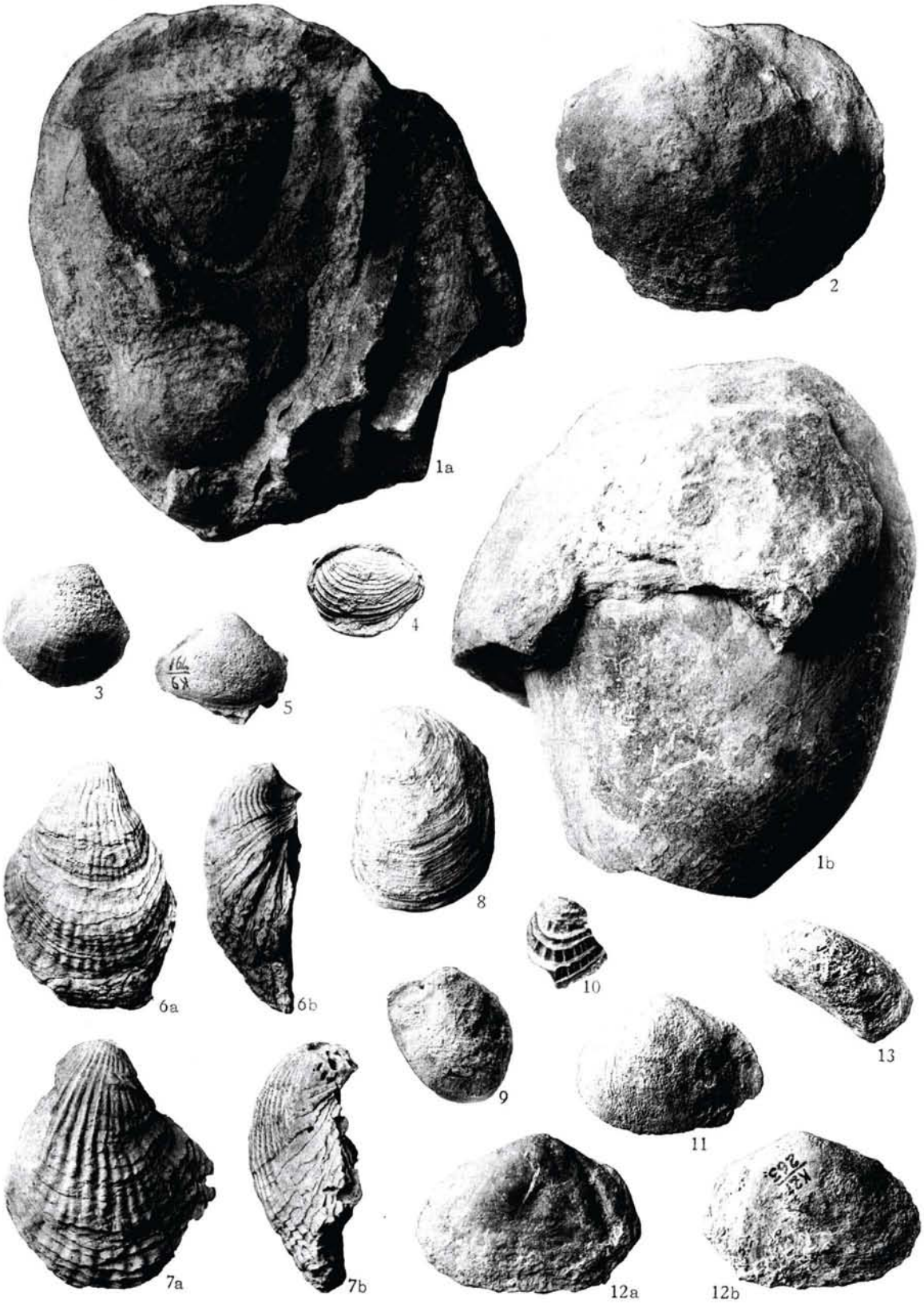
FIG. 11. *Tellina pilgrimi*, sp. nov. Left valve. Kuh-i-Namak, 24 miles north of Bandar Abbas ; Oligocene. (G. S. I., K21/263). (Page 37).

