RECORDS

OF

THE GEOLOGICAL SURVEY OF INDIA

VOLUME LI

Published by order of the Government of India

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SOLD AT THE OFFICE OF THE GEOLOGICAL SURVEY OF INDIA.
27, CHOWRINGHEE ROAD.

1921

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Part 2 (out of print)—Coal seams of neighbourhood of Chanda. Coal near Nagpur. Geological notes on Surat collectorate. Cephalopodous fauna of South Indian cretaceous deposits. Lead in Raipur district. Coal in Eastern Hemisphere. Meteorites.

Part 3 (out of print)—Gastropodous fauna of South Indian cretaceous deposits. Notes on route from Poona to Nagpur *via* Ahmednuggur, Jalna, Loonar, Yeotmahal, Mangali and Hingunghat. Agate flake in pliocene (?) deposits of Upper Godavery. Boundary of Vindhyan series in Rajputana. Meteorites.

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Part 2—Annual report for 1868. Pangshura tecta and other species of Chelonia from newer tertiary deposits of Nerbudda valley. Metamorphic rocks of Bengal.

Part 3—Geology of Kutch, Western India. Geology and physical geography of Nicobar Islands.

Part 4 (out of print)—Beds containing silicified wood in Eastern Prome, British Burma. Mineralogical statistics of Kumaon division. Coal field near Chanda. Lead in Raipur district. Meteorites.

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Part 2 (out of print).—Gold-fields of south-east Wynaad, Madras Presidency. Geological notes on Khareean hills in Upper Punjab. Water bearing strata of Surat district. Geology of Scindia's territories.

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Part 2.—Retirement of Dr. Oldham. Age of some fossil floras in India. Cranium of Stegodon Ganesa, with notes on sub genus and allied forms Sub Himalayan series in Jamu (Jammoo) Hills.

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Vol. X, 1877.

Part 1 (out of print).—Annual report for 1876. Geological notes on Great Indian Desert between Sind and Rajputana. Cretaceous genus Omphalia near Nameho lake, Tibet, about 75 miles north of Lhassa. Estheria in Gondwana formation. Vertebrata from Indian tertiary and secondary rocks. New Emydine from the upper tertiaries of Northern Punjab. Observations on under-ground temperature.

Part 2 (out of print).—Rocks of the Lower Godavari. 'Atgarh Sandstones' near Cuttack. Fossil floras in India. New or rare mammals from the Siwaliks. Aravali series in North-Eastern Rajputana. Borings for coal in India. Geology of India.

Part 3 (out of print).—Tertiary zone and underlying rocks in North-West Punjab. Fossil floras in India. Erratics in Potwar. Coal explorations in Darjiling district. Limestones in neighbourhood of Barakar. Forms of blowing-machine used by smiths of Upper Assam. Analyses of Raniganj coals.

Part 4 (out of print).—Geology of Mahanadi basin and its vicinity. Diamonds, gold, and lead ores of Sambalpur district 'Eryon Comp. Barrovensis,' McCoy, from Sripermatur group near Madras. Fossil floras in India. The Blaini group and 'Central Gneiss' in Simla Himalayas. Tertiaries of North-West Punjab. Genera Chœromeryx and Rhagatherium.

Vol. XI, 1878.

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Part 2.—Geology of Sind (second notice). Origin of Kumaun lakes. Trip over Milam Pass, Kumaun Mud volcanoes of Ramri and Cheduba Mineral resources of Ramri, Cheduba and adjacent islands.

Part 3.—Gold industry in Wynaad. Upper Gondwana series in Trichinopoly and Nellore-Kistna districts. Senarmontite from Sarawak

Part 4.—Geographical distribution of fossil organisms in India. Submerged forest on Bombay Island.

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Part 1.—Annual report for 1878. Geology of Kashmir (third notice). Siwalik mammalia. Siwalik birds. Tour through Hangrang and Spiti. Mud eruption in Ramri Island (Arakan). Braunite, with Rhodonite, from Nagpur, Central Provinces. Palæontological notes from Satpura coal-basin. Coal importations into India.

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Part 3.—Geological features of northern Madura, Pudukota State, and southern parts of Tanjore and Trichinopoly districts included within limits of sheet 80 of Indian Atlas. Cretaceous fossils from Trichinopoly district, collected in 1877-78 Sphenophyllum and other Equisetaceæ with reference to Indian form Trizygia Speciosa, Royle (Sphenophyllum Trizygia, Ung.). Mysorin and Atacamite from Nellore district. Corundum from Khasi Hills. Joga neighbourhood and old mines on Nerbudda.

Part 4.—'Attock Slates' and their probable geological position. Marginal bone of undescribed tortoise, from Upper Siwaliks, near Nila, in Potwar, Punjab. Geology of North Arcot district. Road section from Murree to Abbottabad.

Vol. XIII, 1880

Part 1.—Annual report for 1879. Geology of Upper Godavari basin in neighbourhood of Sironcha. Geology of Ladak and neighbouring districts Teeth of fossil fishes from Ramri Island and Punjab Fossil genera Nöggerathia, Stbg, Nöggerathiopsis, Fstm., and Rhiptozamites, Schmalh., in palæozoic and secondary rocks of Europe, Asia, and Australia. Fossil plants from Kattywar, Shekh Budin, and Sirgujah. Volcanic foci of eruption in Konkan.

Part 2.—Geological notes. Palæontological notes on lower trias of Himalayas. Artesian wells at Pondicherry, and possibility of finding sources of water-supply at Madras.

Part 3.—Kumaun lakes. Celt of palæolithic type in Punjab. Palæontological notes from Karharbari and South Rewa coal-fields. Correlation of Gondwana flora with other floras. Artesian wells at Pondicherry. Salt in Rajputana. Gas and mud eruptions on Arakan coast on 12th March 1879 and in June 1843

Part 4.—Pleistocene deposits of Northern Punjab, and evidence they afford of extreme climate during portion of that period. Useful minerals of Arvali region. Correlation of Gondwana flora with that of Australian coal-bearing system. Reh or alkali soils and saline well waters Reh soils of Upper India. Naini Tal landslip, 18th September 1880.

Vol. XIV, 1881.

Part 1.—Annual report for 1880. Geology of part of Dardistan, Baltistan, and neighbouring districts. Siwalik carnivora. Siwalik group of Sub-Himalayan region. South Rewah Gondwana basin. Ferruginous beds associated with basaltic rocks of north-eastern Ulster, in relation to Indian laterite. Rajmahal plants. Travelled blocks of the Punjab. Appendix to 'Palæontological notes on lower trias of Himalayas.' Mammalian fossils from Perim Island.

Part 2.—Nahan-Siwalik unconformity in North-Western Himalaya. Gondwana vertebrates. Ossiferous beds of Hundes in Tibet. Mining records and mining record office of Great Britain; and Coal and Metalliferous Mines Act of 1872 (England). Cobaltite

RECORDS

OF

THE GEOLOGICAL SURVEY OF INDIA

Part 1] 1920 [May.

GENERAL REPORT OF THE GEOLOGICAL SURVEY OF INDIA FOR THE YEAR 1919. BY H. H. HAYDEN, C.S.I., C.I.E., F.R.S., *Director.*

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DISPOSITION LIST.

1. During the period under report, the officers of the Department were employed as follows :—

Superintendents.

MR. E. VREDENBURG .	At headquarters as Palæontologist throughout the period.
DR. L. L. FERMOR .	At headquarters in charge of office up to 4th September, 1919. On privilege leave from 18th to 27th September, 1919. Placed in charge of Bihar and Orissa and Central Provinces field-party and left headquarters on 2nd November, 1919.
DR. E. H. PASCOE .	Returned to headquarters from Mesopotamia on 19th May, 1919. At headquarters for the rest of the period. Placed in charge of office from 5th September, 1919.

Assistant Superintendents.

DR. G. E. PILGRIM .	Returned to headquarters from Persia on 19th January, 1919. Proceeded on combined leave for one year from 30th April, 1919.
MR. G. H. TIPPER .	Returned from the field on the 24th March, 1919. Granted combined leave from the 12th December, 1919.
MR. H. WALKER . .	Visited Beddadanol coal-field from 19th November to 4th December, 1919, to fix boring sites. At headquarters as Curator for the rest of the period.

MR. K. A. K. HALLOWES	Returned from Burma on 6th April, 1919. Granted combined leave for one year with effect from 14th July, 1919.
MR. G. DE P. COTTER	Returned from the field on 28th August, 1919. Deputed to Central Provinces and left headquarters on 28th October, 1919.
MR. J. COGGIN BROWN	Returned from Tavoy on 18th August, 1919. On deputation with the Imperial Mineral Resources Bureau in London from 15th September, 1919.
MR. H. C. JONES	Returned to headquarters on 10th May, 1919. From 17th to 25th November, 1919, engaged in examining dam sites in Bilaspur district, Central Provinces, and afterwards deputed to investigate the iron-ore deposits of Bihar and Orissa.
MR. A. M. HERON	Returned from Tavoy on 18th May, 1919. Granted privilege leave for six months with effect from 24th May, 1919.
DR. M. STUART .	Returned to headquarters on 6th May, 1919. Attached to Waziristan Field Force and left headquarters on 10th November, 1919.
MR. C. S. FOX	Returned to headquarters on 17th June, 1919, after closing down the Jorasimar mica mines, Hazaribagh. Deputed to carry on an investigation of the bauxite deposits of India and left for the field on 4th October, 1919.
MR. R. W. PALMER	On military duty and leave.

MR. S. SETHU RAMA RAU.	Returned to headquarters on 4th May, 1919. On privilege leave from 2nd to 27th September, 1919. Deputed to Burma to continue the survey of Lower Tenasserim and left headquarters on 1st November, 1919.
MR. M. VINAYAK RAO .	Returned to headquarters on 23rd April, 1919. On privilege leave for 23 days from 10th May to 2nd June, 1919, and combined leave for two months and four days from 25th July to 27th September, 1919. Deputed to Burma to continue the survey of Lower Tenasserim and left headquarters on 1st November, 1919.

Chemist.

DR. W. A. K. CHRISTIE	Services placed temporarily at the disposal of the Government of India in the Finance Department with effect from the 12th April, 1918.

Artist.

MR. K. F. WATKINSON	Returned from privilege leave on 24th January, 1919. At headquarters for the rest of the period.

Sub-Assistants.

BABU BANKIM BIHARI GUPTA.	Appointed on the 6th September, 1919. Granted privilege leave for two months and 13 days from 11th October, 1919.
BABU DURGASHANKAR BHATTACHARJI.	Appointed on the 6th September, 1919. On privilege leave for seven weeks from 11th August to 28th September, 1919. Employed at Jubbulpore from 23rd October to 6th December, 1919, in excavating reptilian fossil remains.

Assistant Curator.

BABU BARADA CHARAN GUPTA.	Appointed on the 6th September, 1919. At headquarters.

ADMINISTRATIVE CHANGES.

Promotions, and appointments.

2. Messrs. S. Sethu Rama Rau and M. Vinayak Rao, Sub-Assistants, were promoted Assistant Superintendents with effect from the 6th September, 1919.

Babu Bankim Bihari Gupta, Assistant Curator, was appointed Sub-Assistant with effect from the 6th September, 1919.

Babu Durgashankar Bhattacharji, Field Collector, was appointed Sub-Assistant with effect from the 6th September, 1919.

Babu Barada Charan Gupta, Field Collector, was appointed Assistant Curator with effect from the 6th September, 1919.

Leave.

3. Dr. L. L. Fermor was granted privilege leave from 18th to 27th September, 1919.

Dr. G. E. Pilgrim was granted combined leave for one year with effect from 30th April, 1919.

Mr. G. H. Tipper was granted combined leave for seven months and twenty-one days from 12th December, 1919.

Mr. K. A. K. Hallowes was granted combined leave for one year with effect from 14th July, 1919.

Mr. A. M. Heron was granted privilege leave for six months with effect from 24th May, 1919.

Mr. R. W. Palmer was granted an extension of leave for six months on medical certificate with effect from 5th June, 1919.

Mr. S. Sethu Rama Rau was granted privilege leave from 2nd to 27th September, 1919.

Mr. M. Vinayak Rao was granted privilege leave for 23 days from 10th May to 2nd June, 1919, and combined leave for two months and four days from 25th July to 27th September, 1919.

Babu Bankim Bihari Gupta was granted privilege leave for two months and thirteen days from 11th October, 1919.

Babu Durgashankar Bhattacharji was granted privilege leave for seven weeks from 11th August, 1919.

4. The services of Lt. Colin Campbell attached to the Geological Survey were replaced at the disposal of the Army Department from the 17th June, 1919.

STUDENTS.

5. Babu Harendra Mohan Lahiri, M.Sc., post-graduate scholar, continued to carry on research work in the Museum and Laboratory up to the end of June, 1919.

PROFESSORSHIPS AND LECTURERSHIPS.

6. Mr. E. Vredenburg was Professor of Geology at the Calcutta University, and Mr. H. Walker, Lecturer on Geology at the Presidency College, throughout the year.

LIBRARY.

7. The additions to the library amounted to 2,493 volumes, of which 921 were acquired by purchase and 1,572 by presentation and exchange.

PUBLICATIONS.

8. During the year, the last part of Volume XLIX and all parts of Volume L of *Records* were published. Five parts of *Memoirs* and two memoirs of *Palæontologia Indica* were prepared for the press.

MUSEUM AND LABORATORY.

Staff.

9. Mr. H. Walker was Curator of the Geological Museum and Laboratory throughout the year. The Assistant Curator, Babu Bankim Bihari Gupta, was promoted to Sub-Assistant, and his place was taken by Babu Barada Charan Gupta, Field Collector. Babu Phanindra Nath Mookerjee, Museum Assistant, was promoted to Field Collector. Babu Ram Chandra Bhattacharji was appointed Museum Assistant.

Chemist.

10. The services of Dr. W. A. K. Christie remained at the disposal of the Government of India in the Finance Department throughout the year.

11. The number of specimens referred to the Curator for examination and report was 546. 347 analyses were made. The corresponding figures for the previous year are 460 and 93. This large increase in the amount of analytical work was due to a number of investigations undertaken by several officers of the Department. The chemical work included analyses of bitumen, trona, chromite, coal, copper-ore, graphite, iron-ore, limestone, manganese-ore, oil shale, reh, saline waters, sodium carbonate waters, sulphur rock, and tin and wolfram concentrates.

Determinative work and analyses.

12. One meteorite was received during the year. It fell about noon on the 1st May near the village of Adhi Kot in the Shahpur district of the Punjab. The weight is 4238·8 grammes.

Meteorite.

13. During the year, various specimens and collections of rocks and minerals were given to—

Donations to museums, etc.

(1) The Forman Christian College, Lahore.
(2) The Bengal Technical Institute, Calcutta.
(3) The McMahon Museum, Quetta.
(4) The Patna Museum.
(5) Durgapur H. E. School.
(6) The Royal Ontario Museum, Canada.
(7) St. John's College, Agra.
(8) St. Michael's High School, Digha Ghat.
(9) The Darjeeling High School.
(10) St. Paul's School, Calcutta.

In addition, two collections, which had been selected and packed, but which, owing to transport difficulties during the war, had not been despatched, were sent to their destinations during the period under report. They were :—

(1) A collection of Indian minerals of economic importance; to the Sedgwick Museum, Cambridge.
(2) Pieces of some Indian meteorites; to the Museum d' Histoire Naturelle, Paris.

14. The following foreign specimens were added to the collections during the year :—

Additions to the collections.

(1) Mica from German East Africa; presented by Major C. L. Walsh, Controller of Mines.

(2) Scheelite from South Island, New Zealand; presented by G. F. Thorpe, Esq.

(3) Wolfram from Queensland; presented by H. G. Mathews, Esq.

(4) Lead and zinc ores from Broken Hill, Northern Rhodesia; by purchase.

The following Indian specimens were received:—

(1) Barytes from Kurnool district; presented by M. R. Ry. P. P. Seshareddy.

(2) Burmite from the Hukong Valley; presented by R. J. C. Swinhoe, Esq.

(3) Specular hematite from near Mount Popa: presented by C. Campbell, Esq.

(4) Bismuthinite and molybdenite from Tavoy district; presented by J. M. Campbell, Esq.

(5) An ingot of best select copper from the Rakha Hills mines; presented by the Superintendent, Cape Copper Co., Ltd.

(6) Velvety pyrolusite on pyrolusite from the Shivrajpur mine, Panch Mahals; presented by the Manager.

(7) Wolfram, scheelite and tungsten products; presented by Messrs. The High Speed Steel Alloys, Ltd.

(8) Phologopite in hexagonal crystals from Travancore; presented by F. Gaston, Esq.

(9) Bauxite from Jammu province; presented by C. S. Middlemiss, Esq., C.I.E.

(10) Zircon crystals from Travancore; presented by S. H. Harman, Esq.

PALÆONTOLOGY.

15. Mr. Vredenburg's work on the Tertiary fossils of North-Western India is still incomplete. He has, however, handed in a large amount of descriptive work, embodying descriptions of over 150 species belonging to 58 genera of post-Eocene gastropods. These descriptions will shortly be published.

STRATIGRAPHY.

Tertiary outlier near Simla.

16. The discovery of fossiliferous rocks in the hills between Matiana and the Shali peak to the north of Simla was recorded in the last General Report; a subsequent visit to the locality resulted in the discovery of nummulitic limestone. The nummulites were examined by my colleague, Mr. E. Vredenburg, who, however, was unable to determine them completely owing to their poor state of preservation. It is hoped that it may be possible to have this area surveyed in detail before long, in which case better specimens may perhaps be obtained. This Tertiary outlier is of considerable interest, since its facies is very similar to that of the lower Tertiary of Solan. Its relationship to the Shali limestone has not yet been worked out, but there appears, superficially, to be a conformable sequence downwards from the fossiliferous beds through indurated shale into a very hard sandstone, resembling quartzite, which overlies the Shali limestone. There is a considerable amount of disturbance and occasional inversion, the white sandstone and the shaly limestone being sometimes found overlying the Tertiary beds. A careful survey on a large scale will be necessary before the true stratigraphical conditions can be determined. The matter is one of importance, as it may throw light on the age of the Shali and other similar limestones.

Lameta beds.

17. An examination of the Lameta beds of the Jubbulpore district, including a detailed survey of part of Jubbulpore Cantonment on the scale of 16 inches to a mile, has been made by Dr. C. A. Matley, who has kindly communicated the results to this Department. He finds that the formation is separable into five zones, and that there is a conformable succession from the Jubbulpore Series through the Lametas to the Deccan Trap. A number of parallel post-trappean strike faults affecting the Lameta beds have been detected by him.

Dr. Matley has also discovered in the Lameta beds of Jubbulpore a large number of hitherto unknown remains of dinosaurs. They include the right and left scapulæ (66 inches long), the right humerus (53 inches long), radius, fibula, right ischium, ribs, vertebræ, chevron bones and other parts of the great sauropod *Titanosaurus indicus*. Lydekker. He has also collected, with the assistance of the Geological Survey, the greater part of the skeleton of a carnivorous (theropod) dinosaur allied to *Megalosaurus*.

ECONOMIC ENQUIRIES.

Bauxite.

18. A considerable amount of attention has recently been paid to Indian bauxite and schemes have been considered for the manufacture of alumina, and even of aluminium, in India. It was, therefore, decided to undertake the examination of all known bauxite deposits in this country, and to publish a memoir on the subject. Mr. C. S. Fox has been entrusted with this work, and it is hoped that the greater part of the field-work will be completed by the end of the season 1919-20.

Chromite.

19. In consequence of the discovery of a new locality for chromite near Fort Sandeman in Baluchistan, it was decided to resume the survey of the Zhob and neighbouring areas between that post and Hindubagh. The first discovery of chromite in Zhob was made by Mr. E. Vredenburg nearly twenty years ago during the course of a reconnaissance made by him and Mr. G. H. Tipper; since then, no opportunity had arisen for the resumption of the systematic examination of that part of Baluchistan. On completion of his investigation of the sulphur deposits at Sanni in Kelat, Mr. Cotter proposed to make a complete survey of the Zhob valley. Unfortunately the outbreak of the Afghan war interrupted his work, and he was able to do little more than pay a flying visit to Fort Sandeman before he was recalled to Quetta. The Fort Sandeman chromite is found at Azghar Tangi, one mile east of Jalat Kalai, in a serpentinised peridotite, in the form of a lenticle 15 feet long by 7 feet wide; an average sample gave only 37·86 per cent. Cr_2O_3. Lumps of ore were also found lying on the surface and embedded in travertine at Saragara, 1⅛ mile south of Gadai Khel Kalai village; here also the neighbouring rock is serpentinised peridotite, but no chromite was found *in situ*. An average sample of the lumps collected yielded 43·62 per cent. Cr_2O_3. These occurrences represent only second-grade ores, but, as Mr. Cotter justly points out, they are of importance as proving the presence of chrome-bearing basic rocks similar to those of Hindubagh and suggesting the possibility of further discoveries of chromite. Mr. Cotter was unable to continue his work here long enough to enable him to ascertain the extent

of the peridotite intrusions, but he found igneous rocks over an area 4½ miles long by 1½ mile wide in the Sanga Ghar range to the east of Walla, and he regards it as probable that they cover a considerably greater area.

Coal.

Burma.

20. During the progress of the survey of the Tenasserim valley, Mr. A.M. Heron took the opportunity of re-visiting the Kawmapyin-Theindaw coalfield. He was not able to add appreciably to the information already available; only boring will do this. All the samples taken by him indicated very poor material, carrying about 30 per cent. of ash, but material collected at Kyaukmithwe from a refuse heap, probably the results of excavations by earlier explorers, was found to cake strongly and to contain only 3·77 per cent. of ash.

Madras.

21. At the request of the Madras Government, Mr. H. Walker visited the Beddadanol coalfield in the Godavari district and fixed sites for deep borings which the Local Government proposes to sink in order to test the field.

Copper.

22. In the course of his work at Fort Sandeman, Mr. Cotter examined a supposed copper lode occurring 1½ mile E. S. E. of Saragara. He found a vein of limonite-malachite rock in a small stream on the footpath to Mandezai Kalai village. The vein occurs in serpentinised peridotite, and can be traced for about 100 yards. The deposit appears to be a poor one, but circumstances prevented Mr. Cotter from opening it up, and its value is therefore still uncertain.

Engineering Questions and Allied Enquiries.

Proposed dams.

23. Several sites for dams were examined and reported on during the year. Mr. H. C. Jones re-visited the Hasdeo site in Bilaspur, Central Provinces, where borings were being put down to test the rock underlying the alluvium.

24. At the request of the Madras Government, Dr. Murray Stuart was deputed to report on a site for a proposed dam on the Siruvani river in Malabar district near the borders of Coimbatore, where it was hoped to construct a reservoir which would be capable of giving

not only an ample water supply but also electric power to the station of Coimbatore. Owing to the porous nature of the rocks on which it was proposed to found the dam, Dr. Stuart was compelled to condemn the site.

Proposed Damuda barrage.

25. With a view to preventing the serious effects of the floods which from time to time devastate the country bordering the Damuda river in Burdwan, proposals have been put forward for the erection of barrages across that river and across the Barakar some miles above the area affected. A site having been suggested at Parjori on the edge of the Jharia coalfield, the Geological Survey was asked to report on it. The enquiry was entrusted to Mr. C. S. Fox, who found that, although the site in question would be suitable from the constructional point of view, the effect on the coalfield might be serious owing to increased percolation into the lower coal-measures from the proposed reservoir.

Boring for coal below Deccan trap.

26. Last year boring operations were undertaken at Bhusawal by the Great Indian Peninsula Railway Company in search of possible coalfields below the Deccan Trap. Dr. Fermor investigated the site before operations were begun and visited it again recently. At the time of Dr. Fermor's last visit in November, 1919, the boring had reached a depth of 255 feet, of which 46 feet 6 inches were alluvium and the rest Deccan Trap.

Natural gob-fire in Sirmur.

27. Considerable alarm was recently created among the inhabitants of a small valley in Sirmur State by the discovery that the rocks of one of the hill-sides were on fire. The matter was reported to the Geological Survey, with a request that the locality should be examined. I took advantage of a visit to Simla in September to return through Sirmur and inspect the fire. The locality in question is close to the village of Ghalja which lies in the hills above the famous Ranka lake and about 25 miles E. N. E. from Nahan. The fire was found to be burning at the back of a landslip which had occurred on the steep side of a small valley, in grey and red ferruginous shales which carry thin bands of lignitic material. The back of the slip is defined by a crack or series of cracks extending for some hundreds of yards along the hill-side. The vertical movement appeared to have been inconsiderable, but the friction had apparently been sufficient to generate combustion in the lignitic material, specimens of which were

found to carry about 13 per cent. of carbonaceous matter. Owing to the presence of the cracks along the back of the slip, the burning material is supplied with sufficient oxygen to maintain combustion. The phenomenon is, in fact, a typical gob-fire produced by natural causes. It is likely to continue until the slipped material eventually subsides into the valley below.

Iron.

Bihar and Orissa.

28. The recent discoveries of iron-ore in the southern parts of Singhbhum have resulted in a large number of applications for prospecting licenses and mining leases, and it was considered advisable that the ferruginous belt should be geologically examined without delay. Mr. H. C. Jones has been engaged on this investigation during the last two field-seasons. The geological results of his work will be found below (pages 17—18). He found the iron-ore to occur usually at or near the tops of hills, the most important being the range running from about 3 miles south-west of Gua to the Kolhan-Keonjhar boundary east of Naogaon, *i.e.*, a distance of about 10 miles. The range, which rises some 1,500 feet above the plain, is said also to continue into the Keonjhar State. Mr. Jones found that good iron-ore formed the top of this range of hills almost without a break. Parallel to this range is another similar line of hills running from the Duargui stream, three miles east of Bada, to the Karo river south-east of Ghatkuri, a distance of about 7 miles. Here the iron-ore was found to occupy the top of the ridge as before, the ore in the southern part being apparently as good and continuous as in the adjoining range; towards the north, however, a considerable amount of disturbance was observed, and replacement appeared to be less complete. To the west a third range of hills runs from the Karo river, east of Salai, to the east of Chota Nagra. Here also iron-ore was found at or near the top of the range, but it appears to be confined to patches, which, however, are of considerable importance. To the west of these ranges again are more irregular patches of ore occupying the tops of hills. The Kolhan hematites usually appear to contain about 64 per cent. of iron, with phosphorus ranging from ·03 to ·08, or, in some cases, to as high as 0·15. The sulphur content is usually below ·03. Titanium is also said to be found occasionally in the ore, usually either as a trace or in very small

quantities. Samples from the better parts of the ore-deposits contain as much as 68 or 69 per cent. iron. Comparatively little prospecting work has been done hitherto by concessionaires on the deposits, but enough is known to justify the belief that the quantities available will run into hundreds—possibly into thousands—of millions of tons. In most cases, the chief obstacle to development lies in the difficult and inaccessible nature of the country.

Madras.

29. At the request of the Government of Madras, Dr. M. Stuart was instructed to re-examine the well-known magnetite deposits of Kanjamalai in Salem district. Dr. Stuart took a number of average samples of the deposits and the result of his work has been to confirm the conclusions arrived at by Mr. Middlemiss twenty-two years ago,—that the ore is really a low-grade quartz-magnetite schist containing about 38 per cent. of iron. The percentages given by Dr. Stuart's samples ranged from 37 to 39. Mr. E. O. Murray kindly put some bulk samples of the ore through a magnetic separator belonging to the Great Indian Phosphate Company, but the results were not entirely satisfactory, and it is proposed to have a further test made as to the possibility of magnetic concentration.

Kaolin.

30. In my General Report last year reference was made to an investigation then being carried out by Mr. K. A. K. Hallowes into the china clay deposits of Upper Burma. The so-called "White Bed," or "White Sand," occurring immediately below the Red Bed at the base of the Irrawaddi Sandstone Series, has long been known to contain a considerable amount of kaolin. Extensive examination of this bed by Mr. Hallowes, both in the Pakokku district and in Yamethin, proved it to contain very large quantities of clay which appears to be eminently suitable for the manufacture of porcelain. The raw sand is said to contain about 60 per cent. of free silica and from 25 to 30 per cent. of kaolin; it is also said to be very free from iron and alkalis. Laboratory tests indicated that the plasticity, refractoriness and colour of the levigated material were good. The white bed is said to run for a distance of some 40 miles, the most important area, however, being regarded by Mr. Hallowes as the Yenangyat and Singu oilfields, where the bed appears to attain its maximum development. Its thickness is variable, and is said to range from

15 to 50 feet. Owing to the proximity of the Yaw and Irrawaddi rivers, levigation could be easily carried out, while cheap water-carriage is available to Rangoon.

Manganese.

31. During the course of his survey of the Nagpur district, Mr. G. de P. Cotter found among the Archæan rocks to the north-east of Kelod thin bands of manganese-ore, which evidently constitute a continuation of the Dudhara occurrence recorded by Dr. Fermor in *Memoirs*, Vol. XXXVII, page 801.

Mica.

32. The urgent demand for mica having ceased soon after the conclusion of the armistice, it was decided to close down the mines at Masnodih which were being worked by the Geological Survey. When orders to close were received, in March, 1919, Mr. C. S. Fox, who was in charge, had succeeded in bringing up the output of the mines from about $1\frac{1}{4}$ ton per mensem to nearly seven tons. The work of both Mr. G. H. Tipper and of Mr. C. S. Fox has been commended by the Local Government and also by the Government of India. In addition to advisory work in Bihar and Orissa, Mr. G. H. Tipper also visited the Nellore mica mines at the request of the Madras Government, and submitted a full report on existing mines and recommendations as to the possibility of improving the local methods of mining.

Petroleum.

33. Dr. Pascoe's memoir, Vol. XL, pt. 3, on petroleum in the Punjab and North-West Frontier Province, was recently completed and is now in the press. The memoir contains references to all recorded seepages, most of which were visited and examined. This work has, unfortunately, suffered considerable delay, especially that caused by the war. An attempt has been made to shew that the theory held by Sir Thomas Holland, myself and others. regarding the structure and age of the Salt Range rocks, fits the facts better than any other and receives confirmation from all the oil seepages connected with the salt and gypsum on both sides of the Indus. The author developes at some length his theory regarding the connection between an

oil-belt and a desiccating gulf, the gulf in this case giving place to a river with a very interesting history.

Soda.

34. An enquiry into the soda deposits and industry in Sind has recently been made by Mr. G. de P. Cotter. Previous to this little was known regarding the nature and extent of these deposits, which are exported in small quantities from Karachi. The salt obtained is a crude trona known locally as "*chaniho*," and is used for washing and dyeing clothes, for hardening treacle, for the preparation of molasses from sugar-cane, in flavouring *goorakho* (a preparation from tobacco) and principally as a yeast in the manufacture of *papars* or pulse biscuits. The only areas at present producing *chaniho* are Khairpur State with an average annual output between 1912-13 and 1916-17 of 734 tons of trona, and the Nawabshah District which produced 555 tons in the two years 1915 to 1917. The total outturn in Sind therefore averages approximately 1,000 tons per annum.

Sulphur.

35. Early in the year under review, Mr. Cotter took up the examination of the old sulphur mines near Sanni in Baluchistan. The result showed that there was likely to be only a small amount of sulphur available. Mr. Cotter's report has already been published in these *Records* (Vol. L, part 2).

Tin.

36. During the course of his work in eastern Tavoy, Mr. Vinayak Rao found that the results of panning gave a good show of tin in the Chaungwa, Makute, Salopu, Kyeku and other streams joining the Tenasserim river from the west. Alluvial flats occur on either side of the upper Tenasserim river in Tavoy, but these have not yet been prospected for tin.

Tungsten.

37. Owing to the absence of further demand for wolfram, Messrs. Coggin Brown and Heron, who had remained for some years continuously at Tavoy in order to advise the Local Government on the

best methods of increasing the output, were re-called at the end of the usual field-season. Mr. Coggin Brown, however, remained for a further short period in order to deal with questions relating to the compensation to be paid to the producers.

Water.

38. The question of increasing the water-supply of Quetta and of other places in Baluchistan has recently been receiving considerable attention, and early in the year under review I visited Baluchistan to discuss the matter with the Local Administration. I could only reiterate the advice given by Mr. R. D. Oldham nearly thirty years before, that deep borings should be put down in the alluvial plain with a view to testing the artesian conditions at depths of from 500 to 1,000 feet below the surface. Subsequently, Mr. G. de P. Cotter was instructed to go into the question fully during last summer; his conclusions were the same as Mr. Oldham's and mine. He also reported on the possibility of increasing the water-supply at various other places, including Spezand and Sariab.

GEOLOGICAL SURVEYS.

39. The Bihar and Orissa and Central Provinces party consisted of Dr. Fermor (in charge), and Messrs. Cotter and Jones.

Bihar and Orissa.

Owing to recent discoveries of large deposits of iron-ore in Singhbhum, it was decided to take up at once the examination of the hitherto unsurveyed parts of that district. Mr. H. C. Jones was deputed to make a geological survey of the Kolhan Government estate and the neighbouring States of Keonjhar and Bonai. During the field-season 1918-19, he succeeded in mapping a considerable area represented by degree sheets (1″=1 mile) 73 F3, 73 F4, 73 F7 and 73 F8. The country examined consists largely of reserved and protected forest-land; it is wholly covered with *sal* forest and is almost uninhabited. Mr. Jones, therefore, experienced considerable difficulties in the matter of supplies and transport, and work was consequently slower than it would have been in more accessible country.

40. Mr. Jones states that the rocks of the area consist chiefly of shales or slates, and phyllites with bands of sandstone, quartzite and banded hematite-quartzite. Thin bands of siliceous limestone

are occasionally found. The banded hematite-quartzites are important as forming the main part of the iron-bearing series. Being extremely hard and consisting largely of insoluble iron oxide, they resist weathering and stand out above the surrounding country, forming most of the high hills and ridges in the area examined. Dykes and interbedded layers of greenstone are common. According to Mr. Jones the sequence of rocks in which the iron-ore occurs appears to be :—

(1) newer slaty shale ;
(2) banded hematite-quartzite ;
(3) older slaty shale.

Above the newer shale Mr. Jones found a band of conglomeratic breccia, which he refers tentatively to the base of the Cuddapah system. Of the ferruginous rocks the commonest type consists of interbanded layers in varying proportions of iron oxide, silica and combinations of the two. The silica is sometimes crystalline and sometimes cherty. The chert, however, is not truly amorphous, but consists of fine interlocking quartz grains. At times the silica is red and jaspideous. The iron oxide is usually hematite, but octahedra of magnetite were sometimes found. According to Mr. Jones, the ore-bodies are derived from these rocks by local enrichment, largely by the leaching out of silica, and to a less extent by the introduction of iron oxide. For further details regarding the ore-bodies see *supra* p. 13.

Burma.

41. The systematic survey of Tavoy and Mergui was continued by the party consisting of Messrs. Coggin Brown, Heron, Sethu Rama Rau and Vinayak Rao. The map of Tavoy on the scale of 1″=1 mile was almost completed by the end of 1919, only a small area of extremely inaccessible country still remaining to be surveyed. Owing to the increased attention that is now being paid to possible tin-bearing ground, work has been pushed on in Mergui, both in the outer ranges and in the Tenasserim valley. Mr. Sethu Rama Rau reports that the rocks of the Palaw valley consist chiefly of members of the Mergui series, including micaceous slates, and shales and quartzites, with bands of granite intruded parallel to the general strike of the sedimentary rocks. The intrusions are usually drawn out lenticles with veins of secondary quartz. The granite is a coarse crystalline muscovite-tourmaline-pegmatite with cassiterite as an accessory mineral in many places. The alluvial flats bordering the streams which flow at the foot

of the pegmatite hills generally carry tin. The ridge of hills east of the Palaw Chaung consists chiefly of argillaceous limestone and, owing to the absence of intrusive granite, is barren of tin.

42. Mr. Vinayak Rao's work was confined chiefly to the Tavoy district and lay among the very inaccessible country in the neighbourhood of Banchaung in the east of the district. Near that village and also at Kyaukton the Tertiary rocks contain a seam of coal of good quality. It is, unfortunately, only six inches thick, and the quantity is negligible. Owing to the uninhabited nature of the country and the impossibility of obtaining transport and supplies, Mr. Vinayak Rao was compelled to leave some of the more inaccessible areas bordering the Siamese frontier unsurveyed for the present. He is now transferring his camp to Mergui, with the intention of working up the Tenasserim valley towards the Tavoy frontier.

Central Provinces.

43. In the Central Provinces Dr. Fermor resumed the survey of the Chhindwara district, and Mr. Cotter that of Nagpur. In Chhindwara Dr. Fermor continued his study of the calcareous Archæan rocks of the Sausar tahsil and has now been able to distribute them amongst two main groups. The first consists of—

(*a*) calcitic marbles—containing diopside hornblende, epidote and garnet;

(*b*) calciphyres—marbles with very abundant accessory minor minerals; and

(*c*) calc-granulites—containing epidote, garnet, pyroxene, hornblende, quartz, microcline and labradorite. These granulites are regarded by Dr. Fermor as products of *lit-par-lit* injection of limestone by an acid intrusive rock characterised by the presence of microcline. The bands of the granulites are usually from 1 inch to 3 inches thick, those representing the original limestone being characterised by the presence of labradorite, while the intrusive material is less calcareous and is characterised by the presence of microcline. In places it has been possible to trace the passage of marble along the strike through banded calciphyre into calc-granulite.

The second group of the calcareous Archæan rocks consists of dolomitic serpentine marbles containing diopside, chondrodite, phlogopite, spinel, forsterite (?) and sometimes tremolite. The diopside, forsterite and chondrodite all pass into serpentine. Dr. Fermor suggests that, like the marbles of Skye, these rocks may result from the metamorphism of sedimentary dolomitic limestone; their origin, however, has not yet been worked out.

44. With the help of the beds of Deccan Trap overlying the Archæan rocks, Dr. Fermor has been able to detect and work out a system of post-Deccan Trap faulting that has affected this area. Similar faulting has been referred to in previous General Reports, but it has now proved more extensive than was originally suspected. It is of the simple block-faulting type, the vertical throw ranging from 50 to 250 feet. This faulting is particularly noticeable in the calc-granulite zone.

45. Mr. Cotter's work lay chiefly in the country covered by sheet 55 K15. The rocks met with consisted of Archæan, Gondwana, Lameta, Deccan Trap and alluvium. The gneiss is generally of the same type as that prevailing in the Sausar tahsil of Chhindwara. Towards the south quartzite bands are common. The Gondwana beds are found west and south of Kelod. According to Mr. Cotter, they are very like the Gondwanas at Parsora in Rewah State and presumably belong to the Kamthi stage. Fossils were found only in one place and consisted of stems of *Schizoneura.* The beds appear to be faulted against the Archæan group the boundary running from N. W. to S. E. The Lameta beds are whitish sedimentary grits usually cemented by calcite.

Mesopotamia.

46. During the winter of 1918-1919 Dr. E. H. Pascoe was deputed to make a geological examination of parts of Mesopotamia. With the concurrence of the Chief Commissioner, Baghdad, and Army General Headquarters, the following itinerary was followed. From Tikrit the right bank of the Tigris was followed through Fathah, Sharqat, El Qaiyarah, and Hammam Ali, as far as Mosul, with short offsets where possible. At Mosul the river was crossed and the route taken passed through Nineveh, Nimrud, across the Greater Zab at Quwair, through Kurkuk, Tazah Khurmatu, Tauq, Tuz Khurmatu, Kifri, Qarah Tappah, to Table Mountain. Digressions were made *en route* to Mar Behnam, Kani Qadir, and the Jabal Gilabat. The country covered was mapped on military skeleton maps on the scale of ½ inch or 1 inch to the mile. The beds encountered were assigned to two series, the lower of which forms part of Dr. Pilgrim's gypsum-

bearing Fars series. This includes marine beds and is followed by a fluviatile series for which Dr. Pascoe proposes the provisional name of "Kurd series," as it is so well developed in Kurdistan; he is of opinion that it will eventually be found to correspond fairly closely with Dr. Pilgrim's Bakhtiari series of Persia. It was found possible to separate this series into four if not five zones or stages, which, although passing one into the other with no definite boundary, form distinct phases in the deposition of the sediments. A highly interesting reversed fault of very large magnitude was observed along the base of the Jabal Nasaz at Kani Qadir.

47. By the courtesy of the Flying Corps Dr. Pascoe was taken for a flight over the Jabal Yawan, partly to visit country whose more intimate acquaintance the hostility of local tribes rendered it inadvisable to make on foot, and partly to test the value of aeroplane reconnaissance for geological work. With regard to the latter the result was on the whole disappointing, though an excellent bird's-eye view of the structure of the anticline was occasionally obtained. The Fars beds could be recognized even at 1,000 feet altitude, but their boundaries could not be observed with sufficient approximation to make this method of surveying of any great use.

Waziristan.

48. Dr. M. Stuart, who is attached to the Waziristan Field Force, accompanied the Tochi column as far as Datta Khel, and was able to confirm the results of the work of F. H. Smith, who accompanied a similar expedition nearly 25 years ago. When military operations were transferred to the Mahsud region, Dr. Stuart accompanied the column, but, up to the end of the period covered by this report, had not been able to visit hitherto unexplored country.

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NOTE ON PSEUDO-CRYSTALS OF GRAPHITE FROM TRAVANCORE. BY G. H. TIPPER, M.A., F.G.S., F.A.S.B., *Geological Survey of India.* (With Plate I.)

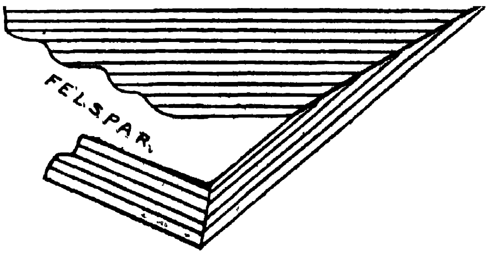
WHILE in Trivandrum in 1909 Mr. H. P Herbert of the Morgan Crucible Co. showed me some specimens of what appeared to be well crystallised graphite then being obtained from one of the Company's prospecting pits. He very kindly arranged for me to have an opportunity of visiting the locality.

The pit, situated near the village of Yerrachelloor (8° 20′ 20″; 77° 11′) 6 miles south of Neyattankarai, had been sunk through the lateritised soil-cap into the decomposed rock below. The rock in which the graphite occurred was chiefly decomposed felspar stained a red brown colour, with a few stringers of quartz. The pit was extremely wet and the material so soft that it could easily be cut with a spade. The graphite was in two forms, pseudo-crystalline and flaky. The latter was much more abundant and some of the plates were several inches across. The mineral occurred in patches in the rock and did not form a continuous vein.

A number of the most perfect pseudo-crystals were collected. The graphite had every appearance of being an original constituent of the rock, and judging from many other occurrences in Travancore and the Tinnevelly hills, the original rock was probably a pegmatite, although as already stated the rock was in such a weathered condition that its original form was completely lost.

The pseudo-crystals (figs. 1—7, Plate 1) are of bright shining graphite which hardly soils the fingers. The faces are usually flat, only occasionally curved or distorted, and the angles sharp. Many of the faces show triple sets of striæ cutting each other at angles of approximately 120°. There is a well defined platy cleavage. The density of the mineral is 2·2. The ash amounts to only 1·20 per cent. and consists of 70 per cent. of iron oxide and alumina, the remainder being silica. Some of this impurity may be of subsequent origin due to the weathering of the enclosing rock.

Some of the specimens are wedge-shaped, of the type shown in figures 6 and 7, Plate 1. In two cases there is a core of weathered felspar showing at the broad end. The structure is that seen in the annexed text figure. The core is surrounded, not by a single individual, but by a number of independent units in each of which the platy cleavage of the graphite is arranged parallel to each face. This structure resembles closely that of wedge mica and is probably of similar origin.



In all the other cases the felspar core is wanting and is replaced by a core of polyhedra of glistening graphite, round which plates of graphite are arranged in a manner exactly similar to that above. This is beautifully shown in the photograph, fig. 1, Plate 1. There is often a considerable difference in the thickness of the external platy layers on different parts of the same structure. Many of these apparent crystals are pyramidal or prismatic and one or two seem to show trigonal symmetry, while some are undoubtedly compounded of several units of the type described. One shows a marked re-entrant angle as if it had grown round some resistant object, the resultant resembling a butterfly twin. In some there is a re-entrant angle formed by the jutting out one of the faces in its own plane beyond the limit of the rest of the crystal (Fig. 4, Plate 1). It is interesting to note that in two cases the angle so made by the projection with the adjacent face corresponds to the angle between the basal plane and a prism face of a plagioclase felspar. This, however, is probably merely a coincidence.

It seems from a description of the structure of these objects that the resultant form is not a true crystal, but is due to portions of different crystals (represented by the different sets of plates of graphite) meeting at varying angles. This is borne out by a study of the angles of the structures. As has been noted, the faces are generally flat and the angles sharp. Careful measurements by my colleague, Mr. C. S. Fox, who considers that the measurements are accurate to half a degree, led him to the conclusion that, although there are a certain number of coincidences, the measurements so obtained cannot be fitted into any of the known crystallographic systems.

In attempting an explanation of these structures, it is necessary to insist on their rarity. They constitute only a small proportion of the graphite in the rock. In spite of the high quality of this form of graphite, profitable mining was only possible while the enclosing rock was weathered and excavation easy.

The ordinary means of study are of no use in the case of an opaque mineral, and owing to the great flexibility of the graphite plates, it is not possible to cut or break the forms and at the same time preserve the inner structure intact. Observations are dependent on chance breakages. Of the thirty-two specimens eight show something of the inner structure. Two of them have a felspathic core, and in these instances the graphite is of a later generation than the felspar. Here the graphite may have simply crystallised from several independent centres round the felspar, as mica is known to do in one form of wedge mica; the latter, however, is never so perfect in form as the graphite in question.

In the remaining six specimens which show inner structure there are no signs of a foreign core, the centre of each individual being formed of polyhedra of graphite. If there had been free crystallisation, there is no reason why a symmetrical form should not have been produced. It would seem, therefore, that there was some directive influence other than that of ordinary crystallisation to account for these unsymmetrical forms. A suggestion may be put forward that the graphite is of a later generation and filled cavities occurring between already crystallised falspar. In this way it might be possible to account for the asymmetry of the growths and also for the re-entrant angles.

EXPLANATION OF PLATE.

FIG. 1. Magnified photograph showing structure × 3.

FIGS. 2—7.—Different types of pseudo-crystals ; fig. 4 shows a re-entrant angle ; natural size.

ON A MINERAL RELATED TO XENOTIME FROM THE MANBHUM DISTRICT, BIHAR AND ORISSA PROVINCE. BY G. H. TIPPER, *Geological Survey of India.* (With Plate 2.)

THE mineral which forms the subject of the present note was sent to the Geological Survey Office by Mr. E. O. Murray from Ara Burru, Kanyaluka mauza, 3 miles west of Dhalbhumgarh, one of the localities where apatite-magnetite rock is developed. On the specimen were a number of long brown prisms, closely resembling in habit and colour zircon. Preliminary physical tests showed that the mineral was not zircon. A qualitative chemical analysis proved the presence of large quantities of rare earths and gave a strong reaction for phosphate. As the crystal system seemed to be tetragonal and the specific gravity was 4·55, it seemed probable that the mineral was xenotime and further chemical and microscopical investigations were undertaken.

Method of Analysis.

The powdered mineral was fused with pure sodium carbonate, treated with hydrochloric acid, evaporated to dryness, taken up with a little more acid and filtered. There was practically no insoluble residue. The filtrate was treated with ammonia in excess, boiled and filtered. The precipitate so obtained, containing practically everything, was dissolved in a small quantity of dilute nitric acid. Solid oxalic acid was added to the solution which was boiled and allowed to stand for at least 12 hours. The precipitated oxalates were a delicate rose pink colour and were considered to contain all the rare earths. The precipitate was filtered off and ignited. The oxides were a light red brown. They were dissolved in fuming nitric acid and the solution evaporated until no more acid fumes were given off. The combined nitrates were dissolved in a little water, an excess of solid potassium sulphate was added, and the whole allowed to stand. It was considered that this separation would give some idea of the relative proportions of the yttrium and cerium earths. As, however, there is a fair percentage of thorium present, the separation is by no means accurate. After the separation by potassium sulphate, the oxalates of both yttrium and cerium earths were precipitated and ignited. The oxides were combined, converted into nitrates and the thorium oxide precipitated in a solution in ammonium nitrate by hydrogen peroxide. The phosphate was determined in the ordinary way. No attempt was made to estimate any other constituent in the mineral, the principal being iron.

Result of Analysis.

Total Rare Earths	61·32
Yttrium Earths	47·6
Cerium Earths	5·8
Thoria (ThO_2)	6·92
P_2O_5	30·7

The solution of the cerium earths gave no absorption spectrum, while that of the yttrium earths showed two bands in the green.

Discussion of the analysis.

No great stress can be laid on the details of this analysis except upon the determinations of the total rare earths and phosphate. These are the means of two separate analyses. The separation of the yttrium and cerium earths by means of potassium sulphate, even supposing that there were nothing harmful present, is not complete in one operation, and the most that can be said of that part of the analysis is that it is sufficient to establish the fact that the yttrium earths are present in greater proportion than the cerium earths. The mineral is a phosphate of the rare earths with those of the yttrium group predominating.

Physical characters of the mineral.

The colour is brown with a resinous lustre, streak pale brown. The mineral is translucent ; specific gravity 4·55 ; hardness 4—5 ; fracture uneven, brittle ; cleavage parallel to the length of the crystal, perfect.

Mode of occurrence.

The mineral occurs as a number of long rhombic-sectioned prisms lying in a matrix of apatite (Plate 2, fig. 1). Terminal faces are developed so badly as to be useless for crystallographic purposes. The crystals are sometimes covered with a thin light brown layer of limonitic material. This layer is easily removed ; it is not due to the decomposition of the mineral itself but has been deposited on it as a result of the weathering of the other minerals present. Thin sections show that the mineral is quite fresh and unweathered. The associated minerals are apatite, forming the bulk of the specimen, a dark rhombic pyroxene, magnetité in small crystals and possible some rutile. The specific gravity of the rock is 3·8.

The refractive index is practically equal to that of apatite, its associate. There is a faint dichroism. The double refraction is high and resembles that of monazite. There are two cleavages, of which one is slightly better than the other. The intersections of the cleavages in a basal section are almost at right angles (Plate 2, fig. 2). In all sections parallel to the length of the crystals (Plate 2, fig. 3), of which there are several at varying angles, the extinction is straight, thus barring a monoclinic habit for the mineral. The basal section, cut with some care, does not extinguish as it ought if the mineral were tetragonal. There is on the one hand no indication of anomalous dispersion, while on the other the basal section extinguishes at about 45 degrees to the cleavages, indicating that these are prismatic. An obscure figure can be obtained, which seems to be biaxial.

Optical characters.

The composition of the mineral, as judged from the analysis given, suggests that the mineral is intermediate between xenotime on the one hand and monazite on the other. Xenotime is tetragonal, monazite monoclinic. The optical evidence already given is sufficient to negative a tetragonal or a monoclinic habit for this mineral. The most reasonable explanation is that the mineral is orthorhombic. The only crystallographic measurement which can be made is that between the prisms obtained from a cross section. This angle differs distinctly from a right angle by between 3 and 4 degrees, evidence confirmatory of the non-tetragonal habit. Unfortunately although a further large supply of material has been received, it has not furnished better preserved crystals, and the crystallographic confirmation of the suggestion made must be awaited. It is, however, legitimate to suggest that there may be a progressive change from xenotime, yttrium orthophosphate, to monazite, cerium orthophosphate, and that differences in chemical composition are accompanied by changes in crystal symmetry of a more drastic character than mere differences of angles as in isomorphous salts.

Crystal system.

EXPLANATION OF PLATE.

FIG. 1.—Mode of occurrence of the mineral: × 2.

FIG. 2.—Basal section showing the intersection of the cleavages: ordinary light: ×48.

FIG. 3.—Prismatic section: ordinary light: × 48.

ON THE COAL SEAMS OF THE FOOT-HILLS OF THE ARAKAN YOMA, BETWEEN LETPAN YAW IN PAKOKKU AND NGAPÈ IN MINBU, UPPER BURMA. BY K. A. KNIGHT HALLOWES, M.A. (Cantab.), F.G.S., A.R.S.M., A.INST.M.M., *Geological Survey of India.* (With Plate 3.)

I.—INTRODUCTION.

Previous Observers.

COMMENCING the examination of the coal belt from a point a short distance to the south of Tazu which lies to the south-west of Pauk in the Pakokku district, beyond which point the investigations of my colleague Mr. Cotter did not extend, I examined the seams mapped by the late Mr. H. S. Bion as far south as Ngape in the Minbu district, *i.e.* over a distance of rather more than 100 miles. At the northern end of the belt coal occurs not only at Tazu, but also at Letpanhla, some 60 miles west of Pakokku; this had already been investigated by Mr. Cotter.[1] The same observer and Mr. S. Sethu Rama Rau had also examined the geology of the southern part of the belt near Ngape[2]. The geology of the intermediate portion which, as stated above, continues for more than one hundred miles, had been admirably mapped in detail by Mr. Bion. All these observers, in the course of mapping the geological formations, had indicated on their maps some of the outcrops of the coal seams, but further examination of the latter had been postponed pending the completion of Mr. Cotter's investigation of the more promising coalfield near Tazu.

Near Kyaukset some 30 miles south-west of Minbu, coal was at the time of my visit in November, 1918, being mined by Maung Mit on behalf of Maung Tun Aung Gyaw, late Municipal Secretary of Thayetmyo. By the 15th of November of that year about 35 tons had been sent away, while 10 tons were stacked at the mine; in all, therefore, 45 tons of coal had been excavated from this occur-

[1] *Rec. Geol. Surv. Ind.*, Vol. XLV, pt. 3.
[2] *Rec. Geol. Surv. Ind.*, Vol. XLI, pt. 4.

rence (see plate 3). South of Kyaukset, the coal belt continues east of Kyet-u-bok, west of Kyaukpe and Magyisan, and as far as Yenanman in the Minhla Township.

II.—GEOLOGY.

The coal-bearing rocks.

The coal is confined almost entirely to (1) the Shwezetaw Sandstones (Lower Pegus) which Mr. Cotter has shown to contain near Ngape the fossil beds designated by him D. E. & F.,[1] (2) the Yaw Shales (Upper Eocene), which the researches of the same observer[2] along with those of Mr. Bion have shown to be characterised by the zone of *Velates schmiedeli*, occurring on the top of this stage, and which, near Ngape (Minbu), has been designated "G" by Mr. Cotter[3], and finally (3) the Pondaung Sandstones (Upper Eocene), which west of Kinmungyon form the Nwamataung hill range, and near Ngape contain Mr. Cotter's fossil bed H.[4] Coal is generally absent from the Upper Pegus; the same is true of the Tabyin Clays and Tilin Sandstones, for although large areas of these rocks were explored not a single coal-seam was observed in them.

Regarding the rocks containing the coal seams Bion observed that the Shwezetaw sandstones (Lower Pegus) near Ngahlaingdwin are unfossiliferous; at latitude 20° 58′ fossil wood begins to occur in them, and in some places they contain so much of it, that they resemble or might easily be mistaken for beds of the Irrawaddi Series. The following section from the upper to the lower horizons through the Yaw Stage, the most important of the coal-bearing stages, is given by Bion:—

(*a*) Calcareous sandstone with *Operculina*; this fossil is always strictly confined to the Yaw Stage.

(*b*) Zone of *Velates schmiedeli*; *Velates* does not occur N. of 21° 6′.

(*c*) Shales.

(*d*) Coral limestone; 2′ thick; with small gastropods. This bed is not found north of 21° 5′ because of the prevalence of an arenaceous facies; below it is a bed of sand containing a profusion of large *Ostraeae*.

[1] *Rec. Geol. Surv. Ind.*, Vol. XLIV, pt. 3.
[2] *Rec. Geol. Surv. Ind.*, Vol. XLI, pt. 4.
[3] *Ibid*, p. 226.
[4] *Ibid*, p. 227.

(*e*) Shales.

(*f*) Shales with *Nummulites yawensis*, *Cardium thetkegyinense* etc. This horizon can be traced through the Yaw Stage as far north as Tazu.

(*g*) Coal and carbonaceous shale.

(*h*) Shales with siliceous bands and septaria.

(*i*) Limestone band; 1′—2′ thick; with small *Nummulites* and *Operculina*.

This section indicates, therefore, that the lignite is Upper Eocene in age.

The massive sandstones which underlie the Yaw Stage and were named by Cotter the "Pondaung Sandstones" were found by Bion to have a thickness of about 3,000 ft. in the coal belt, and to be characterised by fine-grained concretions of harder matter; two hundred feet from the top of this group they enclose a fossil wood zone. These rocks are usually unfossiliferous, but, as Bion points out, the fossils which he found at rare intervals show that they are "in the main marine." He further draws attention to the fact that when they are traced northwards "there is a gradation to a more shallow-water facies."

Dr. Cesare Porro[1] has divided the Tertiary beds near Ngahlaingdwin into seven sub-divisions which from the work of Bion can be correlated with the sub-divisions adopted by Mr. Cotter,[2] in other parts of Burma. His sub-divisions 2 ("lignite-bearing shales with sandstones") and 3 ("alternations of sandstones and shales with beds containing foraminifera") represent Mr. Cotter's Yaw Stage which is the chief coal-bearing horizon of the belt.

Folding of the coal-seams.

In the Kyaukset area some 30 miles south-west of Minbu, the coal-seams, interbedded between Eocene sandstones and shales, have been folded along with those rocks, and show signs of great contortion.

[1] *Rec. Geol. Surv. Ind.*, Vol. XLV, p. 249.

[2] *Rec. Geol. Surv. Ind.*, Vol. XLI, p. 232; Vol. XLIV, p. 164; Vol. XLV, p. 268 and Vol. XLVII, p. 44.

III.—TABLE OF THE COAL SEAMS.

For the sake of conciseness the main geological features characterising the numerous seams have been condensed into the following table:—

Locality of Coal.	Geological horizon.	Roof.	Floor.	Dip of seam.	Nature and thickness of seam or seams.
1. Newe Chaung E. of Letpan Yaw.	Shwezetaw Sandstones. (Lower Pegus).	Bluish grey calcareous sandstones.	Calcareous sandstones.	17° to E.	Carbonaceous shales with thin partings of lignite ·25" — 1" thick.
2. Kyaukpan C. E. of Letpan Yaw.	Do.	Do.	Do.	Do.	Do.
3. Letpan C. N. of Letpan Yaw.	Yaw Shales (Eocene).	Pale greenish grey calcareous sandstones.	Do.	15° to S. 80° E.	Thin partings of lignite 1"—2" thick.
4. N. N. E. of Letpan Yaw, in the Sha Hla road cutting.	Do.	Do.	Do.	25° to E.	Carbonaceous shales with thin partings of lignite ·25"—1" thick.
5. Chauknet Chaung, E. of Letpan Yaw.	Shwezetaw Sandstones.	Calcareous sandstones.	Soft sandstones.	26° to S. 40° E.	Do.
6. Tributary of the Chauknet Chaung, W. of Sha Hla.	Upper Pegus.	Do.	Shale and calcareous sandstones.	22° to E.	Thin seam of lignite a few inches thick.
7. Wun-nge Chaung E. of Saw Letpan.	Shwezetaw Sandstones.	Dark grey carbonaceous shales.	Carbonaceous shale.	17° to E.	Seam 3'—4" thick (practically all solid lignite).
8. Letpan C. near Letpan Yaw.	Yaw Shales.	Pale greenish grey calcareous sandstones.	Soft calcareous sandstones.	22° to S. 80° E.	Thin seam of lignite a few inches thick.
9. Head of the Tettu Chaung S. W. of Paing.	Shwezetaw Sandstones.	Ochre yellow calcareous sandstones and carbonaceous shales.	Carbonaceous shales and greenish grey shales.	25° to N. 70° E.	Seam of solid lignite 2' thick
10. W. of Saw Letpan.	Pondaung Sandstones.	Pale greenish grey friable calcareous sandstones.	Soft sandstones.	22° to E.	Thin lenticular deposits of lignite.
11. E. of Thonlanbyi.	Shwezetaw Sandstones.	Dark reddish brown and dark bluish grey carbonaceous shales.	Dark bluish grey shales.	30° to N. 50° E.	Seam of solid lignite 11"—1' thick.
12. Head of the Kyauk-kyan C, West of Ainggyi.	Do.	Dark bluish grey carbonaceous shales.	Shales somewhat carbonaceous.	50° to N. 60° E.	Seam of lignite 1' 9" thick.
13. Just N. of Thonlanbyi.	Do.	Orange coloured ochreous pale grey shales.	Pale grey shales.	37° to S.E.	Very shaly seam of lignite 1', 11" thick.

Locality of Coal.	Geological horizon.	Roof.	Floor.	Dip of seam.	Nature and thickness of seam or seams.
14. Thekke Chaung.	Shwezetaw Sandstones.	Orange coloured ochreous pale grey shales.	Pale grey shales.	30°-37° to S.E.	Carbonaceous shales with rare lenticules and stringers of lignite 2 mm.-1" thick.
15. Just S. of Mandu in the Kyingyi Chaung.	Pondaung Sandstones.	Carbonaceous shales.	Shales. . .	50° to S. 80° E.	Very shaly seam of lignite 2' 0" thick.
16. One mile due west of Kwindaw in the Salin Chaung.	Shwezetaw Sandstones.	Dark grey carbonaceous shales.	Soft shales .	20°-25° to E.	Very shaly seam of lignite 1' 2" thick.
17. 10 miles E. of Kwindaw at the head of the Thayetkôn Chaung.	Do. .	Pale greyish white friable sandstones	Soft sandstones.	70°-75° to S. 80° E.	Sandstones with thin partings of lignite ·25"-·4" thick.
18. In the Chaung about 1 mile S.S.E. of Kwindaw.	Padaung Clays.	Pale yellowish white soft friable sandstones.	Dark carbonaceous shales.	32° almost exactly to E.	Two thin seams of lignite one 5" and the other 7" thick.
19. In the Chaung nearly half a mile E. of Ngataung.	Shwezetaw Sandstones.	Pale greyish white thin bedded sandstones.	Soft sandstones.	36° to N. 60° E.	Carbonaceous shales with knife—partings of lignite.
20. In the Hni C. between Ngataung and Hni.	Yaw Shales.	Dark carbonaceous shales.	Carbonaceous shales with a reddish tinge.	48° to N. 70° E.	Very shaly seam of lignite, 1' 0" thick.
21. In the Pauk Chaung between Hni and Paukchaung.	Shwezetaw Sandstones.	Dark bluish-grey carbonaceous shales.	Dark chocolate-brown ferruginous and carbonaceous shales.	53° to N. 70° E.	Very shaly seam of lignite 2' 0" thick.
22. E. flank of Dudataung Range, E. of Tindu.	Yaw Shales.	Dark carbonaceous shales.	Dark reddish-brown ferruginous and carbonaceous shales.	75°-80° to E.	Seam of solid lignite, 3' 0" thick.
23. In the Thayetkon Chaung E. of Tindu.	Shwezetaw Sandstones.	Carbonaceous shales.	Dark shales.	80° to E.	Thin interbedded seams of lignite ·12" to 1' 6" thick.
24. In the Salin R., S. of Zabyaw.	Yaw Shales .	Dark carbonaceous shales.	Dark red ferruginous and carbonaceous shales.	83° to vertical, to W.	A group of six thin seams of lignite varying from 1' to 2' 9" thick.
25. In the Salin R., S. E. of Zabyaw.	Shwezetaw Sandstones.	Pale bluish grey sandstones.	Light brown friable sandstones.	75° to E.	Sandstones with interbedded partings of lignite 2 mm.—·50" thick.
26. Palè Chaung near Alèywa.	Do. .	Dark carbonaceous shales.	Dark shales .	40° to E.	Seam of solid lignite 1' 2" thick.
27. Thanwingyaung Chaung.	Yaw Stage .	Dark black carbonaceous shales.	Dark carbonaceous shales with thin stringers of lignite.	45°-46° to N. 70°-80° to E.	Two seams of solid lignite, one 7½" and the other 1' 9" thick.

Locality of Coal.	Geological horizon.	Roof.	Floor.	Dip of seam.	Nature and thickness of seam or seams.
28. Bônmagyi .	Shwezetaw Sandstones.	Pale bluish grey shales.	Grey shales .	45° to N. 80° E.	Very shaly seam of lignite 8" thick.
29. Do. .	Do. .	Do. . .	Do. . .	Do. .	Shaly seam of lignite 7" thick.
30. Kywè-u Chaung	Do. .	Carbonaceous shale and pale greenish grey Pegu shales.	Dark ferruginous carbonaceous shales.	50° to N. 80° E.	Two seams of solid lignite, one 4½" and the other 1½" thick.
31. Do. .	Do .	Dark carbonaceous shales.	Carbonaceous shales.	Do. .	Seam of solid lignite 4" thick.
32. Head of Kywè-u Chaung.	Yaw Shales .	Do. . .	Do . . .	52° to N. 70° E.	Very shaly seam of lignite 6" thick.
33. Zaha C., E. of Kywè-u.	Do. .	Do. . .	Do. . .	50° to S. 70° W.	Dark carbonaceous shales with thin partings of lignite.
34. Do. .	Do. .	Do. . .	Do. . .	Nearly vertical.	Seam of solid lignite 1' 6" thick.
35. Do. .	Do. .	Do. . .	Do. . .	64° to S. 70° W.	Four seams of solid lignite, with the following thicknesses: 2' 2"; 2"; 5"; 1' 6".
36. Do. .	Shwezetaw Sandstones.	Do. . .	Do. . .	65°-67° to N. 70°-80° to E.	Four seams of lignite with the following thicknesses; 9"; 7"; 2' 7"; and 1' 6".
37. W. of Kywè-u in the Tetoma Chaung.	Yaw Shales .	Do. . .	Do. . .	55° to N. 70° E.	A group of 3 seams of the following thicknesses: 1' 8"; 2' 7"; 2' 2".
38. S. W. of Kywè-u.	Shwezetaw Sandstones.	Soft sandstones	Sandstones .	45° to N. 75° E.	Thin seams of lignite a few inches thick.
39. In the Kin-mungyon C., S.S.W. of Kin-mungyon.	Do. .	Dark carbonaceous shales.	Dark shales. .	60° to eastwards.	Dark carbonaceous shales with thin partings of lignite.
40. E. flank of the Nwamataung Range S. W. of Kin-mungyon. (See Fig. 1.)	Yaw Shales .	Do. . .	Do. . .	55°-70° to N. 60°-70° to E.	A group of 4 seams of the following thicknesses: 2' 0"; 2' 3"; 1' 9"; 1' 2"; most of these are composed of solid lignite.
41. E. flank of the Ngahlaingdwin anticline near Δ 1059.	Shwezetaw Sandstones.	Do. . .	Do. . .	62° to S. 80° E.	A thin seam of lignite 2" thick.

Locality of Coal.	Geological horizon.	Roof.	Floor.	Dip of seam.	Nature and thickness of seam or seams.
42. W. flank of Ngahlaingdwin anticline W. of Δ 1059.	Shwezetaw Sandstones.	Sandstones .	Soft sandstones	60°-65° westwards.	Thin seams of lignite a few inches thick.
43. Kyauk-o .	Yaw Stage. .	Pale grey ferruginous shales.	Contorted dark red ferruginous shales.	Nearly vertical.	A group of 4 seams of the following thicknesses: 7″; 10″; 11″.
44. At the head of the Tanyauktin Chaung S. W. of Kyauk-o.	Do.	Pale grey shales.	Dark carbonaceous shales.	60°-65° to E.	Seam of solid lignite 2′ 2″ thick.
45. E. flank of the Nwamataung Range W. of Pyindin.	Do. .	Dark carbonaceous shales.	Dark shales .	60° to E.	Dark carbonaceous shales with thin partings of lignite.
46. In the Paung C., 2 miles W. of Myaung-u. *See* fig. 2.	Do. .	Do. . .	Do. . .	45°-50° to N. 80° E.	A group of 3 seams of the following thicknesses: 1′; 5′ 2″; 14″.
47. On the west flank of the Nwamataung Range and in the Liktwin C., 1¼ miles E. of Pazaw.	Do. .	Do. . .	Do. . .	30° to S. 80° E.	Stringers of lignite, 1″ thick.
48. In the S. bank of the Môn C, 1 mile S. E. of Kyi-ôn.	Do. .	Shales . .	Pale grey shales	Average dip = 22° to E.	Contorted seam of lignite 1′ thick.
49. 1¼ m. N. E. of Kyida in the Yengan Chaung.	Do. .	Dark reddish brown carbonaceous shales.	Pale grey and dark reddish brown shales.	32° to N. 55° E.	Seam of lignite 3′ thick.
50. 1¼ m. N. E. of Kudaw.	Do. .	Dark carbonaceous shales.	Shales and thin bedded sandstones.	35° to N. 70° E.	Thin partings of lignite in dark carbonaceous shales.
51. 2 m. E.N. E. of Pa-aing E.	Do. .	Pale green soft friable sandstones.	Soft sandstones	45°-50° to N. 70° E.	Thin lenticular stringers of lignite in the sandstones.
52. 2 m. E. N. E. of Pa-aing E.	Do. .	Bluish grey shales.	Ferruginous pale bluish grey shales.	55° to N. 65° E.	Seam of lignite 3′ 3″ thick.
53. 1½ m. N. N. E. of Le-einzu in the Theyesan Chaung.	Do. .	Light brown thin bedded sandstones.	Carbonaceous shales.	30° to N. 50° E.	Knife-partings of lignite in carbonaceous shales. Oil seepage.
54. In the Man C. at Peinhnebin 3 m. E. N. E. of Ngapè.	Do. .	Carbonaceous shales.	Dark shales .	45° to eastwards.	Seam of shaly lignite 1′ 6″ thick; associated with 2 oil seepages.
55. W. of Kyaukset, 1 m. N. of milestone 30, on main road from Minbu to Ngapè (*vide* Plate 3, fig. 2).	Do. .	Shales and carbonaceous clays.	Ochreous and carbonaceous clays and shales.	55°-65° to N. 55°-72° to E.	A group of 3 main seams having the following thicknesses:—Uppermost = 3′ 0″, Intermediate = 4′ 7″, Lowest = 2′ 1″.

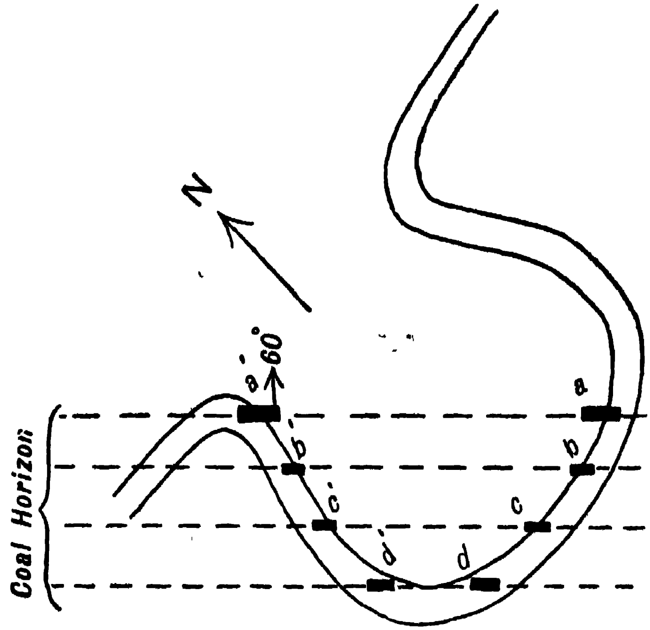


FIG. 1.—Coal seams, Tauktyabin Chaung; indicating how the same coal-seam is exposed more than once in the same stream.

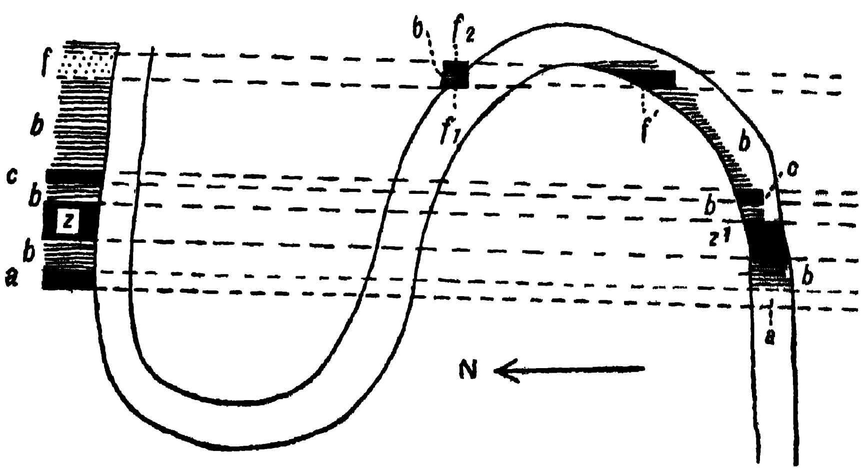


FIG. 2.—Sketch plan showing lateral variation in the coal seams in the Paung Chaung 2 miles west of Myaung-u. (*a*) Coal-seam, not exposed at *a*.[1] (*b*) Carbonaceous Yaw stage shales. (*z*) Seam of solid lignite, 5′ 2″ thick, which can be traced southwards from z-z^1 for a distance of 432′, is found at z^1 to have thinned to 3′ 10″ and to have diminished in quality, for it here contains a considerable amount of carbonaceous shale as thin partings. (*c*) Thin coal-seam 1′ 2″ which has the same thickness at *c* as at c^1. (*f*) Seam of solid lignite 2′ thick; this when traced northwards splits into a thin western seam 1′ 6″ and a thin eastern one of a thickness of 1′ 3″, carbonaceous shale for an extent of 3′ separating the two. Further north the seam is covered up with talus at *f*.

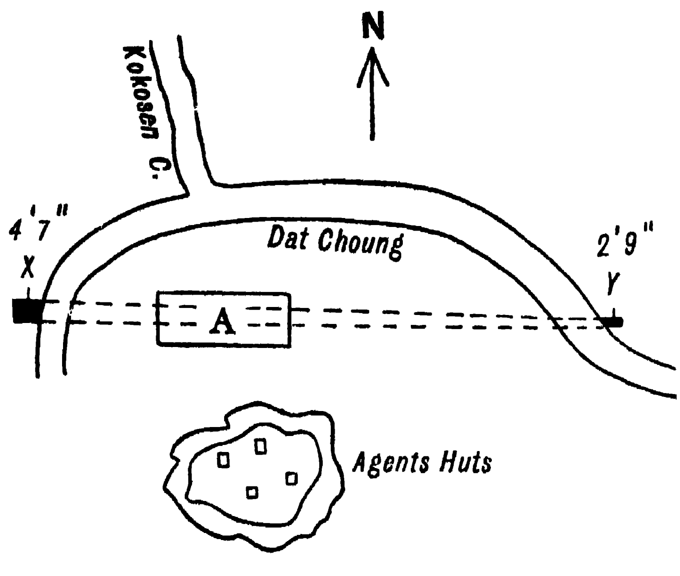


FIG. 3.—Kyaukset coal area. Sketch plan showing how the main intermediate coal seam thins from 4′ 7″ at X to 2′ 9″ at Y in a distance of 55 yards.

The opening up of the coal-seams.

The coal seams are generally exposed only in the deep streams which cut across them. They are rarely seen outcropping on the mountain side, on account of the deep layer of talus and soil which covers up the rocks. Even when seen in the streams they are imperfectly exposed and occur in the midst of thick bamboo jungle through which it is frequently necessary to cut lines of access. The seams in each of the localities enumerated in the preceding table were cleared, and opened up by prospecting trenches and pits. The coal, as excavated from these seams, is a hard black lignite with a conchoidal fracture, and possesses the lustre and appearance of pitch. With this black lignite is sometimes associated, as for instance in the Kywè-u Chaung near Kywè-u, a yellow fossil resin. The lignite is also frequently covered with a white efflorescence consisting of sodium sulphate, and a canary-yellow iron salt.

The roof and floor of the seams.

The roof and floor of the seams are composed either of soft Upper Eocene or Lower Pegu sandstones, or of light grey or dark reddish-brown Upper Eocene shales more or less decomposed into ochreous clays. The roof and floor are, therefore, distinctly bad and extensive timbering would be necessary.

Thickness.

An examination of the foregoing table will show that the thickness of the seams other than those which are only a few inches thick varies in general, from 1′ 0″ to 3′ 4″. Near Kyaukset some 30 miles south-west of Minbu, see Plate No. 3, the main, seam attains a thickness of 4′ 7″ but dips at 60°. Only one seam was found to attain a thickness of 5 feet; it occurs, as noted in the table above, in the Paung Chaung 2 miles west of Myaung-u.

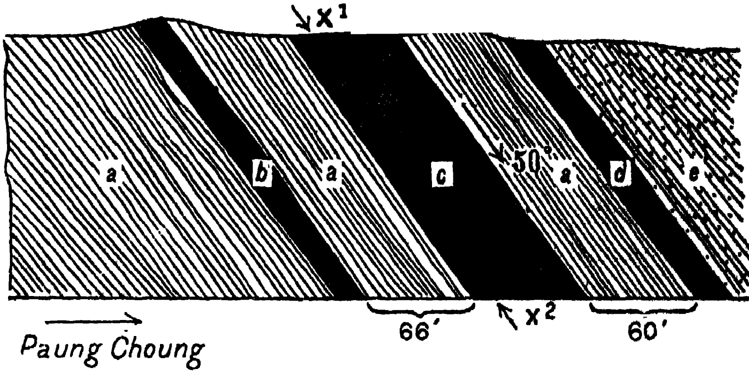


FIG. 4.—Five-foot coal-seam of the Paung Chaung 2 miles west of Myaung-u. (*a*) carbonaceous shales; (*b*) and (*d*) lignite; (*c*) coal; (*e*) Yaw Shales.

The Burmans of the locality say that the seam was worked in the days of King Mindon Min, when there was a cart track from it to the Mon River, and that the coal was sent down on rafts along that river to the Irrawaddi.

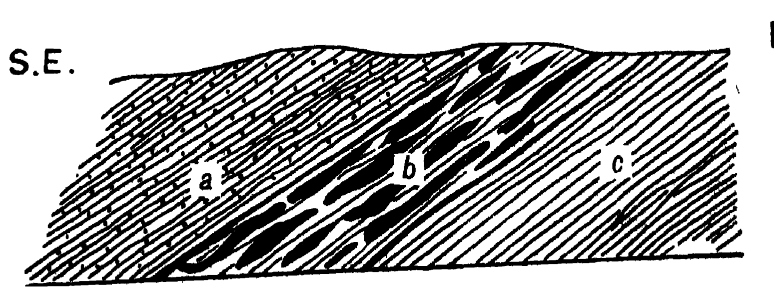


FIG. 5.—(*a*) and (*c*.) Shales of Shwezetaw Sandstone series. (*b*) Seam, type II, composed of thin lenticles of lignite scattered through a bed of dark carbonaceous shale; thickness of this bed 1′ 11″; dip 30°-37° S.E. Lenticles of lignite 2 m.m. to 5″ in thickness.,

Types of Coal-seams.

Five different types of coal-seam occur along the Tazu-Ngape Coal-belt. Type I consists of a seam of solid lignite free from shale; Type II is composed of lenticles of lignite scattered through a bed of dark carbonaceous shale (See fig. 5); Type III is the same as Type I except that it is characterised by a stratum of solid lignite along the base of the seam; Type IV consists of an upper horizon of solid lignite above a stratum of carbonaceous shale through which are scattered numerous lenticles of lignite; finally Type V is composed of lignite which suddenly thins and thickens from point to point, so as to give the seam an almost nodular character.

IV.—QUANTITY.

Kyaukset.

The total thickness of coal in the three horizons of the Kyaukset area is 9′ 8″. As the coal measures rather less than 40 cubic feet to the ton[1], for every 1,000 feet of outcrop, to a depth of 20 feet, there are at least 4,500 tons of coal available.

Lenticularity.

The total quantity, however, is not large, for when the seams are traced for a short distance in either direction along the strike, they either thin out altogether or fray into a number of worthless seams only a few inches thick. Thus the uppermost main seam when traced along the strike, thins from 2′ 9″ to 1′ 9″ of available coal in 102 yards; while the intermediate seam rapidly diminishes from 4′ 7″ to 2′ 9″ in the short distance of 55 yards.

This lenticularity of the seams is true, generally speaking, for the whole length of the Tazu-Ngape coal belt; the seams are mere lenticles of lignite which thin out altogether when traced for a short distance in either direction along the strike. Moreover, as the pits and trenches excavated upon them have shown that the coal seams frequently diminish in thickness a few feet from the surface, there is always the possibility that they may disappear in depth.

A few of the most interesting cases of the lenticularity of the seams will now be given:—

(*i*) The seam at (37) in the Tetoma Chaung W. of Kywè-u when traced for a few yards along the strike diminishes in thickness from 3′ 6″ to 2′ 2″.

(*ii*) Though the Shwezetaw Sandstones are very finely exposed as great bars of rock across the Thanat Chaung west of Tanyauktin not a trace of coal was observed in them.

[1] Figure kindly given by the Locomotive and Carriage Superintendent, Prome, Burma Railways.

It therefore appears that the coal seam of Kinmungyon (39), further to the north, thins out altogether to the south, before this river is reached. This may be because the Shwezetaw Sandstones to the south near Tanyauktin are of marine type, while as we proceed further and further north past Kinmungyon they become more and more estuarine, indicating that in the north, though not in the south, the conditions were favourable to the deposition of coal.

(*iii*) In the Paung Chaung, 2 miles west of Myaung-u (see figs. 2 & 4) the 5′ 2″ seam lignite (Z), when traced to the south for 432 feet across the bends of the river, is found at (Z^1) to have diminished in thickness to 3′ 10″. In the same river the 2′ seam of lignite (f^1), when traced a few yards to the north, is seen to split into two seams (f^1, f^2) one of which (f^1) is 1′ 6″ and the other (f^2) 1′ 3″ thick, these being separated by a thickness (b) of 3′ of dark carbonaceous shales.

(*iv*) Interesting cases of the lenticular nature of the coal-seams occur near Kyaukset.

V.—QUALITY.

Varying quality in the same seam.

The coal of the several seams is poor in quality for it consists in every case of lignite, the grade of which is lessened by the incorporation of considerable quantities of carbonaceous shale and sand. The quality of the coal, moreover, at different points between the roof and the floor of one and the same seam often varies considerably.