FIGS. 12*a*, *b*. *Tellina pilgrimi*, sp. nov. Holotype, (*a*) left valve, (*b*) right valve. Kuh-i-Namak, 24 miles north of Bandar Abbas ; Oligocene. (G. S. I., K21/263).

FIG. 13. *Lithophaga cordata* (Lamarck). Kishar Bala, Khamir ; Oligocene (600 feet below Miocene gypsum). (G. S. I., K21/239). (Page 35).

FOSSIL MOLLUSCA FROM SOUTHERN PERSIA (IRAN) AND BAHREIN ISLAND.

Geol. Surv. of India. Plate IV.



L. R. Cox. photo. Zinco-Collotype Co., Edinburgh.

PLATE V.

OLIGOCENE AND MIOCENE MOLLUSCA.

FIG. 1. *Pecten* (*Amussiopecten*) cf. *labadyei*, d'Archiac & Haime. Kishar Bala, Khamir; Oligocene (600 feet below Miocene gypsum). (G. S. I., K21/238). (Page 36).

FIG. 2. *Ostrea khamirensis*, sp. nov. Khamir; Oligocene (600 feet below Miocene gypsum). (G. S. I., K21/237). (Page 35).

FIGS. 3*a*, *b*. *Ostrea khamirensis*, sp. nov. Holotype. Khamir; Oligocene (600 feet below Miocene gypsum). (G. S. I., K21/237).

FIG. 4. *Ostrea khamirensis*, sp. nov. Khamir; Oligocene (20 feet below Miocene gypsum). (K21/252). (Page 35).

FIG. 5. *Mytilus persicus*, sp. nov. Holotype. Godar bridge, Karun river, Bakhtiari country; Oligocene ? (G. S. I., K9/977). (Page 34).

FIGS. 6*a*, *b*. *Cucullaea farsensis*, sp. nov. Holotype. Near Chinar Rahdar, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/955). (Page 44).

FIG. 7. *Navicula* cf. *avellana* (Lamarck). Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/895). (Page 43).

FIG. 8. *Anadara* cf. *antiquata* (Linné). Near Chinar Rahdar, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/952). (Page 43).

FIG. 9. *Lucina dalikiensis*, sp. nov. Holotype. Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/867). (Page 57).