Hand-picked coal was analysed by the Burma Oil and the British Burma Petroleum Companies with the following results:—

Locality of Coal.	Analyst.	Moisture.	Ash.	Fixed carbon.	Volatile matter.	Sulphur.	Calorific value.
Intermediate Main coal-seam near Kyaukset.	B. O. C.	10·59	4·58	46·69	48·73	..	Two-thirds that of Bengal coal.
Coal from Kyaukset.	B. B. P. C.	7·56	4·08	52·82	35·51	2·55	5,750 calories or 10,350 B.T.U. s. approx.
Near Kinmungyon (collected by Mr. G. H. Tipper).	G. S. I.	4·84	5·63	54·64	34·89	..	

It will be seen that the moisture and ash contents of the hand-picked coal of Kyaukset are both favourably low. The following are results from average samples obtained by channeling across the cleaned faces of the seams, the coal being well mixed and subsequently coned and quartered:

Locality of Coal.	Analyst.	Moisture.	Ash.	Fixed carbon.	Volatile matter.	Sulphur.	Calorific value.
Uppermost Main seam at (y) Kyaukset.	G. S. I. .	23·05	22·44 (light brown).	25·42	29·09	..	
Uppermost Main seam at (B) Kyaukset.	Do. .	26·44	14·97 (light brown).	25·19	33·40	0·53	
Intermediate Main seam at (x) Kyaukset.	Do. .	26·32	29·82 (brown).	12·94	30·92	..	
Lowest Main seam at (q) Kyaukset.	Do. .	13·76	19·70 (brown).	30·24	36·30	..	
Myaung-u . .	Chemical Examiner to the Government of Burma.	5 56	14·06	54·32[1]	26·06	..	10,314 British Thermal units.
50. Kyauk-o .	Do .	12 20	12 27	46·33	29·20	..	8,928 British Thermal units.

It is of interest to compare the average composition of the coal of the Tazu and Letpanhla Coal-fields[2] with that of the coal of the Tazu-Ngape belt.

Average percentage of the constituents.	Tazu and Letpanhla coal-fields	Tazu-Ngape coal belt.
Moisture	18·69	17·88
Ash	11·33	18·87
Fixed carbon	35·84	32·40
Volatile matter	34·13	30·82

[1] The fixed carbon content of the seam at Myaung-u is exceptionally high; it is the *only* coal seam along the belt between Ngapè, which has a fixed carbon content of over 50 per cent.

[2] G. de P. Cotter, *Rec. Geol. Surv. Ind.*, Vol. XLIV, p. 182.

From the above table it will be seen that the coals of the belt between Tazu and Ngape are inferior to those of the Tazu and Letpanhla coal-field examined by Mr. Cotter and found to be of no present economic value, while the coals of both the above areas are far below those of Bengal in quality.

The calorific values of the coals of Letpanhla and Tazu, and of the coal belt between Tazu and Ngape, are shown in the following table:—

Locality.	Calorific value of coal.
Tazu and Letpanhla fields	4,490—4,835[1]
Coal between Tazu and Ngape	3,913—4,610

The calorific value of the coal from between Tazu and Ngape is therefore inferior to that of the coal of the Tazu and Letpanhla fields, and is only about two-thirds that of Bengal coal.

The percentage of sulphur in those coal-seams between Tazu and Ngape, which have been analysed for this constituent, varies from 0·52 to 2·50. The sulphur in the coal of the Tazu and Letpanhla fields was found to be 2·285—5·628 per cent[2]. As iron pyrites is seldom seen in the coal between Tazu and Ngape, the sulphur content has probably been derived from the needles and thin plates of selenite which occur in the joints traversing the seams. To sum up, therefore, the quality as shown by chemical analysis, of average samples of the coal from between Tazu in Pakokku and Ngape in Minbu, is not good.

Disintegration on atmospheric exposure.

Although large coal can be won from the seams, owing to rapid loss of moisture, it disintegrates when exposed to the air breaking up into small coal. Some of the lumps which have not actually fallen to pieces do so on being touched; there would therefore be considerable loss in handling.

Locomotive trials.

The Deputy Locomotive Superintendent gave the first 15 tons lot of hand-picked Minbu coal selected from near Kyaukset, a test on a train between Rangoon and Letpadan. He reported that in the first trial the coal

[1] G. de P. Cotter, *Rec. Geol, Surv. Ind.*, Vol. XLIV, p. 183.
[2] *Ibid.*

burned freely in the fire-box and that there was no difficulty in keeping up steam and running to time. It was not found necessary to clean the fire between Rangoon and Letpadan, the distance between these two places being 77·25 miles. The "pricker," however, was used at Hmawbi, 24·75 miles from Rangoon. The "drop-grate" was not opened until Taikkyi had been reached when a distance of 41·45 miles had been traversed. At Letpadan two large pieces of "clinker" were removed from the "drop-grate" close to the "tube-plate" the rest of the fire being clean. It was found that the fire-irons could not be used much or the whole fire would have been knocked through the grate with a 1-inch air space, which is the same as that employed for wood fuel; with Bengal coal an air space of 1·375 inches is used. There was no trouble with black smoke and the ashes were comparatively free from unburned matter. The coal used in this trial consisted mostly of large lumps which had been hand-picked from smaller material at the mine itself. This trial gave the high consumption of 66 lbs. per train mile against 45 lbs. for Bengal coal. By fitting a brick-arch to the fire-box of the locomotive in a second test between Rangoon and Prome the consumption was diminished to 55 lbs.; the fire needed cleaning at Taikkyi and Zigon.

During an additional trial between Letpadan and Prome in a locomotive fitted with a brick arch and a grate with a one inch air space, with an average bulk sample of the Kyaukset coal collected by myself, the consumption rose to 77 lbs. to the train mile; fifteen minutes were lost on account of shortage of steam, while there was a great deal of "clinkering" and loss due to the small size of the coal.

Exploitation.

The coal belt is a feverish area, and labour expensive. From the Irrawaddi to the Tazu area is some 60 miles, to the Ngape area 35 miles, and to a point half way between 40 miles. Existing roads are bad. The quality and quantity of coal available does not justify either (*a*) the expense of laying a light tramway over the difficult country which intervenes between the occurrence and the Irrawadi River, or (*b*) extensive repairs to the Public Works Department main road, which crosses numbers of streams, all of which would have to be bridged.

Economic Value.

From the foregoing facts it is clear that the coal seams between Tazu and Ngape are not as good as those of the Yaw River section in the Pakokku district, which Mr. Cotter found not to be of present economic value.[1] I was informed in Rangoon that the cost of delivering one ton of Minbu coal in Rangoon for a locomotive test was Rs. 50. Rates of Bengal coal delivered in the Locomotive Yard, Rangoon, were:

Year.	Rate per ton.		
	Rs.	A.	P.
1912	11	4	0
1913	14	0	0
1915	14	0	0
1916	16	0	0
1917	20	0	0
1918	35	0	0

Prices have fallen since the end of the war, and the lignitic coal of the Yoma belt is not likely to be able to compete with that of Bengal, the former having a calorific value of only two-thirds that of the latter. There is no local demand, since the villagers living in the neighbourhood prefer wood, of which there is an ample supply for domestic purposes.

[1] *Rec. Geol. Surv. Ind.*, Vol. XLIV, p. 28.

EXPLANATION OF PLATE.

FIG. 1.—Sketch Plan of the Kyaukset Coal area, 30 miles S. W. of Minbu.

FIG. 2.—Map of the country between Letpanhla and Ngape, Burma. Scale 1 inch = 14 miles.

OBSERVATIONS ON "PHYSA PRINSEPII," SOWERBY AND ON A CLIONID SPONGE THAT BURROWED IN ITS SHELL. BY N. ANNANDALE, D.SC., F.A.S.B., *Zoological Survey of India.* (With Plates 4 and 5.)

BIOLOGICAL INTRODUCTION.

IN the Intertrappean (late Cretaceous) beds of India shells that have usually been assigned to the genus *Physa*, Dreparnaud are abundant. Indeed, in the wide-spread paludine deposits of this age in the Central Provinces certain gigantic forms hitherto known as *Physa prinsepii* have provided the commonest and most conspicuous fossils. Similar shells have also been found in beds believed to be of approximately the same age in Central India, eastern Madras and Baluchistan. The shells are associated in the Central Provinces with fossils of freshwater and terrestrial genera, while those from other parts of India have been found with the remains of estuarine and even exclusively marine organisms. Hitherto all the larger specimens from the different localities have been regarded as representing a single species, with at least one variety, *elongata*, Hislop. I am of the opinion, however, that the latter is specifically (indeed, probably generically) distinct, while it seems to me to be possible to distinguish both a true freshwater race (the *forma typica*) and an estuarine race of the species *prinsepii*. For the latter race I propose the subspecific name *euryhalinus*. Certain smaller shells to which names have been given (*P. dubia* and *P. intermedia*, Hislop (MS.) and *P. hislopiana*, Oldham) I believe to be merely young shells of *elongata* or *prinsepii*, while Hislop's var. *inflata* I regard as a dimorph of *prinsepii*.

Shells of the *Physa* type, which is not unlike that of *Limnaea* but sinistral instead of dextral, are always hard to place in their proper taxonomic position, because of the difficulty of distinguishing between those of the genera *Physa* and *Aplecta* of the family Physidae on the one hand and those of the genus *Bullinus* of the family Planorbidae on the other. I know of no definite structural character whereby shells of the two families can be distinguished invariably, and yet the radulae and soft parts are very different, In identifying fossils, therefore, it is necessary to rely on comparison with recent species of known anatomy and on geographical considerations. The latter are a dangerous ground on which to build in reconstructing the fauna of past epochs, but may be used with due caution in discussing genera of which the present geographical range is well known and well understood, as is that of the Physidae and the Bullininae at any rate so far as the Old World is concerned.

The Physidae are Holarctic and probably Neotropical, well represented in Europe and North America and less so in the impoverished aquatic fauna of northern Asia. The Planorbidae are cosmopolitan, but *Bullinus* is essentially Ethiopian, Australasian and, to a limited extent, Oriental. Species of *Physa* and of the allied genera *Aplecta* occur round the Mediterranean and *Aplecta* is common in Central America, while the range of *Bullinus* extends well into the Mediterranean sub-region. The few shells of this type known from South America have been assigned to *Physa*. *Physa*, in other words, is (in the Old World) primarily a northern, non-tropical genus, while *Bullinus* is a southern, tropical one. The two genera meet in the Mediterranean basin, but not elsewhere.

One of the anomalies of the living freshwater fauna of India and the adjacent countries on the mainland of Asia is the apparent absence of molluscs with the *Physa* type of shell. *Physa* and *Aplecta* could hardly be expected to occur, but why is *Bullinus* absent? The genus is well represented in Africa, it is the dominant genus among the living freshwater Gastropods of Australia, whence over fifty species have been described; several species are known from the Malay Archipelago. But the few records of the existence of "*Physa*" in India at the present day fail on investigation to be substantiated.

The most definite of these records is enshrined in a specific name, *viz.*, *Physa coromandeliana*, Dunker; but as von Martens[1] has pointed out, the specimen to which this name was given represented in all probability an Australian species of *Bullinus*. E. A. Smith[2] has shown even more definitely that this is so with *P. aliciae*, Reeve, stated by Sowerby to be from India. The only other published records that I have been able to trace refer to the peculiar genus *Camptoceras*, Benson, which has been united with *Physa* by some authors. With this genus I will deal immediately,

[1] von Martens in Weber's *Zool. Ergebn. Reise Neederl. Ost-Ind.* IV, p. 7 (1897)
[2] Smith, *Journ. Linn. Soc., Zool.* XVI, p. 293 (1882).

but I must first state that there exist in the Indian Museum several small shells from different parts of India labelled "*Physa* sp." and that all these are merely young shells of the common *Planorbis exustus*.[1]

Camptoceras consists of four Indian and one Japanese species with sinistral shells of a very peculiar type. Some doubt exists as to its true taxonomic position. Walker[2] considers it an ally of *Planorbis* (and therefore of *Bullinus*), while Dr. Baini Prashad and I[3] saw reason to associate it rather with *Ancylus*. However this may be, it cannot be assigned to *Bullinus* and is certainly not related to *Physa*.

We may take it, therefore, as a fairly well established fact that *Bullinus* does not live in India, and no evidence exists that *Physa* ever did so. The survival of *Bullinus* as a living genus in the Malay Archipelago on the one hand and in Africa and south-western Asia on the other provides a strong presumption that this genus once occurred in intermediate territory. When the shells of *prinsepii* are compared with those of Mesopotamian and Australian species the presumption becomes practically a certainty. The position of *elongatus* must be left doubtful for the present, but it was probably not very remote from that of *prinsepii*. These points will be discussed further in the systematic part of my paper, but assuming for the present that the Indian fossil species belong to *Bullinus*, it may be profitable to enquire why they became extinct. To do so it is necessary to consider the conditions in which they lived. These probably differed somewhat in the habitats of the three forms here recognized, namely *B. prinsepii*, *B. prinsepii euryhalinus* and *B.* (?) *elongatus*. We may deal with each form separately.

The environment in which the typical *B. prinsepii* flourished was evidently paludine rather than lacustrine or fluviatile. The stone in which its shells abound is often full of fragments of vegetation, among which Characeae have been identified. In specimens from the neighbourhood of Nagpur the vegetable remains are in a state that suggests their having been partially decayed before being fossilized, the shells are all more or less broken, many of them contain the remains of smaller shells of other families, and the structure of the stone, apart from crystalization, resembles that of the mud of the bottom of a shallow pool or marsh choked with submerged

[1] Annandale, *Rec. Ind. Mus.* XIV, p. 111, pl. xi, figs, 1, 1a.

[2] Walker, *Occ. Papers Mus. Zool. Unv. Michigan*, No. 64 (1919)

[3] Annandale and Prashad, *Journ. As. Soc. Bengal* (n. s.) p. 457 (1919) Since this was written I have been able to examine living specimens, which confirm Walker's view.

vegetation decaying as well as growing. The shells of Gastropods are those of both freshwater and terrestrial genera. The great size of *B. prinsepii*, as well as its abundance in these beds, proves that it must have had not only abundant food, presumably of a vegetable nature, but ready access to air in shallow water, for among the Pulmonates it is only very small species of Limnaeidae and Planorbidae that can live in deep water and obtain oxygen from it. The habits of *B. prinsepii* must, indeed, have been very similar to those of *Pachylabra globosa* (Ampullariidae), the mollusc that has taken its place as the giant among the gastropods in the fauna of freshwater pools in India. *P. globosa*, though not a Pulmonate, resembles the larger aquatic Pulmonates not only in possessing a lung and in being mainly a breather of air but also in living in shallow water. It frequently rises to the surface to breathe and eats large quantities of water-plants and is only found in those districts in which an abundant food-supply of the kind exists. Its natural habitat is in shallow pools or swamps and when these dry up it buries itself in the mud and awaits the return of the floods. Many individuals, however, die annually in the dry season, either through exhaustion or from some other cause, and quantities of empty shells are always to be found at the edge of pools of water frequented by the species. From the great abundance of shells of *B. prinsepii* in the Nagpur beds, from the condition of these shells, and from the fact that they often contain smaller shells unrelated to them, it seems to me probable that the same phenomena occurred in the bionomics of this fossil mollusc.

The race *euryhalinus* of *B. prinsepii* probably lived in a somewhat different habitat from the *forma typica*. It is found, possibly in Madras and certainly in Baluchistan, associated with estuarine or marine organisms and the extreme variability of its shell suggests that the conditions in which it existed were to some extent abnormal. This variability is precisely parallel to that which occurs in recent shells of *B. contortus* in the estuarine tract of Lower Mesopotamia.[1] At Mazar Drik in Baluchistan the fossil shells themselves provide strong evidence of a marine, or at any rate an estuarine[2], habitat in that they are partly destroyed by the burrows of a Clionid sponge and retain traces of oyster-spat and the tubes of Serpulid worms on

[1] Annandale, *Rec. Ind. Mus.* XIV, p. 167, pl. XX, figs. 6-11 (1918).

[2] A sponge of this family (*C. celata*) is found in shells of *Cymia* and *Ostraea* in brackish water in the Chilka Lake, while Serpulid worms as well as oysters are often abundant in Indian estuaries and lagoons containing water of comparatively low salinity.

their surface. The race probably lived in shallow pools of brackish water in the delta of great rivers or in maritime lakes and may occasionally have become acclimatized in shallow bays of the sea in which some such plant as *Zostera* flourished.

Shells of *B.* (?) *elongatus* have always been found with those of the typical form of *B. prinsepii*, but all that I have examined have been much worn on the surface, even when not mere casts, as well as being broken, and it is possible that they may have had a fluviatile habitat and been carried in floods to the beds in which they were finally preserved.

B. prinsepii must have possessed a certain adaptability in acclimatizing itself to abnormal conditions in the chemical composition of the water in which it lived, but it was, as is shown by its great size, a highly specialized form and as such probably unable to modify its feeding habits. It is improbable from the state of its fossil remains that it was completely wiped out by volcanic or other cataclysms. Species rarely disappear for such reasons, and the freshwater molluscs in particular, so long as conditions are suitable for the survival of the race, have a reproductive vigour that makes it possible for a very large proportion of the individuals to perish without endangering the continued existence of the species. It is not difficult, however, to believe that even a comparatively slight change in circumstances would be liable to render a country unsuitable for the continued existence of species that had assumed relatively gigantic proportions. *Pachylabra* is absent from certain Indian districts (*e.g.*, the vicinity of Hyderabad, Deccan) well within the boundaries of its range, and it seems improbable that it never penetrated into them. The only traces of the genus that I have seen from the Punjab are apparently subfossil remains from the Salt Range.

I believe, therefore, that *Bullinus* disappeared from India and the neighbouring countries, because, in a period exceptionally favourable to its activities, it grew to so great a size that it was unable to survive when conditions became slightly less favourable. The genus survives in regions in which conditions were never so favourable, namely Africa, the Malay Archipelago and especially Australia, because in those regions it has never become too large to be content with an environment a little less favourable.

Before proceeding to describe the species and races of *Bullinus* found in the late Cretaceous beds of India, I must express my thanks to Mr. E. Vredenburg of the Geological Survey of India, who has placed his knowledge of the bibliography of Indian palaeontology at my disposal in the most generous manner. Without his help it would have been impossible for me to have ventured so boldly on an unfamiliar field. It has been a great pleasure to me to collaborate with the Geological Survey of India in helping to identify its rich store of fossil organisms, all the more so that Mr. Vredenburg has himself done the same service for the Zoological Survey of India in working at our collection of recent marine shells. I am convinced that one of the great dangers to which all branches of biology are at present exposed is that of being buried beneath the accumulation of separate fragments of information produced without reference to cognate subjects, vast in their bulk, chaotic and void of significance. And the only remedy open to human limitations is true scientific co-operation free from personal and departmental jealousies.

SYSTEMATIC DESCRIPTIONS.

Fam. PLANORBIDAE.

BULLINUS, Adanson.

1757. *Bulinus*, Adanson, *Voy. Sénégal, Coquillages*, p. 5, pl. i, figs.
1815. *Bullinus*, Oken, *Lehrb. Naturgesch.* III, p. 303 (*f.* Hedley).
1830. *Isidora*, Ehrenberg, *Symb. Phys.* (unpaged).
1882. *Physa*, Smith (*nec* Draparnaud), *Journ. Linn. Soc., Zool.*, XVI, p. 290.
1887. *Platyphysa*, Fischer, *Man. Conchyl.*, p. 810 (as a subgenus of *Bullinus*).
1906. *Bulinus*, Pelseneer, in Lankester's *Treatise on Zoology*, V, (Moll.), p. 185.
1913. *Bullinus* & *Isidora*, Hedley, *Rec. Austr. Mus* XII, p. 3, plates.
1918. *Bullinus*, Annandale, *Rec. Ind. Mus.* XV, p. 167.

The name *Isidora* is used by some authors instead of *Bullinus*, while others again regard the former as that of a distinct genus or subgenus. The name here adopted was originally written *Bulinus*, but I have given reasons for accepting "*Bullinus*" in a recent paper (*op. cit.*, 1918).

BULLINUS PRINSEPII (Sowerby).

1833. Silicified fossil shell, Spilsbury, *Journ. As. Soc. Bengal* II, p. 205, pl. xx, figs. 3, 4.
1833. Fossil shell, Spry, *ibid*, p. 640, pl. xxvi, fig.
1839. Fossil shells (in part), Spilsbury, *ibid*, VIII (2), p. 709, pls., figs. 1, 2, 4.
1840. *Physa Prinsepii*, Sowerby (in Malcolmson), *Trans. Geol. Soc., London* (2) V pl. xlvii. figs. 14, 15 (not 16).

1860. *Physa Prinsepii* (varr. *normalis* and *inflata*), Hislop, *Quar. Journ. Geol. Soc London*, XVI, pp. 173, 174, pl. v, figs. 23a, 23d.

1860. *Physa Prinsepii, P. tumida* and *P. hislopiana* (in part), Oldham, *Mem. Geol. Surv. Ind.* II, pp. 212, 213.

1879. *Physa prinsepii*, Medlicott & Blanford, *Man. Geol. Ind.* I, pp. 315, 318, pl. xiv, fig. 2.

1884. *Physa Prinsepii*, Neumayr, *N. Jahrb. Min.* I, pp. 74—76.

1907. *Physa Prinsepii*, Vredenburg, *Rec. Geol. Surv. Ind.* XXXV, p. 115 (in part).

The shell is very large[1] and was apparently rather thick. It has 6½ or 7 whorls, but the apical whorl or half whorl is minute and often disappears. The outline is rather variable, but always accuminate and rather narrowly ovate. Internally the shell appears to have been perforate, but the umbilicus is completely covered by the columellar callus. The suture is linear, a little impressed and slightly oblique on the spire but becoming more so above the body-whorl. In worn specimens it appears much deeper than in well-preserved fossils. The external surface is usually worn smooth, but where it is well preserved numerous coarse and well-defined transverse striae can be detected and also remains of narrow, flattened, curved and sinuate longitudinal ridges. The latter run parallel to one another and are separated by spaces broader than their own diameter; they were probably conspicuous on the living shell. The first 4 (or 5) whorls increase gradually and uniformly, while the fifth or penultimate complete whorl becomes, mainly owing to the increased obliquity of the suture, suddenly much larger and is considerably deeper on the inner than on the outer side of the shell. This feature is sometimes greatly exaggerated and the whorl assumes a tumid appearance as well as being exceedingly oblique.

The body-whorl varies somewhat in breadth but is never so swollen as in some species. In dorsal view it is oblique. On both sides the profile is arched and regular.

The mouth is narrow and elongate and does not project much from the body-whorl in ventral view, though its main axis is nearly parallel to that of the shell. It is narrowly oval, with the anterior extremity narrowly rounded and the posterior end hardly pointed, and

[1] Much the largest specimen I have seen was recently collected by Dr. C. A. Matley at Pisdevi in the Central Provinces in association with Dinosaur remains. It is imperfect and very badly preserved but must have been at least 9·5 cm. high and 6 cm. broad when complete. Its mouth is 7·5 cm. high and 4 cm. broad. The condition of the specimen is such that a precise identification is impossible, but shells of normal size that certainly represent either the typical form of B *prinsepii* or its race *euryhalinus*, were found with it.

is usually at least three times as long as broad. Its upper extremity is situated some distance below the upper margin of the body-whorl.

The columellar callus is well developed and has the form of a flat plate adherent to the shell. In a line proceeding forwards from the occluded umbilicus it is raised in a longitudinal pleat as though to preserve an open communication between the internal channel of the column and the anterior extremity. Whether this tunnel-like canal remained open is, however, doubtful. The columella is nearly straight and not at all twisted. It merges gradually into the lip anteriorly and in perfect specimens cannot have been truncate as Hislop's figure (*op. cit.*, 1860, pl. V, figs. 23a, 23d) would seem to indicate.

Individual variation in this race does not seem to have been of an extreme kind. Shells fall into two series equivalent to Hislop's var. *normalis* and var. *inflata* respectively, but neither is well defined in the typical form and the differences are not very great. The case seems to be one of dimorphism, similar to that recently described in *Limnaea bactriana*[1] from Seistan.

Distribution.—*B. prinsepii* (*s. s.*) is abundant in all the paludine deposits in the Central Provinces of the intertrappean period. and Mr. Matley has found it in beds he believes to Intertrappean. It is, as already stated, invariably associated with freshwater and terrestrial organisms.

Race EURYHALINUS, nov.

1907. *Physa prinsepii*, Holland, *Rec. Geol. Surv. Ind.* XXXV, p. 56.
1907. *Physa Prinsepii*, Vredenburg, *ibid.*, XXXV, p. 116.
1908. *Physa Prinsepii*, *id.*, *ibid.*, XXXVI, pp. 176, 178, 193.

The constant differences between this race and the *forma typica* are small and difficult to estimate owing to differences in the nature and results of preservation, and in the type-series the surface is much better preserved than in any specimens of the *forma typica* I have seen. Most of these latter are, indeed, little more than casts. It seems worth while, however, from a biological point of view to recognize the two races. Perhaps the most characteristic feature of the new race is the extreme individual variability displayed by its shells. Their dimorphic character is also better displayed than that of the *forma typica*, though of exactly the same

[1] See Annandale and Prashad, *Rec. Ind. Mus.* XVIII, p. 45, pl, v, figs. 1, 2. (1919).

nature. Both phenomena are better shown in the figures on plate V than can be expressed in words. True individual variability consists in this race mainly in differences in the form of the spire, while the dimorphism affects the degree of inflation of the last two whorls. The latter is due not to any fundamental difference in structure, but to abrupt changes in the direction of the spiral of the shell in the course of growth.

The constant differences between the two races are that the suture is always less impressed and usually still more oblique above the body-whorl in *euryhalinus*, which has the outlines more rounded and the body-whorl as a rule more compressed. The columellar callus is broader and coarser and the longitudinal canal beneath it better developed. The surface of the shell may also have been smoother, but the longitudinal ridges were well developed. There is no reduction in size. The measurements of shells of the type-series are as follows :—

Measurements of Shells (in millimetres) *of Bullinus prinsepii euryhalinus.*

Height	70	70	76	70	72	64
Breadth	42	45	41	41	40	32
Height of mouth	46	52	43	46	43	42
Breadth of mouth	25	25	25	22	18	18
Length of spire[1]	15	7	21	11	21	13

These shells have been selected not only for their good preservation but also to illustrate the range of variation. The first three are of the *inflata*, the last three of the *normalis* type. The measurements are far less discordant than the outlines and the former do not fully illustrate the variations of the latter. The proportion of breadth to height in the *inflata* type is 1 : 1·55—1·85 ; in other words the height is from $1\frac{1}{2}$ to $1\frac{4}{5}$ (approximately) the breadth ; in the *normalis* type the corresponding figures are 1 : 1·7—2·0, and $1\frac{3}{4}$ to twice. The height of the mouth to the total height in the *inflata* type is 1 : 1·34—1·77, the total height being thus from about $1\frac{1}{3}$ to $1\frac{3}{4}$ that of the mouth ; the corresponding figures in the other type are 1 : 1·52—1·67, and $1\frac{1}{2}$ to $1\frac{3}{5}$. The proportion of the breadth

[1] Measured from the central point of the suture on the dorsal surface to the apex of the shell in a straight line.

to the height of the mouth perhaps shows a slightly greater difference in the two types; in the *inflata* type it is 1: 1·64—2·08, in the other type 1: 2·09—2·38; the height of the mouth, therefore, in the former type varies from $1\frac{4}{5}$ to $2\frac{1}{10}$ times the breadth, and in the latter type from $2\frac{1}{10}$ to $2\frac{4}{5}$ times. The greatest difference capable of being illustrated by these measurements is, however, that in the proportion of the width of the mouth to that of the whole shell. This varies in the *inflata* type from 1 : 2·8 to 1 : 3·04 and in the normal type from 1 : 3·18 to 1 : 4, *i.e.*, the breadth of the shell is from $2\frac{4}{5}$ to 3 times the breadth of the mouth in one type and from $3\frac{1}{5}$ to 4 times in the other. In other words the mouth is narrower, as might be expected, in the normal than in the inflated type, the difference in the actual proportions of the body-whorl being concealed in the measurements of the height and breadth of the whole shell by uncorrelated differences in the proportions of the spire.

All these measurements and proportions are based on shells from Narsingarh in Central India, in the Intertrappean estuarine beds of which they are particularly well preserved. I do not think that results from the measurements of shells from the other estuarine beds would be materially different.

Type-series. No. $\frac{K\ 9}{738}$ a-h. *G. S. I.*

Distribution.—The type-series is from S. E. by S. from Kankeria, Chapera tahsil, Narsinghar, Central India (*Middlemiss*[1] coll.). I have also examined specimens from Kateru, Rajahmundry, Godaveri district, Madras Presidency (*G. de P. Cotter* coll.) and from Mazar Drik, Baluchistan (*Noetling* coll.). Vredenburg[2] has discussed the age of the beds where these last specimens were obtained and concludes that they are Maestrichtian. The specimens from Baluchistan were found with true marine organisms and others were actually parasitic upon them. Shells were found at Kateru also associated, though not so intimately, with estuarine organisms. The Geological Survey, however, have hitherto believed the series from Narsinghar to be from true freshwater beds. Further evidence on this point would be welcome. The beds in Madras and Central India where the series were found are believed to be of approximately the same age as those at Mazar Drik.

Affinities of Bullinus prinsepii.—Different opinions as to the affinities of this important and conspicuous species have been

[1] See Holland, *Rec. Geol. Surv. Ind.* XXXV, p. 56 (1907).
[2] Vredenburg, *Rec. Geol. Surv. Ind.* XXXV, p. 114 (1907).

expressed. Indian geologists have been content for the most part to let it rest in the genus *Physa*, but Neumayr (*loc. cit.* 1884), who had apparently not seen specimens, went further in attempting to establish specific affinities with North American species. He was of the opinion that *P. prinsepii* was closely related to the late Cretaceous North American species *P. copei*, White[1] and had a relationship of a more general kind with certain species from the Oligocene of London and Paris. That there is a similarity of facies between all these species cannot be denied, but the resemblance is very little if any closer than that between certain living Palaearctic species of *Aplecta* (Physidae) and certain living Australian and Malaysian species of *Bullinus*. I believe it to have been purely convergent. Neumayr was concerned to prove the contemporary date of the different deposits to which he referred and in the abundance of *Acella* (Limnaeidae) in the Intertrappean beds he found a strong resemblance between these beds and others believed on other grounds to be of similar date in other countries. *Acella*, however, was probably a cosmopolitan genus for a long period of time, for a single species still survives in North America, and among the fossils of the paludine deposits of the Central Provinces I have as yet found no freshwater Gastropod shell except those of *Bullinus* that cannot be at least compared with living Indian species.

Fischer (*loc. cit.*, 1887) took a different view of the taxonomic position of *B. prinsepii*. He placed it in the genus *Bullinus* and the family Planorbidae but erected for it a new subgenus, *Platyphysa*. His statement, however, shows that he had been misled by Hislop's incorrect figure into thinking that the columella resembled that of the African genus or subgenus *Physopsis*.

The only other character to which he refers, apart from the gigantic size of the shell (namely, the broadening of the last whorl near the suture) is found in many specimens of *Bullinus contortus*, the most widely distributed of the recent species.

In outline and general structure, but not in dimensions, the shell of *B. prinsepii* closely resembles that of this living mollusc, and it is noteworthy that in circumstances similar to those in which the estuarine race of the fossil species probably lived, *B. contortus* exhibits a very similar type of individual variation and develops a comparable form of shell-sculpture (see plate B 2., fig. 9.) *B. contortus* has not the wide, plate-like columellar callus of *B. prinsepii*

[1] White, *Ann. Rep. U. S. Geol. Surv.* 1878, p. 84. pl. xxii, fig. 1.

and its umbilicus remains narrowly open. The peculiar callus is, however, well developed in a living Australian form (*B. hainesii* var. *crebrecilliata*, T. Woods) in which the channel below the plate is clearly indicated in Hedley's figure (*op. cit.*, pl. ii, fig. 19; 1913).

In every respect the shells of *B. prinsepii* seem to me to be more like those of *B. contortus* and the Australian species of *Bullinus* than they are to recent and fossil species of *Physa* and *Aplecta*.[1] I have not seen specimens of the fossil forms with which Neumayr compared them, but to judge from figures, the mouth of the shell, so far as it is preserved, differs considerably in structure.

BULLINUS (?) ELONGATUS (Hislop).

1839. Spilsbury, *op. cit.*, pl., figs. A 11, 3, (?) 9.
1840. *Physa Prinsepii* (in part), Sowerby, *op. cit.*, pl. xlvii, fig. 16.
1860. *Physa Prinsepii* var. *elongata*, Hislop, *op. cit.*, p. 174, figs. 23*b*, 23*c*.
1860. *Physa hislopiana*, Oldham, *op. cit.*, p. 213 (juv.).
1884. *Physa prinsepii* var. *elongata*, Medlicott and Blanford, *op. cit.*, pl. xiv, fig. 2.

The status of this species has been misunderstood hitherto, mainly because most of the specimens that have been examined have been casts. These do not as a rule show the most characteristic specific character (the presence of strong longitudinal ribs on the shell) at all clearly, but this character was well illustrated by Spilsbury eighty years ago and traces of it can often be found even on casts. In some young shells in which the surface has been exceptionally well preserved the ribs are very prominent.

The shape and size of the shells are variable. I have no doubt that Oldham's *Ph. hislopiana*, of which I have examined the type-series, was based mainly on immature specimens of this species, but some of his shells may represent young of *B. prinsepii*. The specimen from Baluchistan assigned to *elongatus* by Vredenburg (*op. cit.*, 1907, p. 116) is much distorted and cannot be separated, in my opinion, from those shells of *B. prinsepii euryhalinus* that have the spire exserted. The species probably did not grow as large as *B. prinsepii*, but specimens much larger than Hislop's type occur commonly (see Pl. IV, fig. 2). The largest I have seen must have been when complete at least 50 mm. high.

[1] In America fossil shells of *Aplecta* are frequently referred to *Bullinus*, but without any real justification. The more typical shells of the latter genus have inflated whorls and are not elongate like those of *Aplecta*.

The ribs on the shell have a peculiar character and seem to have been better developed on fairly young than on old shells. In the former it might, indeed, be more exact to speak of broad grooves separating raised areas rather than of ribs, for the raised areas are often broader than the depressed ones. The upper whorls are nearly smooth and on the penultimate and last whorls the grooves are much nearer together on the older part of the whorl than on the younger. It is possible that on fully adult shells they disappeared altogether on that part of the shell that was formed after the last resting period, for they are clearly of the nature of varices representing a greatly thickened outer lip, and the part added to the shell evidently increased considerably at each growth-period. Unfortunately the mouth is broken in all the specimens I have examined and the one figured by Hislop was both immature and incomplete as well as being apparently a mere cast.

The species is commonly found with the *forma typica* of *B. prinsepii* in the intertrappean beds of the Central Provinces, but as I have pointed out above, I am not sure that the origin of the fossils was quite the same.

Affinities of B. elongatus.—The affinities of this species are doubtful. Probably it belonged to an undescribed genus bearing a somewhat similar relationship to *Bullinus* as the thickened and highly sculptured *Miratesta*[1] from Celebes. There is certainly no relationship, as Neumayr imagined, to North American or European fossil forms. The elongate form resembles that of the shell of *Aplecta*, but so does that of several Australian species anatomically inseparable from *Bullinus*.

DESCRIPTION OF A CLIONID SPONGE PARASITIC IN THE SHELLS OF *Bullinus prinsepii*.

Only the burrows of this sponge are preserved but as they have a very distinctive character the species may be described. I place it in the genus *Cliona*, Grant rather than in any other mainly because of its resemblance in certain particulars to the common living species *Cliona celata*, Grant. Its chambers are, however, better defined and more regular in shape than those of any living species or genus of the family with which I am acquainted.

[1] P. & F. Sarasin, *Die Sussw. Moll. v. Celebes*, p. 73, pl. X, figs. 137—144 (1898) and *Zool. Anz.* 1897, p. 242.

CLIONA BULLINI, sp. nov.

The burrows consist of series of well-defined chambers without connecting channels but joined together in a moniliform manner. They are arranged in more than one horizontal tier and in each tier are disposed in a straight line with occasional lateral branches on either side of the main trunk. The linear series radiate outwards from a more or less congested central area. The fully-formed chambers are flattened and transverse, hexagonal in outline, over 2 mm. broad and about twice as broad as long. Younger chambers, budding off at the extremities or sides of the older ones, are at first longer than broad and then nearly circular. The method of budding is cruciform, *i.e.*, each older chamber is capable of giving rise in a horizontal plane to a single anterior bud and a lateral bud on each side. Lateral buds are, however, comparatively seldom produced and arise at an acute angle to the parent chamber, from which they open directly without intervening channel. Each complete chamber has four apertures, one above, one below, one in front and one behind. Additional apertures are of course present if there are lateral buds, one to each bud. The upper and lower apertures are minute and circular, opening the one on the surface of the shell, the other into a chamber on a lower level. Before and behind the chambers are separated by a deep ridge with a broad angular transverse notch.

Locality and Horizon.—Mazar Drik, Baluchistan; Cretaceous horizon 13 (*Noetling*). In shells of *Bullinus prinsepii euryhalinus.*

Type-specimen. No. 11,798 *G. S. I.*

The burrows of *C. bullini* are remarkable for the regularity and uniformity of the chambers and the total absence of horizontal connecting channels. Their transverse form is also characteristic, as well as the structure of the partitions between them with the broad angular notches, which were probably occupied in the living sponge by cellular diaphragms as in the recent *C. ensifera* and *C. mucronata*, Sollas.[1] In some respects, as already noted, the excavations are not unlike those of the recent *C. celata*,[2] (with which the Upper Cretaceous *Vioa nardina*, Michelin[3] is probably identical), but in that species the chambers are not so broad and much less uniform in shape and the terminal branches are usually dichotomous

[1] Sollas, *Ann. Mag. Nat. Hist.* I (5), p. 54, pl. i (1878).
[2] Hancock, *ibid*, III (2), p. 332, pl. xiii, fig. 3 (1849).
[3] Michelin, *Icon. Zoophyt.*, p. 333, pl. lxxix, fig. 8 (1847).

instead of linear or cruciform. From the chambers of *C. quadrata*, Hancock,[1] those of the species just described differ in the same features and also in never being connected by short horizontal channels.

[1] Hancock, *op. cit.*, p. 344, pl. xv, fig. 6 (1849).

DESCRIPTION OF PLATES.

PLATE IV.

FIG. 1.—Solid section of rock containing numerous broken shells of *Bullinus prinsepii* (*c. t.*) from Nagpur.
The section is magnified four times. The dark marks represent cavities, some of which contain fragments of shell, others imperfectly preserved vegetable remains.

FIG. 2.—A large shell of *Bullinus elongatus* from the Central Provinces. Nat. size.
This specimen, though only a natural cast, shows traces of the prominent longitudinal ribs characteristic of the species.

FIGS. 3, 3*a*.—Much smaller shells of the same species from the same locality with the ribs better preserved. Nat size.

FIG. 4.—Type-specimen of the sponge *Cliona bullini*, sp. nov. in a. shell of *Bullinus prinsepii euryhalinus* from Mazar Drik, Baluchistan. Nat. size.

FIG. 5.—Enlarged view of part of the same specimen (x7).
The area contained in the photograph is that outlined in white on fig. 4.
The light is so arranged that chambers of the sponge stand out like a cast.

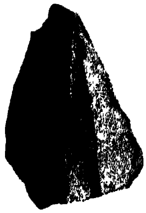
PLATE V.

FIGS. 1-8.—Type series of *Bullinus prinsepii euryhalinus*, subsp. nov., illustrating extreme variation.

FIGS. 1, 2, 3 and 7 represent shells of the *normalis*, figs. 4, 5, 6, and 8 shells of the *inflata* type.
All the specimens are figured of the natural size and come from Narsingarh in Central India.

FIG. 9.—Four subrecent shells of *Bullinus contortus approximans*, Mousson, from Lower Mesopotamia (× 2) showing similar variation.

CALCUTTA: PRINTED BY SUPDT. GOVT. PRINTING, INDIA, 8, HASTINGS



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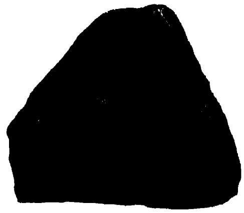

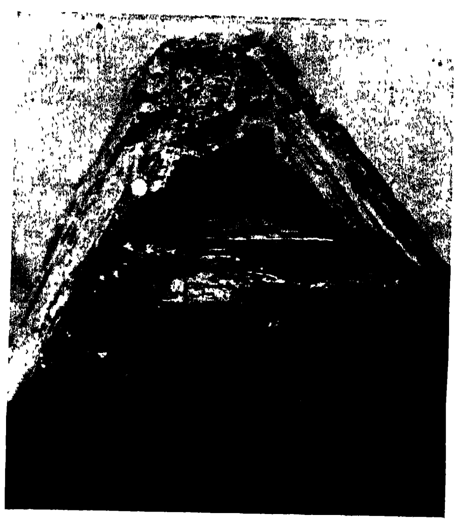

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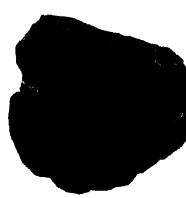

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7

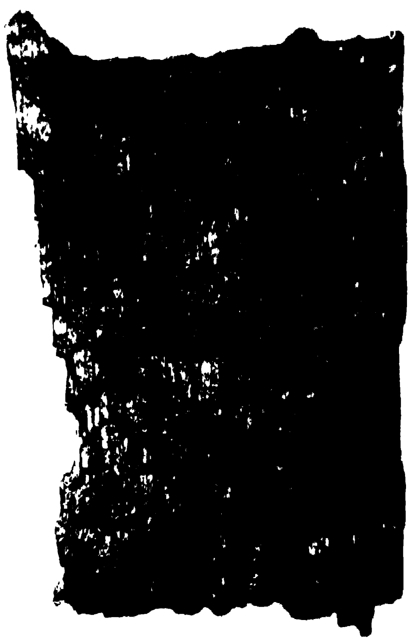
Photographs by K. F. Watkinson. *G. S. I. Calcutta*

PSEUDO-CRYSTALS OF GRAPHITE.