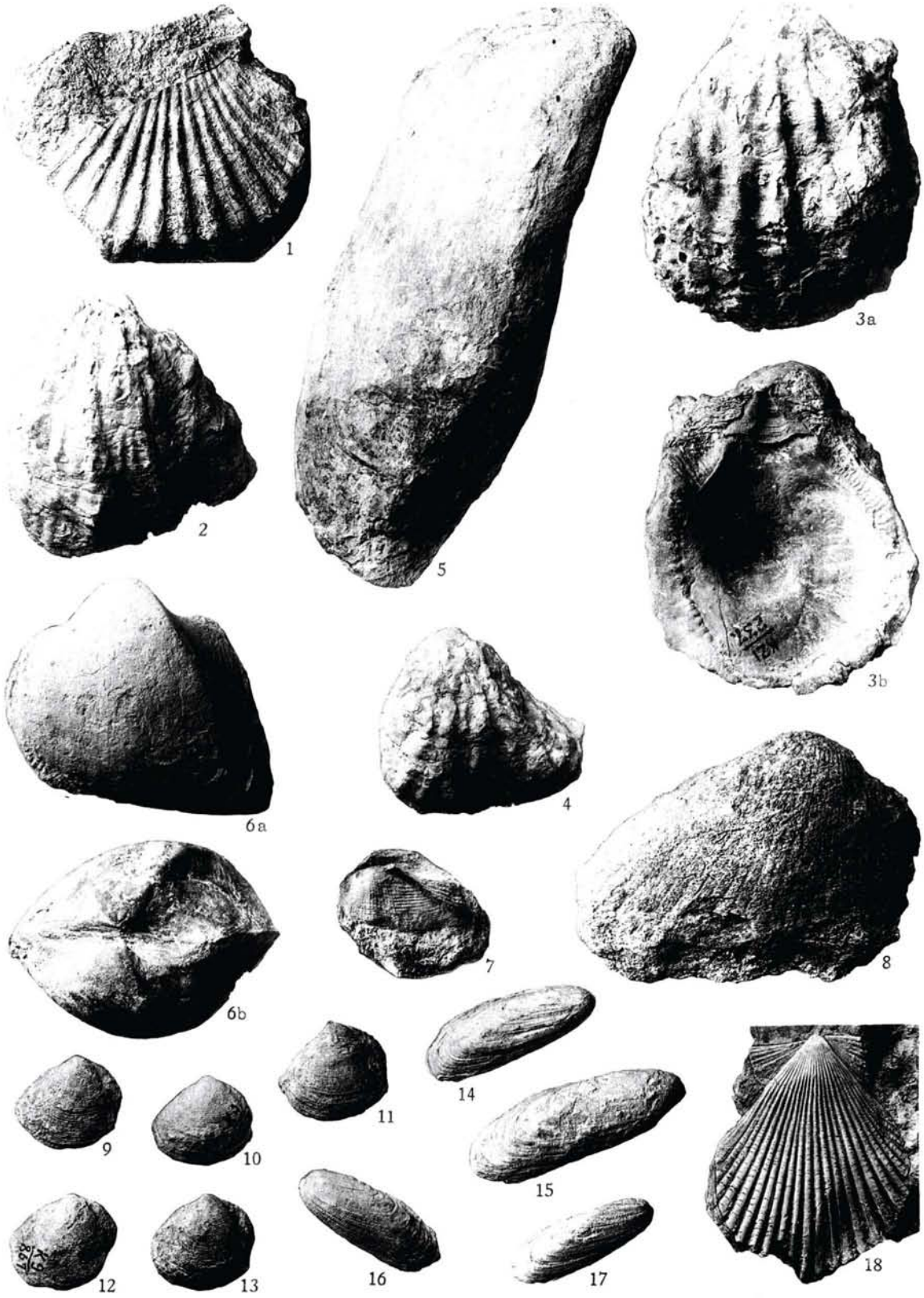
FIGS. 10-13. *Lucina dalikiensis*, sp. nov. Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/867).

FIGS. 14-17. *Lithophaga lithophaga* (Linné). Between Daliki bridge and Konar Takhta, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/887). (Page 45).

FIG. 18. *Chlamys senatoria* (Gmelin). 7 miles north-east of Latidun (west of Bandar Abbas). Burdigalian ? (G. S. I., K21/248). (Page 54).

FOSSIL MOLLUSCA FROM SOUTHERN PERSIA (IRAN) AND BAHREIN ISLAND.

Geol. Surv. of India. Plate V.



L. R. Cox. photo.

Zinco-Collotype Co., Edinburgh.

PLATE VI.

MIOCENE MOLLUSCA.

FIG. 1. *Chlamys pusio* (Linné). Kotel Kamarij, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/931). (Page 55).

FIG. 2. *Pecten* (*Oopecten*) *gigas* (Schlotheim). Left valve. Murad Bulaq, 10 miles east of 'Hamadan, central Persia; Burdigalian. (Brit. Mus., L. 43503). (Page 53).

FIG. 3. *Pecten* (*Oopecten*) *gigas* (Schlotheim). Right valve, interior. Murad Bulaq, 10 miles east of Hamadan, central Persia; Burdigalian. (Brit. Mus., L. 43495).

FIG. 4. *Pecten* (*Oopecten*) *gigas* (Schlotheim). Right valve, exterior. Murad Bulaq, 10 miles east of Hamadan, central Persia; Burdigalian. (Brit. Mus., L. 43496).

FIG. 5. *Pecten* (*Oopecten*) *gigas* (Schlotheim). Left valve, exterior. Shalil, Bakhtiari country; Burdigalian (Asmari limestone). (G. S. I., K9/970).

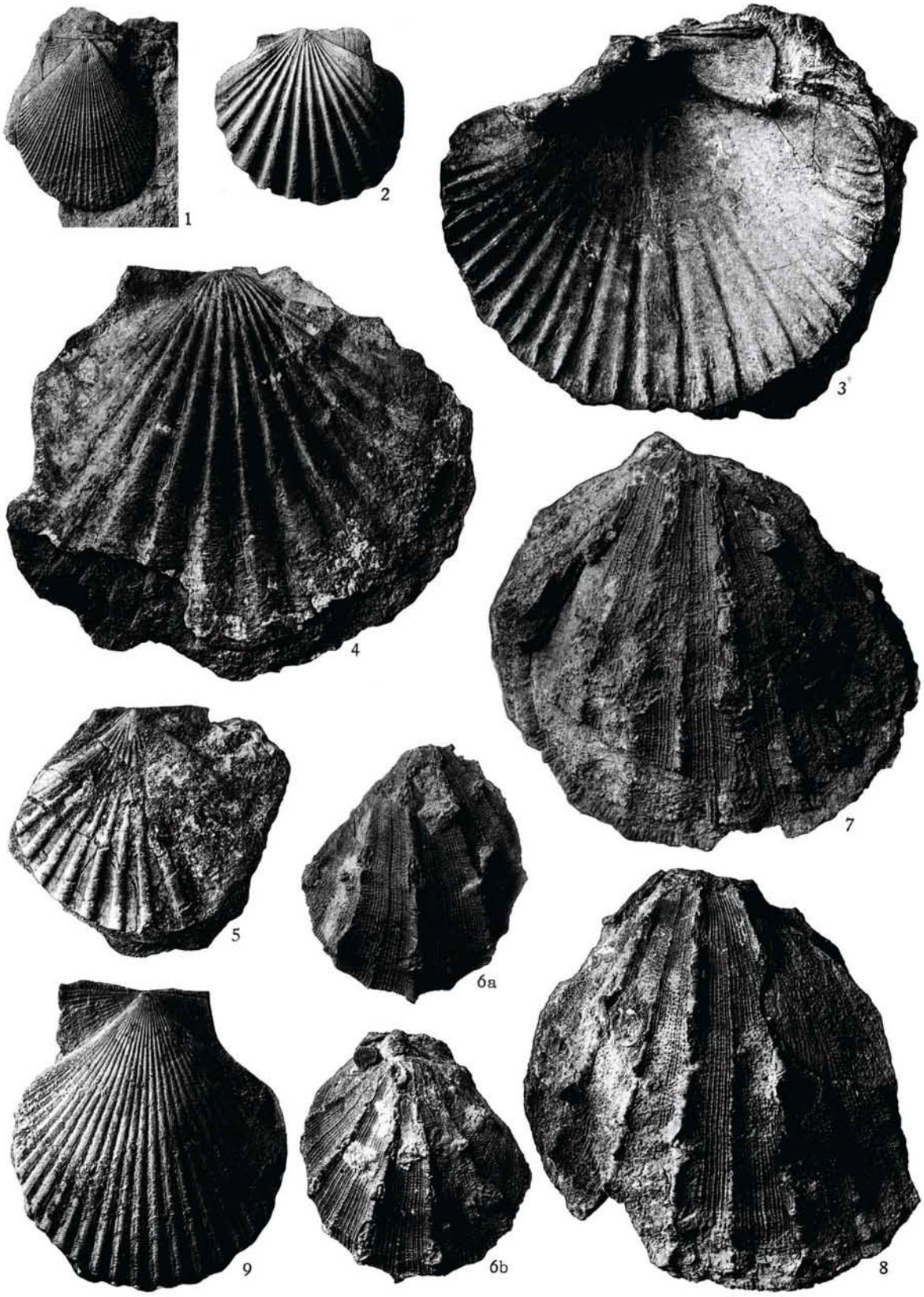
FIGS. 6*a*, *b*. *Spondylus crassicosta*, Lamarck. (*a*) Right valve, (*b*) left valve. Close to Latidun (west of Bandar Abbas); Burdigalian. (G. S. I., K21/219). (Page 56).