Fig 1. Photograph showing structure, × 3.

Figs. 2-7. Different types of Pseudo-Crystals. (Fig. 4. Shows a re-entrant angle,) Approximately natural size.

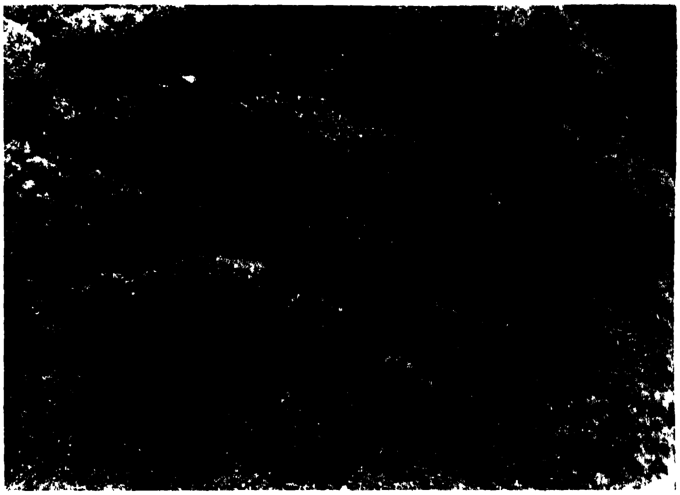
FIG. 1. MODE OF OCCURRENCE OF THE MINERAL X 2



Photographs by G. H. Tipper. G. S. I. Calcutta.

FIG. 2. BASAL SECTION SHOWING INTERSECTION OF THE CLEAVAGES. Ordinary light X 48.

FIG. 3. PRISMATIC SECTION. Ordinary light X 48.



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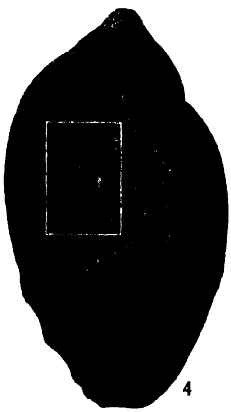

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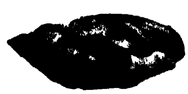

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Photo. Z. S. I. *G. S. I. Calcutta*

BULLINUS PRINSEPII, B. ELONGATUS, ETC.

Photographs Z. S. I. *G. S. I. Calcutta*

BULLINUS PRINSEPII, ETC.

RECORDS

OF

THE GEOLOGICAL SURVEY OF INDIA.

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CLASSIFICATION OF THE RECENT AND FOSSIL CYPRÆIDÆ.

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I.—GENERAL REMARKS.

Introduction.

THE following pages contain a summary of the results obtained by attempting to apply to one of the most important families of the Gastropoda the comparative system of study of recent and extinct forms that has already yielded results of the greatest importance in several groups of the animal kingdom, but which up till now has been used only to a somewhat incomplete extent with regard to the Mollusca.

Amongst the various branches of zoological research, it would be impossible to overrate the importance of the results that have been achieved by combining the study of the extinct forms of vertebrates with that of their modern representatives. At first it was by applying to the fossil remnants the knowledge acquired by a careful study of the anatomy of the living forms that it became possible to interpret these fragmentary remains, but it was not long before the study of the extinct forms began, in its turn, to react upon that of their living successors.

Quite apart from the evidence which it may give for or against the more or less controverted questions of evolution and of its methods, the study of the fossil remnants has revealed an incalculable wealth of positive information of paramount importance. In such a group as that of the Mammalia almost every line of enquiry amongst the living forms has benefited from the light afforded by the study of the extinct species and genera. A vast amount of information has thereby been gained not only as to the relationship between modern forms and their predecessors, but also as to the mutual affinities of the living forms themselves. Many of the most important points concerning the classification of the recent Mammalia have been established by studying the fossil remains of forms that lived in past geological ages. In the present state of zoological science no comprehensive account of the Mammalia could be complete without dealing fully with the extinct as well as with the recent forms.

Apart from the exceptional instances of individuals preserved in what may be called the fossil ice of the arctic regions, the viscera of the extinct Mammalia have perished; nevertheless the skeleton is so intimately connected with the structures of the more perishable parts as to supplement much of the information for which direct evidence is wanting.

An equally close or even closer relationship between the indurated and durable parts and the more perishable portions of the organism is observed amongst many groups of invertebrates such as the Arthropoda or the Echinoidea. It is true that, owing to the delicacy and fragility of their structures, certain groups, for instance the Insects, are poorly represented in a fossil condition; but, in other instances, the fossil record is of bewildering richness. In a group such as the Echinoidea, without the fossil forms we would be seriously handicapped in any attempt to form a truly adequate idea of the class just as much as with the Mammalia.

Of all the great divisions of the animal kingdom the one that is by far the most abundantly represented in a fossil condition is that of the Mollusca. More than any other organic remains, has the succession of molluscan faunas contributed to define the series of stages in the history of Creation. Yet, from the zoological point of view, the linking together of the extinct and living forms has not reached so satisfactory a stage as amongst several other animal groups. The present unsatisfactory state of the systematic classification of the mollusca depends partly on the fact that the correspondence between the indurated portions and the essential organs is less close than amongst the vertebrates and many groups of invertebrates. The viscera of the mollusca occupy in a more or less floating condition a membranous sac, the "mantle," enveloping the whole body, and of which the "shell," generally the only portion capable of preservation, is a mere calcified appendage. Nevertheless, our classifications of the mollusca, even of the living forms, rest largely upon this somewhat accessory structure. Our knowledge of the anatomy of the mollusca is still very incomplete. Further studies in this branch may lead to important amendments in the classifications hitherto founded almost exclusively on the shell. It is not unlikely that in many instances the anatomical features are correlated with certain characters of the external shell which in turn will become of use in the classification of fossil forms. Nevertheless, amongst shells of the character of the "holostomatous" type of the Gastropods, merely a spirally coiled cone of more or less circular or elliptical section, the range of possible differentiation is so limited that the value of the shell structures for classificatory purposes is extremely reduced. In the absence of the radula or of certain characteristic viscera, we are often at a loss to determine not only the genus but even the family or order of some of these indifferent types of shell amongst recent specimens. The exact classification of a large proportion of similar fossil forms must for ever remain conjectural.

Nevertheless, there are many families of Gastropoda, especially amongst the carnivorous forms, where the structures of the shell, notwithstanding their lack of connection with the essential organs, exhibit such marked characteristics that they form a satisfactory basis for a classification, so far, at least as the grouping of species is concerned. Here then we have an opportunity for comparing the fossil and recent forms, and for attempting to trace the former history of some of the recent groups.

Yet, nothing complete has up to now been accomplished in this direction; nothing comparable to the remarkable synthetic schemes that have been arrived at for the classification and history of such groups as the Mammalia, Reptilia, Echinoidea or Crinoidea. This is due not only to the inherent difficulties of identification of molluscan remains, but also to the unwieldy proportions to which the palæontological literature of the mollusca has grown, coupled with its lack of co-ordination.

Whatever may be the imperfections of the present-day classifications of the mollusca so far as the grouping of the species into genera and higher divisions is concerned, nevertheless, if we consider their recent representatives, there is scarcely a class of animals in which specimens may be correctly identified with relatively so little labour. This is especially true of the marine forms, and is due to the publication of the splendid illustrated monographs that have succeeded one another during the last hundred years, above all those of the Sowerbys.

The great monographs in which we have to seek for information regarding fossil mollusca deal with local faunas, generally embracing all groups of animals. No thorough co-ordination of these separate faunas has as yet been attempted, not even for areas so rich in contemporaneous fossil remains and situated so close together as the Paris, London and Hampshire tertiary basins, not to speak of other neighbouring areas such as Belgium, Normandy, Brittany, also containing synchronous faunas. In addition to the large monographs, there is a bewildering superabundance of scattered short publications which the most persevering industry can never hope to cope with. Specimens of fossil species are generally much more difficult to secure for purposes of comparison than those of living forms, and there are very few instances in which the illustrations representing them can compare in definiteness and accuracy with those of the living species ; a state of things frequently aggravated by the unsatisfactory condition of the original fossil specimens.

Evidently a continuation of the present state of things must soon bring any further useful work in molluscan palæontology to a standstill. It is high time that the work so successfully accomplished for the recent species should be attempted for the fossil species also. In order to make a fresh start of profitable work, we require monographs of each genus combining all the fossil and all the recent forms known up to the present day. The work will need much patience and the concourse of many collaborators, but it must be done, and its postponement can only aggravate the present confusion and increase the difficulties of eventual success. There exists no satisfactory complete monograph of the fossil representatives of any of the larger genera, and, *a fortiori*, none embracing both the fossil and recent forms.

Under the present circumstances we cannot feel too grateful for the magnificent pioneer work that has been accomplished by Cossmann in the "Essais de Paléoconchologie comparée" commenced in 1896, and now embracing the greater part of the prosobranchiate gastropods, together with the relatively scanty fossil representatives of the Opisthobranchiata. The work is concerned primarily with fossil forms, but no conchologist dealing either with recent or fossil representatives of the families so far reviewed can afford to ignore it. Taking Cossmann's work as a basis, the next step will be, as already suggested, the preparation of monographs embracing the totality of known fossil and living forms in each genus and family. Only when this is accomplished, shall we be able to reconstitute for each group of the Mollusca a connected history such as has already been outlined for the Mammalia, Reptilia or Echinoidea.

I have attempted to work out such a scheme for the Cypræidæ, one of the most important families of marine shells, both recent and fossil, and the following classificatory sketch represents the systematic result of this study.

Subsequently to the preliminary broad classificatory schemes of Gray and of Troschel, two elaborate classifications of the Cypræidæ have been published, firstly by Jousseaume in 1884 (Bull. Soc. Zool. Fr., Vol. IX, pp. 81-100) and secondly by Cossmann in 1903 (Ess. Pal. Comp., Livr. V, pp. 143-185), with additions in 1906 (*Op. cit.* Livr. VII, pp. 238-240).

In Jousseaume's scheme the Cypræidæ, exclusive of *Erato* (at that time classified with the Marginellidæ), are classified in thirty-six divisions each containing groups of species regarded as closely related to one another. In most instances the grouping has stood the test of further researches.

Jousseaume has given to all these divisions the rank of separate genera, and as he has not provided for any sub-families, the scheme, excellent in its details, lacks coherence as a whole, as it does not indicate the mutual relationships of the several divisions. Moreover, some of these divisions are mere groups of species differing from other divisions by features of so trifling a nature as not to entitle them even to the rank of sections.

In Cossmann's scheme the classification is harmonised into an organised system, principally by reducing most of Jousseaume's genera to the rank of sections. These in their turn are united into sub-genera, and finally into eleven genera, including *Amphiperas* (=*Ovula*), *Cyphoma*, *Calpurnus*, *Erato*, *Pedicularia*, not included by Jousseaume amongst the Cypræidæ, and *Vicetia*, *Rhynchocypræa*, *Transovula*, founded upon fossil forms mostly unknown to Jousseaume. If we leave out of account these eight genera, we see that the thirty-six genera of Jousseaume's scheme have been reduced by Cossmann to three. The total number of sections admitted by Cossmann is forty-three, of which fourteen belong to the eight genera above mentioned as including forms not taken into account by Jousseaume. There remain thus twenty-nine sections making a reduction of seven from the total number of divisions admitted by Jousseaume. Moreover, seven of these, *Siphocypræa*, *Cypræoglobina*, *Gaskoinia*, *Eocypræa*, *Austrocypræa*, *Cypropterina*, *Semitrivia*, though coinciding partly with Jousseaume's divisions, do not belong to Jousseaume's scheme, and the total number of Jousseaume's divisions regarded by Cossmann as superfluous amounts therefore to fourteen.

It would have been mere presumption on my part to take up this subject again after it had been through the hands of two such great authorities, were it not that neither scheme is complete in its scope; that of Jousseaume dealing principally with the living forms, that of Cossmann principally with the fossil forms. Out of 216 species enumerated by Jousseaume only 18 are extinct.

The few amendments suggested in the present scheme mostly represent further simplifications, principally amongst some of the exclusively recent groups not specially considered in Cossmann's work. *Mauritia* Troschel, *Trona* Jousseaume, *Cavicypræa* Cossmann (= *Basterotia* Bayle), *Ponda* Jousseaume appear superfluous, and have been united with *Cypræa s. str.* *Zoila* Jousseaume cannot be precisely separated from the section *Bernayia*. *Umbilia* Jousseaume is also dispensed with, the included species being re-distributed partly under *Gisortia*, partly under *Bernayia*. *Luponia* Gray, *Gaskoinia* Roberts, *Austrocypræa* Cossmann, have been incorporated with *Cypræovula*. *Naria* Gray and *Erronea* Troschel have been united with *Adusta*. *Cypropterina* has been united with *Monetaria*, *Nuclearia* with *Erosaria, Ipsa* with *Pustularia, Rhynchocypræa* with *Gisortia.*

I have maintained the separation, as a section of *Erato,* of Sacco's *Eratotrivia,* merged by Cossmann with *Eratopsis.* Conrad's *Sulcocypræa* is provisionally maintained as a section.

Exclusive of *Ovula* (*Amphiperas*), *Cyphoma,* and *Calpurnus* regarded as constituting a family *Ovulidæ* distinct from the *Cypræidæ,* the total number of sections is reduced from thirty-four in Cossmann's classification to twenty-five in the present scheme.

As to the grouping of the sections into sub-genera or genera, I have ventured to remove *Eocypræa, Cyprædia* (including *Cypræoglobina* and *Sulcocypræa*) and *Trivia* from *Cypræa* as entirely distinct genera. I have also adopted Troschel's separation of *Trivia* into a sub-family Triviinæ to which have been added *Erato* and *Pedicularia.*

Even after the removal of *Eocypræa, Cyprædia* and *Trivia,* the genus *Cypræa,* as restricted in the present scheme, still includes a far larger share of the original Linnean or Lamarckian genus than any of the other genera here included within the Cypræidæ.

It is necessary to say a few words about another scheme, the method of which, from a taxonomic point of view, represents the opposite extreme to that adopted by Jousseaume. It is that published in 1888 by Cosmo Melvill as "A Survey of the genus Cypræa..." (Mem. and Proc. of the Manchester Lit. and Phil. Society, Ser. 4, Vol. I, pp. 184—252). While Jousseaume has split up the original Linnean and Lamarckian genus into thirty-six divisions amongst which the original generic name has almost disappeared, Melvill retains all the Cypræidæ (exclusive of *Erato* and *Pedicularia* then referred to other families) within a solitary genus *Cypræa.* Yet, in spite of this apparently wide divergence, both systems, independently and simultaneously worked out by Jousseaume and by Melvill, almost exactly coincide; that is, although Melvill has not marked off any groups with separate generic designations, yet the species are placed side by side, according to their mutual affinities, in a manner which almost exactly coincides with the groupings indicated by Jousseaume. The method which Melvill has defined as the "circular" system is one that, with certain modifications, should really be of wide application. An attempt has been made to place all the species in a continuous series in such a way that each form is placed between the two to which it is closest related. The point selected as the commencement of the series is arbitrary in this sense that the two species nearest related to No. 1 are No. 2 on the one hand, and, on the other hand, the last number in the list. Every classification is in reality essentially dichotomous, and Melvill's ingenious system draws attention to one of the unavoidable drawbacks of the dichotomous classification as usually expressed, endeavouring at the same time to obviate it. For instance, let us imagine a set of six species, closely related to one another, that can conveniently be arranged in three groups of two each. It will be necessary to select one of these groups as the first and another as the third and to represent them in a serial table or in a branching scheme in that order; yet the third group may be just as closely related to the first group from which it is necessarily severed in the diagrammatic scheme as to the second. The fact is that while, for practical reasons, we represent our classificatory schemes on a flat sheet in two dimensions, they should in reality be constructed in three dimensions like the branches of a tree or of a candelabrum. It is this misleading character of the two-dimension scheme that Melvill has attempted to obviate in the "circular system." That it should work out quite satisfactorily in so vast an assemblage as the Cypræidæ can scarcely be expected, for, instead of a single gigantic circle, a congeries of smaller circles would in reality be needed, and this again can with difficulty be attempted in any diagrammatic or serial arrangement—unless indeed some stereographic mode of representation were devised; but again, apart from this minor difficulty, it is clear that, for an entirely different reason, in spite of the great care exercised in distributing the species according to their affinities, Melvill's scheme exhibits some obvious gaps, which have either been filled by a form which is not truly related to the adjacent ones, or else is bordered on either side by species exhibiting a rather strained analogy instead of a true relationship.

An instance of what might be described as a "stop-gap" is that of No. 12 of Melvill's list, *Cypræa umbilicata* Sow. It separates *C. venusta* No. 11 from *C. Scottii* No. 13. In its turn, *C. Scottii* is followed by *C. marginata*, *C. thersites*, *C. decipiens*, *C. mus*, *C. leucostoma*, all of which clearly belong to the same group. It is most probable that *C. venusta* itself belongs to the same group, though it is adjacent to *Cypræa stercoraria*, No. 10, which decidedly differs. Therefore, there does exist a gap between No. 10 and No. 11, though there is probably no gap between No. 11 and No. 13. At all events, *C. umbilicata* bears no true relation either to *C. venusta* or to *C. Scottii.* Moreover, while both *C. venusta* and *C. Scottii* (as indeed also *C. stercoraria*) truly belong to the genus *Cypræa*, "*Cypræa*" *umbilicata* belongs to an entirely different genus, and is the only surviving representative of the remarkable cretaceous and eocene genus *Gisortia.* Its true place in the "circular" system should be quite different, while to connect continuously *C. stercoraria* and *C. venusta*, it would be necessary to intercalate various extinct species.

Instances of strained analogy are to be found where *Trivia* comes into contact with the genuine representatives of *Cypræa.* Fifty-two species are included by Melvill under *Trivia*, ranging from No. 89 to No. 140. The first species, *C. pustulata*, No. 89, is closely related to the last, *C. staphylæa*, No. 140. If the *Trivia* group, as understood by Melvill, is to be treated as a subsidiary ring within the circular system, the arrangement is perfectly consistent and logical. Nevertheless, on closer inspection, we find serious gaps, within the ring and also at its limit. Thus, the species classified under No. 88, at the junction, therefore, of *Cypræa s. str.* and *Trivia* as interpreted by Melvill, is *C. Adamsonii*, a shell usually striated dorsally, but in which the spiral ornaments truly belong to the shell wall, while the ridges occasionally seen on the dorsal surface of adult specimens in *C. pustulata* are superficial callous growths belonging to the same order of structures as the apertural denticulations. It is true that, at immature stages, *C. pustulata* is spirally striated, and in that condition closely resembles *C. Adamsoni.* Yet they belong to different groups, *C. Adamsoni* being a typical "*Cypræovula*," while *C. pustulata* should be classified with *Erosaria.* Still, if we are dealing exclusively with living forms, the juxtaposition proposed by Melvill is the best that can be contrived, though, as in the previously mentioned instance, it still leaves a gap which could only be filled by the intercalation of fossil forms, many of which are still unknown.

The last number of the ring *Trivia*, as interpreted by Melvill, is *C. staphylæa*, No. 140, and this is a true *Erosaria*; the following number, No. 141, being apportioned to *C. helvola*, also an *Erosaria*, followed in its turn by numerous species of *Erosaria.* This portion of the scheme is therefore quite satisfactory; but it is within the ring "*Trivia*" that the most serious gaps occur. First of all, it should be noticed that the three first and the six last species referred to *Trivia* in Melvill's scheme belong to other genera. The three first, *C. pustulata*, No. 89, *C. madagascariensis*, No. 90, *C. nucleus* No. 91, are members of the *Erosaria* group of *Cypræa*. Of the six last species, *C. margarita*, No. 135, and *C. staphylæa*, No. 140, are likewise members of the *Erosaria* group, while intercalated between *C. margarita* and *C. staphylæa* are the four species, *C. annulata*, *C. Childreni*, *C. globulus*, *C. cicercula*, that constitute the genus *Pustularia*. In the systematic portion of the present essay, reasons are given for considering *Trivia* not only as a genus totally distinct from *Cypræa*, but even as a member of a separate sub-family. Here, therefore, we have four obvious gaps: firstly between *C. nucleus* No. 91, which is a true *Cypræa* of the *Erosaria* group, and *C. radians*, No. 92, which is a typical *Trivia*; secondly, between *C. scabriuscula*, No. 134, which is a *Trivia*, and *C. margarita*, No. 135, which is a *Cypræa* of the *Erosaria* group; thirdly between the species last-named, which is a *Cypræa*, and *C. annulata*, No. 136, which is a *Pustularia*; lastly, between *C. cicercula*, No. 139, also a *Pustularia* and *C. staphylæa*, No. 140, which is again a *Cypræa* of the *Erosaria* group. It is quite true that, in a classificatory scheme restricted to the living Cypræidæ, the nearest approach of *Pustularia* to *Cypræa* seems to be in the region of the group *Erosaria*. Yet the resemblance may be perhaps mainly superficial, and here again, to attempt a real connection, it would be necessary to take fossil forms into account.

I have ventured upon these remarks not as a criticism of Melvill's admirable work, the value of which can only be described as priceless, but as an attempt to illustrate the assistance which modern conchology can derive from the study of fossil shells. The advantage is entirely mutual, and it is absolutely necessary that the votaries of palæontology and zoology should combine their efforts at the present stage of evolution of both sciences.

The interpretation of *Cypræa umbilicata* by various systematists affords an instructive example of the insufficiency of the characters of the living forms if exclusively relied upon for classificatory purposes without the help of the fossils. It is indeed singular how this shell has remained classified amongst the typical forms of the genus *Cypræa* in spite of its totally aberrant characters. G. B. Sowerby, in 1837 (Conch. Ill., fig. 169), and again, in 1846, Reeve

(Mon. Gen. Cypræa, species 7) regarded it as a mere monstrosity and referred it to the species *Cypræa pantherina* as a variety *umbilicata*. Nevertheless, as early as 1849, Gray clearly indicated the extremely close relationship between *Cypræa umbilicata*, which, in after years, was to become the type of *Umbilia*, and *Cypræa eximia* Sow., which was to become the plesiotype of *Rhynchocypræa*, being perhaps identical with the type *C. loxorhyncha* (Proc. Zool. Soc. London, 1849, p. 125). Gray further came to the conclusion that both shells should be removed from the genus *Cypræa* and transferred to the genus *Cypræovula*. It will be shown in the sequel of the present notice that Gray's *Cypræovula* cannot be separated from *Cypræa* otherwise than as a subgenus. Nevertheless, in the note above alluded to, Gray further noticed that both *Cypræa umbilicata* and *C. eximia* differ from other forms referred to *Cypræovula* by their large size, by the length of the terminal canals, and by the peculiar callous impression dorsally situated at the root of the anterior canal; all of which features are now known to be characteristic of *Gisortia*. These valuable observations appear to have been overlooked by subsequent authors.

Again, in 1870 (Thes. Conch., Cypræa, p. 61), Sowerby separated *Cypræa umbilicata* from *Cypræa pantherina*, and not only asserted that the resemblance between these shells is quite superficial, but even hinted at the propriety of separating *C. umbilicata* generically from the remainder of the Cypræidæ. Like the previous observations of Gray, these remarks of Sowerby seem to have remained unnoticed.

Jousseaume, it is true, made *Cypræa umbilicata* the type and unique species of a genus *Umbilia*, but as his system establishes neither links nor separations between the various groups of the Cypræidæ, the creation of this genus remains without definite significance, all the more so as the identity of *Umbilia* with the genus *Gisortia* also established for the first time in the same classificatory scheme remained unnoticed. Melvill, as we have already seen, placed *C. umbilicata* in the neighbourhood of *C. venusta* and *C. Scottii* the resemblance with which is just as superficial as with *C. pantherina*.

In the latest and most comprehensive monograph of the recent Cypræidæ (Monografia de las especies vivientes del genero Cypræa, Mem. R. Ac. Cienc., Madrid, Vol. XXV, 1906-07), Hidalgo, like Melvill, recognises a single genus *Cypræa*, divided into groups to which no separate names are given, but in which the affinities of the species are indicated in a manner generally coinciding with the schemes of Jousseaume and Melvill. In this work *Cypræa umbilicata* is given an isolated position, but is placed in the midst of groups including exclusively typical species of *Cypræa s. str.* Cossmann has separately retained both *Umbilia* and *Gisortia* and has added a genus *Rhynchocypræa*, the type of which is an Australian tertiary fossil scarcely distinct even specifically from *Cypræa* (or more exactly *Gisortia*) *umbilicata.* It should be noticed that there exist no adequate illustrations of *Cypræa umbilicata*, and that from the published figures, without the help of actual specimens, no one would suspect the close relationship, amounting, as already said, almost to specific identity, between *Cypræa umbilicata* and the type of *Rhynchocypræa.* As a result of these various sources of error, *Cypræa umbilicata* has been grouped by Cossmann with various fossils, one of which, the Australian form *C. amygdalina* Tate is indeed closely related, while the others are members of the *Bernayia* section of *Cypræa*, and the whole assemblage has in turn been treated as a mere section of Cypræa. Cossmann has carefully indicated the extremely close relationship (in reality amounting to identity) between *Rhynchocypræa* and *Gisortia*, but has failed to recognise the identity of *Cypræa umbilicata* with either. In the northern hemisphere *Gisortia* died out with the eocene; but the later Australian tertiaries contain forms resembling the type of *Rhynchocypræa*, forming a complete transition between the living *Cypræa umbilicata* and the gigantic, presumably upper eocene *Cypræa gigas* McCoy, and unquestionably congeneric with both. There can be no hesitation in referring the Australian *Cypræa gigas* to the same genus as *Gisortia gisortiana* and thereby we can fully establish the congeneric character of *Cypræa umbilicata*, of the type of *Rhynchocypræa* and of the type of *Gisortia.* Precedence, in the literature of the subject, belongs to the designation *Gisortia*, which, therefore should be the generic name applicable to all these forms.[1]

Moreover, the recognition of these relationships affords a clue to the generic position of a considerable number of hitherto puzzling cretaceous forms, indicating that the period of highest develop-

[1] Harris, in 1897 (Catal. Tert. Moll. Brit. Mus., Part I, Austr. Tert. Moll), has referred to *Umbilia* the Australian fossil forms subsequently classified by Cossmann under *Rhynchocypræa*; but through some unaccountable misinterpretation of Jousseaume's scheme, has referred to the diminutive group *Erosaria* the gigantic *Cypræa gigas*, thereby missing the recognition of the generic identity of *Umbilia* and *Gisortia.*

ment of this singular genus coincides with the upper cretaceous. From these various considerations we must finally conclude that *Gisortia umbilicata* must rank by the side of the famous Trigonias as one of the most remarkable relics of the mesozoic fauna surviving in the Australian seas of the present day, and we can only deplore that nothing is known of the anatomy or life-history of this most interesting of all the Cypræidæ.

I have dwelt at length upon this instance so as to exemplify how certain facts of the most absorbing interest have escaped notice from several of the most able naturalists as a consequence of their having dealt exclusively or almost exclusively either with the living or with the fossil representatives of the group; while the simultaneous study of the fossil and recent forms has brought to light the almost complete history of a phylum reaching back far into the mesozoic, and the extremely interesting fact of its survival at the present day.

Geological antiquity of the Cypræidæ.

According to most palæontological treatises, the Cypræidæ are stated to be exclusively tertiary and recent. This view was especially popularised by d'Orbigny who referred to "*Ovula,*" that is principally to *Gisortia* as at present understood, all the cretaceous shells of cowry-like appearance. d'Orbigny's conclusions were harshly criticised by Stoliczka (Cretaceous Fauna of Southern India, Vol. II, pp. 51, 55), who described many species of "*Cypræa*" from the cretaceous of Southern India. Nevertheless, so late as 1903, Cossmann has declared that there are no undoubted occurrences of Cypræidæ older than tertiary (Ess. Pal. comp. V, p. 145).

A study of the information at present available has amply demonstrated the abundance of the remains of Cypræidæ throughout the formations of upper cretaceous times. The oldest Cypræidæ so far recorded belong to the "Albian" that is the Middle Cretaceous, immediately succeeding the age generally classified as Lower Cretaceous.

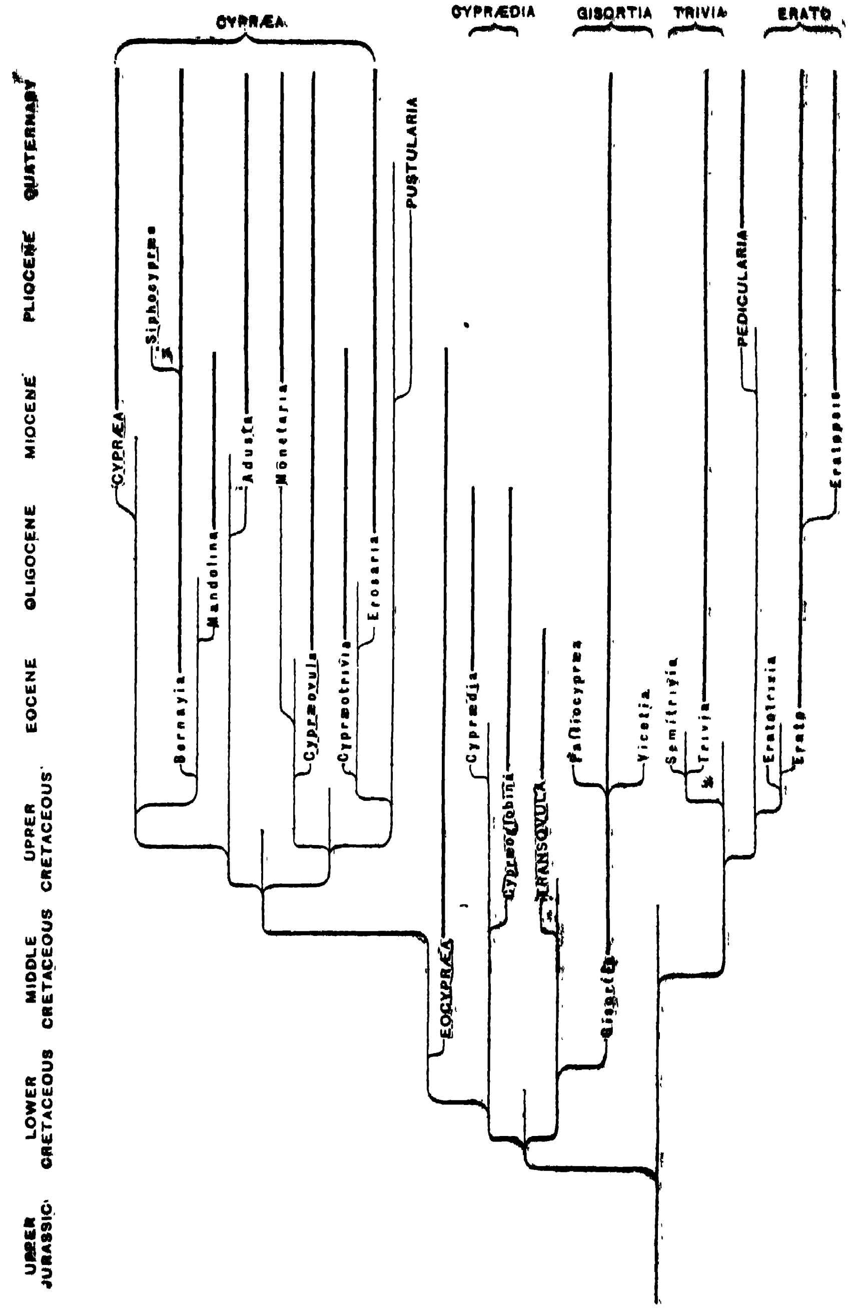
Nevertheless, modern research has entirely confirmed the conclusions established by the unparalleled learning and sagacity of d'Orbigny. None of the numerous cretaceous forms so far discovered belong to the genus *Cypræa.* They principally belong to *Gisortia,* that is to the group of forms included by d'Orbigny and his contemporaries under "*Ovula.*" Others belong to *Eocypræa,* *Transovula*, and *Cypræoglobina*. The true *Cypræa* is first represented in the eocene by the section *Bernayia*, while the oldest undoubted representative of the section *Cypræa s. str.* is miocene, the oligocene *C. apenninensis* being of doubtful systematic position.

Trivia and *Erato* have not been met with in rocks older than eocene.

As already mentioned, the oldest Cypræidæ so far known occur in the Albian stage of the Middle Cretaceous, where they are represented by the already strongly differentiated genera *Eocypræa* and *Gisortia*. The origin of the family must therefore be set much further back in geological times. Immature shells of the Cypræidæ resemble some of the Doliidæ, especially the shells of *Pirula*, a genus already characteristically developed in the Turonian. It is not improbable that the Cypræidæ and Doliidæ are derived from a common stock and that the divergence took place in later Jurassic times.

The following diagram illustrates the suggested affinities and geological history of the main classificatory divisions recognized in the present scheme. The names written in larger characters refer to the groups to which it is proposed to assign the rank of genera. The others represent sub-genera or sections.[1]

[1] The name "Cypræa," where it refers to the section and not to the genus, has, by mistake been written in large characters.


CYPRÆA
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OLIGOCENE
EOCENE
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MIDDLE CRETACEOUS
LOWER CRETACEOUS
UPPER JURASSIC
PUSTULARIA
PEDICULARIA
Siphocypræa
CYPRÆA
Bernayia
Mandolina
Adusta
Monetaria
Cypræovula
Cypræotrivia
Erosaria
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TRANSOVULA
Palliocypræa
Gisortia
Vicetia
Semitrivia
Trivia
Eratotrivia
Erato
Eratopsis

Distinctness of the Cypræidæ and Ovulidæ.

Cossmann and several other naturalists have included within the Cypræidæ the genus *Ovula* (or, as it is sometimes called, *Amphiperas*). As indicated by their generic name, many species of *Ovula* have an ovoid shape recalling in general appearance the adult stage of most Cypræidæ; only the mode of growth of *Ovula* is so different from that of *Cypræa* as to indicate that the resemblance is merely superficial. It is only at the adult stage, or at least at each arrest of growth, that the shells of *Cypræa* acquire their characteristic ovoid shape; when immature they are elongate shells resembling certain forms of Volutidæ, and the pronounced alteration of the mode of growth that marks the adult stage constitutes precisely one of the most characteristic features of all the forms that are undoubtedly members of the family Cypræidæ. No such dimorphism of growth is known in *Ovula*, the immature shell being generally quite identical with the full-grown stage, but for such subsidiary details as the thickening of the apertural lips such as is observed in many other gastropoda. In a few species the adult stage exhibits superficial callous growths which further enhance the superficial resemblance to the Cypræidæ; but it must be remembered that similar excrescences are observed in certain forms of the Strombidæ and Cassididæ.

The protoconch of *Ovula* does not seem to have been figured or described, and I have had no opportunity of examining it; but there is no doubt that, throughout its post-embryonic stages, *Ovula* is completely devoid of a true spire, the apex being invariably umbilicated. The Cypræidæ always have a spire occasionally flat or even inverted, frequently concealed in the adult, but always present, even in a group like *Cyprædia* in which the apex is umbilicated in the adult, but in which the earlier stages of growth, succeeding the protoconch, are provided with a true spire.

Not only does *Ovula* differ from the true Cypræidæ in its general mode of growth but it widely diverges from them in the structure of the channelled terminations of the aperture, precisely therefore in one of the most important characters that have been used for classifying the Cypræidæ.

It is essential to observe that the apertural terminations of the Ovulidæ are not homologous with those of the Cypræidæ even in such instances in which the callous growths of the adult stage are apt to give rise to a deceptive appearance of similarity. The divergence of structure is especially marked in the posterior termination which consists of a more or less deflected canal, situated beyond what might normally be regarded as the apex of the axis of convolution, and included between a peculiar spiral fold and the outer lip which, beyond its most posteriorly situated point, is completely recurved upon itself in an anterior direction in order to unite with the above mentioned spiral fold. This spiral fold, generally regarded as a columellar structure is really a winding funiculum issuing from the interior of the shell. In immature specimens we may readily observe that it bears no relation to the longitudinal callous apertural structures generally classified with the columella. In a number of instances, the re-entering space on the anterior side of the above mentioned funiculum is apt to become completely immersed in callus, and if, at the same time, the posterior outlet is strongly deflected posteriorly to the left, in accordance with the main direction of outline of the outer surface (as in *O. margarita*, *O. lactea*, *O. semistriata*, also in the group of *O. marginata*), there may result a most deceptive appearance entirely simulating the posterior mode of termination observed in *Cypræedia* and *Cypræoglobina* amongst the Cypræidæ. It is sufficient, nevertheless, to compare immature specimens with the fully developed shell in order to realise how entirely different is the mode of origin of these structures in *Ovula* and in *Cypræedia*.

The essential difference between the posterior apertural outlet of *Ovula* on the one hand, and, on the other hand, the posterior apertural outlet of the Cypræidæ, is therefore that, while in the Cypræidæ the structure is constituted by the elements of both the outer and columellar lip, in *Ovula*, the outer lip alone takes part in its constitution, together with an internal spiral funiculum which does not correspond with any recognised structure of the Cypræidæ. The true columellar lip takes no part in the constitution of the posterior outlet in *Ovula*.

Very frequently the characteristic posterior outlet of *Ovula* is more or less nearly vertically produced in an apical direction. It may then happen that a more or less channelled space remains between the usually thickened end of the columellar lip and the left border of the true outlet; this space corresponding in a rudimentary fashion with the usual posterior outlet of the Cypræidæ. The shell may thus appear to possess two posterior outlets. It is very doubtful, however, whether the more or less rudimentary Cypræa-like channel possesses any real physiological meaning.

The anterior apertural outlet of *Ovula* is built on a plan closely similar to that of the posterior outlet and also differs very essentially from the same region of the shell in the Cypræidæ. Like the posterior outlet, it is bounded on the left, or on the side furthest from the extremity, by a spiral funiculum issuing from the interior of the shell, and sometimes closely recalling in general appearance the anterior twisted columellar edge so conspicuously developed in many fully developed shells amongst the Cypræidæ. Only, in the Cypræidæ it is an adult structure built of superadded callus, while in the Ovulidæ it is especially conspicuous in immature shells, or else in species of primitive aspect, like those of the group of *O. marginata* in which it does not become obscured by callus at full-grown stages. The extremely oblique elongate narrow twisted bulge which, in immature specimens of *Cypræa*, is formed by the accretions of the terminal outlet is scarcely recognisable in the immature specimens of *Ovula;* and it is along the inner margin of the zone corresponding to that bulge that the anterior funiculum of the Ovulidæ is developed, nothing of the kind being seen in the immature shells of the Cypræidæ. The steeply twisted bulge often remains more or less visible as an elongated protuberance across the " fossula " of fully developed *Cypræa* shells, and we may then easily observe that it bears no relation whatsoever to the anterior twisted columellar ridge which often cuts across it obliquely in a position which may vary a great deal even amongst specimens of the same species.

Lastly, the radula of *Ovula* differs very conspicuously from all those hitherto observed in the Cypræidæ, this structure, so far as is known, exhibiting much uniformity throughout all the groups generally included within the family Cypræidæ.

Taking all these facts into consideration it seems best to classify *Ovula* separately from the Cypræidæ in a family " Ovulidæ " together with the singular callus-overgrown genus *Calpurnus.*

Ovula has not been met with in rocks older than eocene; but these delicate shells are far less suited to preservation in a fossil condition than the robust Cypræidæ, and, their apparent absence from the mesozoic may be attributable merely to the incompleteness of the available fossil record. Some of the Strombidæ, for instance *Terebellum,* slightly recall *Ovula* in the disposition of the shell, and it is perhaps on the side of the Strombidæ rather than the Cypræidæ that we should seek the relationships of the Ovulidæ.

II.—SYSTEMATIC PORTION.

Family: CYPRÆIDÆ.

Gastropoda in which the fully-formed shell acquires a very uniform ovoid appearance owing to the modified growth of the body-whorl in which the right side becomes more or less inflated and then reflexed in such a manner as to greatly contract the aperture.

The immature stages usually exhibit but little resemblance to the fully formed shell, being more elongate, with a wide aperture, a simple, anteriorly retrocurrent outer lip, with a narrow anterior outlet on the left side of the aperture, the accretions to which form a narrow steeply winding bulge. The spire which is always of small or moderate size frequently becomes concealed in the later stages of growth, while the disposition of the anterior termination becomes always more or less completely disguised in the fully-developed shell.

In addition to the characters depending on the altered mode of growth of the later stages, the outline may also be considerably modified by external accretions of callous matter.

The following table illustrates the scheme of sub-families, genera, sub-genera and sections which it is proposed to adopt.

CYPRÆINÆ.

CYPRÆA .	CYPRÆA	Cypræa.
		Bernayia.
		Mandolina.
		Siphocypræa.
	ADUSTA.	
	CYPRÆOVULA.	
	MONETARIA.	
	EROSARIA . . .	Erosaria.
		Cypræotrivia.