FIG. 7. *Spondylus crassicosta*, Lamarck. Left valve. Close to Latidun (west of Bandar Abbas); Burdigalian. (G. S. I., K21/219).

FIG. 8. *Spondylus crassicosta*, Lamarck. Left valve. Close to Latidun (west of Bandar Abbas); Burdigalian. (G. S. I., K21/219).

FIG. 9. *Chlamys senatoria* (Gmelin). Left valve. Close to Latidun (west of Bandar Abbas); Burdigalian. (G. S. I., K21/218). (Page 54).

Geol. Surv. of India. Plate VI.



L. R. Cox, photo.

Zinco-Collotype Co., Edinburgh.

PLATE VII.

MIOCENE MOLLUSCA.

FIG. 1. *Ostrea digitata*, Eichwald. Right valve. Close to Latidun (west of Bandar Abbas); Burdigalian. (G. S. I., K21/213). (Page 47).

FIG. 2. *Ostrea virleti*, Deshayes. 3 miles south-west of Khaneh Zinian, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/915). (Page 49).

FIGS. 3*a*, *b*. *Dosinia* sp. Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/896). (Page 59).

FIG. 4. *Antigona granosa* (J. de C. Sowerby). Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/868). (Page 61).

FIGS. 5, 6. *Antigona granosa* (J. de C. Sowerby). Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/870).

FIGS. 7, 8. *Antigona granosa* (J. de C. Sowerby). Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/871).

FIGS. 9*a*, *b*. *Meretrix persica*, sp. nov. Holotype. Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/908). (Page 58).

FIG. 10. *Paphia persica*, sp. nov. Near Chinar Rahdar, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/954). (Page 62).

FIG. 11. *Paphia persica*, sp. nov. Holotype. Near Chinar Rahdar, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/954).

FIG. 12. *Clausinella persica*, sp. nov. Holotype, ×1·3. North-west of Chinar Rahdar, south-western Persia. Upper Burdigalian? (Lower Fars). (G. S. I., K9/963). (Page 60).

FIG. 13. *Clausinella persica*, sp. nov. Typical limestone block crowded with shells of this species, including the holotype. North-west of Chinar Rahdar, south-western Persia. Upper Burdigalian? (Lower Fars). (G. S. I., K9/963). (Page 60).