CYPRÆOGEMMULA.		
PUSTULARIA.		
CYPRÆD A	CYPRÆDIA.	
	CYPRÆOGLOBINA.	
	SULCOCYPRÆA.	
EOCYPRÆA.		
TRANSOVULA.		
GISORTIA	GISORTIA . . .	Gisortia.
		Palliocypræa.
	VICETIA.	

TRIVIINÆ.

TRIVIA	TRIVIA.	
	SEMITRIVIA.	
ERATO	ERATO	Erato.
		Eratopsis.
	ERATOTRIVIA.	
PEDICULARIA.		

Sub-Family : CYPRÆINÆ.

Posterior apertural extremity or else both apertural extremities deeply notched.

Genus : CYPRÆA.

Both apertural extremities deeply notched.

Sub-genus : CYPRÆA.

Terminal notches deep and constricted, very sharply defined and relatively very large (larger than in all other sub-genera or sections); spire always more or less projecting, never in a well defined depression; dorsal rim, when present, never denticulated.

Section : CYPRÆA s. str.

Throughout the entire length of the columellar lip there is a longitudinal depression beyond which the apertural crenulations usually extend internally. The columella stands out anteriorly from the base of the penultimate whorl and is terminated by an oblique twisted ridge, these structures enclosing a "fossula" which is always ribbed and often very deep. Spire small usually more or less visible.

Remarks.—All the forms here included in the section *Cypræa s. str.* invariably exhibit an anterior well defined columellar fossula, often very wide and deep, and invariably ribbed. A more or less pronounced longitudinal depression extends internally along the whole length of the columellar lip, and, in all the species of which it has been possible to examine specimens or trustworthy illustrations, the apertural ridges extend internally across or reappear internally beyond this depression; though, in some instances this character may vary considerably amongst individuals of one species. For instance, in *Cypræa tigris*, the internal prolongations, posteriorly to the fossula, may be entirely missing in some specimens, very strongly developed in others.

It has not been possible, in this respect, to ascertain what the exact disposition may be in *C. tessellata* Swains, *C. Barclayi* Reeve, *C. leucodon* Brod., *C. histrio* Meusch., and *C. gemmula* Weink.

1ST DIVISION.

Group of *Cypræa mappa.*

Spire more or less visible, shape oval to subcylindrical, denticulations of columellar lip not extending over the ventral surface or only slightly, extremities not rostrate or only feebly rostrate, marginal callus usually moderately developed, and if at all thickened, its rim moulded to the outline of the dorsal surface, not flattened out transversely; columella denticulate, denticulations extending across the anterior fossula which is well developed.

Remarks.—*Cypræa mauritiana* and *C. tigris* have been separated by Cossmann as a section *Mauritia* Troschel on account of the posterior notch pointing towards the left of the spire instead of towards the right. The character is not constant in either of these species and is observed frequently in other species for instance in *Cypræa mappa*, the genotype of *Cypræa* and cannot therefore be used for generic distinction.

In this group which largely corresponds with *Lyncina* Troschel 1863, I have included all the species of Jousseaume's genus *Vulgusella*, with the exception of *C. pantherina*, here referred to another division. As noticed by Cossmann, *Vulgusella* Jousseaume is synonymous with *Cypræa s. str.* as defined by Lamarck, the genotype, *C. mappa* being the same in either case. The group, as here defined, includes also all the species of Jousseaume's genus *Porcellana* Klein, with the exception of *C. Chemnitzi* Dunk. which I have been unable to trace, and *C. isabella* Linn. (here classified as a *Bernayia*). The present group also includes the totality of Jousseaume's genus *Ponda*, and the solitary species of his genus *Tessellata*. It also includes *C. leporina* Lam., Jousseaume's type of *Basterotia* Bayle (= *Cavicypræa* Cossmann).

2ND DIVISION.

Group of *Cypræa arabica.*

(*Mauritia* Troschel, *Arabica* Jousseaume, *Trona* Jousseaume.)

Spire rather prominent, general shape as in the group of *Cypræa mappa* from which it is distinguished by its flattened ventral callosity forming a more or less pronounced rim to the dorsal surface.

This group is remarkable for containing an assemblage of forms, *C. arabica*, *C. reticulata*, *C. intermedia*, *C. histrio*, which are probably varieties of a single species, but which, nevertheless, possess very definite distinctive characters, while no passage forms have as yet been precisely described or figured. There are, moreover, certain varieties or races which clearly belong to the one or the other of the above-named forms. If all these shells are to be regarded as constituting a single species, the only way of dealing symmetrically with the varieties in question would be to treat them as sub-varieties or races, thereby introducing an awkward element of complexity in the nomenclature. For the sake of convenience, the forms above-mentioned are therefore treated, in the present catalogue, as separate species.

The group, as here defined, includes the totality of Jousseaume's genus *Arabica*, together with *C. Mauritiana*, the solitary species of his genus *Mauxenia*, and also *C. stercoraria* the type of his genus *Trona*. *C. venusta* Sow (= *C. Thatcheri* Cox) referred by Jousseaume to *Trona* is here classified with *Bernayia*. As mentioned by Cossmann, the designation *Mauritia* Troschel claims precedence on *Mauxenia* Jousseaume, but, as already noticed, the degree of obliquity of the posterior notch that has been relied upon to retain this division at least as a section, is too variable a character to be taken into account.

3RD DIVISION.

(*Cypræa s. str. sec.* Jousseaume.)

The forms included in this division are oval or cylindrical. Ventrally they are neither flattened nor expanded. The anterior expansion of the aperture, and the narrow, shallow fossula distinguish them from the forms included in the 1st division, or Group of *Cypræa mappa*. The spire, more or less concealed in the adult, is relatively very elongate.

All the forms included in this division appear to belong to a single species, *Cypræa exanthema* Linnæus. This species was selected by Lamarck, in 1801, as the type of the genus *Cypræa*, in supersession of his choice of *Cypræa mappa*, in 1798. Jousseaume has adhered to Lamarck's second definition, but the matter is of no importance, for the divisions at present under consideration are not entitled even to rank as sections.

4TH DIVISION.

(*Pantherinaria* Sacco.)

Large shells, with the ventral surface flattened, or even concave, the aperture anteriorly expanded, posteriorly somewhat rostrate, and with the crowded folds of the columellar lip extending outward over the ventral surface; spire very small, flat, sunken in a small depression in the adult, or entirely concealed.

The only forms included in this division are *Cypræa pantherina* and its varieties.

Group of *Cypræa mappa*.

1. *Cypræa mappa* Linn.
2. „ *vitellus* Linn. Living throughout the Indo-Pacific region; fossil in the upper Miocene of Java.
3. „ *aurantium* Martyn.
4. „ *carneola* Linn.
5. „ *arenosa* Gray.
6. „ *ventriculus* Lam.
7. „ *tessellata* Swains.
8. „ *sulcidentata* Gray.
9. „ *Barclayi* Reeve.
10. „ *leucodon* Brod.
11. „ *princeps* Gray.

12. *Cypræa prunum* Sow, (incl. *C. Willcoxi* Dall, *C. simplicissima* Martin; *var. nasuta* Sow. incl. *C. Granti* d'Arch.) Lower Miocene of Kachh, Sind, Burma, Java, Florida.
13. „ *minor* Grat. Miocene of Turin. (Identification uncertain.)
14. „ *nivosa* Brod.
15. „ *leporina* Lam. Miocene of Europe.
16. „ *Broderipi* Gray.
17. „ *globosa* Dujardin. Miocene of Europe.
18. „ *melanostoma* Leathes.
19. „ *lynx* Linn.
20. „ *tigris* Linn. Living throughout the Indo-Pacific region, fossil in the upper miocene of Java.
21. „ *testudinaria* Linn.
22. „ *talpa* Linn.
23. „ *exusta* Sow.
24. „ *argus* Linn.
25. „ *apenninensis* Sacco. (Oligocene of Piedmont.) (Systematic position uncertain.)

Group of *Cypræa arabica.*

26. *Cypræa mauritiana* Linn.
27. „ *arabicula* Linn.
28. „ *arabica* Linn.
29. „ *reticulata* Martyn.
30. „ *intermedia* Gray.
31. „ *histrio* Meusch.
32. „ *scurra* Chemn.
33. „ *gemmula* Weink.
34. „ *stercoraria* Linn.

Group of *Cypræa exanthema.*

35. *Cypræa exanthema* Linn (incl. *C. cervus* Linn.) *cum var.*

Group of *Cypræa pantherina.*

36. *Cypræa pantherina* Sol. *cum var.* Living throughout the Indo-Pacific region. Fossil in the upper miocene of Piedmont.

Section: BERNAYIA.

Throughout the greater part of the columellar lip, the crenulations do not extend internally beyond the longitudinal depression. The "fossula" is usually smooth, but is also occasionally ribbed. Spire small, visible or more or less concealed.

Remarks.—Amongst the forms which it is proposed to classify in this section, *C. porcellus* has the fossula ribbed and columella crenulate. The columella is crenulate in the four following species: *C. subexcisa*, *C. subrostrata*, *C. irravadica*, *C. humerosa*, the fossula being smooth or only faintly ribbed in *C. subexcisa*, either smooth or ribbed in *C. irravadica* and *C. subrostrata* and generally ribbed in *C. humerosa*. The two Burmese fossils *C. arakanensis* and *C. singuensis* probably agree in these respects with *C. irravadica*, but the internal characters of the aperture are concealed in all the available specimens. The fossula is either ribbed or smooth, and the columella crenulate or smooth in various specimens in *C. fabagina* and *C. Lanciæ*. The fossula is practically smooth and the columella crenulate in *C. cinerea*, *C. pulchra and C. elongata*. The fossula is smooth and the columella smooth, or in some cases, faintly crenulate in *C. lurida*, *C. media*, *C. Chevallieri*, *C. Junghuni*, *C. pinguis*, *C. Malandainei*. Owing to the inadequacy of the published iconography and descriptions, it has not been possible to ascertain the internal characters of *C. clara*, *C. dominicensis*, *C. dertoflavicula*, *C. spurcoides*, *C. columbaria*, *C. Beyrichi*, *C. alabamensis*, *C. caput-draconis*, *C. Lioyi*, *C. Bayani*, *C. Smithi*, *C. denticulina*, *C. subatomaria* and *C. planodentata*, the systematic position of the four last-named as well as of *C. dertoflavicula* and *spurcoides* being somewhat doubtful. Illustrations of *C. Fultoni* are not available in India. In all the other forms which it is here proposed to include within the group under consideration, the fossula appears to be smooth and the columella smooth or only faintly crenulated.

Since it has been ascertained that a crenulate columella and a ribbed fossula exist in many species undoubtedly belonging to the section *Bernayia* as generally understood, the only distinction from *Cypræa s. str.* rests on the absence of internal prolongations of the apertural denticulations beyond the longitudinal depression along the posterior portion of the columellar lip. This might so readily result from atrophy that it constitutes a very insecure foundation for the establishment of a section. Indeed, we have already noticed that in certain species of *Cypræa s. str.* there occur individuals, apparently fully developed, in which these prolongations are absent, as is frequently observed in *C. tigris*. Nevertheless *Bernayia*, as here understood, includes several groups which are clearly homogeneous, and in all of which one observes a tendency towards a more or less pronounced atrophy of the apertural denticulations, while, throughout the section *Cypræa s. str.* apart from individual aberrations, the complete development of the apertural ridges is carried out with great consistency.

To what extent the various groups included respectively in *Cypræa s. str.* and in *Bernayia* are truly related to one another, remains somewhat uncertain. As above suggested, certain groups of *Bernayia* might merely correspond with certain groups of *Cypræa s. str.*, being made up of such species as show a tendency towards the obliteration of the apertural denticulations. For instance *C. pulchra*, which is generally regarded as a typical *Bernayia* is classified by Melvill next to *C. talpa* which most authors would refer to *Cypræa s. str.*; and it cannot be denied that, except for the difference in the internal development of the denticulations along the columellar lip, they exhibit, superficially at least, a close resemblance.

Whether, therefore, all the groups here classified as *Cypræa s. str.* are really nearer related to one another than to any of the groups classified as *Bernayia*, and *vice versâ*, must remain somewhat doubtful until more is known regarding the anatomy of the animals. In the meanwhile the two sections *Cypræa* and *Bernayia* constitute convenient divisions in the distribution of the numerous species respectively classified under these headings.

In Jousseaume's scheme, *Bernayia* was considered to consist only of fossil forms. Cossmann has shown that the living forms referred by Jousseaume to the genus "*Luria*" cannot be separated from *Bernayia* on the ground of any precise distinction. The present scheme also unites with *Bernayia* Jousseaume's genus *Zoila* consisting of living species which bear the closest relationship to some of the fossil forms referable to *Bernayia*. Cossmann has referred to *Bernayia* a very large number of fossil forms that were unknown to Jousseaume or not taken by him into consideration, and, although the amended section contains a number of recent shells, yet the fossil species greatly predominate over the recent ones, the proportion between living and fossil being therefore the reverse of what is observed in the section *Cypræa s. str.*

5TH DIVISION.

Group of *Cypræa cinerea* (*Luria* Jousseaume, *pars*).

This division includes medium or small oval shells, which agree with the group of *Cypræa mappa* in their general shape, in their denticulated columella, and the presence of a well developed fossula across which the denticulations are frequently continuous. They differ owing to the abrupt cessation of the denticulations against the depression that marks the inner limit of the columellar lip, posteriorly to the fossula. Spire very small, sunken in a depression. The transverse bands of the immature shells remain visible on the dorsal surface of the adult.

6TH DIVISION.

Group of *Cypræa lurida* (*Luria* Jousseaume, *pars*).

Elongate-oval shells resembling some of the more elongate forms of the group of *Cypræa mappa* which they recall owing to the absence of a well developed marginal border, but distinguished by the smoothness of the axial portion of the fossula though the columella is denticulated.

As in the previous division, the denticulations of the columellar lip do not extend internally beyond the depression which abruptly forms its inner limit posteriorly to the fossula. The spire is small, surrounded by a slight depression. In the living species, the extremeties of the shell are invariably marked by four dark spots, two at each end.

7TH DIVISION.

Group of *Cypræa subrostrata.*

The forms included in this group are of small or medium size, elongate, moderately convex, anteriorly tapering, and are characterised by the feeble development of callus on the ventral surface and along the margins. They are all extinct.

If the inclusion of the lower eocene forms *Cypræa prisca*, and *C. exerta* within this assemblage is correct, the group includes the earliest known representatives of the genus *Cypræa*, *C. prisca* being indeed Thanetian. These forms, however, exhibit somewhat generalised features and give rise to some hesitation as to whether they are referable to the sub-genus *Cypræa*, or else to the sub-genus *Cypræovula*, the latter group being precisely marked by somewhat archaic features. Moreover the anteriorly sunken aperture of these forms is not unlike that of certain cretaceous species especially amongst the genus *Eocypræa*. There is reason to believe that the genus *Cypræa* was derived, in late cretaceous times from the same stock as *Eocypræa*, and that, at the commencement of the eocene it diverged into two branches one of more primitive aspect that has survived to the present day in *Cypræovula*, while the other gave rise to *Bernayia*, and, through it, to *Cypræa s. str.* The proximity to the point of divergence of the above-mentioned lower eocene forms such as *C. prisca* and *C. exerta* would therefore account for their ambiguous features.

8th Division.

The shells of this division are primarily characterised by being marginally thickened.

In this division may be included two groups, one, the group of *Cypræa media*, constituted by shells of moderately globose outline, the other, the group of *Cypræa mus*, including extremely broad forms, more or less heart-shaped, and very convex. Amongst the forms belonging to the group of *Cypræa mus*, the marginal thickenings are apt to invade the dorsal surface, and dorsal protuberances may be developed. The group of *Cypræa media*, genotype of *Bernayia*, appears to be entirely fossil.

The group of *C. mus* is undoubtedly derived from that of *C. media*. The earliest forms of oligocene age are without the dorsal prominences frequently observed in *Cypræa mus*. These prominences first appear in later oligocene times. From miocene to recent times, species have been developed both with and without prominences, those of the first type being represented at the present day by *C. mus*, those of the second, by the recent *C. thersites* and *C. decipiens*.

Amongst the species of this group, *C. mus* and *C. leucostoma* have been classified by Jousseaume and by Melvill with the extinct giant cowries of the group *Gisortia* found in the cretaceous and eocene, after which *Gisortia* became extinct in the northern hemisphere.

The resemblance to *Gisortia gisortieusis* resulting from the presence of dorsal protuberances in the recent *C. mus.* and in certain related fossil forms is quite superficial. The apertural characters of *C. mus* and other related forms exactly coincide with those of

Cypræa and bear no resemblance to those of *Gisortia gisortiensis* and other species of *Gisortia.*

9TH DIVISION.

This division contains only the curious *C. Malandainei* Chédeville from the lutecian of the Paris region, a moderately elongate shell which resembles some of the forms of the group of *C. media,* but is distinguished by its flattened ventral surface and the considerable outward extension of the apertural denticulations.

Section : BERNAYIA.

5TH DIVISION.

Group of *Cypræa cinerea.*

37. *C.* (*Bernayia*) *cinerea* Gmel.
38. „ *clara* Gask.

6TH DIVISION.

Group of *Cypræa lurida.*

39. *C.* (*Bernayia*) *lurida* Linn.
40. „ *pulchra* Gray.
41. „ *dominicensis* Gabb. Lower miocene of San Domingo.
42. „ *isabella* Linn.

7TH DIVISION.

Group of *Cypræa subrostrata.*

43. *C.* (*Bernayia*) *exerta* Desh. Lower eocene of the Paris basin (systematic position of this and the two next species somewhat doubtful).
44. „ *Smithi* Aldr. Lower eocene of Alabama and Maryland.
45. „ *prisca* Desh. Thanetian of the Paris basin.
46. „ *subrostrata* Gray (= *C. bartonensis* Edw., *acyensis* de Rainc.) Upper eocene of Barton, of the Paris Basin, of Normandy and of Brittany.

47. *C.* (*Bernayia*) *Haueri* Micht. Miocene of Piedmont.
48. „ *angusta* Fuchs. Oligocene of the Vicentine, Liguria and Aquitaine.
49. „ *Lioyi* Bayan. Middle eocene of the Vicentine.
50. „ *Bayani* Oppenh. Middle eocene of the Vicentine.
51. „ *subphysis* d'Orb. Miocene of Piedmont, Touraine, Vienna.
52. „ *labrosa* Bon. (incl. *C. Davidi* Font.) Pliocene of Piedmont, Liguria and the Rhone valley.

8TH DIVISION.

Group of *Cypræa media.*

53. *C.* (*Bernayia*) *media* Desh. Upper eocene of Paris Basin.
54. „ *Chevallieri* Cossm. Lower eocene of Paris basin.
55. „ *elongata* Brocchi. Pliocene of Piedmont and Emilia.
56. „ *dertoflavicula* Sacco (systematic position uncertain). Tortonian of Piedmont.
57. „ *amygdalum* Brocchi. Miocene of Europe.
58. „ *Lanciæ* Brusina. Later miocene of Vienna, Piedmont, Transylvania.
59. „ *Junghuhni* Mart. Upper miocene of Java.
60. „ *spurcoides* Gabb. Lower miocene of San Domingo.
61. „ *columbaria* Lam. Miocene of Europe.
62. „ *pinguis* Bonelli. Miocene of Piedmont.
63. „ *sublyncoides* d'Orb. Miocene of Aquitaine and Piedmont.
64. „ *porcellus* Brocchi. Pliocene of Piedmont and Emilia.
65. „ *denticulina* Sacco. Oligocene of Liguria. (The systematic position of this species and of the two next ones is provisional.)
66. „ *subatomaria* d'Orb. Miocene of Aquitaine and Piedmont.
67. „ *planodentata* Sacco. Miocene of Piedmont.

Group of *Cypræa mus.*

68. *C.* (*Bernayia*) *subexcisa* Braun (incl. *C. Jenkinsi* d'A. and H., *C. pinguis* Conr. (*non* Bonelli), *C. tumulus* Heilpr., *C. ventripoteus* Cossm.). Oligocene of Europe, India, Florida, Upper eocene of Mississipi, Lower miocene of Sind.
69. „ *Orbignyana* Grat. Older miocene of Aquitaine and Piedmont.
70. „ *chilona* Dall. Loner miocene of Florida.
71. „ *tumescens* Edw. Middle eocene of England.
72. „ *Philippii* Spey. Upper oligocene of Cassel.
73. „ *Beyrichi* Semp. Oligocene of Germany.
74. „ *sphæroides* Conr. (incl. *C. obesa* Desh., *C. excellens* Koen.). Upper eocene of the Paris basin; lower oligocene of Mississipi and North-Germany.
75. „ *angystoma* Desh. Middle eocene of Paris region; (?) lower eocene of Sind.
76. „ *alabamensis* de Greg. Middle eocene of Alabama. (? *C. nuculoides* Aldr. perhaps identical).
77. „ *irravadica* Vred. Oligocene of Burma.
78. „ *arakanansis* Vred. Oligocene of Burma.
79. „ *beberkiriana* Mart. Lower miocene of Java.
80. „ *singuensis* Vred. (Pal. Ind., new ser. Vol. I, part 3, i. Pl. XIX, fig. 11). Upper oligocene of Burma.
81. „ *humerosa* Sow. Lower miocene of western India.
82. „ *caput-viperæ* Mart. Lower miocene of Java.
83. „ *Henikeri* Sow (incl. *C. murisimilis* Mart.; probably *C. ovata* Mart.). Miocene of Java and San Domingo.
84. „ *Blandiana* Vred. Lower miocene of San Domingo.
85. „ *mus*. Linn.
86. „ *carolinensis* Conr. Miocene of Carolina.
87. „ *leucostoma* Gask.
88. „ *decipiens* Smith.
89. „ *thersites* Gask.
90. „ *Scotti* Brod.

91. *C. (Bernayia) caput-draconis* Melv.
92. „ *venusta* Sow.
93. „ *Fultoni* Sow.
94. „ *gendinganensis* Mart.

9TH DIVISION.

95. *C. (Bernayia) Malandainei* Chéd. Middle eocene of the Paris region.

Section : MANDOLINA.

The solitary fossil species included in this division is characterised by an escutcheon shape in dorsal or ventral aspect, with the maximum dorsal elevation quite close to the posterior extremity. The internal characters of the aperture have never been figured, or minutely described, and, in the only specimen at present available in Calcutta, the interior is filled with a hard adhering rocky incrustation which cannot be removed. The species is probably an aberrant form of *Bernayia.*

10TH DIVISION.

96. *C. (Mandolina) gibbosa* Borson. Oligocene and miocene of Europe.

Section : SIPHOCYPRÆA.

This division also includes a single fossil species. The posterior notch is replaced by a spirally disposed hiatus. The internal characters of the columellar lip and columella correspond with those of *Bernayia*, of which this form appears to be an aberrant representative.

11TH DIVISION.

97. *C. (Siphocypræa) problematica* Heilpr. Pliocene of Florida.

Sub-genus : ADUSTA.

Shells of medium or small size in which the "fossula" is feebly developed or absent. Spire small, usually sunken in an apical depression.

Remarks.—The sub-genus, as here interpreted, includes most of the forms classified by Jousseaume in the genera *Zonaria* Jousseaume, *Adusta* Jousseaume, *Erronea* Troschel, *Stolida* Jousseaume, *Cribraria* Jousseaume, *Naria* Gray. Amongst these various designations, *Naria* Gray is anterior to *Adusta.* In Gray's scheme, *Naria* included a solitary species, characterised by the prominence of the more anterior denticulations. As there are not more than two other related species in which a similar feature is observable, it would be inconvenient to extend the name to the large group *Adusta* as here interpreted; for if the grouping here advocated is not adopted, there would thereby arise undesirable fluctuations in the nomenclature.

The designation *Erronea* Troschel is intermediate in date between *Naria* and *Adusta*, but was also originally applicable to so small a group that its extension to the large sub-genus here considered might likewise lead to confusion. Of Jousseaume's own designations, *Zonaria* is printed one page before *Adusta*, but the *Adusta* group, in Jousseaume's scheme, is so much more compact and consistent that this designation seems preferable.

The columella never diverges strongly from the base of the penultimate whorl with which it is often practically continuous. It is always at a short distance from the anterior edge of the columellar lip to which it is parallel. Consequently, the broad spoon-shaped or triangular fossula which characterises *Cypræa s. str.* and various other groups of Cypræidæ is never developed. In its place one generally observes a narrow shallow longitudinal depression which merges posteriorly into the longitudinal internal groove or depression of the columellar lip. In a few instances there is no distinct trace of the columellar depression. The columella is usually, though not invariably crenulate, and the anterior crenulations usually extend across the narrow fossula or columellar depression. There are a few instances in which the depression is smooth in spite of the columella being crenulate, while sometimes the anterior crenulations are so thick and prominent as to entirely obliterate the columellar depression. Posteriorly to the columella, the denticulations often extend internally beyond the longitudinal internal groove or depression of the columellar lip.

The fossula is entirely absent or quite rudimentary, the columella smooth or nearly smooth, and there are no internal prolongations of the crenulations along the columellar lip in the following species: *C. spadicea, undata, pirum, pallida, picta, Sowerbyi.* In *C. Cumingi*, the fossula is smooth and there are no inner prolongations of the crenulations posteriorly to the columella, though the columella itself is crenulated. In *C. ziczac* and *Goodalli*, the fossula is smooth or nearly smooth, but the columella is crenulated and there are internal prolongations of the crenulations posteriorly to the columella. The columella is crenulate and the fossula ribbed, but the inner prolongations of the crenulations are wanting or indistinct posteriorly to the level of the columella in the following species: *C. pulchella, utriculata, microdon, xanthodon, punctulata fabula, cruenta.* The fossula is nearly or completely obliterated by the strong development of the anterior ridges, though the inner prolongations of the crenulations, posteriorly to the columella, are feeble or absent in the following forms: *C. Walkeri, errones, ursellus, irrorata.*

The columella is crenulate, but, in the absence of actual specimens it has not been possible to ascertain whether the crenulations are internally prolonged posteriorly to the columella in the following species: *C. zonata, erythrœensis, gracilis, Gaskoini.*

Lastly, it has been impossible, from the available descriptions and illustrations to ascertain the exact disposition of the internal apertural characters in the following six species: *C. sanguinolenta, Hungerfordi, Adelinœ, Saulœ, Rashleighana, Coxeni.*

In all the other species which it is proposed to unite with *Adusta,* the columellar depression is ribbed, the columella is crenulated, and the crenulations of the columellar lip are produced internally posteriorly to the columella; but there are considerable variations in the degree of development or distinctness of these various features, which often constitute excellent specific characters.

12TH DIVISION.

Group of *Cyprœa onyx.*

Medium to small, elongate pear-shaped; spire small and sunken. The columella is close to the columellar lip, and the anterior twist is steep so that there is no properly developed fossula. Columella either crenulate or smooth. The crenulations of the columellar lip are apt to reappear in the interior of the shell.

The group, as here interpreted, includes the totality of Jousseaume's genus *Adusta* with the exception of *C. contaminata* and *C. pallida,* both of which, in the present scheme, are also classified under *Adusta,* but in other groups.

13TH DIVISION.

Group of *Cypræa fimbriata.*

The somewhat more ovoid shape and the minute dimensions distinguish this group from that of *C. onyx.* In outline they are somewhat intermediate between the pear-shaped forms of the group of *C. onyx* and the cylindrical shells of the group of *C. stolida.*

14TH DIVISION.

Group of *Cypræa stolida.*

Elongate sub-cylindrical, small spire in a depression; columella denticulate; denticulations of the columellar lip extending into the interior of the shell; the marginal callus forms a rim to the dorsal surface, especially on the right side; the apertural denticulations may extend over the whole width of the ventral surface and as far as the edge of the dorsal rim, or at least reappear as dorsal crenulations along the edge of the dorsal rim, at least on the right side. The terminal extensions of the marginal callus form a distinct rim round the terminal apertural notches.

The extremities each carry a pair of dark spots.

From the shells here classified in the group of *C. onyx,* those of the present group are principally distinguished by their more cylindrical shape.

This group coincides principally with Jousseaume's genus *Stolida.* With respect to *C. punctata,* here included in the group, some confusion must have crept into Jousseaume's lists as it is twice repeated, once under *Zonaria* and once under *Cribraria.*

15TH DIVISION.

Group of *Cypræa errones.*

Shape sub-cylindrical to broadly oval. Spire sunken. The rims round the small terminal notches, especially round the posterior one, are less sharply defined than in the group of *Cypræa stolida;* the inner furrow of the columellar lip is less distinct, the denticulations do not spread externally to the same extent, the four terminal spots are usually present.

16TH DIVISION.

Group of *Cypræa irrorata.*

Small, more or less elongate, ovoid, spire small and flat, but not surrounded by a depression.

There is no fossula in consequence of the peculiar disposition of the edge of the columellar lip which, in an anterior direction sinks inward in such a way as to coalesce with the anterior edge of the columella. Four terminal spots are present as in the preceding groups.

This group corresponds with the genus *Naria* Gray as interpreted by Jousseaume.

17TH DIVISION.

Group of *Cypræa teres.*

The forms of this group resemble those of the group of *C. errones* but are distinguished by the more extended callus which disguises the terminal spots at the adult stage.

18TH DIVISION.

Group of *Cypræa caurica.*

Callous border more exaggerated than in the group of *C. teres*, and more or less gibbous or tumefied.

This group includes two species, *C. cruenta* and *C. caurica.* which form a link between the group of *C. teres* and the sub-genus *Erosaria.*

They are remarkable for their powerful denticulations especially on the outer lip. The internal furrow is distinct though shallow in *C. cruenta.* In *C. caurica* it is almost obliterated by the prominence of the denticulations.

19TH DIVISION.

Group of *Cypræa cribraria.*

Small shells sharply bordered on the right, dorsal rim denti culated; ribbed internal groove; sunken spire.

These shells show an approach towards the sub-genus *Erosaria. Cypræa cribraria* is distinguished from most species of *Erosaria* by the presence of internal prolongations to the apertural denticulations throughout the entire length of the columellar lip, a feature very seldom observed in *Erosaria*. In *C. Cumingi* these internal prolongations are not developed posteriorly to the columella proper. If we rely upon this character alone, *C. Cumingi* might therefore be classified with *Erosaria* as well as with *Adusta*; nevertheless, it is, in many respects, so closely related to *C. cribraria* that its inclusion in the same group seems well-founded. Similarly, although it has not been possible to ascertain fully the internal characters of *C. Coxeni* and *C. Gaskoini*, their resemblance to *C. cribraria* has prompted their classification next to that species rather than in *Erosaria*, the very homogeneous aspect of which they would impair by their somewhat different facies.

Further information concerning the radula or the anatomy of these forms would probably remove these uncertainties of classification.

It may be mentioned that the pale spots usually seen on the dorsal surface of the shells of the *Cribraria* group are caused by the resorption of patches of a thin dark layer, while the dorsal spots of *Erosaria*, on the contrary, originate from a discontinuous superficial layer deposited in patches.

All the forms here included in the group of *C. cribraria* are classified by Jousseaume in his genus *Cribraria*.

Sub-genus: ADUSTA.

12TH DIVISION.

Group of *Cypræa onyx*.

98. *C.* (*Adusta*) *onyx* Linn.
99. „ *spadicea* Swains.
100. „ *lutea* Gronov.
101. „ *asellus* Linn.
102. „ *lentiginosa* Gray.
103. „ *zonata* Chemn.
104. „ *sanguinolenta* Gmel.
105. „ *piriformis* Gray. (*C. sondeiana* Mart., fossil in the pliocene of Java, is probably identical.)
106. „ *Walkeri* Gray.
107. „ *pulchella* Swains.
108. „ *subviridis* Reeve.

109. *C.* (*Adusta*) *undata* Lam.
110. „ *ziczac* Linn.
111. „ *clandestina* Linn.
112. „ *pirum* Gmel.
113. „ *utriculata* Lam. Living in the Mediterranean; fossil in the upper miocene and pliocene of Piedmont, and in the pliocene of Piedmont, the Vicentine and the Alpes Maritimes.
114. „ *Hungerfordi* Sow.

13TH DIVISION.

Group of *Cypræa fimbriata.*

115. *C.* (*Adusta*) *fimbriata* Gmel.
116. „ *macula* Ad.
117. „ *microdon* Gray.
118. „ *contaminata* Gray.
119. „ *Goodalli* Gray.
120. „ *Adelinæ* Rob.

14TH DIVISION.

Group of *Cypræa stolida.*

121. *C.* (*Adusta*) *stolida* Linn.
122. „ *erythræensis* Beck.
123. „ *hirundo* Linn.
124. „ *neglecta* Sow.
125. „ *coffea* Sow.
126. „ *Oweni* Gray.
127. „ *insculpta* Mart. Fossil in Java, probably pliocene.
128. „ *punctata* Linn.
129. „ *gracilis* Gask.
130. „ *Saulæ* Gask.
131. „ *quadrimaculata* Gray.
132. „ *cylindrica* Born. (incl. *C. subcylindrica* Sow.).
133. „ *cincta* Mart. Lower miocene of Java.

15TH DIVISION.

Group of *Cypræa errones.*

134. *C.* (*Adusta*) *errones* Linn.
135. „ *pallida* Gray.
136. „ *xanthodon* Gray.
137. „ *punctulata* Gray.
138. „ *nigropunctata* Gray.
139. „ *picta* Gray.
140. „ *Sowerbyi* Kien.

16TH DIVISION.

Group of *Cypræa irrorata.*

141. *C.* (*Adusta*) *ursellus* Gmel.
142. „ *fabula* Kien.
143. „ *irrorata* Sol.

17TH DIVISION.

Group of *Cypræa teres.*

144. *C.* (*Adusta*) *teres* Gmel.
145. „ *Rashleighana* Melv.
146. „ *interrupta* Gray.
147. „ *rhinoceros* Souv.

18TH DIVISION.

Group of *Cypræa caurica.*

148. *C.* (*Adusta*) *caurica* Linn.
149. „ *cruenta* Linn.

19TH DIVISION.

Group of *Cypræa cribraria.*

150. *C.* (*Adusta*) *cribraria* Linn.
151. „ *Coxeni* Cox.
152. „ *Gaskoini* Reeve.
153. „ *Cumingi* Gray.

Sub-genus: CYPRÆOVULA.

The chief characteristic is the feeble development of the terminal notches, which are nevertheless distinct. The columella is denticulate. Superficial callus feebly developed.

Remarks.—Owing principally to the feeble development of callus and of the uppermost final porcellaneous layer, the species here included within this group curiously resemble immature specimens of Cypræidæ of other groups, principally those of the section *Cypræa s. str.* To this fact is largely due the persistence of a more or less distinct spiral or reticulated sculpture in the adults of many species; such spiral ornaments being frequently observed on the immature shells of various groups of Cypræidæ, though less frequently in *Cypræa s. str.* than in certain other groups. It is particularly interesting to observe that, in *C. Adamsoni*, a species particularly noticeable for its pronounced spiral sculpture, there occur specimens in which a superficial final coating of porcellaneous substance has almost obliterated the spiral markings.

In accordance probably with the immature facies of the shells of this group, the internal apertural characters are exceedingly variable; the fossula being occasionally very large, strongly ribbed, the columella crenulate, and the denticulations prolonged internally in the manner of a *Cypræa s. str.* as in *C. pulicaria;* while in other instances the development is much less complete and recalls various dispositions observed in *Bernayia* or *Adusta.*

Information regarding the internal apertural characters is not available for the following forms: *C. Archeri, C. Jonesiana, C. pirulata, C. ampullacea, C. subpirulata, C. brachypyga, C. eratoformis.*

Amongst other species, the majority have a distinct fossula which, nevertheless, becomes small or even rudimentary in *C. algoensis, C. fuscodentata, C. similis, C. edentula.* The fossula is indistinct in *C. capensis* and *C. amphithales* and is said to be missing in *C. Dalli. Cypræa subsidua* has a large fossula, but there is no information as to whether it is smooth or ribbed. In *Cypræa Adamsoni*, both the columella and the well-developed fossula are smooth. In the four species already alluded to, namely *C. algoensis, C. fuscodentata, C. similis, C. edentula,* the fossula is either feebly ribbed or smooth, the columella either smooth or feebly crenulate; these characters varying amongst different specimens of one species. The indistinctness of the fossula in *C. capensis* and *C. amphithales* is due to the absence of a well marked apertural edge to the anterior part of the columellar lip, but in both these species, the columella is crenulate. In all the other species regarding which information is available, namely *C. contusa*, *C. Reevei*, *C. angustata*, *C. piperita*, *C. pulicaria*, *C. squalena*, *C. parallela*, the fossula, in the adult stage, is always distinctly ribbed and the columella distinctly crenulate. As regards the presence or absence of internal prolongations to the denticulations of the columellar lip posteriorly to the columella, there is no available information with regard to *C. squalena* and *C. parallela*. The internal prolongations are well developed in *C. pulicaria*, they are absent in all the other species above alluded to.

The Australian Tertiary form *C. contusa* M. Coy, together with a number of other Australian tertiary species, has been classified by Cossmann separately from the group of *C. algoensis* in a section *Austrocypræa*, on account of the ribbed columellar fossula exhibited by these fossils. From the above enumeration it will be observed that this feature is too variable amongst both the living and fossil forms to be taken into account as a sectional character.

It has not been possible to sub-divide this sub-genus into sharply defined groups. It may be treated therefore as a single division.

NOTE.—The sub-genus as here interpreted includes both *C. capensis* and *C. algœnsis*, the genotypes respectively of Gray's genera *Cypræovula* and *Luponia*, and it is necessary therefore to decide upon a choice between these designations.

In the introductory part of his great "Monograph of the Cypræidæ," it was Gray's original intention, in 1824, to include in the Cypræidæ three genera, which he named *Cypræa*, *Cypræovula*, and *Ovula*, without designating any types. The genus *Cypræovula* was founded chiefly upon the very subsidiary character of the absence of denticulations along the columellar lip (Zool. Jour., Vol. I, p. 75).

Four years later (Vol. III, p. 574), Gray withdrew the genus *Cypræovula* and re-united it with *Cypræa*, informing us at the same time that the type was to have been *Cypræa capensis*. Indeed the sentence is worded in such a manner as to convey the impression that *C. capensis* was to have been the only member of the proposed genus: "When I commenced this Monograph, I intended to have separated this species from the other Cowries, as a distinct genus, under the name *Cypræovula* (Zool. Journal, i, 75)." While thus re-uniting *C. capensis* with the genus *Cypræa*, Gray very appropriately commented upon its extremely close relationship with *C. algoensis*. Gray's revised opinion of 1828, was very soon once more retracted; nevertheless it has been adhered to by the great majority of naturalists, and it is generally admitted that *Cypræa capensis* does not exhibit any characters that would justify its generic separation from *Cypræa* though it may constitute the type of a sub-genus. At all events the establishment of *C. capensis* as genotype of *Cypræovula* is amply authenticated, if not with the date 1824, at least with the date 1828, and, as *C. algoensis* undoubtedly belongs to the same group, we are definitely spared from making use of the hideous name "*Luponia*" which Gray, in 1832, selected for a new genus, with *C. algoensis* as the type, and which various authors have inflicted upon numerous shells, many of which are objects of rare elegance.

It may be mentioned that Melvill's discovery of *C. amphithales* irrevocably defeats all possibility of separating *Cypræovula* and *Luponia* even as distinct sections.

154. C. (*Cypræovula*) *contusa* McCoy. Eocene of Australia.
155. " *angustata* Gmel.
156. " *piperita* Sol. (incl. *C bicolor* Gask.) (specific distinctness from *C. angustata* not well established).
157. " *Reevei*, Gray.
158. " *squalena* Tate. Upper eocene of Australia.
159. " *parallela* Tate. Upper eocene of Australia.
160. " *Archeri* T.-Woods. Upper eocene of Tasmania.
161. " *subsidua* Tate. Upper eocene of Australia.
162. " *Jonesiana* Tate. Miocene and pliocene of Australia.
163. " *pirulata* Tate. Upper eocene of Australia.
164. " *ampullacea* Tate. Eocene of Australia.
165. " *subpirulata* Tate. Upper eocene of Australia.
166. " *brachypyga* Tate. Upper eocene of Australia.
167. " *pulicaria* Reeve.
168. " *algoensis* Gray.
169. " *fuscodentata* Gray.
170. " *similis* Gray.
171. " *edentula* Sow.
172. " *capensis* Gray.
173. " *amphithales* Melv.

174. *C.* (*Cypræovula*) *Adamsoni* Gray.
175. „ *eratoformis* H. and A. Miocene of Transylvania.
176. „ *corbuloides* Bell. Upper eocene of Nice.
177. „ *Dalli* Aldrich. Upper eocene of Mississipi.

Sub-genus: MONETARIA.

Small-medium. Ventrally flattened and sub-symmetrical. Interior longitudinal groove along columellar lip feeble or absent. The marginal swelling forms a continuous rim round the dorsal surface, broader than in *Erosaria* and not crenulated. The small spire is quite flat and is entirely concealed when the specimens are adult.

21ST DIVISION.

Group of *Cypræa moneta.*

The shells of this group are distinguished by the complete absence of denticulations along the columella. Colours pale.

In this group I have ventured provisionally to classify the eocene fossil *C. Ceciliæ*, the type of *Cypropterina* de Gregorio, as the available figures and descriptions do not reveal any precise differential characters. Cossmann has retained the division as a section owing to the absence of dorsal protuberances. These protuberances which usually characterise *C. moneta* are not seen in other species of the sub-genus and cannot therefore be regarded as characters of more than specific value.