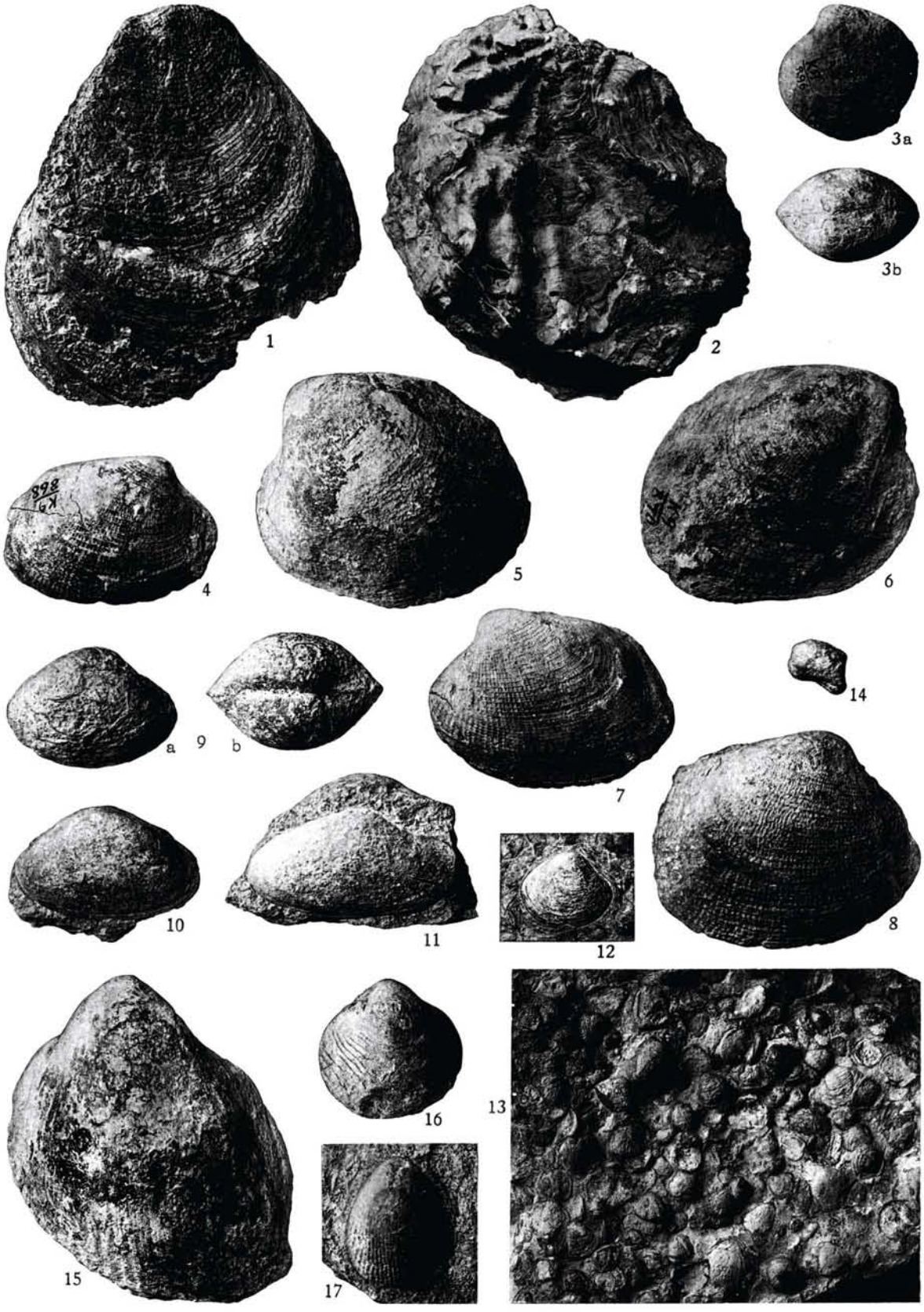
FIG. 14. *Saxicava* sp., ×1¾. Between Daliki bridge and Konar Takhta, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/899). (Page 66).

FIG. 15. *Cardium* sp. Internal cast. Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/889). (Page 63).

FIG. 16. *Cardium* (*Discors*) cf. *triforme*, J. de C. Sowerby. Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/896). (Page 64).

FIG. 17. *Cardium* sp., ×1¾. South-west of Khaneh Zinian, south-western Persia; Upper Burdigalian? (Lower Fars). (G. S. I., K9/950). (Page 64).

Geol. Surv. of India. Plate VII.



L. R. Cox. photo.

Zinco-Collotype Co., Edinburgh.

PLATE VIII.

MIOCENE, PLIOCENE AND PLEISTOCENE MOLLUSCA.

Fig. 1. *Lutraria* cf. *philippinarum*, Reeve. Near Chinar Rahdar, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/956). (Page 65).

Fig. 2. *Meretrix* (*Pitar*) *dalikiensis*, sp. nov. Holotype. Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/871). (Page 59).

Fig. 3. *Apolymetis papyracea* (Gmelin). Internal cast. Henjam I., Persian Gulf; Pliocene (*P. vasseli* beds). (G. S. I., K10/40). (Page 57).

Fig. 4. *Pecten pilgrimi*, sp. nov. Left valve. Kharag I., Persian Gulf; Pliocene or Pleistocene. (G. S. I., K21/292). (Page 52).

Fig. 5. *Pecten pilgrimi*, sp. nov. Holotype, a right valve. Kharag I., Persian Gulf; Pliocene or Pleistocene. (G. S. I., K21/292). (Page 52).

Fig. 6. *Mactrinula tryphera*, Melvill. Henjam I., Persian Gulf; Pliocene? (G. S. I., K25/287). (Page 66).

Fig. 7. *Clementia papyracea* (Gray). Close to Latidun (west of Bandar Abbas); Burdigalian. (G. S. I., K21/217). (Page 62).