22ND DIVISION.

In this division, the columella is slightly denticulate. The colours are vivid and dark, of various tinges of brown, associated with white.

This division includes only one species. *C. caput-serpentis.*

Sub-genus: MONETARIA.

21ST DIVISION.

Group of *Cypræa moneta.*

178. *C.* (*Monetaria*) *moneta* Linn.
179. „ *obvallata* Lam.

180. *C.* (*Monetaria*) *annulus* Linn. Living throughout the Indo-Pacific region; fossil in the miocene of Java.

181. ,, *Ceciliæ* de Grag. Middle eocene of the Vicentine.

22nd DIVISION.

182. *C.* (*Monetaria*) *caput-serpentis* Linn.

Sub-genus: EROSARIA.

Small to fairly large-medium. Somewhat pear-shaped, broad to moderately elongate. More or less flattened ventrally. Spire small, often surrounded by a groove in the adult shell. The callous thickening of the ventral surface does not extend to any distance over the dorsal surface round which, therefore, it forms a rim surrounding the entire margin of the shell, even round the terminal notches, dorsally fimbriated with denticulations which may coincide with the apertural denticulations, or else are more crowded. The fossula is narrow and often feebly developed. The apertural denticulations are often expanded externally over a considerable extent of the ventral surface.

The surface of the adult is frequently ornamented with pale spots which may be ocellated. Immature shells in which the final callous thickening is not yet fully developed, are undistinguishable from *Cypræovula.*

For the sake of convenience in the enumeration of the species, they may be distributed into four groups, namely those of *C. spurca*, *C. ocellata*, *C. Lamarcki*, and *C. erosa*, of which, however, only the one last-named is at all sharply demarcated.

Remarks.—In some of its internal apertural features this group is fairly consistent. Posteriorly to the level of the columella there are never any distinct internal prolongations of the denticulations along the columellar lip, except in *C. nucleus*. The columella is usually close to the apertural edge of the columellar lip so that the fossula is usually reduced to a narrow elongate depression and may even be rudimentary or absent. The species in which the fossula is most conspicuously developed are *C. polita*, *C. staphylæa* and *C. nucleus*. In the majority of instances, the fossula is ribbed and the columella crenulate. In *C. gangranosa*, the very narrow fossula is practically obliterated by the strongly developed prominent ridges. In *C. Beckii* and *C. margarita*, the fossula, though well developed, is smooth, and the columella crenulate. The fossula is rudimentary though the columella is crenulate in *C. ocellata*, *C. miliaris*, *C. eburnea*, *C. guttata*. The fossula is rudimentary or absent and the columella obscurely crenulate or quite smooth in the following species: *C. turdus*, *C. pustulata*; the same apparently being the case with *C. bicallosa*, *C. Listeri* and *C. citrina* so far as can be judged from available illustrations.

Section: EROSARIA.

Surface surrounding the aperture not sunken; anterior termination not abruptly constricted (characters which distinguish *Erosaria s. str.* from the section *Cypræotrivia*).

The group, as here defined, includes all the species classified by Jousseaume in *Erosaria*, with the exception of *C. caput-serpentis* here referred to *Monetaria* and the somewhat uncertain *C. Macandrei* Sow. It also includes the forms constituting Jousseaume's genera *Staphylæa* and *Nuclearia*. *C. limacina* which bears the closest relationship to *C. staphylæa*, the genotype of Jousseaume's genus *Staphylæa* is so closely related to *C. erosa*, the genotype of *Erosaria* as to give rise frequently to some hesitation in the identification of certain specimens; while several authors regard it as a mere variety of *C. staphylæa*. Obviously neither a generic nor even a sectional distinction can be attempted where even the specific differences are so feebly marked.

Neither can *Nuclearia* be separated even as a section. The dorsal pustules observed in *C. nucleus* and several related species, are merely exaggerations of the typical dorsal spots of the species belonging to the group of *C. erosa*, while the transverse dorsal ridges are nothing but extensions of the marginal dorsal crenulations. *C. staphylæa* with dorsal pustules is very closely related, on the one hand, to *C. nucleus* with pustules and ridges, type of *Nuclearia*, and on the other hand to *C. limacina*, with smooth dorsal surface, which, as already observed, many authors regard as specifically identical; while the close relationship between *C. limacina* itself and *C. erosa* has also been alluded to. It is obvious that the type-species of *Erosaria* and *Nuclearia* cannot be placed in separate sections, and that the section *Nuclearia* must be dispensed with.

23RD DIVISION.

Group of *Cypræa spurca.*

This division which may be distinguished as the group of *Cypræa spurca* includes small to medium shells with the dorsal marginal rim feebly prominent. They are usually of various shades of brown, and spotted.

24TH DIVISION.

Group of *Cypræa ocellata.*

The shells of this division which may be distinguished as the group of *Cypræa ocellata* are of medium size and have a broad margin and a flattened sub-symmetrical ventral surface. The living species are bright-coloured.

25TH DIVISION.

Group of *Cypræa Lamarcki.*

The shells constituting this division which may be distinguished as the group of *Cypræa Lamarcki* are fairly large, more pear-shaped than those of the *C. ocellata* group, with the margin more or less expanded.

26TH DIVISION.

Group of *Cypræa erosa.*

The shells of this division are of small or medium to fairly large size, characterised by the extremely pronounced development of the marginal thickening on the right side, which may be carried to such an extent as to give a sub-symmetrical shape to the shell. The dorsal spots consist of patches of superadded callus frequently so thickened as to form raised granules.

Section : CYPRÆOTRIVIA.

Small to medium, pear-shaped, almost symmetrical, dorsal surface margined on both sides, ventral surface sloping inwards from both sides towards the deeply inset narrow aperture terminated posteriorly by a small notch, while the anterior extremity is either very feebly notched or merely truncated, or else the enclosing rim may even exhibit a convex appearance in a dorsal or ventral view. There is often a median dorsal groove. The apertural ridges may be continued over the dorsal surface which may also carry granules.

The forms which it is proposed to include within the above-defined group so seriously impair the homogeneousness of any other group with which we may attempt to associate them that they may perhaps be more conveniently classified in a separate section. The anterior snout-like contraction of the shell and the sunken aperture differentiate these forms from such species, here grouped with *Erosaria*, as show a pronounced approach to symmetery, such as *C. nucleus*. The structure of the anterior apertural termination is the exact opposite of that which characterises *Pustularia*, in which the anterior termination, viewed dorsally or ventrally, instead of truncated or convex, appears deeply and narrowly concave in consequence of the extensions of the apertural lips. The forms under consideration are also less spherical than *Pustularia*.

The proposed group ranges through the eocene, oligocene and miocene, being represented by different species in each of these periods.[1]

Most of these forms appear to have a well developed fossula usually ribbed. It is said to be smooth in *C. Duclosiana* and rudimentary in *C. Recluzi*.

Of the two species included by Jousseaume in his genus *Jenneria*, *Cypræa pustulata*, the genotype, is a typical *Erosaria*; the second species being *C. Duclosiana* which may be taken as the type of the section here proposed. Sacco has retained the generic name *Jenneria* in which he includes *C. pustulata* which is a typical form of *Erosaria*, and *C. læviapenninica*, and *C. Duclosiana*. The use of the designation *Jenneria* for the group at present under consideration would so alter its original meaning as to lead to confusion. Under the circumstances it has been considered best to establish a new designation, provisionally at least, until it can be ascertained whether *C. parvulorbis* the type of de Gregorio's *Cypræoglobina* may not also belong to the group at present under consideration.

[1] There is reason to suspect that the group under consideration includes *C. parvulorbis* de Gregorio, specimens and descriptions of which are not available in India, which constitutes the type of de Gregorio's genus *Cypræoglobina*. In this case, the group here defined as *Cypræotrivia* would naturally become *Cypræoglobina*, while *Cypræoglobina* as understood in the present work, would resume the designation *Luponovula* Sacco.

Sub-genus : EROSARIA.

Section : EROSARIA.

23RD DIVISION.

Group of *Cypræa spurca.*

183. *C.* (*Erosaria*) *cernica* Sow.
184. „ *poraria* Linn.
185. „ *gangranosa* Sol.
186. „ *flaveola* Linn.
187. „ *spurca* Linn.
188. „ *Antillarum* Vred. (= *C. spurca* L. *sec.* Gabb, Trans. Am. Phil. Soc. Philad., n. s. Vol. XV, p. 235). Lower miocene of San Domingo.
189. „ *bicallosa* Gray.
190. „ *Thomasi* Crosse.
191. „ *Listeri* Gray.
192. „ *albuginosa* Mawe.
193. „ *Beckii* Gask.
194. „ *Martini* Schepm. Pleistocene of Celebes.
195. „ *margarita* Sol.

24TH DIVISION.

Group of *Cypræa ocellata.*

196. *C.* (*Erosaria*) *helvola* Linn.
197. „ *citrina* Gray.
198. „ *ocellata* Linn.

25TH DIVISION.

Group of *Cypræa Lamarcki.*

199. *C.* (*Erosaria*) *Lamarcki* Gray.
200. „ *miliaris* Gask.
201. „ *eburnea* Barnes.
202. „ *guttata* Gray.
203. „ *turdus* Lam.

26TH DIVISION.

Group of *Cypræa erosa.*

204\. *C.* (*Erosaria*) *erosa* Linn. *cum var.* Living throughout the Indo-Pacific region; fossil in the upper miocene and pliocene of Java and Sumatra, and the pleistocene of Obock.

205\. ,, *limacina* Lam.

206\. ,, *polita* Rob.

207\. ,, *staphylæa* Linn.

208\. ,, *gampingensis* Mart. Probably miocene. Java.

209\. ,, *sindiensis* Vred. Oligocene of Sind.

210\. ,, *nucleus* Linn.

211\. ,, *Woodwardi* Vred. (Geol. Mag., Dec. 2, Vol. VI, Pl. XIII, fig. 7). Miocene of Nias.

212\. ,, *madagascarensis* Gmel.

213\. ,, *pustulata* Lam.

214\. ,, *Gabbiana* Guppy. Lower miocene of San Domingo.

Section: CYPRÆOTRIVIA.

27TH DIVISION.

215\. *C.* (*Cypræotrivia*) *Recluzi* Cailliaud. Upper eocene of Britanny.

216\. ,, *pulliensis* Oppenh. Middle eocene of the Vicentine.

217\. ,, *pisularis de* Greg. Middle eocene of the Vicentine. The exact systematic position of this shell and of the following one is doubtful.

218\. ,, *Zignoi* Oppenh. Middle eocene of the Vicentine.

219\. ,, *Oppenheimi* Vred. (Mem. Geol. Surv. Ind. Vol. XXVII, Pl. V, fig. 12).

220\. ,, *læviæapenninica* Sacc. Oligocene of Liguria and Venetia.

221. *C.* (*Cypræotrivia*) *Duclosiana* Bast. Miocene of Aquitaine, Piedmont, Vienna, Hungary.
222. „ *Neugeboreni* H. and A. Miocene of Hungary.
223. „ *Everwijni* Mart. Upper miocene of Java.
224. „ *obolus* Oppenh. (systematic position doubtful). Upper eocene of the Priabona region.

Genus : CYPRÆOGEMMULA.

Exceedingly small, ovoid and posteriorly somewhat ovoid, with visible spire. Dorsal surface entirely ornamented with granulated transverse ribs of various alternating sizes, which, just as in *Cyprædia*, belong to the proper dorsal shell-wall, and do not represent prolongations of the apertural crenulations. Ventral surface unsymmetrical, rather sunken anteriorly, sharply margined by a pronounced angulated rim. Aperture narrow, nearly straight, terminated at each end by a small constricted somewhat tubular canal. The posterior terminations of the apertural lips project in such a manner as to communicate a deeply notched appearance to the dorsal aspect of the posterior apertural outlet. Apertural ridges extending outward over the whole width of the ventral surface.

It has been thought advisable to establish this genus for *Trivia scabriuscula* von Koenen, as it is impossible to fit this extraordinary little shell in any hitherto recognised division of the Cypræidæ. It probably comes nearest to *Pustularia* of which it perhaps represents an ancestral form.

I. *Cypræogemmula scabriuscula* Koen. Oligocene of Lattorf.

Genus : PUSUTLARIA.

Small, dorsally globular, ventrally somewhat flattened, practically symmetrical with respect to the right and left halves of the shell, as also with reference to a plane perpendicular to the axis. Extremities produced into small narrow canals. Aperture linear; columella always terminated by a prominent internal oblique ridge anteriorly limiting a well-defined fossula. The columella is always smooth in *P. annulata*, usually crenulate in every one of the other species.

The genus is not known in a fossil condition.

1. *Pustularia cicercula* Linn.

2. *Pustularia globulus* Linn.
3. ,, *Childreni* Gray.
4. ,, *annulata* Gray.

Genus: CYPRÆDIA.

Globose or ovoid shells small medium to large, in which the apex becomes involute in the later stages of growth.

Sub-genus: CYPRÆDIA.

This sub-genus is characterised by the persistence of spiral ornaments at the adult stage. Certain forms of Eocypræa are spirally ornamented even in the adult stage, thereby resembling *Cyprædia.*

The proportions are usually more symmetrically attenuated towards both extremities in *Cyprædia* than in *Eocypræa*, the maximum diameter occupying a less posterior position in *Cyprædia* than in *Eocypræa;* moreover, the maximum diameter, in *Cyprædia*, is, at the same time, the region of maximum curvature, so that the general outline tends to assume a spindle-shape instead of the more evenly globose or ovoid shape of *Eocypræa*, the apical portion, in particular, acquiring thereby somewhat more of a conical instead of spherical disposition in *Cyprædia* than in *Eocypræa.*

The columellar lip is internally bordered by a narrow longitudinal furrow, across which the denticulations may internally reappear. This furrow does not exhibit any tendency to expand at its anterior termination where it may even be entirely obliterated by the strong development of the more anterior denticulations. When the furrow is not anteriorly obliterated, the columella is denticulate.

At later stages of growth the apex is completely involute, though the umbilical funnel thereby produced is usually visible only in internal casts, as, when the shell is complete, it is concealed by the termination of the outer lip. In the two species of which the embryonic shell has been described, *C. sulcosa* Lam. (Pezant, 1910, Coq. foss. Parnes, p. 24, Pl. XIV, fig. 14), from the middle and upper eocene of the Paris basin, and *C. conigera* Martin (Samml. d. geol. Reichsmus, in Leiden, n. F., Vol. II, H. 4, p. 156, Pl. V, fig. 121) from the upper eocene of Java, it has the shape of a steep minute cone, in which the smooth protoconch is succeeded by two or three whorls carrying two sets of oblique raised lines intersecting one another in "engine-turned" fashion, succeeded by another whorl decorated with a trellis of square meshes of axial and transverse raised lines, the final type of sculpture such as characterises the full-grown shell, being first assumed only with the fifth or sixth whorl after the nucleus. The published illustrations of *C. conigera* clearly show how, as soon as the adult character of sculpture is established, the suture, which hitherto had exhibited a normally anteriorly oblique trend in a forward direction, becomes posteriorly oblique, thus initiating the involute disposition of the apex characterising the later whorls. Even in a form apically so flattened in the adult stage as *C. elegans*, Cossmann has observed that the embryonic shell has a conical spire (Mollusques éocéniques de la Loire-Inférieure, Vol. I, p. 152).[1]

In addition to the forms enumerated below, it is also possible that *Cypræa denseplicata* Boettg. (Tertiärform. v. Sumatra, Th. 1, in Pal. Suppl. III, p. 77, Pl. VI, fig. 5), from the upper eocene of Sumatra, may also belong to the *sulcosa* group of this sub-genus, but it is founded on material too imperfect for a secure determination.

There is some doubt as to the correct generic attribution of the Javanese *Cyprædia Feuilletaui* Martin (1912, Samml. d. geol. R. M. in Leiden ser., 1, Vol. IX, p. 134, Pl. IX, fig. 1), presumably miocene, the apex of which is undescribed and the aperture concealed; perhaps might it be an immature stage of *Cypræa* (*Erosaria*) *gampingensis* Mart. from the same locality Gunung Gamping near Djokdjokarta.

The species included in this division may be arranged into two groups: one of relatively broad shells, including *C. elegans* and *C. alveolinarum;* and a second group of more elongate, almond-shaped shells, including *C. sulcosa, C. interposita, C. Sophiæ. C. metingenis, C. conigera,* and *C. birmanica* which is perhaps identical with *C. conigera.*

Cyprædia is almost entirely restricted to the eocene, though in America one species, *C. fenestralis,* survived from the upper eocene into the oligocene.

Group of *Cyprædia elegans.*

Shape relatively globose, posterior terminal portion of outer lip almost transverse to the axis.

1. The conical spire of the Javanese shell has been regarded by Martin as a character distinguishing it from all other species of *Cyprædia.* It is obvious, however, that the solitary type, the maximum restored length of which does not reach 8 mm. is an immature specimen, this dimension being greatly inferior to that of all other *Cyprædia* species; a conclusion further confirmed by Pezant's observations on the immature stages of the rather large *C. sulcosa,* in which the embryonic shell corresponds in size and shape with that of *C. conigera.*

Group of *Cyprædia sulcosa.*

In the shells of this group, the most posteriorly situated portion of the outer lip meets the axis at an angle of considerably less than 90° instead of being disposed transversely or nearly transversely as in the shells belonging to the group of *C. elegans.*

Sub-genus: CYPRÆOGLOBINA.

Large ovate shells, with a more or less concealed umbilicated apex in place of a spire, with usually a relatively broader anterior extremity than *Eocypræa*, and with crenulated columella, terminated anteriorly by a prominent twisted rib which is disposed more transversely than the steeper corresponding portion in *Eocypræa.*

NOTE.—De Gregorio's work on the fauna of San Giovanni Ilarione not being available in India, it is impossible to form any opinion as to the merits of *Cypræoglobina* as originally defined in 1880. The fact that de Gregorio's type *C. parvulorbis* is a small shell casts a very serious doubt upon its belonging to the group *Cypræoglobina* as re-defined by Cossmann in 1903, and if it should prove to belong to some other division, precedence would belong to *Luponovula*, with *C. Proserpinæ* for its type, as established in 1894 by Sacco who totally discarded de Gregorio's *Cypræoglobina* on the plea that it is made up of a heterogeneous assortment of shells belonging to various groups. Sacco has included only three species in *Luponovula*: *C. Proserpinæ*, *C. oligovata*, and *C. Neumayri* Hoernes and Auinger. The latter is a small miocene shell, represented by a solitary specimen which shows no trace of the columellar characters distinguishing *Cypræoglobina* as defined by Cossmann. Moreover there is strong reason to suspect that *C. Neumayri* is merely an immature individual of *C. Duclosiana* which belongs to a different group. *Luponovula* is therefore not much more homogeneous than the original *Cypræoglobina*. For the present, we may adhere to the euphonious name *Cypræoglobina*, in the sense of Cossmann's definition, to designate those remarkable shells, with either *C. Proserpinæ* or *C. oligovata* as neotype.

Sub-genus: SULCOCYPRÆA.

This division may be treated as a separate sub-genus pending the possibility of obtaining more information regarding its characters, though there is little doubt it will eventually be found to correspond with one or other of the preceding sub-genera, or with *Eocypræa.*

The genotype is of small-medium size, recalling in outline the more pear-shaped forms of *Cyprædia s. str.*, such as *C. clathrata* or *C. Lhommei*; it also resembles *Cypræoglobina*, but is anteriorly more attenuated. The ornamentation appears to differ very essentially from that of *Cypraedia s. str.*, since it consists of spiral grooves, not of spiral ribs. Moreover, on the dorsal surface it would seem that these grooves are so fine and so crowded as to be clearly visible only with the help of a lens, while, on the left side of the ventral surface, they are wide spaced and very deep. The "much thickened, profoundly striated" outer lip, as shown in the illustrations agrees completely with the corresponding portions of *Cypræoglobina.*

A close analogy with *Cypraedia s. str.* seems excluded in spite of a general resemblance in shape, and the choice rests between *Eocypræa* and *Cypræoglobina.* The earlier whorls of *Eocypræa* are usually striated spirally, and the striations sometimes persist on the body-whorl (as in *C. Cunliffei* and *C. sphærica*). The striated sculpture of Sulcocypræa is therefore as consistent with *Eocypræa*, as with *Cypræoglobina.* The structure of the anterior columellar termination should decide to which group the shell is referable. Unfortunately it has not been described and is not clearly shown in the illustration. Should the type belong to the same group as the shells here placed under *Cypræoglobina*, the name *Sulcocypræa*, dating from 1865, would afford a welcome escape from the difficulties of nomenclature regarding the choice between the designations *Cypræoglobina* and *Luponovula.*

Sub-genus: CYPRÆDIA.

Group of *C. elegans.*

1. *Cypraedia elegans* Defr. Middle and upper eocene of the Paris basin and of Egypt, upper eocene of Normandy, Brittany and Nice.
2. „ *fenestralis* Conr. Upper eocene and oligocene of America.
3. „ *Girauxi* Cossm. Upper eocene of the Paris basin.
4. „ *clathrata* Tate. Upper eocene of Australia.
5. „ *Lhommei* Cossm. Lower eocene of the Paris basin.
6. „ *Cossmanni* Vred. Middle eocene of Balúchistán.
7. „ *striatissima* Vred. Lutecian of Balúchistán.
8. „ *alveolinarum* Vred. Lybian of Sind.

9. *Cyprædia barcinensis* Gray (includes *C. funiculifera* Cossm.). Middle eocene of Catalonia.
10. ,, *multicarinata* Dall. Oligocene of Florida.

Group of *C. sulcosa.*

11. ,, *Cailliaudi* Vass. Upper eocene of Brittany.
12. ,, *vendrestensis* Cossm. Upper eocene of the Paris basin.
13. ,, *interposita* Desh. Lower eocene of the Paris basin.
14. ,, *sulcosa* Lam. Middle and upper eocene of the Paris basin.
15. ,, *elegantiformis* Oppenh. Middle eocene of the Veronese.
16. ,, *birmanica* Vred. (Q. J. G. S., Vol. LXIV, Pl. LVII, figs. 7, 8; perhaps the adult condition of the following). Upper eocene of Burma.
17. ,, *conigera* Mart. Upper eocene of Java.
18. ,, *Gervillei Sow.* (includes *C. Georgii* Defr. and *C. Brasili* C. and P.). Upper eocene of Normandy.
19. ,, *Sophiæ* Bernay. Middle eocene of the Paris basin and of Sind.

Sub-genus: CYPRÆOGLOBINA.

20. *C.* (*Cypræoglobina*) *cordiformis* Vred. Middle Maestrichtian of Balúchistán.
21. ,, *Proserpina* Bay. Middle and upper eocene of the Vicentine.
22. ,, *oligovata* Sacco. Oligocene of Liguria.
23. ,, *Bowerbanki* Sow. (incl. *C. Raspaili* Chéd.). Middle eocene of the Anglo-Parisian region.
24. ,, *Edwardsi* Vred. (Edwards, Mon. Eoc. Ceph. and Univ. Engl., Vol. I, Pl. XVII, fig. 1 *a*, *b*, *non c*, *d*.). Lower eocene of the London basin.
25. ,, *Feddeni* Vred. (Pal. Ind., new ser., Vol. III, Mem. 1, Pl. IV, fig. 13). Lower eocene of Sind.
26. ,, *bullina* Oppenh. Lybian of Egypt.

27. *C.* (*Cypræoglobina*) *Genyi* Bell. Upper eocene of Nice.
28. ,, *parvulorbis* de Greg. (systematic position doubtful). Middle eocene of the Vicentine.

Sub-genus: SULCOCYPRÆA.

29. *C.* (*Sulcocypræa*) *lintea* Conr. Oligocene of Mississipi.

Genus: EOCYPRÆA.

Small or medium, shape posteriorly globose, the general outline usually strongly inflated; the apex occupied by a small inverted umbilicated spire, almost completely involute, more or less concealed by the posterior termination of the outer lip which is bent in such a manner as to become almost perpendicular to the axis of the shell, in consequence of which the more or less notched posterior outlet of the aperture is laterally deflected to such an extent that it is sometimes not visible in a apical view of the shell. The smooth or slightly crenulate columella diverges from the base of the penultimate whorl, and is terminated by an oblique ridge which may enclose a fossula.

At early stages of growth, the shell frequently carries fine, crowded spiral ridges, often decussated by raised axial lines. This ornamentation may sometimes even persist in the adult.

According to Cossmann's original diagnosis (Essais de paléoconchologie, livr. 5, p. 163), the terminal columellar ridge is merely the last denticulation of the columellar lip, an appearance strongly suggested by some of the Tertiary species. Nevertheless, in some of the cretaceous species in which the apertural denticulations are so small as to be scarcely visible, the terminal columellar ridge remains so distinct as to indicate that it is a true independent columellar structure. This is one of the most important features in which these cretaceous species differ from the cretaceous forms of *Gisortia* in which there is no differentiated anterior columellar ridge, and in which the anterior apertural ridges of the columellar lip are widely oblique to the edge of the columella from which they remain independent, though often continued to the close neighbourhood of the anterior extremity.

Eocypræa, which appears to be now extinct, is, together with *Gisortia*, the oldest group of Cypræidæ as yet known. All the cretaceous forms and several of the eocene ones closely recall many forms of *Gisortia* in the disposition of the ventral surface, the anterior portion of which constitutes two symmetrically situated sharp ridges which converge towards the anterior extremity, and from which the surface slopes steeply towards the aperture the anterior portion of which is therefore deeply sunken at the bottom of a more or less elongate funnel-shaped depression. *Eocypræa* is, nevertheless, distinguished from *Gisortia* by the terminal ridge of its columella and by its small inverted spire, the spire of *Gisortia* being usually wide, and always exsert, at least near its apex, though in some species it is so strongly extraconic as to become broadly inverted with increasing growth, as is observed in the living *Gisortia umbilicata*.

The largest species of *Eocypræa* are of moderate dimensions, the shells of this group never reaching the gigantic dimensions frequently observed in *Gisortia*.

Owing to the peculiar characteristics of the shells constituting *Eocypræa* their association with any of the other genera of Cypræidæ would so disturb the homogeneousness of any group, that it has been considered best to classify them, provisionally at least, as a separate genus which, nevertheless, shows relations not only with *Gisortia* but also with *Cypræovula*, and with *Cyprædia*. Some of the early forms of *Bernayia* exhibit the peculiar anterior apertural depression that characterises the cretaceous forms of *Eocypræa*, yet, the extremely reduced inverted spire clearly separates *Eocypræa* from *Cypræovula* and *Bernayia* in which the spire is exsert, and therefore, notwithstanding the general similarity of the apertural characters, it seems best to keep *Eocypræa* and *Cypræovula* separate so long as no passage forms are known, for the conspicuous distinction in the apical structure may be correlated by other shell characters that have not yet been clearly discerned, or else by anatomical peculiarities that cannot, unfortunately, be ascertained, since *Eocypræa* appears to be extinct.

The umbilicated apex induces a very close general resemblance to *Cyprædia*, which may be further accentuated by the presence of spiral ornaments, though the latter character is common also to certain forms of *Cypræovula*. Nevertheless, the resemblance with *Cyprædia* is perhaps more apparent than real, for there is reason to believe that the development of the apex differs in the two groups. In *Eocypræa*, the spire is greatly reduced and is inverted, but is apparently always present, and, moreover appears to exhibit consistently the same structure at all stages of growth. In *Cypraedia*, the spire, at early stages of growth, is not only exsert, but may be, even, very steeply prominent, while it disappears entirely at the more adult stages, the apex becoming completely involute with the entire obliteration of any structure that can properly be assimilated to a spire even of an inverted disposition. This dimorphous growth of the apex in *Cypraedia*, no indication of which has been observed in *Eocypraea*, suggests the existence of a relatively wide gap between the systematic positions of these two groups.

NOTE.—Seekers after priority may wish to replace the name *Eocypraea* by *Cypraeacites* Schlotheim, under which denomination have been described some forms belonging to this group. It is clear, however, that, in accordance with a custom still prevailing in his time, Schlotheim has modified the generic name when applied to extinct species, and that "*Cypraeacites*" is merely intended as an equivalent of "*Cypraea*" applicable to fossil forms.

Four divisions may be recognised.

1. Group of *E. pilulosa*, small; aperture sunken throughout entire length.
2. Group of *E. Deshayesi*; teeth strong.
3. Group of *E. oviformis*; medium to medium large; aperture sunken only anteriorly.
4. Group of *E. inflata*, medium to medium large, aperture not sunken.

Genus: EOCYPRÆA.

1ST DIVISION.

Group of *Eocypraea pilulosa.*

1. *Eocypraea pilulosa* Stol. Albian of Southern India.
2. „ *involuta* Zek. Turonian of Gosau.
3. „ *Orbignyana* Vred. (=*Cypraea Newboldi* Forbes *sec.* Stoliczka). Lower senonian of Southern India.
4. „ *bullaria* Schloth. (incl. *C. Mortoni* Gabb), Maestrichtian or Danian of Faxoe; upper senonian or danian of New Jersey and Alabama.
5. „ *Newboldi* Forbes. Upper senonian of Southern India and Luristan.
6. „ *marticensis* Math. Lower senonian of Provence.

2ND DIVISION.

7. *Eocypræa Deshayesi* Binkhorst (position doubtful), Maestrichtian of Limbourg.

3RD DIVISION.

Group of *Eocypræa oviformis.*

8. *Eocypræa Cunliffei* Forbes. Upper senonian of southern India.
9. „ *oviformis* Sow. Lower eocene of the London region.

4TH DIVISION.

Group of *Eocypræa inflata.*

10. *Eocypræa inflata* Lam. Middle and upper eocene of the Paris basin. Middle eocene of England and the Vicentine.
11. „ *leilanensis* Vred. (Pal. Ind., new ser., Vol. III, Mem. I, Pl. IV, fig. 12). Lower eocene of Sind.
12. „ *Dollfusi* de Laubr. Middle eocene of the Paris basin.
13. „ *Laubrieri* Cossm. Upper eocene of the Paris basin.
14. „ *globularis* Edw. Middle eocene of Bracklesham.
15. „ *sphærica* Phil. Lower oligocene of North Germany and Belgium.
16. „ *ovulina*. Grat. Miocene of Aquitaine and Piedmont.
17. „ *oligovulæa* Sacco. Oligocene of Liguria.
18. „ *Levesquei* Desh. (*C. Dalli* Cossm. *non* Aldr. perhaps the immature stage). Lower eocene of the Paris basin.
19 „ *Murrayana* Tate (systematic position doubtful). Upper eocene of Australia.
20. „ *Sellei de* Rainc. Middle eocene of the Paris basin.
21. „ *pumila* von Koen. Oligocene of Lattorf.
22. „ *orthocheila* Edw. Middle eocene of England.
23. „ *hiantula* Cossm. Middle eocene of the Paris basin.
24. „ *oligolævis* Sacco. Oligocene of Liguria.

Genus: TRANSOVULA.

Small to small medium shells, sub-symmetrical, with rostrated extremities and very narrow aperture, densely denticulated along both lips. The spire is exsert, but is entirely concealed by the body-whorl. The anterior termination of the columella appears to be steep, without a definite fossula.

The rostrated extremities denticulated throughout their entire length and notched only at their termination distinguish this genus from *Cypræa*, the small size and sub-symmetrical shape distinguish it from *Gisortia*. From *Pustularia* with which it shows considerable outward resemblance, *Transovula* appears to be readily distinguished by the steep anterior edge of the columella, and the absence or feeble development of a fossula, in which, characters it appears to be closely related to *Gisortia*.

If, however, *Transovula* should be found to possess the very characteristic almost transverse anterior columellar fold and deep fossula of *Pustularia*, it must be classified as a sub-division of the latter genus. Amongst the species which I consider to be referable to *Transovula*, the only one of which there exist clear photographic illustrations is *Transovula delphinoides* Cossm. So far as can be ascertained, the anterior edge of the columella is steeply oblique and does not exhibit the characteristic features of *Pustularia*. All the Indian specimens referred to *Transovula* have, unfortunately, the anterior extremity broken.

1. *Transovula globulina* Stol. Maestrichtian of Pondicherri.
2. ,, *anomala* Stol. Upper Senonian of Southern India.
3. ,, *spirata* Schloth. Maestrichtian or Danian of Faxoe.
4. ,, *delphinoides* Cossm. Middle eocene of Paris.
5. ,, *Moloni* Bay. Middle eocene of the Vicentine.
6. ,, *persona* Oppenh. Upper eocene of Priabona.

Genus: GISORTIA.

Cypræidæ of varying size, usually medium to large or even gigantic, of oval to oval-conical shape, with a relatively broad low spire which may be more or less concealed in the adult, with both apertural extremities produced into canals the terminations of which appear more or less notched in dorsal aspect, with the edge of the columella passing very steeply, almost vertically into the left border of the anterior canal.

Occasionally the columella may carry an oblique spiral fold situated at some distance from the anterior extremity. It is not certain that this can be regarded as homologous with the anterior columellar ridge of *Cypræa.* The anterior canal is usually marginally and dorsally accompanied by callous growths, while callous protuberances may or may not be developed in other parts of the marginal region or upon the dorsal surface.

The chief characters that distinguish these shells from *Cypræa* are the generally much broader spire, and the undifferentiated structure of the termination of the columella, the nearest analogy to which is to be found in some forms of *Erato.* The anterior columellar fold occasionally observed is not situated as in *Cypræa.*

The channelled extremities, together with the disproportionately larger dimensions distinguish them from the forms here grouped under the Triviinae which frequently have a relatively wide spire.

The posterior channel recalls that observed in some forms of *Pustularia* and *Monetaria* in which, nevertheless, the anterior termination and the columella are very different and quite *Cypræa*-like.

Three sub-divisions of this genus may be recognised. *Gisortia s. str.* in which there is usually no dorsal ridge, or only one, posteriorly situated, and in which the posterior extensions of the apertural lips are unsymmetrically disposed, *Palliocypræa,* in which the margin is expanded into a thin flange, *Vicetia* in which the posterior terminations of the apertural lips are approximately symmetrical and in which there are two dorsal ridges.

Gisortia is entirely fossil with the exception of one species, the Australian *Cypræa umbilicata* Sow., which ranks by the side of the Australian Trigonias as a remarkable relic of the mesozoic fauna.

The earliest representatives are from the age of the Gault and are already of large size; the group having apparently already assumed its distinguishing characters at this relatively early period from which date also the earliest known representatives of *Eocypræa.* Some of the late cretaceous forms of *Gisortia* already attain giant dimensions. It is abundantly represented in the eocene, the upper eocene yielding the most gigantic forms. *Vicetia* appears to be restricted to the middle and upper eocene, while *Palliocypræa* is only known from the Australian beds of probably upper eocene age.

A comparison of the anatomy of *Gisortia* with that of *Cypræa* would be highly interesting, but nothing appears to have been published on the subject, and even the radula does not seem to have been figured.

Many of the fossil forms are known only in the condition of internal casts.

Sub-genus : GISORTIA.

Medium to large or gigantic. Apertural crenulations or ridges often well developed. Posterior rostration oblique posteriorly towards the left.

Section : GISORTIA.

No marginal flange (distinction from *Palliocypræa*).

In addition to the species enumerated below, it is just possible that *Cypræa Geinitzi* Boettg. (Tertiärf. v. Sumatra, Th. 1, in Pal., Suppl. III, p. 76, Pl. VI, fig. 10), and *C. extenuata* Boettg. (*loc.*, *cit.*, p. 93, Pl. XI, fig. 1), both from the eocene of Sumatra, might also belong to this group; but they are founded on material too imperfect for analysis.

There is also much uncertainty regarding the systematic position of *Globiconcha Marrotiana* d' Orbigny (1842, Pal. Franç. terr. crét., Vol. II, p. 145, Pl. CLXX, figs. 1, 2) from the Maestrichtian of Aquitaine, an incomplete internal cast distinguished by its very wide inverted spire.

Section : PALLIOCYPRÆA.

Margins extended by a thin callous growth into a wide flange.

Sub-genus : VICETIA.

Large to gigantic. Two transverse dorsal ridges. Ventral aspect sub-symmetrical, posterior terminations of the apertural lips symmetrically developed. Denticulations feebly developed. Sometimes an anterior columellar fold.

The internal casts have a more or less sub-cylindrical shape readily distinguishing them from the more evenly globular or ovoid or conical internal casts of *Gisortia s. str.*

This section includes the largest of all the Cypraidæ.

Group of *Gisortia Cossmanni.*

Rather small to very large; ovoid more or less elongate, posterior rostration moderately elongate, aperture anteriorly sunken. Cretaceous.

1. *Gisortia Cossmanni.* Vred. (=*Ovula expansa d'* A. and H. *sec.* Noetling, Pal. Ind., Ser. XVI, Vol. I, part 3, p. 63;=*Gisortia expansa d'* A. and H. *sec.*, Vredenburg, Rec. Geol. Surv. Ind., Vol. XXXVI, pp. 176, 178). Upper Maestrichtian and Danian of Balúchistán.
2. „ *baluchistanensis* Noetl. Middle Maestrichtian of Balúchistán.
3. „ *Archiaci* Vred. Danian of Sind.
4. „ *Kayei* Forbes. Maestrichtian of Southern India.
5. „ *ovula* d' Orb. Maestrichtian of Southern India.
6. „ *coromandelica* Vred. (Stoloczka, Cret. Fauna South Ind., Vol. II, Pl. IV, fig. 10). Lower senonian of Southern India.
7. „ *escragnollensis* Vred. Albian of Escragnolles.
8. „ *ventricosa* Reuss. Lower senonian of Bohemia.

Group of *Gisortia jhirakensis.*

Moderately large, pear-shaped, posterior rostration short.

With the exception of *Gisortia jhirakensis*, this group is entirely sub-Antarctic. Eocene.

9. *Gisortia jhirakensis* Vred. (= *Cypræa Granti* d' A. *sec.* C. and P., Pal. Ind., new ser., Vol. III, part 1, p. 42). Lower eocene (upper Cuisian) of Sind.
10. „ *leptorhyncha* McCoy. Upper eocene of Australia.
11. „ *platyrhyncha* McCoy. Upper eocene of Australia and Tasmania.
12. „ *amygdalina* Tate. Upper eocene of Australia.
13. „ *Gisortia platypyga* McCoy. Upper eocene of Australia and Tasmania.
14. „ *consobrina* McCoy (distinctness from foregoing doubtful). Upper eocene of Australia.

Group of *Gisortia umbilicata.*

Medium-size to very large, pear-shaped, posterior rostration very elongate. Cretaceous to recent.

15. *Gisortia ficulina* Stol. Lower senonian of Southern India.
16. „ *veraghoorensis* Stol. Upper senonian of Southern India.
17. „ *umbilicata* Sow. Living along the coasts of New South Wales. Victoria and Tasmania.
18. „ *eximia* Sow. (incl. *Cypræa sphærodoma* Tate). Upper eocene of Australia and Van Diemen.
19. „ *loxorhyncha* Tate. (distinctness from foregoing, doubtful). Upper eocene of Australia.
20. „ *rostrata* Zekeli (incl. *Ovula striata* Zek.). Turonian of Gosau.

Group of *Gisortia Benedicti.*

Gigantic, shape very broad. Maestrichtian to upper eocene.

21. *Gisortia Benedicti* Vred. Lower Maestrichtian of Balúchistán.
22. „ *tuberculosa* Duclos. Lower eocene of Paris and Sind.
23. „ *gigas* McCoy. Upper eocene of Australia.
24. „ *dorsata* Tate. Upper eocene of Australia.
25. „ *gisortiensis* Valenciennes (incl. *Ovula gigantea* Münst., *Cypræa Coombii* Sow., *Gisortia Chevallieri* Cossm. *G., postalensis* Oppenh.). Middle eocene of Europe and India.

Section : PALLIOCYPRÆA.

26. *G.* (*Palliocypræa*) *gastroplax* McCoy. Lower Tertiary of Victoria.
27. „ *Mulderi* Tate. Upper eocene of Australia.

Sub-genus : VICETIA.

28. *G.* (*Vicetia*) *Murchisoni* d' Arch. Lybian of Sind.
29. „ *depressa* Sow. Lutecian of Kachh, Sind, Balúchistán, Persia.
30. „ *Jamesi* Vred. (perhaps identical with *G. depressa*). Middle eocene of Sind.

31. *G.* (*Vicetia*) *metingensis* Vred. Lower Lybian of Sind and Sarawán.
32. „ *silistrensis* Vred. Middle eocene of Cherrapoonjee.
33. „ *Hantkeni* H. et M.-Ch. Lutecian of the Vicentine.
34. „ *Douvillei* Cossm. Lutecian of the Paris basin.
35. „ *Bellardii* Desh. (incl. *Cypræa roncana* de Greg.). Upper eocene of the Alpes-Maritimes and Vicentine.
36. „ *Hoernesi* H. et M. Ch. Upper eocene of Priabona.

Sub-Family: TRIVIINÆ.

Small shells in which the posterior termination of the outer lip, when not entirely disguised by the final callous accretions of the adult stage, is placed at right angles to the apex and is situated ventrally with respect to the spire, without any structure strictly comparable to the posterior notch of the Cypræinæ. The columella forms a projecting blade, but there is never any structure strictly homologous with the more or less transversely disposed terminal ridge of many Cypræinæ.

Genus: TRIVIA.