Fig. 8. *Clementia papyracea* (Gray). Daliki bridge, south-western Persia; Vindobonian (Middle Fars or *O. virleti* beds). (G. S. I., K9/897).

Figs. 9*a*, *b*. *Pecten pascoei*, sp. nov. Holotype, a right valve. East end of Qishm I., Persian Gulf; Pliocene (*P. vasseli* beds). (G. S. I., K10/65). (Page 50).

Fig. 10. *Pecten pascoei*, sp. nov. Small right valve, much flatter than holotype. Between Khanu Sukh and Bostanah (near Lingeh, Persian Gulf); Pliocene (*P. vasseli* beds). (G. S. I., K21/265).

Fig. 11. *Pecten pascoei*, sp. nov. Left valve. Between Khanu Sukh and Bostanah (near Lingeh, Persian Gulf); Pliocene (*P. vasseli* beds). (G. S. I., K21/265).

Fig. 12. *Pecten pascoei*, sp. nov. Right valve. Near Ishtak, Mekran Coast; Pliocene (Mekran beds). (Brit. Mus., L. 63159).

Fig. 13. *Pecten pascoei*, sp. nov. Left valve. Near Ishtak, Mekran Coast; Pliocene (Mekran beds). (Brit. Mus., L. 63160).

Fig. 14. *Conus* (*Dendroconus*) *loroisii*, Kiener. Nur Mohammadi, eastern Persia; Pliocene (Mekran beds). (G. S. I., K16/840). (Page 42).

Fig. 15. *Conus* (*Dendroconus*) *loroisii*, Kiener. Hushdan, 12 miles north-east of Jask, eastern Persia; Pliocene (Mekran beds). (Brit. Mus., G. 36943).

Fig. 16. *Clavatula tipperi*, sp. nov. Holotype. Nur Mohammadi, eastern Persia; Pliocene (Mekran beds). (G. S. I., K16/843). (Page 41).

Fig. 17. *Rapana mekranica*, sp. nov. Hangar near Jargin river, 26 miles E. N. E. of Jask, eastern Persia; Pliocene (Mekran beds). (Brit. Mus., G. 36973). (Page 40).

Figs. 18*a*, *b*. *Rapana mekranica*, sp. nov. Holotype. Hushdan, 12 miles north-east of Jask, eastern Persia; Pliocene (Mekran beds). (Brit. Mus., G. 36940).

Figs. 19*a*, *b*. *Nassarius persicus*, sp. nov. Holotype. Nur Mohammadi, eastern Persia; Pliocene (Mekran beds). (G. S. I., K16/843). (Page 40).

Fig. 20. *Turritella angulata*, J. de C. Sowerby. Pozug, eastern Persia; Pliocene (Mekran beds). (G. S. I., K16/848). (Page 38).

Figs. 21-23. *Turritella angulata*, J. de C. Sowerby. Chah Bashua plain, eastern Persia; Pliocene (Mekran beds). (G. S. I., K16/846).

Fig. 24. *Turritella angulata*, J. de C. Sowerby. Bicarinate variety, cf. *T. acuticarinata*, Dunker. Hushdan, 12 miles north-east of Jask, eastern Persia; Pliocene (Mekran beds). (Brit. Mus., G. 36956).

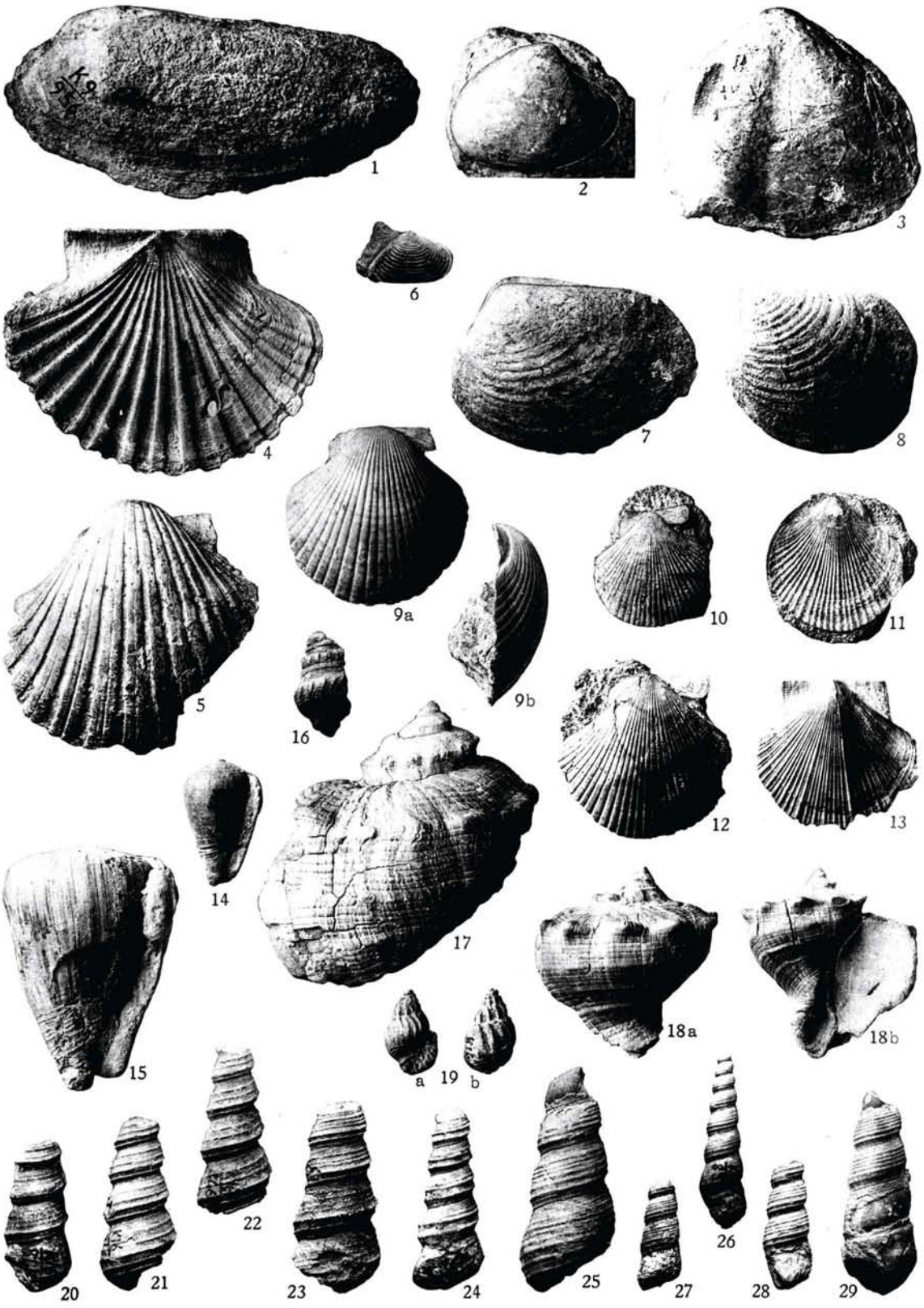
Fig. 25. *Turritella harrisoni*, sp. nov. Hushdan, 12 miles north-east of Jask, eastern Persia; Pliocene (Mekran beds). (Brit. Mus., G. 36938). (Page 39).

Fig. 26. *Turritella harrisoni*, sp. nov. Holotype. Nur Mohammadi, eastern Persia; Pliocene (Mekran beds). (G. S. I., K16/838).

Figs. 27, 28. *Turritella harrisoni*, sp. nov. Nur Mohammadi, eastern Persia; Pliocene (Mekran beds). (G. S. I., K16/838).

Fig. 29. *Turritella harrisoni*, sp. nov. Hushdan, 12 miles north-east of Jask, eastern Persia; Pliocene (Mekran beds). (Brit. Mus., G. 36958).

Geol. Surv. of India. Plate VIII.



L. R. Cox. photo.

Zinco-Collotype Co. Edinburgh.