Small shells characterised by the almost complete absence of an anterior notch. The posterior notch is also very feeble or practically absent, but the posterior termination of the outer lip does not rise over the apex as in the genus *Cyprædia.* The projection of the small spire is nearly or completely concealed by the callous growth by which it is always covered in adult specimens. The later stages of growth never develop an involute apex as in the genus *Cyprædia.*

The apertural ridges usually spread over the dorsal surface, those nearer the middle of the shell extending as parallel ridges, while the terminal ones converge respectively towards two points dorsally situated in a line with the apertural terminations. The transverse dorsal ridges are often symmetrically divided by a groove uniting the two points of convergence above mentioned.

The columella forms a prominent blade springing at a pronounced angle from the base of the penultimate whorl; this blade and the edge of the columellar lip together enclosing a fairly wide and fairly deep longitudinal furrow. In a ventral aspect, the columellar blade has an arched appearance, and terminates anteriorly against the anterior inner wall of the shell. There is never any structure resembling the characteristic terminal oblique ridge which unites with the termination of the columellar lip in many Cypræinæ. Whenever the shell is externally ribbed the columellar depression is also ribbed and the columella crenulated, except in the two aberrant eocene species T. *pedicularis* Desh and T. *Bouryi* Cossm.

The colours of Trivia are mainly white and pink, separately or combined, or pinkish brown.

Remarks.—The dorsal ridges of *Trivia* being mere prolongations of the apertural denticulations are homologous with the dorsal denticulations or ridges of *Erosaria*, and do not in any way correspond with the spiral ornaments of *Cypræovula* or *Cypræedia.* The immature shell, in all cases that have come under observation, is entirely destitute of the spiral lines almost invariably developed at early stages of all the groups here classified under *Cypræovula* or *Cypræedia.* Nevertheless the lines of growth, in full-grown specimens, are apt to form a delicate trellis in the intervals between the transverse ridges, especially on the right side of the shell.

The general appearance of the shell, in *Trivia,* is apt to be disguised to such an extent by the superficial ridges, or by the terminal thickenings of the aperture as to give rise to a deceptive general resemblance to many of the forms here classified as *Cypræinæ.* In the few instances in which the extraneous additions are missing, as in *T. ovulata,* it will be noticed that the apertural characters differ totally not only from those of *Cypræa,* as here understood, but also from those of *Cypræedia*: the posterior extremity of the thickened outer lip being bent until it becomes practically perpendicular to the axis of shell, but terminating anteriorly to the spire or on a level with it instead of posteriorly to the apex as in *Cypræedia* and situated in front of the axis, not bent backwards as in *Cypræedia* till it reaches the axis; the posterior notch being indistinct. This disposition is quite comparable to that observed in *Erato.*

The extent to which *Trivia* differs from the Cypræinæ in the characters of the apertural terminations and especially in the structure of the columella, fully entitles it to a separate generic rank such as is at first sight so distinctly indicated by its uniformly small dimensions, as well as by its geological history.

Trivia is already represented in the lower eocene by T. *Wetherelli* Edw., a form closely related to the genotype, *T. europæa.* The middle eocene of San Giovanni Ilarione contains several forms the descriptions of which are, unfortunately not available in India.

Out of five species described from the upper eocene, *T. intus-crenata* C. and P., from Normandy, has a modern facies, and *T. avellanoides* McCoy, from Australasia, the largest representative of the genus, appears to be still living. It is a typical *Trivia*, though not closely related to any other known form. Another Australasian fossil, *T. erugata* Tate, distinguished by its elongate shape and the great breadth of the anterior termination of the aperture, is the type of the extinct section *Semitrivia* Cossmann, and lastly the two Paris species *T. pedicularis* Desh. and *T. Bouryi* Cossm. differ from all other ribbed forms by the absence of internal prolongations of the ribs along the columellar lip.

In the oligocene, the genus is represented entirely by forms of modern facies including most of the groups at present living and even an ancestral variety of *T. europæa*, the type of the genus.

No cretaceous predecessors of *Trivia* have as yet been discovered, but the existence of forms of modern facies at early stages of the eocene shows that *Trivia* must have already diverged from *Cypræa* in pre-tertiary times. The permanence of its characters throughout the Tertiary is in marked contrast with the rapid transformations that have affected the Cypræinæ during that same era.

In spite of the unwieldy proportions of this genus which, exclusive of the section *Semitrivia* includes more than sixty species, its homogeneity precludes the possibility of dividing it into subgenera or sections. Amongst the groups partly or entirely represented by living forms, those of *T. radians* and *T. costata* are the only ones with differential characters so definite as might perhaps entitle them to sectional distinction. But as the one contains only three species, and the other only three or four, the advantage of separating them would be negligible and would be more than counterbalanced by the disadvantage of adding two more sectional names to the nomenclature.

It is by no means impossible that the European eocene fossil species, with the exception of *T. Wetherelli* Edw. and *T. intuscrenata*

C. and P., should constitute a separate section or sub-genus; for in two of them, *T. pedicularis* Desh. and *T. Bouryi* Cossm., it has been recorded, as above noticed, that the apertural denticulations of the columellar lip are not continued into the interior of the aperture, a peculiarity not existing in any other externally ribbed species that has come under observation. Nevertheless, in the absence of actual specimens for comparison it is necessary to abstain from classifying these forms separately.

Section: Trivia *s. str.*

Globular or ovoid, aperture not expanded or feebly expanded anteriorly (distinctions from *Semitrivia*).

Group of *Trivia europæa.*

Globose to ovoid. Ridges simple, not granulated. Aperture unsymmetrically situated. Margined only on the right. Dorsal groove present or absent.

According as to whether the dorsal sulcus is distinct, or else feeble or absent, these shells may be classified into two sub-groups which, however, are quite artificial.

A.—Sub-Group of *Trivia europæa.*

Globular, aperture very unsymmetrically situated. Dorsal groove feeble or absent.

This sub-group includes all the species referred to *Trivia* as restricted by Jousseaume.

1. *Trivia europæa* Mont. Oligocene of Liguria; miocene of Touraine, Aquitaine, Provence, Piedmont, Vienna, the Morea; pliocene of England, Italy, Sicily. Living throughout the seas of Europe and North Africa.
2. „ *mediterranea* Risso (incl. *T. multilirata* Sow.). Mediterranean and Adriatic.
3. „ *sphæriculata* Lam. (incl. *C. avellana* Sow. and *C. subpediculus* d'Orb.). Upper miocene and pliocene of Europe.
4. „ *Wetherelli* Edw. Lower eocene of the London Basin.
5. „ *formosa* Gask. The Cape.
6. „ *dimidiata* Br. Pliocene of Emilia and Liguria.

7. *Trivia dorsolævigata* Cocc. (distinctness from preceding species doubtful). Pliocene of Emilia and Liguria.
8. „ *Napolini* Ducl. Spain and West Africa.
9. „ *australis* Lam. Indo-Pacific region.
10. „ *sanguinea* Gray. California to Ecuador.
11. „ *galapagensis* Melv. Albemarle I., Galapagos archipelago.
12. „ *fusca* Gray. Mexico to Ecuador; Galapagos.
13. „ *rubescens* Gray. California to Colombia; Galapagos.
14. „ *retusa* Sow. (incl. *T. Angliæ* Wood).
15. „ *candidula* Gask. Algeria, Morocco, Spain, Portugal, West Africa, Atlantic islands.
16. „ *pulex* Sol. Mediterranean, Portugal, West Africa, Atlantic islands.
17. „ *intuscrenata* C. and P. Upper eocene of Normandy.
18. „ *pedicularis* Desh. (systematic position doubtful). Upper eocene of Paris basin.
19. „ *Farachii* de Greg. (description not available). Middle eocene of the Vicentine.
20. „ *californiana* Gray. Vancouver to Mexico. Fossil in the pleistocene of California. (? *T. panamensis* Dall, perhaps a small race of this species.)
21. „ *depauperata* Sow. California.

Sub-group of *Trivia quadripunctata.*

Globose to oval. Generally like the sub-group of *T. europæa*, but with a distinct dorsal groove.

22. *Trivia pilula* Kien. Indo-Pacific region.
23. „ *globosa* Gray. (incl. *C. sphærula* Migh. *C. acutisulcata* Ken.). Pliocene of Florida. Living in the West Indies.
24. „ *brevissima* Sow. Ceylon.
25. „ *subrostrata* Gray. West Indies. (? *T. atomaria* Dall, from Panama, perhaps identical.)
26. „ *pulla* Gask. California to Ecuador, Galapagos.
27. „ *pisum* Gask. Ceylon.
28. „ *Grayi* Mich. Oligocene of Liguria.
29. „ *quadripunctata* Gray. West Indies.
30. „ *affinis* Duj. Miocene of Touraine, Aquitaine, Piedmont, Vienna. Lower pliocene of England.

31. *Trivia Maugeriæ* Gray. Galapagos.
32. „ *avellanoides* McCoy. Living in Australasia. Fossil in the Upper eocene of Victoria, South Australia, Tasmania.
33. „ *sulcata* Gask. South Africa. Torres Straits. Philippines.
34. „ *vitrea* Gask. Indo-Pacific region.
35. „ *cicatrosa* Sow. Habitat unknown.
36. „ *pauciliriata* Sow. Melanesia.
37. „ *Bouryi* Cossm. Upper eocene of the Paris basin.
38. „ *palumbella* de Greg. (description not available). Middle eocene of the Vicentine.

Group of *Trivia pediculus.*

Like the sub-group of *T. quadripunctata* but with a tendency for the formation of granules along the ridges.

Dorsal surface margined only on the right.

39. *Trivia pediculus* Linn. Pliocene of Florida and Costa Rica Living in tropical Atlantic.
40. „ *costispunctata* Gask. California.
41. „ *nivea* Gray. West Indies.
42. „ *pacifica* Gray. California to Colombia; Galapagos.
43. „ *Hidalgi* Vred. (= *T. affinis* Marrat 1867 *non* Dujardin 1835). West Indies.
44. „ *suffusa* Gray. Pliocene of Florida and California; living in the West Indies.
45. „ *birmanica* Vred. Oligocene of Burma.

Group of *Trivia oryza.*

Extremities rostrate. Aperture almost symmetrically situated. Dorsal surface not distinctly margined on either side, or else feebly margined to the right.

This group corresponds essentially with Jousseaume's genus *Trivirostra.*

46. *Trivia oryza* Lam. Indo-Pacific region.
47. „ *scabriuscula* Gray (perhaps a variety of the preceding). Indo-Pacific region.
48. „ *Smithi* Mart. Fossil in Java, probably Miocene.
49. „ *intermedia* Kien. Habitat unknown.

50. *Trivia grando* Gask. Indo-Pacific region.
51. „ *pellucidula* Gask. Indo-Pacific region.
52. „ *insecta* Migh. Indo-Pacific region.
53. „ *exigua* Gray. Indo-Pacific region.

Group of *Trivia radians.*

Often relatively large; dorsal surface surrounded by a rim along both margins. There is a median dorsal groove bordered on either side by prominent granules which terminate the ribs. Aperture sub-symmetrically situated.

54. *Trivia radians* Lam. Lower California to Chile.
55. „ *Noetlingi* Vred. (Pal. Ind., new ser., Vol. I, part 3, Pl. XIX, fig. 13). Oligocene of Burma.
56. „ *Solandri* Gray. Vancouver to Peru.

Group of *Trivia producta.*

Margined on both sides. The apertural lips are produced at both extremities in such a manner as to communicate a dorsally notched appearance to the terminations, as well as a rostrated appearance to the general outline.

57. *Trivia producta* Gask. Pacific region.
58. „ *rubinicolor* Gask. Ceylon, Borneo.

Group of *Trivia costata.*

This group is characterised by the relatively wide aperture and narrow outer lip. The dorsal groove may be absent or present, or there may be a complete absence of the external ridges. Margined only on the right.

The group essentially corresponds with Jousseaume's genus *Triviella.*

59. *Trivia vesicularis* Gask. The Cape.
60. „ *costata* Gmel. West Indies.
61. „ *oniscus* Lam. The Cape.
62. „ *ovulata* Lam. The Cape.
63. „ *pomphulogota* Tate (unfigured, systematic position doubtful). Upper eocene, Adelaide.

Incerta sedis.

64. *Trivia corbuloides* de Greg. (description not available). Middle eocene of the Vicentine.

Section: SEMITRIVIA Cossmann 1903.

The single species at present included in this section is very small and is distinguished from all other forms of *Trivia* by its cylindrical shape and its anteriorly expanded aperture. The ridges do not extend dorsally beyond the margin of the dorsal surface.

65. *T.* (*Semitrivia*) *erugata* Tate. Upper eocene of Victoria.

Genus: ERATO.

Small, pear-shaped, unsymmetrical, spire more or less obscured by callus, but always forming a visible projection which is never covered by the posterior apertural termination. The shell is usually margined to the right, never to the left.

When the shell is viewed apically, the posterior termination of the outer lip may seem quite straight and radially disposed with respect to the axis, or may appear so disposed as to produce a small embayment, which may be ventrally constricted, but there is no appearance of a well defined posterior apertural notch in a dorsal view.

The anterior termination is sub-rostrate, truncated, or very feebly notched. The columella forms a ridge or rather edge, practically continuous with the base of the penultimate whorl, separated from the edge of the columellar lip by a narrow flat or feebly sunken space.

The extent to which the denticulations of the columellar lip penetrate into the shell is very variable; consequently, the columella may be either smooth or crenulated.

In some instances the anterior extremity of the columella is directly connected with a twisted ridge forming the anterior termination of the columellar lip, yet, it never exhibits a distinct independent terminal edge as in the Cypræinæ, although it does not end blindly in the interior of the shell as in *Trivia*.

Like *Trivia*, *Erato* has not been observed in pre-tertiary strata. The oldest eocene forms belong to the extinct sub-genus *Eratotrivia*.

Sub-genus: ERATO.

Apertural denticulations restricted to the neighbourhood of the aperture (distinction from *Eratotrivia*).

Section: ERATO *s. str.*

The apertural crenulations are restricted to the aperture or its immediate neighbourhood. The columella is smooth. The outer surface of the shell is smooth.

1. *Erato lævis* Donov. (incl. *E. uniplicata* Depont.). Miocene and pliocene throughout Europe. Living in the seas of Europe.
2. „ *Emmonsi* Whitf. Miocene of New Jersey.
3. „ *callosa* A. and R. China and Japan.
4. „ *prolævis* Sacco. Oligocene of Cassel.
5. „ *incrassata* Dod. Miocene of Italy.
6. „ *australis* Tate. West Indies.
7. „ *Maugeriæ* Gray. West Indies.
8. „ *angystoma* Sow. Indian Ocean, Philippines.
9. „ *spiralis* Dod. Tortonian of Piedmont.
10. „ *lachryma* Gray. Pacific Ocean.
11. „ *minor* Tate. Upper eocene of Australasia.
12. „ *pirulata* Tate. Upper eocene of Australia.
13. „ *morningtonensis* Tate. Upper eocene of Australia.
14. „ *sandwicensis* Pease. Sandwich Islands.
15. „ *pellucida* Reeve. Bombay.
16. „ *angulifera* Sow. Borneo.
17. „ *gallinacea* Hinds. Pacific region.
18. „ *vitellina* Hinds. Acapulco to South California.
19. „ *ovulatella* Tate. Upper eocene of Australia.
20. „ *columbella* Menke. Mazatlan to Santa Barbara.
21. „ *duplicata* Johnst. (systematic position doubtful). Upper eocene of Tasmania.

Section: ERATOPSIS Hoernes and Auinger.

Apertural characters generally as in *Erato s. str.* Columella smooth except in some specimens of *Erato scabriuscula*. The dorsal surface may carry small longitudinal granulations, or a medium groove or both.

As has already been noticed by Boettger (Neues Jahrb. f. M. G. u. P., j. 1884, II, p. 136), the transition between *Erato* and the forms grouped under *Eratopsis* is so gradual as to make the latter division almost superfluous. One species, *E. illota* Tate, has been described with the groove and without the granules, while there are several species with more or less distinct granules which never have a groove. In certain cases the granules or groove may be either present or absent amongst specimens of the same species. For instance E. *guttula* Sow. is classified as an *Erato s. str.* by Tryon, although all the specimens available in Calcutta are granulated, and should therefore be grouped with *Eratopsis*. Cossmann has classified *E. Maugeriæ* as an *Eratopsis* though I have failed to detect any granulations on any of the available specimens.[1]

In several forms of *Eratopsis* the apertural denticulations are particularly feeble, and the external longitudinal granulations cannot in any way be regarded as extensions of the apertural ridges, and are not therefore homologous with the transverse external ridges of *Trivia* and *Eratotrivia*.

Section: ERATOPSIS.

22. *E.* (*Eratopsis*) *scabriuscula* Gray. Pacific.
23. ,, *guttula* Sow. Mauritius.
24. ,, *sulcifera* Gray (incl. *E. corrugata* Hinds). Indo-Pacific region.
25. ,, *Barrandei* H. and A. Miocene of Niederleis.
26. ,, *planulosa* Bon. (incl. probably *E. transiens* and *E. Kimakowiczi* Boettg.). Miocene of Europe.
27. ,, *nana* Ducl. Indo-Pacific region.
28. ,, *illota* Tate. Miocene of Victoria.
29. ,, *Schmeltziana* Crosse. Viti Islands.
30. ,, *ventricosa* Gray.
31. ,, *bimaculata* Tate.
32. ,, *prayensis* Rochebrune.

[1] *Erato oligostata* Dall (Nautilus, XVI, p. 44, Bull. Mus. Comp. Zool. Harvard, Vol. XLIII, Pl. XI, fig. 8) from Panama, probably belongs to this section, but has been omitted from the list of species because its precise characters cannot be very clearly realised from the available description and figure.

Sub-genus: ERATOTRIVIA Sacco 1894.

(Moll. terr. terz. Piem. e Lig. parte XV, p. 62.)

General shape like *Erato*, or *Eratopsis*. Spire more completely immersed in callus, through which it nevertheless forms a visible projection beyond the termination of the aperture. The apertural denticulations are much more powerfully developed than in *Erato* or *Eratopsis* and extend outward over the entire surface of the shell, terminating dorsally on either side of a medium sulcus. The columella is denticulate.

While, on the one hand, there is so complete a passage between *Erato* and *Eratopsis* as to make it doubtful whether the latter is to be ranked even as of sectional importance, on the other hand, no connecting links have hitherto been discovered between *Erato* and *Eratotrivia*. It is therefore convenient to treat *Eratotrivia* as a separate group, especially in view of its different geological history.

All the species of *Eratotrivia* are extinct, the group being restricted to the eocene and oligocene.

Sub-genus: ERATOTRIVIA.

33. *E.* (*Eratotrivia*) *crenata* Desh. Middle and upper eocene of Paris basin.
34. „ *Wateleti* Desh. Lower and middle eocene of the Paris basin.
35. „ *platystoma* Edw. (incl. *E. Bernayi* Cossm.). Upper eocene of the Anglo-Parisian region.
36. „ *rediviva* Oppenh. Upper eocene of the Priabona region.
37. „ *costulata* Gieb. Lower oligocene of North Germany.
38. „ *Prestwichi* Edw. Eocene of England.
39. „ *Ritæ* Vin. Middle eocene of the Vicentine.

Genus: PEDICULARIA.

At the earlier stages of growth, the shell resembles that of *Erato*, the disposition of the columella being very closely similar, and the outer lip crenulated. When the shell is fully developed, the apertural margins coalesce in a broadly expanded funnel. The surface is spirally ridged.

The dimensions are small, and the colours, principally white and pink, recall those of *Trivia* and *Erato.*

1. *Pedicularia sicula* Swains. Mediterranean.
2. „ *Deshayesi* Seg. Pliocene of Sicily.
3. „ *elegantissima* Desh. Mascarenes.
4. „ *pacifica* Pease. Pacific region.
5. „ *japonica* Dall. Japan.
6. „ *californica* Newc. Southern California.

INDEX OF SPECIES.

For facility of reference, the species mentioned in the previous lists are alphabetically indexed below, with the names of the genera to which they have been referred. Names printed in italics are those of synonyms.

NOTE ON *Cypræa umbilicata.*—Since the foregoing review was printed, I received the following information kindly communicated by Mr. C. Hedley, Curator of the Australian Museum, regarding *Cypræa umbilicata* : " I agree with you that it represents a group which flourished in the Australian Tertiaries and of which *C. gigas* McCoy was a conspicuous member. But I think that it and they lived on a soft bottom, unlike ordinary *Cypræa.* The species has been taken alive. If it had not been too late (your article being in type) I would have sent you all my notes on *C. umbilicata.*"

SULPHUR NEAR THE CONFLUENCE OF THE GREATER ZAB WITH THE TIGRIS, MESOPOTAMIA. BY E. H. PASCOE, M.A. (Cantab.), D.Sc. (Lond.), F.G.S., *Offg. Director, Geological Survey of India.*

IN the course of a journey up the right bank of the Tigris from Tekrit to Mosul in January 1919, a large milky yellow pool, occupying what looked like a dammed up branch of the river, was observed from the top of the cliffs of the Jabal Mishrak. A strong odour of sulphuretted hydrogen was at the same time noticeable; when the wind blew from the east this smell was perceptible several miles west of the river. After crossing the Tigris at Mosul and Nineveh I made a hurried digression in order to investigate the phenomenon. The locality is some 24 miles S. S. E. of Mosul, about 1½ miles north of the confluence of the Greater Zab with the main river, and 1½ miles west of a village called Jaif (see map, Pl. 6). At this spot the Tigris has deserted its eastern channel and confined itself to a channel west of the island. One of the Arab names for this locality is "The Fountain of Hell." The eastern channel remains as a long sheet of water, which would have been completely shut off from the present river, were it not for a copious spring in the channel bed, which feeds its northern end, and causes it to overflow southwards into the Tigris. This large spring gives origin to a stream of water winding through the sandy flat and flowing into the old Tigris channel. For 40 or 50 yards along its course from its source, this stream is characterised by innumerable points of escape of sulphuretted hydrogen. The evolution of the gas is so brisk in places as to produce the appearance of ebullition, and it is dangerous to attempt to breathe below the top of the bank which is about five feet above the water. The odour above the bank is intensely strong and not to be endured for long; as already mentioned, it can be smelt two or three miles away. Occasionally one momentarily catches the odour of tar, but this is usually completely drowned by the sulphuretted hydrogen. Bituminous earth occurs in the bank of the stream, and the Tertiary beds beneath the superficial deposits are obviously of Fars age. The water is warm and bitter to the taste. Further and further from the spring the oxidation of the hydrogen sulphide and liberation of free sulphur increase to such an extent that the southern end of the Tigris arm is a milky yellow pool. The sulphur, present as such, is, however, too disseminated to be capable of collection in any useful quantity, but the amount of hydrogen sulphide evolved is very large. It is not a difficult matter to oxidise H_2S to SO_2 and ultimately to H_2SO_4, and I think the occurrence is worth the attention of a sulphuric acid expert. The supply may be variable, but the evolution has existed for some time and there is no reason why it should not persist for many more years. The risks and difficulties to be faced seem to be :—

(*i*) The Tigris may attempt to revert to its old course.

(*ii*) The supply may vary with the season of the year.

(*iii*) The supply may be altogether capricious.

(*iv*) The supply may be affected by any boring for oil in the immediate neighbourhood.

(*i*) could be controlled without much difficulty. With regard to (*iii*), the oldest inhabitants of a Kurdish village not far distant assert that the phenomenon has existed ever since they can remember and has been known for at least 100 years, so that the chances of the evolution continuing indefinitely, are good, provided contingency no. (*iv*) does not interfere with it. The gas could be collected by building a gas-tight dome over the "live" area of the stream, with a pipe leading off. Oxidation would soon destroy the smell. Two or three types of sulphuretted hydrogen burners are in modern use for the manufacture of sulphuric acid, and all of them of simple structure. One consists of a brick chamber with "baffling-walls," into which the gas is admitted by a cast-iron pipe, the rate being controlled by an inlet valve. Air for the combustion of the gas is introduced partly by an annular aperture round the point of ingress of the cast-iron pipe, and partly by a separate regulatable aperture in the brick chamber. The heat produced is not only enough to prevent the flame of the burning sulphuretted hydrogen from being extinguished, but may also be used in concentrating the final product. The process is perfectly continuous and uniform, and the consumption of nitre reduced in consequence. A different form of burner furnished with shelves is described by E. Lombard.[1] If a complete sulphuric acid plant

[1] *Monit Scient.* 1889, p. 1231.

be considered unfeasible in the present state of the country, large quantities of free sulphur could be obtained by burning the sulphuretted hydrogen in a limited supply of air, or by passing sulphur di-oxide into the stream. Sulphur di-oxide is easily obtained by burning sulphur in air, and reacts with hydrogen sulphide in the following way :—

$$2H_2S+SO_2 = 2H_2O+3S.$$

Some of the sulphur thus obtained could be burned to produce fresh supplies of sulphur di-oxide. There is no doubt that large quantities of sulphur are obtainable in this way, the final product being collected in a system of settling tanks with controlled inlets and outlets. With a properly constructed apparatus such as that used by Simpson and Parnell, a still greater yield of sulphur would be possible.[1] At present the sulphur precipitated is only a very small fraction of the hydrogen sulphide evolved.

The utilization of hydrogen sulphide is a problem well worth consideration in Mesopotamia, as the gas will probably be evolved in vast quantities from any oil wells that may be obtained. There will probably be an almost unlimited source of sulphur for anyone who can devise a simple contrivance for oxidising H_2S as it issues from oil wells and seepages.

[1] G. Lunge; *Sulphuric Acid and Alkali,* 3rd Edit., Vol. I, p. 370.

MISCELLANEOUS NOTES.

Note on Monazite in the Southern Shan States.

During my examination of the antimony deposits of the Southern Shan States in 1918, I had occasion to visit the granitic hills to the south-west of Mong Kung in Mong Kung State. I panned some of the sand from the stream flowing past the village of Wan Hapalam (21° 32′ : 97° 29′), which drains the easterly slopes of the hills of Loi Sang. The heavy concentrate contains considerable quantities of monazite, which occurs as small yellow-green grains, often showing crystalline faces and having sharp edges, showing that it had not travelled far. There is also present a fair quantity of zircon, some garnet, magnetite, ilmenite, a little rutile, and hornblende. The lighter portion of the sand which is washed off, consists of quartz, felspar, biotite, a little tourmaline, and some kaolinised felspar. The quantity of sand is small, and is of no economic importance.

[H. CECIL JONES.]

Note on an occurrence of Graptolites in the Southern Shan States.

Mr. LaTouche has described the occurrence of graptolites which he discovered in the Northern Shan States. (*Mem. Geol. Surv., India*, Vol. XXXIX, part 2.) This note is to put on record an occurrence of graptolites which I came across whilst examining antimony deposits in the Southern Shan States in 1918.

The graptolites occur very abundantly in some shales which are exposed near, and in a small stream just west of the village of Hwe-noi (21° 46′ : 97° 35′), about 12 miles north of the town of Mong Kung, in the Mong Kung State. White and yellowish sandy shales are seen overlying a nearly black variety of shale, and in the three varieties the graptolites, which consist of *Monograptus* sp., and *Diplograptus* sp., are found. Owing to lack of time, I was not able to follow up the band, or work out the geology, but a short distance to the north-east and apparently dipping under these graptolite shales is an exposure of the Hwe Mawng purple beds.

[H. CECIL JONES.]

The growth of an efflorescence of Cerium sulphate on Travancore Graphite (Plate 7).

The object of this short note is to place on record the phenomenon of the growth of an efflorescence of cerium sulphate, under ordinary atmospheric conditions, on the surface of a specimen of graphite. Plate No. 7 shows a series of photographs ($4\frac{1}{2}$ times natural size) of the efflorescence growing on the surface of the specimen. The formation of the efflorescence was first noticed in the Presidency College, Madras, where I was Professor of Geology. The graphite came originally from a mine at Vellanad in the Nedumangad Taluk of Travancore State, and was obtained from a vein of graphite at a depth of 580 feet. The mines were closed about 1910 immediately after the vein had been reached. When first received at the Presidency College, Madras, the specimen was exactly like ordinary graphite in appearance but on being kept in one of the show cases of the Geological Museum the efflorescence of cerium sulphate slowly formed on its surface. A portion of the specimen was subsequently brought to the offices of the Geological Survey of India, Calcutta, where the efflorescence continued to form.

The graphite contains visible grains of amber coloured monazite, and occasional minute grains of iron pyrites. The monazite grains, as far as could be observed, never show any sign of decomposition, and the growth of the cerium sulphate efflorescence is least vigorous where monazite is visible in the specimen. The efflorescence is canary yellow in colour; it dissolves slowly but completely in cold water, the solution giving :—

(1) a copious precipitate with acid barium chloride solution, and
(2) a dense white precipitate of lenticular crystals of $3\ Ce\ SO_4.\ Na_2\ SO_4.\ 2\ H_2O.$ with sulphuric acid and sodium sulphate solution.

That the cerium is present in the *cerous* form is shown by the fact that the aqueous solution of the efflorescence gives, with caustic soda, a white precipitate changing gradually to yellow, while the addition of hydrogen peroxide followed by a little ammonia gives a dark orange precipitate of $Ce\ O_3.\ H_2O$.

The following estimation of cerium in the original graphite was made by my colleague W. Erlam Smith, Professor of Chemistry in the Presidency College, Madras. 4·560 grammes of graphite dust, as free as possible from monazite and pyrites, were fused with sodium peroxide in a nickel crucible with a view to burning off the carbon. The melt was extracted with water and digested with hydrochloric acid, and, after filtering off the insoluble residue (silica and some unburnt graphite), ammonium oxalate was added to the filtrate to precipitate rare earths. On examination in the usual way the filtrate from the oxalate treatment was found to contain only iron and aluminium (both in considerable quantity) and phosphoric acid (*a very small amount*). The rare earth oxalate precipitate was found to contain no thorium or yttrium, only a trace of lanthanum and didymium, and 0·295 grammes of $Ce\ O_2$, which is equivalent to nearly $6\frac{1}{2}$ per cent. in the original graphite.

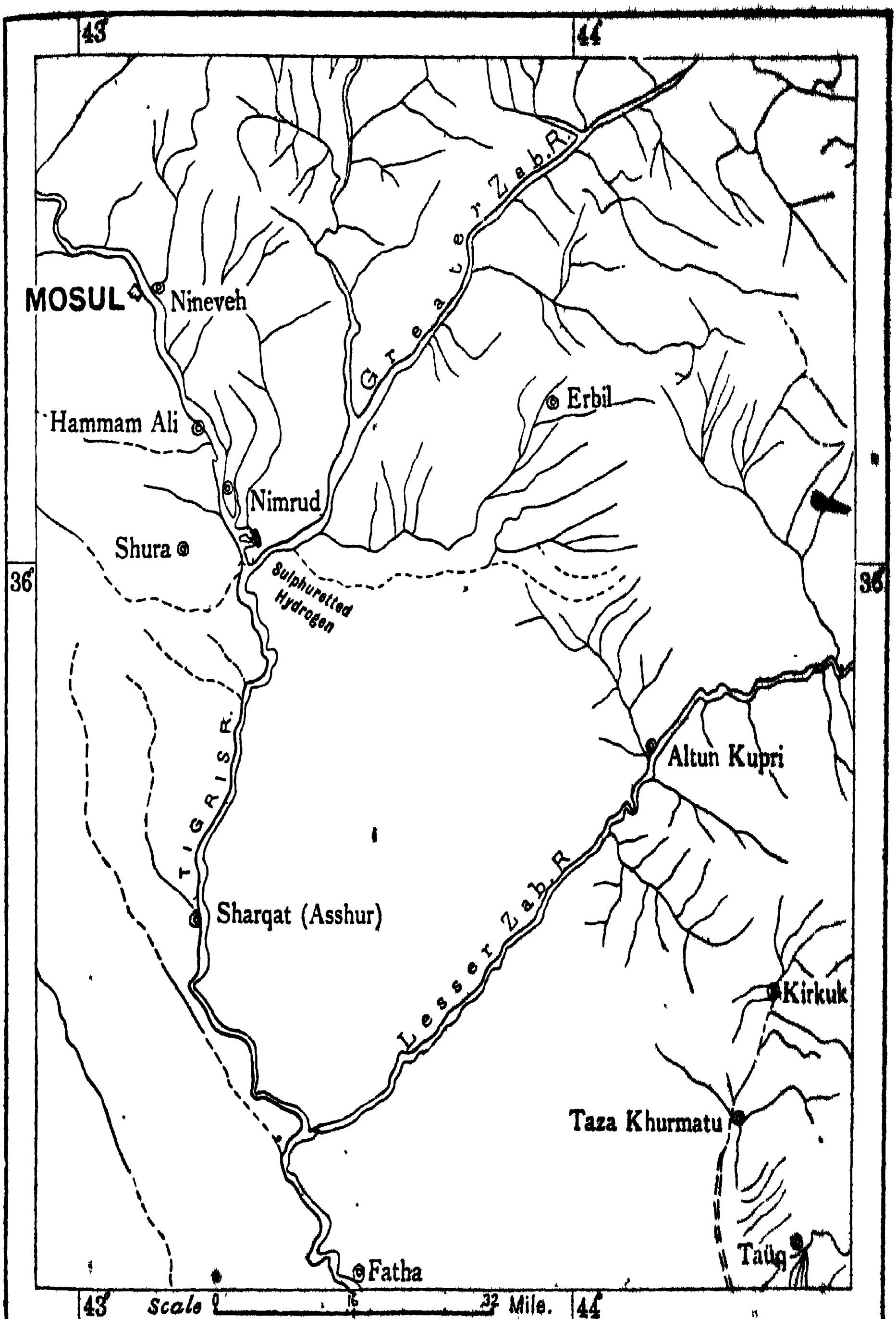
In view of the very small amount of phosphoric acid, lanthana and didymia found, and the absence of thoria it seems probable that cerium is present in the graphite in some other mineral form in addition to monazite. Up to the present it has been impossible definitely to identify any other compound of cerium, but the behaviour of the crude graphite *in vacuo*, and in the presence of water, is somewhat significant. A specimen of the graphite dust (obtained by cutting through the specimen with a fine hacksaw), as free as possible from monazite and pyrites, was washed thoroughly with water and then transferred immediately, while wet, to a glass tube sealed at one end. In the open end of the tube was then placed a roll of lead acetate paper, and the end of the tube was attached to a Gaede pump and the tube exhausted. The moist solid was then *very gently* warmed when immediately the lead paper blackened all over. This could not be due to the action of water on pyrites and would appear to indicate the presence of some less stable sulphide.

EXPLANATION OF PLATE 7.

Growth of an efflorescence of cerium sulphate on the surface of a specimen of Travancore graphite (magnified 4½ times).

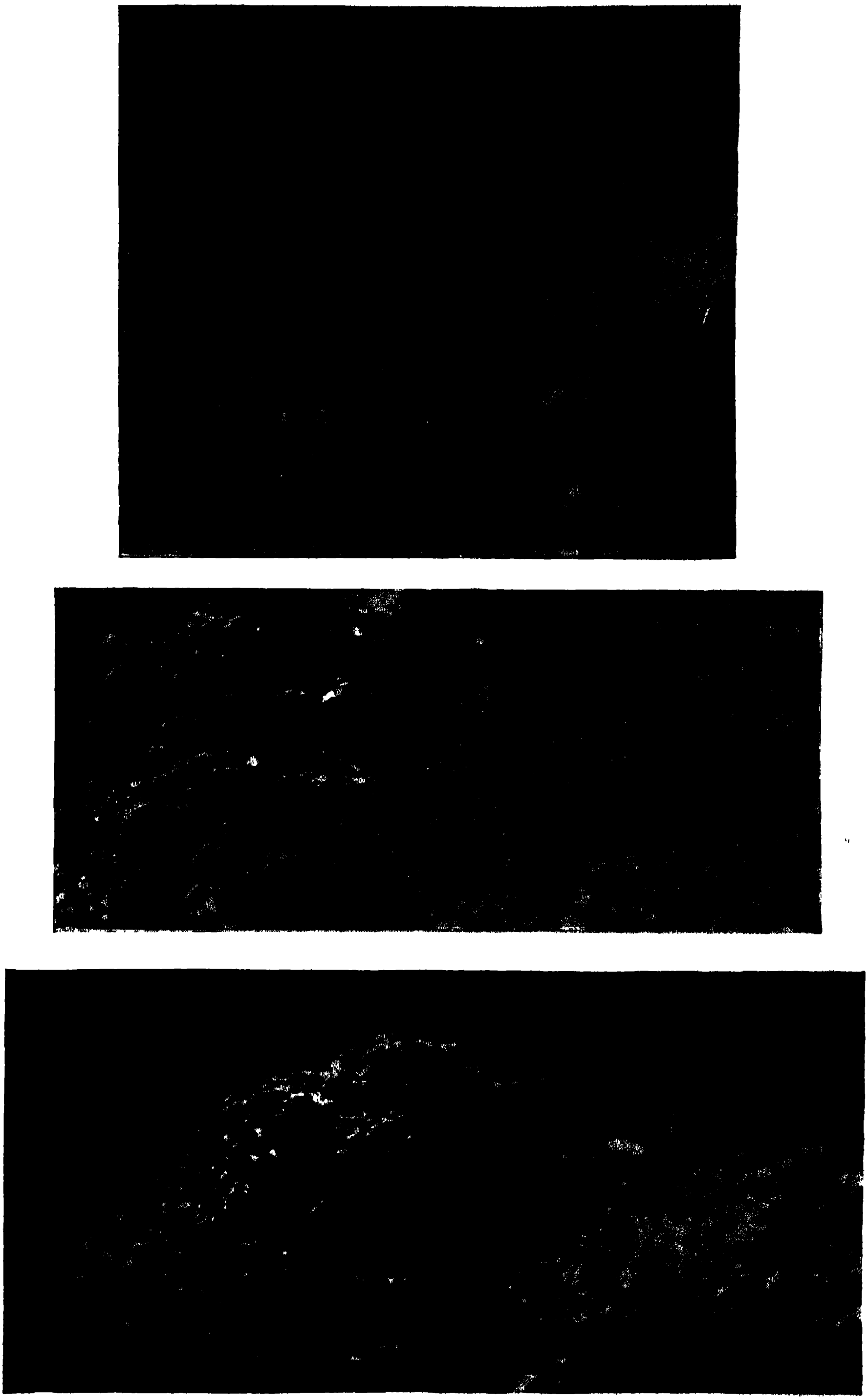
[MURRAY STUART.]

CALCUTTA : PRINTED BY SUPDT. GOVT. PRINTING, INDIA, 8, HASTINGS STREET.



G. S. I. Calcutta.

SULPHURETTED HYDROGEN NEAR MOSUL.



Photos. by K. F. Watkinson. *G. S. I. Calcutta.*

GROWTH OF AN EFFLORESCENCE OF CERIUM SULPHATE ON THE SURFACE OF A SPECIMEN OF TRAVANCORE GRAPHITE (magnified 4½ times).

RECORDS

OF

THE GEOLOGICAL SURVEY OF INDIA.

Part 3.] 1921 [March.

THE MINERAL PRODUCTION OF INDIA DURING 1919. BY E. H. PASCOE, D.SC., M.A., F.G.S., *Officiating Director, Geological Survey of India.*

CONTENTS.

I.—INTRODUCTION.

THE method of classification adopted in the first Review of Mineral Production published in these *Records* (Vol. XXXII) although admittedly not entirely satisfactory, is still the best that can be devised under present conditions. The methods of collecting the returns are becoming more precise every year and the machinery employed for the purpose more efficient. Hence the number of minerals included in Class I—for which approximately trustworthy annual returns are available—is gradually increasing, and it is hoped that before long the minerals of Class II—for which regularly recurring and full particulars cannot be procured—will be reduced to a very small number. In the case of minerals still exploited chiefly under primitive native methods and thus forming the basis of an industry carried on by a large number of persons each working independently and on a very small scale, the collection of reliable statistics is impossible, but the total error from year to year is not improbably approximately constant and the figures obtained may be accepted as a fairly reliable index to the general trend of the industry. In the case of gold, the small indigenous alluvial industry contributes such an insignificant portion to the total outturn that any error from this source may be regarded as negligible.

From table 1 it will be seen that there has been an apparent increase of over £6,000,000 or 38·39 per cent. in the value of the total production over that of 1918. The value figures, however, are largely artificial. In some instances although the output has increased in quantity, it has decreased in value. This decrease is principally due to the fall in the market prices of ores and metals which indicate that the market is gradually returning to normal conditions as a result of the cessation of the war. In accordance with an order of the Government of India, the sterling values in all tables for the year 1919 have been derived from rupee values by conversion at the rate of Rs. 10=£1. The actual average value of the rupee during 1919 was 1*s.* $8\frac{27}{32}$*d.* (Rs. 11·514=£1); the highest value reached was 2*s.* $4\frac{7}{8}$ *d.* and the lowest value 1*s.* $5\frac{31}{32}$*d.* The values for the year 1918 have been calculated at the rate of one rupee=1*s.* 4*d.* (Rs. 15=£1), the actual average value of the rupee being 1*s.* $5\frac{11}{16}$*d.*; the highest value reached in that year was 1*s.* $5\frac{31}{32}$*d.* and the lowest 1*s.* $4\frac{31}{32}$*d.*

Mineral Concessions granted.

The number of mineral concessions granted during the year amounted to 708 as against 719 in the preceding year; 602 of these were prospecting licenses and 106 mining leases,

TABLE 1.—*Total value of Minerals for which returns of Production are available for the years 1918 and 1919.*[1]

—	1918. (Rupee = 1*s.* 4*d.*)	1919. (Rupee=2*s.*)	Increase.	Decrease.	Variation per cent.
	£	£	£	£	
Coal	6,017,215	10,119,256	4,102,041	...	+68·1
Gold	2,060,152	2,256,039	195,887	...	+9·5
Petroleum	1,131,904	1,834,308	702,404	...	+62
Salt	1,645,195	1,823,522	178,327	...	+10·8
Manganese(*a*)	1,481,735	1,546,330	64,595	...	+4·36
Mica(*a*)	625,271	863,448	238,177	...	+38·1
Lead and Lead-ore	450,477	668,642	218,165	...	+48·32
Tungsten-ore	726,681	539,544	...	187,137	—25·75
Silver	295,696	487,246	191,550	...	+64·72
Saltpetre	589,190	471,247	...	117,943	—20
Building materials	263,290	436,183	172,893	...	+65·7
Tin and Tin-ore	134,635	241,150	106,515	...	+79·1
Ruby, Sapphire and Spinel	40,310	108,087	67,777	...	+168·1
Chromite	52,063	88,724	36,661	...	+70·4
Jadestone(*a*)	124,113	87,102	...	37,011	—29·8
Monazite	58,819	60,712	1,893	...	+3·2
Copper-ore	4,053	52,416	48,363	...	+1193·2
Clay	14,084	49,960	35,876	...	+254·7
Iron-ore	41,105	45,887	4,782	...	+11·6
Diamond	2,625	20,825	18,200	...	+693·3
Magnesite	4,641	19,728	15,087	...	+325·08
Steatite	7,708	6,498	...	1,210	—15·7
Corundum	4,108	5,347	1,239	...	+30·16
Alum	960	4,800	3,840	...	+400
Ochre	2,890	3,600	710	...	+24·6
Gypsum	1,139	2,869	1,730	...	+151·9
Bauxite	894	1,934	1,040	...	+116·4
Asbestos	965	1,656	691	...	+71·6
Barytes	2,948	1,561	...	1,387	—47·05
Antimony	6	203	197	...	...
Graphite	361	819	458	...	+126·9
Amber	87	616	529	...	+608
Apatite	3,400	500	...	2,900	—85·3
Molybdenite	62	101	39	...	+63
Potash	46	42	...	4	—8·7
Samarskite	4	10	6	...	+150
Aquamarine	180	...	...	180	...
Platinum	2	...	...	2	...
Total	**15,789,014**	**21,850,912**	6,409,672	347,774	+38·39
			+ 6,061,898		

(*a*) Export values.

[1] The increases or decreases are shown in sterling values, taking the rupee at 1*s.* 4*d.* for 1918 and at 2*s.* for 1919. (The true average for 1918 was 1*s.* 5$\frac{1}{16}$*d.* and for 1919, 1*s.* 8$\frac{27}{32}$*d.*)

II.—MINERALS OF GROUP I.

Chromite.	Gold.	Lead.	Monazite.	Salt.
Coal.	Graphite.	Magnesite.	Petroleum.	Saltpetre.
Copper.	Iron.	Manganese.	Ruby, Sapphire and Spinel.	Silver.
Diamonds.	Jadeite.	Mica.		Tin.
		Tungsten.		

Chromite.

The marked increase in the output of chromite during the year 1918 was not repeated during the present year. In fact there was a distinct decrease in output, especially in Baluchistan, but a decided increase in the total value of the material won, which is due largely to the increase in the exchange value of the rupee. The recently discovered property in Mysore all but maintained its yield of the year previous.

TABLE 2.—*Quantity and value of Chromite produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)		Quantity.	Value. (Rupee = 2*s.*)	
	Tons.	Rs.	£	Tons.	Rs.	£
Baluchistan . .	22,944	3,44,160	22,944	13,223·3	4,29,757	42,976
Bihar and Orissa .	1,085·5	24,666	1,644·4	843·8	12,721	1,272
Mysore . . .	33,740	4,12,115	27,474·3	22,372	4,44,766	44,476
Total .	**57,769·5**	*7,80,941*	*52,062·7*	**36,439·1**	*8,87,244*	*88,724*

Coal.

There was an increase of about 2 million tons, or over 9 per cent., in the output of coal. This increase was due largely to Bengal and Bihar and Orissa; Central India and Baluchistan shewed a decided decrease. There was a small increase in the pit's mouth value everywhere, except in Central India and the Central Provinces. In the fields of Bengal and Bihar and Orissa, the rates of increase were respectively Re. 0-1-2 and Re. 0-2-11 per ton.

TABLE 3.—*Average price (per ton) of coal extracted from the Mines in each province during the year 1919.*

Province.	Average price per ton.		
	Rs.	A.	P.
Assam	7	10	6
Baluchistan	15	12	2
Bengal	5	0	1
Bihar and Orissa	4	1	2
Burma	(a)0	4	0
Central India	3	9	7
Central Provinces	5	7	0
North-West Frontier Province	5	0	0
Punjab	11	12	8
Rajputana	6	9	0

(a) The low value is due to difficulty of transport.

TABLE 4.—*Origin of Indian Coal raised during 1918 and 1919.*

—	Average of last five years.	1918.	1919.
	Tons.	Tons.	Tons.
Gondwana Coalfields	17,542,676	20,322,892	22,238,802
Tertiary Coalfields	408,907	399,601	389,235
Total	...	**20,722,493**	**22,628,037**

TABLE 5.—*Provincial Production of Coal during the years 1918 and 1919.*

Province.	1918.	1919.	Increase.	Decrease.
	Tons.	Tons.	Tons.	Tons
Assam	294,484	291,734	...	2,750
Baluchistan	43,125	34,328	...	8,797
Bengal	5,302,295	5,777,632	475,337	...
Bihar and Orissa	13,680,030	15,119,812	1,439,782	...
Burma	...	1,500	1,500	...
Central India	199,975	182,141	...	17,834
Central Provinces	481,470	497,021	15,551	...
Hyderabad	659,122	662,196	3,074	...
North-West Frontier Province	240	20	...	220
Punjab	50,418	46,893	...	3,525
Rajputana	11,334	14,760	3,426	...
Total	**20,722,493**	**22,628,037**	*1,938,670*	*33,126*

TABLE 6.—*Output of the Gondwana Coal fields for the years 1918 and 1919.*

—	1918. Tons.	1918. Per cent. of Indian Total.	1919. Tons.	1919. Per cent. of Indian Total.
Bengal, Bihar and Orissa—				
Daltonganj	81,816	·39	63,250	·28
Giridih	846,592	4·09	950,045	4·20
Jainti	140,373	·68	154,850	·69
Jharia	10,952,010	52·85	12,145,917	53·68
Bokaro-Ramgarh . .	541,977	2·62	722,682	3·19
Raniganj	6,368,519	30·74	6,815,126	30·11
Sambalpur (Hingir-Rampur)	51,038	·25	45,574	·20
Central India—				
Umaria	199,975	·96	182,141	·80
Central Provinces—				
Ballarpur	135,375	·65	126,366	·56
Pench Valley . . .	267,303	1·29	285,356	1·26
Mohpani	78,792	·38	85,299	·38
Hyderabad—				
Singareni	659,122	3·18	662,196	2·93
Total .	**20,322,892**	**98·08**	**22,238,802**	**98·28**

TABLE 7.—*Output of Tertiary Coalfields for the years 1918 and 1919.*

—	1918. Tons.	1918. Per cent of Indian Total.	1919. Tons.	1919. Per cent of Indian Total.
Assam—				
Makum	267,749	1·42 (Makum to Khasi and Jaintia Hills)	259,652	1·29 (Makum to Khasi and Jaintia Hills)
Naga Hills . .	24,299		29,941	
Sibsagar . . .	1,827		1,541	
Khasi and Jaintia Hills .	609		600	
Baluchistan—				
Khost	29,600	·21 (Khost to Burma)	23,703	·16 (Khost to Burma)
Sor Range . . .	13,525		10,625	
North-West Frontier Province—	240		20	
Burma— . .	...		1,500	
Punjab—				
Jhelum . . .	39,651	·24 (Jhelum to Shahpur)	35,845	·21 (Jhelum to Shahpur)
Mianwal . . .	5,152		5,822	
Shahpur	5,615		5,226	
Rajputana—				
Bikanir	11,334	·05	14,760	·06
Total .	**399,601**	1·92	**389,235**	**1·72**

Exports of coal rose to over half a million tons. Imports, on the other hand, fell from 54,000 tons to 49,000 tons.

TABLE. 8.—*Exports of Indian Coal.*

—	1918.		1919.	
	Quantity.	Value. (Rupee = 1s. 4d.)	Quantity.	Value. (Rupee = 2s.)
	Tons.	£	Tons.	£
Ceylon	51,935	36,442	296,192	353,169
Straits Settlements (including Labuan).	10,279	6,853	116,304	128,899
Sumatra	...	...	41,756	51,350
Other Countries	12,121	8,703	53,678	67,476
TOTAL	74,335	51,998	507,930	600,894
Coke and Patent Fuel	131	346	607	2,917
Total Coal, Coke and Patent Fuel	**74,466**	*52,344*	**508,537**	*603,811*

TABLE 9.—*Imports of Coal, Coke and Patent Fuel during 1918 and 1919.*

—	1918.		1919.	
	Quantity.	Value. (Rupee = 1s. 4d.)	Quantity.	Value. (Rupee = 2s.)
	Tons.	£	Tons.	£
Australia (including New Zealand).	4,857	9,741	3,320	6,364
Natal	13,020	29,805	18,089	54,302
Portuguese East Africa	22,680	37,416	16,880	43,716
United Kingdom	7,580	33,944	4,656	19,750
Other Countries	5,065	17,578	4,734	10,588
TOTAL	53,202	128,484	47,688	134,720
Coke	1,144	6,227	957	6,773
Patent Fuel	...	11	30	171
Total	**54,346**	*134,722*	**48,675**	*141,664*

The average number of persons employed daily in the coalfields increased by over 12,000 or about 6½ per cent. The average output per person employed was more than that in the preceding year, *viz.*, 111·05 tons as against 108·3. The total number of fatal accidents was 287 corresponding to a death-rate of 1·41 per thousand persons employed.

TABLE 10.—*Average number of persons employed daily in the Indian Coalfields during 1918 and 1919.*

Province.	Number of persons employed.		Output per person employed.	Number of deaths by accident.	Death-rate per 1,000 persons employed.
	1918.	1919.	1919.	1919.	1919.
Assam . . .	3,085	3,230	90·3	13	4·02
Baluchistan . .	993	1,006	34·1	4	3·97
Bengal . . .	46,149	48,642	118·8	72	1·48
Bihar and Orissa .	118,849	129,927	116·4	161	1·24
Burma . . .	...	70	21·4	...	...
Central India . .	3,047	1,293	140·9	1	·77
Central Provinces .	6,052	6,306	78·8	9	1·43
Hyderabad . .	11,582	11,974	55·3	26	2·17
North-West Frontier Province.	12	5	4·0	...	...
Punjab . . .	1,358	1,191	39·4	1	·84
Rajputana . . .	198	108	136·7	...	...
Total .	**191,325**	**203,752**	...	287	...
AVERAGE .	...	...	111·05	...	1·41

Copper.

The output of copper ore in Singhbhum fell from 20,108 tons in 1917 to only 3,619 tons in 1918. The industry more than recovered itself, however, in 1919, when 32,750 tons, valued at over £52,000, were obtained (see Table 1). Smelting operations were begun at the Rakha Mines during the year 1918 and resulted in the production of 980¼ tons of refined copper in the year 1919.

Diamonds.

The output of diamonds from Central India amounted to 311·9 carats valued at Rs. 2,08,253 (£20,825) as against 73·29 carats valued at Rs. 39,377 (£2,625) in the preceding year.

Gold.

There was again a decrease, amounting to 28,858 oz. in the output of gold. All provinces with the exception of the Punjab shared in this decrease which, however, was borne chiefly by the Mysore fields where the output fell by 19,164 oz.

TABLE 11.—*Quantity and value of Gold produced in India during 1918 and 1919.*

—	1918.			1919.			Labour.
	Quantity.	Value. (Rupee=1*s.* 4*d.*)		Quantity.	Value. (Rupee=2*s.*)		
	ozs.	Rs.	£	ozs.	Rs.	£	
Bihar and Orissa—							
Singhbhum	2,085	1,48,573	9,905	173	11,776	1,178	228
Burma—							
Myitkyina	105·57	6,069	404	..	..	..	..
Katha	19·23	1,060	71	7·70	440	44	} 38
Upper Chindwin	46·40	3,960	264	30·84	2,981	298	
Hyderabad	11,502·8	6,74,046	44,936	10,647·6	6,10,195(*a*)	61,019(*a*)	910
Madras	17,831	10,08,279	67,219	11,018	5,62,918(*b*)	56,292(*b*)	554
Mysore	504,412	2,90,51,774	1,936,785	485.248	2,13,62,846(*c*)	2,136,285(*c*)	24,409
Punjab	109·95	8,119	541	130·73	8,914	891	286
United Provinces	6·37	398	27	4·6	321	32	20
Total	**536,118·32**	*3,09,02,278*	*2,060,152*	**507,260·56**	*2,25,60,391*	*2,256,039*	**26,454**

(*a*) Figures for actual sales not available.
(*b*) English sales £36,011 ; Indian sales Rs. 2,02,808.
(*c*) English sales £1,236,155 ; Indian sales Rs. 90,01,296.

Graphite.

There was a recovery in the output of graphite which rose from 81 tons valued at Rs. 5,410 in 1918 to 127 tons valued at Rs. 8,189 in the year under review. Rajputana produced only 5 tons; in Kalahandi the output rose from 80 to 100 tons and in Patna amounted to 22 tons.

Iron.

There was a considerable increase in the output of iron-ore. The Tata Iron and Steel Company produced 232,368 tons of pig iron, 134,061·2 tons of steel including rails and 2,650 tons of ferro-manganese, while the Bengal Iron and Steel Company produced

84,965 tons of pig iron, 4,732 tons of ferro-manganese and 29,635 tons of cast iron castings. In the Central Provinces there was a reduction of over 31 per cent. in the number of indigenous furnaces which fell from 232 in 1918 to 159 in the year under review. The Burma Corporation Limited are extracting limonite at Wetwun near Maymyo, Burma, for use as a flux in their lead smelting at Namtu; large quantities are said to be available.

TABLE 12.—*Quantity and value of Iron-ore produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)		Quantity.	Value. (Rupee = 2*s.*)	
	Tons.	Rs.	£	Tons.	Rs.	£
Bihar and Orissa—						
Singhbhum .	120,363	1,27,239	8,483	104,728·5	139,639	13,963·9
Orissa} . .	339,304·6	4,52,163	30,144	424,543·6	294,566	29,456·6
Burma . .	26,680	13,982	932	31,880	15,947	1,594·7
Central Provinces	6,097	23,185	1,546	2,596	8,716	871·6
Other Provinces and States.	224·5	(*a*)	...	2·1	(*a*)	...
Total .	**492,669·1**	*6,16,569*	*41,105*	**563,750·2**	*458,868*	*45,886·8*

(*a*) Not available.

Jadeite.

There was a decrease of nearly 37 per cent. in the output of jadeite in Burma, which fell from 3,203·1 cwt. valued at Rs. 3,78,135 (£25,209) in 1918 to 2,019·2 cwt. valued at Rs. 2,80,454 (£28,045) in the year under review.

Lead.

There was an increase of some 6,600 tons in the amount of ore and slag produced at the Bawdwin mines; the amount of metal extracted was also greater than that recovered in the year 1918, the total output being 19,090 tons valued at Rs. 66,86,416 as against 18,995 tons valued at Rs. 67,51,842 in the preceding year. The quantity of silver extracted rose from 1,970,614 oz. valued at Rs. 44,33,881 in 1918 to 2,164,854 oz. valued at Rs. 48,70,919 in the year under review.

TABLE 13.—*Production of Lead and Silver Ore during 1918 and 1919.*

—		1918.					1919.				
		QUANTITY.	VALUE. (Rupee=1*s.* 4*d.*)				QUANTITY.	VALUE. (Rupee=2*s.*)			
		Lead-ore and slag.	Lead-ore and lead.		Silver.		Lead-ore and slag.	Lead-ore and lead.		Silver.	
		Tons.	Rs.	£	Rs.	£	Tons.	Rs.	£	Rs.	£
Burma—											
Northern States.	Shan	50,679 (ore)	61,97,478(*a*)	413,165	41,50.793	276,720	67,816 (ore)	66,56,300(*g*)	665,630	48,62,113	486,211·3
		2,042 (slag)	2.69,040(*b*)	17,936	26,388	1,759	96 (slag)	12,250(*h*)	1,225	754	75·4
		9,254 (gossan flux)	1,61,070(*c*)	10,738	83,675	5,578	1,124 (gossan flux)	12,950(*i*)	1,295	7,958	795·8
		425 (secondaries)	1,24,254(*d*)	8,284	1,73,025	11,535	2 (copper-ore)	..	..	94	9·4
Southern States.	Shan	117·05	4,865	324	..	..	125·61	4,466	446·6	..	..
Central Provinces—											
Drug . . .		3	450	30	..	..	2·5	450	45	..	..
Mysore—											
Chitaldrug . .		·03	(*e*)	..	..	..	..	..	..	..	..
Total .		62,520·08	*67,57,157*	*450,477*	*44,33,881*(*f*)	295,592	69,166·11	*66,86,416*	*668,641·6*	*48,70,919*(*f*)	*487,091·9*

(*a*) Value of 17,507·34 tons of lead extracted.
(*b*) Value of 760·18 tons of lead extracted.
(*c*) Value of 376·40 tons of lead extracted.
(*d*) Value of 351·03 tons of lead extracted.
(*e*) Value not returned.
(*f*) Value of 1,970,614 ozs. of silver extracted.
(*g*) Value of 19,018·06 tons of lead extracted.
(*h*) Value of 34·98 tons of lead extracted.
(*i*) Value of 37·07 tons of lead extracted.
(*f*) Value of 2,164,853·68 ozs. of silver extracted.

Magnesite.

The sudden demand for Indian magnesite, which arose during the war owing to the temporary loss of Styrian supplies, ceased during the year 1918 and the Salem output fell from over 18,000 tons in 1917 to a little under 6,000 tons. In 1919, however, the industry revived and the output reached a figure only 1,000 tons short of the quantity raised in 1917.

TABLE 14.—*Quantity and value of Magnesite produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee=1*s.* 4*d.*)		Quantity.	Value. (Rupee=2*s.*)	
Madras—	Tons.	Rs.	£	Tons.	Rs.	£
Salem . .	5,773	69,276	4,618	13,012	156,144	15,614
Mysore . .	80	342	23	4,114	41,140	4,114
Total .	**5,853**	*69,618*	*4,641*	**17,126**	*197,284*	*19,728*

Manganese.

The output of manganese ore increased slightly from about 518,000 tons in 1918 to about 538,000 tons in the year under review. As usual, over 80 per cent. of the production came from the Central Provinces. The amount exported (exclusive of exports from Mormugao) was only 370,000 tons, resulting in a further increase in stocks held in this country.

TABLE 15.—*Export of Manganese ore during 1918 and 1919.*

—	1918.		1919.	
	Quantity.	Value. (Rupee =1*s.* 4*d.*)	Quantity.	Value. (Rupee=2*s.*)
To—	Tons.	£	Tons.	£
United Kingdom . .	246,005	321,360	224,157	422,516
France	48,400	66,908	52,300	92,163
Italy	2,475	3,185	3,250	7,249
Japan	24,846	43,912	1,690	5,170
United States of America .	29,100	47,217	12,800	22,951
Other Countries . .	...	...	76,262	147,683
Total .	**350,826**	*482,582*	**370,459**	*697,732*

TABLE 16.—*Quantity and value of Manganese ore produced during 1918 and 1919.*

—	1918.		1919.	
	Quantity.	Value f. o. b. at Indian ports.	Quantity.	Value f. o. b. at Indian ports.
	Tons.	£	Tons.	£
Bihar and Orissa—				
Singhbhum . . .	450	1,170	325	877
Gangpur . . .	15,895	41,327	21,208	57,262
Bombay—				
Chota Udepur . .	7,202	18,725	14,993	40,481
Panch Mahals . .	30,893	80,322	29,540	79,758
Central Provinces—				
Balaghat . . .	214,972	634,167	238,681	704,109
Bhandara . . .	32,245	95,123	34,632	102,254
Chindwara . . .	72,398	213,574	55,310	163,165
Jubbulpore . . .	65	192	...	...
Nagpur . . .	118,948	350,897	115,852	341,763
Madras—				
Vizagapatam . . .	2,230	3,382	2,778	5,047
Mysore	22,655	42,856	24,676	51,614
Total .	**517,953**	*1,481,735*	**537,995**	*1,546,330*

Mica.

The declared output of mica shows a decrease of nearly 9,000 cwt., over that of the previous year, having dropped from about 54,700 cwt. to 45,700 cwt. These figures are, however, not very reliable, and cannot be regarded as indicating a relaxation of the urgent demand for this mineral in all the allied countries. As usual, the exports considerably exceeded the recorded production and amounted to 59,098 cwt. valued at £863,448. This figure is less by 856 cwt. than the exports of the year 1918.

TABLE 17.—*Quantity and value of Mica produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1s. 4d.)		Quantity.	Value. (Rupee = 2s.)	
	Cwts.	Rs.	£	Cwts.	Rs.	£
Bihar and Orissa	45,607·5	18,60,714	124,047·6	34,230·2	15,96,781	159,678·1
Central India (Gwalior State).	290·2	(*a*)	...	...	...	...
Madras . .	6,544·7	4,61,593	30,772·9	8,320·6	5,25,800	52,580
Mysore . .	17·9	781	52	...	...	...
Rajputana .	2,250	56,429	3,762	3,232·9	75,845	7,584·5
Total .	**54,710·3**	*23,79,517*	*158,634·5*	**45,783·7**	*21,98,426*	*219,842·6*

(*a*) Value not returned.

Monazite.

There was a slight decrease in the output of monazite in Travancore, which fell from 2,117·2 tons, valued at £58,819 in the year 1918 to 2,023·7 tons, valued at £60,712, in the year under review.

Petroleum.

There was an increase of about 19 million gallons in the output of petroleum, the total production being 305,651,816 gallons. The chief increases were over 32½ million gallons from the Singu field, over ½ million from the Upper Chindwin field and 1 million from the Badarpur field in Assam. The Yenangyaung field was responsible for the principal decrease in production, its output having fallen by about 13½ million gallons. There were also falls in the outputs of Yenangyat, Minbu, Digboi, and Attock.

TABLE 18.—*Quantity and value of Petroleum produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)		Quantity.	Value. (Rupee = 2*s.*)	
	Gallons.	Rs.	£	Gallons.	Rs.	£
Burma—						
Akyab . .	10,821	3,122	208	10,718	3,092	309·2
Kyaukpyu .	46,598	22,305	1,487	48,944	22,865	2,286·5
Yenangyaung Field.	203,638,048	1,17,57,392	783,826	190,322,077	1,09,88,797	1,098,879·7
Singu Field .	61,035,972	35,24,016	234,934	93,626,506	54,05,802	540,580·2
Yenangyat Field	4,739,587	2,63,310	17,554	4,123,387	2,32,828	23,282·8
Minbu . .	4,826,735	6,03,342	40,223	4,423,361	8,29,380	82,938
Thayetmyo .	63,000	7,900	527	113,784	14,223	1,422·3
Upper Chindwin	473,800	35,535	2,369	1,085,030	81,877	8,187·7
Assam—						
Digboi (Lakhimpur).	5,425,580	2,68,453	17,897	5,242,617	2,59,400	25,940
Badarpur .	5,574,068	4,18,055	27,870	6,546,062	4,90,953	49,095·3
Punjab—						
Attock . .	750,000	75,000	5,000	113,360	14,170	1,417
Mianwali .	807	129	9	970	191	19·1
Total .	286,585,011	*1,69,78,559*	*1,131,904*	305,651,816	*1,83,43,078*	*1,834,307·8*

There was a very large increase in the imports of kerosene oil, which rose from 21¾ gallons in 1918 to 3½ times that amount in 1919, *viz.*, 74⅕ million gallons, valued at over £5¼ million. The exports of paraffin wax rose from 508,952 cwt., valued at £775,962 in the year 1918 to 532,479 cwt., valued at £1,216,252 in the year under review.

TABLE 19.—*Imports of Kerosene oil during 1918 and 1919.*

—	1918.		1919.	
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)	Quantity.	Value. (Rupee = 2*s.*)
From—	Gallons.	£	Gallons.	£
Borneo	...	...	19,160,462	1,017,638
Persia	8,193,438	315,946	11,986,659	871,997
Straits Settlements (including Labuan).	...	...	4,431,042	232,917
United States of America	13,574,515	772,719	38,635,385	3,142,300
Other Countries . .	223	16	444	55
Total .	*21,768,176*	*1,088,681*	*74,213,992*	*5,264,907*

TABLE 20.—*Exports of Paraffin wax from India during 1918 and 1919.*

—	1918. Quantity.	1918. Value. (Rupee = 1*s.* 4*d.*)	1919. Quantity.	1919. Value. (Rupee = 2*s.*)
To—	Cwt.	£	Cwt.	£
United Kingdom . .	103,680	157,099	131,764	290,639
China	12,592	28,818	44,300	108,289
Japan	88,520	134,255	129,308	294,199
Egypt	46,959	71,223	21,909	50,019
Portuguese East Africa .	61,200	92,820	11,280	25,662
United States of America	14,000	21,233	32,800	74,621
Australia (including New Zealand).	61,441	93,209	48,569	110,496
Other Countries . .	120,560	177,305	112,549	262,327
Total .	**508,952**	*775,962*	**532,479**	*1,216,252*

Ruby, Sapphire and Spinel.

There was a fall in the output of the Ruby Mines, from 164,115 carats valued at Rs. 6,04,649 to 158,577 carats valued at Rs. 10,80,870.

TABLE 21.—*Quantity and value of Ruby, Sapphire and Spinel produced in India during 1918 and 1919.*

—	1918. Quantity.	1918. Value. (Rupee = 1*s.* 4*d.*)		1919. Quantity.	1919. Value. (Rupee = 2*s.*)	
	Carats.	Rs.	£	Carats.	Rs.	£
Burma— Mogok .	1,01,637 (Rubies)	5,17,367	34,491	88,847 (Rubies)	8,74,343	87,434
	34,949 (Sapphires)	83,571	5,571	47,286 (Sapphires.)	2,01,699	20,170
	27,529 (Spinels)	3,711	248	22,444 (Spinels)	4,828	483
Total .	**164,115**	*6,04,649*	*40,310*	**158,577**	*10,80,870*	*108,087*

Salt.

The large increase in the output of salt in the year 1918 was maintained in the year under review, the total approaching 2 million tons. The chief increase was one of 150,000 tons in Bombay and Sind. With the exception of Burma all other localities registered small decreases. Imports rose from 388,500 tons in 1918 to 481,700 tons in the year under review, more than half of the total imports being from Egypt and Aden.

TABLE 22.—*Quantity and value of Salt produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1s. 4d.)		Quantity.	Value. (Rupee = 2s.)	
	Tons.	Rs.	£	Tons.	Rs.	£
Aden	142,075	14,78,063	98,538	127,561	15,34,454	153,445·4
Bengal	30	582	39	10	161	16·1
Bombay and Sind	481,808	55,92,452	372,830	630,481	50,23,066	502,306·6
Burma	62,828	51,60,774	344,051	74,492	48,77,182	487,718·2
Central India	5·3	362	24	...	...	...
Gwalior State	312	14,864	991	149	7,080	708·0
Madras	596,671	92,62,352	617,490	552,308	42,54,068	425,406·8
Northern India	572,668	31,53,660	210,244	505,864	25,25,843	252,584·3
Rajputana	299·4	14,816	988	273	13,367	1,336·7
Total	**1,856,696·7**	*2,46,77,925*	*1,645,195*	**1,891,138**	*1,82,35,221*	*1,823,522·1*

TABLE 23.—*Quantity and value of Rock-Salt produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1s. 4d.)		Quantity.	Value. (Rupee = 2s.)	
	Tons.	Rs.	£	Tons.	Rs.	£
Salt Range	159,497	4,07,034	27,136	174,598	4,99,550	49,955
Kohat	21,260	37,215	2,481	25,931	53.050	5,305
Mandi	5,085	90,834	6,055	4,800	85,750	8,575
Total	**185,842**	5,35,083	35,672	**205,329**	6,38,350	63,835

TABLE 24.—*Quantity and value of Salt imported into India during 1918 and 1919.*

—	1918.		1919.	
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)	Quantity.	Value. (Rupee = 2*s.*)
From—	Tons.	£	Tons.	£
United Kingdom . .	19,233	94,513	85,017	417,954
Spain	38,305	172,088	53,707	274,928
Aden and Dependencies .	94,061	385,502	136,936	639,219
Egypt	203,662	821,832	145,513	693,729
Italian East Africa . .	33,085	123,990	60,418	282,328
Other Countries . .	213	1,357	158	3,010
Total .	**388,559**	*1,599,282*	**481,749**	*2,311,168*

Saltpetre.

There was a decided fall in the total production of saltpetre due chiefly to a decrease of 41 per cent. in the production of the United Provinces. The output of the Punjab fell by about 18½ per cent. and that of Bihar by 20 per cent. The total Indian production amounted to 17,550 tons valued at Rs. 47,12,474 (£471,247). Exports fell from 23,000 tons in 1918 to 17,000 tons in the year under review. The exports to the United Kingdom fell from 17,000 tons to 6,700 tons, and those of the United States from 5,500 tons to 1,300 tons.

TABLE 25.—*Quantity and value of Saltpetre produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)		Quantity.	Value. (Rupee = 2*s.*)	
	Tons.	Rs.	£	Tons.	Rs.	£
Bihar . .	6,299·3	23,13,103	154,207	5,044·4	11,66,268	116,627
Central India .	26·2	2,698	180	47·6	4,185	418
Punjab . .	6,946·7	19,84,956	132,330	5,661·8	17,13,277	171,328
Rajputana .	245	80,290	5,353	180	46,005	4,600
United Provinces	11,223·6	44,56,808	297,120	6,616·2	17,82,739	178,274
Total .	**24,740·8**	*88,37,855*	*589,190*	**17,550**	*47,12,474*	*471,247*

TABLE 26.—*Distribution of Saltpetre exported during 1918 and 1919.*

	1918.		1919.	
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)	Quantity.	Value. (Rupee = 2*s.*)
	Cwt.	£	Cwt.	£
Ceylon	...	...	59,749	76,044
Japan	11,968	14,775	10,145	20,733
Mauritius and Dependencies .	...	...	39,534	58,463
United Kingdom . . .	337,828	445,825	133,898	235,875
United States of America .	110,067	141,947	25,896	38,947
Other Countries . . .	8,717	11,908	75,192	124,014
Total .	468,580	*614,455*	344,414	*554 076*

Silver.

The output of silver from Bawdin has already been shown under lead. In addition to this a small quantity, amounting to 753 oz., was produced from the Anantapur gold mine in Madras. The total Indian production of silver was 2,165,606·7 oz., valued at Rs. 48,72,456 (£487,246).

Tin.

The output of tin-ore was nearly doubled rising from 15,607 cwt. in 1918 to 26,891 cwt. in the year under review. The whole of the ore was produced in Lower Burma, nearly 38 per cent. of it in Tavoy, and 39 per cent. in the Southern Shan States. Mergui also produced 2,700 cwt. of block tin. The imports of tin rose from 24,596 cwt. in 1918 to 41,860 cwt. in the year under review. By far the greater part of the tin imported came from the Straits Settlements.

TABLE 27.—*Quantity and value of Tin and Tin-ore for the years 1918 and 1919.*

—	1918.						1919.					
	BLOCK TIN.			TIN-ORE.			BLOCK TIN.			TIN-ORE.		
	Quantity.	Value. (Rupee = 1*s.* 4*d.*)		Quantity.	Value. (Rupee = 1*s.* 4*d.*)		Quantity.	Value. (Rupee = 2*s.*)		Quantity.	Value. (Rupee = 2*s.*)	
	Cwt.	Rs.	£	Cwt.	Rs.	£	Cwt.	Rs.	£	Cwt.	Rs.	£
Burma—												
Amherst	..	..	..	1,317·5	1,31,500	8,767	..	..	..	1,232·5	85,040	8,504
Mergui*	2,013·6	4,21,854	28,123	1,471·2	1,86,483	12,432	2,742	4,88,183	48,818	3.807·7	3,81,904	38,190
Southern Shan States.	..	..	..	7,609	7,70,415	51,361	..	..	..	10,540	6,56,115	65,612
Tavoy*	..	..	..	4,052·7	4,65,837	31,056	..	..	..	10,160·9	6,81,673	68,107
Thaton	..	..	..	1,157	43,440	2,896	..	..	..	1,149·9	1.19,193	11,919
Total	**2,013·6**	*4,21,854*	*28,123*	**15,607·4**	*15,97,675*	*106,512*	**2,742**	*4,88,183*	*48,818*	**23,831**	*19,23,325*	*192,332*

* Figures taken from "Note on the Mineral Production of Burma for 1918 and 1919."

TABLE 28.—*Imports of Tin unwrought (blocks, ingots, bars and slabs) into India during 1918 and 1919.*

—	1918.		1919.	
	Quantity.	Value. (Rupee = 1*s*.4*d*.)	Quantity.	Value. (Rupee = 2*s*.)
From—	Cwt.	£	Cwt.	£
United Kingdom . .	289	3,993	1,429	10,419
Straits Settlements (including Labuan).	323,833	323,860	39,574	706,392
Other Countries . .	474	4,869	857	14,466
Total .	**24,596**	*332,722*	**41,860**	*731,277*

Tungsten.

There was a decided decrease in the output of wolfram, which fell from 4,431 tons in 1918 to 3,577 tons in the year under review. As usual, most of the output came from Tavoy.

TABLE 29.—*Quantity and value of Tungsten-ore produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1*s*. 4*d*.)		Quantity.	Value. (Rupee = 2*s*.)	
Bihar and Orissa—	Tons.	Rs.	£	Tons.	Rs.	£
Singhbhum .	2·5	7,465	498	1·5	3,867	387
Burma—						
Kyaukse .	·1	250	17	·2	100	10
Mergui* .	376·6	7,87,359	52,490	194·4	3,02,842	30,284
Southern Shan States.	287	6,24,225	41,615	397·6	5,72,544	57,254
Tavoy* .	3,636·1	91,62,490	610,833	2,889·5	44,15,722	441,572
Thaton . .	91·5	2,04,945	13,663	48·1	1,00,370	10,037
Rajputana—						
Marwar .	37·4	1,13,479	7,565	45·5	(*a*)	...
Total .	**4,431·2**	*1,09,00,213*	*726,681*	**3,576·8**	*53,95,445*	*539,544*

* Figures taken from "Note on the Mineral Production of Burma for 1918 and 1919."
(*a*) Not available.

III.—MINERALS OF GROUP II.

Alum. The production of alum rose from 1,322 cwt. in 1918 to 1,853 cwt. valued at Rs. 48,000 (£4,800) in the year under review. The whole output came from the Mianwali district of the Punjab.

Amber. The production of amber in Burma rose from 2·9 cwt. in 1918 to 7·4 cwt. valued at Rs. 6,160 (£616) in the year under review.

Antimony. 6·4 tons of antimony ore valued at Rs. 2,000 (£200) were produced in the Southern Shan States during the year under review. The value represents the actual cost of extraction. There was also a production of 2 lbs. of antimony valued at Rs. 32 from the Jhelum District in the Punjab.

Apatite. The production of apatite from the apatite-magnetite deposits of Singhbhum fell from 5,100 tons in 1918 to 500 tons in 1919. The estimated value of the production was Rs. 5,000 (£500).

Asbestos. There was a rise in the output of asbestos from 357 tons in 1918 to 388 tons valued at Rs. 16,556 (£1,656) in the year under review. Of this 379 tons were won in the Hassan district of Mysore and 9 tons in the Bhandara district of the Central Provinces.

Barytes. 2,590 tons of barytes valued at Rs. 15,615 (£1,561) were produced in the Karnul district of the Madras Presidency, against 2,724 tons in 1918.

Bauxite. There was an increase of 490 tons in the output of bauxite, which amounted to 1,682 tons valued at Rs. 19,343 (£1,934). The whole output came from Jubbulpore. Important bauxite deposits have been recently discovered by Mr. C. S. Middlemiss in the neighbourhood of Chakar in the province of Jammu. The quantity available by quarrying at the surface has been estimated at over one million tons, the beds extending uninterruptedly for many miles. Patches of the same mineral were also observed by Sir Henry Hayden at Sangar. Analyses of three specimens yielded 79·43, 67·03 and 59·56 per cent. of Al_2O_3 and 1·32, 14·15 and 20·67 per cent. of SiO_2 respectively.

TABLE 30.—*Production of Building Materials and Road Metal in India during the year 1919.*

(Rupee = 2s.)

—	GRANITE.		LATERITE.		LIME.		LIMESTONE AND KANKAR.		MARBLE.		SANDSTONE.		SLATE.		TRAP.		MISCELLANEOUS.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£	Tons.	£	Tons.	£	Tons.	£	Tons.	£	Tons.	£	Tons.	£	Tons.	£
Assam .	..	..	..	..	..	..	63.674	14,207	..	..	..	..	..	..	..	..	..	..
Baroda .	1,400	1,722	..	..	..	..	..	..	4	118	..	..	..	..	..	..	..	..
Bihar and Orissa.	..	..	1,523	56	156	6	380,288	82,306	..	..	13,933	1,115	3.035	4.930	40,413	4,392	246,377	20,030
Burma .	177,517	34,310	247.444	32,785	..	..	214.274	32,555	..	..	89,697	13,354	..	..	..	..	387,344	36,288
Central India	..	..	..	..	18,779	23,477	66,960	6,683	..	..	..	..	..	..	..	..	..	..
Central Provinces.	..	..	..	..	..	..	137.488	18.930	..	..	..	..	..	..	..	..	..	..
Hyderabad	52	(a)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Madras .	53,930	1,360	103,314	8,141	..	..	17.490	1,634	..	..	..	..	..	..	..	..	146,638	15,379
North-West Frontier Province.	..	..	..	..	..	..	11.217	757	..	..	..	..	..	..	..	..	..	..
Punjab .	..	..	..	..	..	..	31,046	6.081	..	..	1.840	390	8,058	12.836	..	..	10,153	227
Rajputana .	..	..	..	..	..	..	812	719	8,229	5,947	62,025	17.730	..	..	..	..	31,570	4,238
United Provinces.	..	..	..	..	38	20	2.432	927	..	..	6,000	2,950	17.786	538	..	..	141,799	29,045
Total .	**232,899**	*37,392*	**352,281**	*40.982*	**18,973**	*23,503*	**925,681**	*164,799*	**8,233**	*6,065*	**173,495**	*35,539*	**23,879**	18,304	**40,413**	*4,392*	**983,881**	*105,207*

(a) Not available.

Building Materials. The total estimated value of building-stone and road-metal produced during the year 1919 was Rs. 43,61,833 (£436,183).

Clay. The recorded production of clay was 176,007 tons valued at Rs. 4,99,603 (£49,960).

Corundum. The output of corundum amounted to 14,131 cwt. in the year under review, scarcely more than a third of what it was in 1918.

TABLE 31.—*Quantity and value of corundum produced during the years 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value (Rupee = 1s. 4d.)		Quantity.	Value. (Rupee = 2s.)	
	Cwt.	Rs.	£	Cwt.	Rs.	£
Assam—						
Khasi and Jaintia Hills.	37,920	57,930	3,862	12,660	47,475	4,747
Central India—						
Rewah State .	736	3,022	201	1,471	6,002	600
Central Provinces—						
Bhandara .	1,600	490	33	...	...	...
Hyderabad .	(a)	38	2	...	...	...
Madras—						
South Canara	25	151	10	...	...	...
Total .	40,281	*61,631*	*4,108*	14,131	*53,477*	*5,347*

(a) Quantity not available.

Gypsum. The production of gypsum shewed a marked increase, the total output being 28,318 tons valued at Rs. 28,692 (£2,869), against 16,746 tons in 1918.

TABLE 32.—*Production of Gypsum during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1s. 4d.)		Quantity.	Value. (Rupee = 2s.)	
	Tons.	Rs.	£	Tons.	Rs.	£
Punjab—						
Jhelum . .	1,871	1,403	93·5	4,719	10,705	1,070
Rajputana—						
Bikanir .	8,469	11,576	771·7	14,326	12,030	1,203
Merwar .	6,406	4,115	274·3	9,273	5,957	596
Total .	**16,746**	*17,094*	*1,139·5*	**28,318**	*28,692*	*2,869*

Molybdenite. Only 4½ cwt. of molybdenite, valued at Rs. 1,012 (£101) were won during the year 1919; this amount was recovered in the course of wolfram mining operations in Tavoy.

Ochre. The output of ochre fell from 8,109 tons in 1918 to 2,704 tons valued at Rs. 35,998 (£3,600) in the year under review.

TABLE 33.—*Production of Ochre during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1s. 4d.)		Quantity.	Value. (Rupee = 2s.)	
	Tons.	Rs.	£	Tons.	Rs.	£
Bihar and Orissa	145	9,589	639	281·3	18,807	1,881
Burma . .	...	...	...	4·6	855	85
Central India .	7,874	32,883	2,192	1,948	9,737	974
Central Provinces	16	5	...	12	3	...
Madras . .	...	...	...	250	1,500	150
Mysore . .	74	888	59	208	5,096	510
Total .	**8,109**	*43,365*	*2,890*	**2,703·9**	*35,998*	*3,600*

Potash Salts. 83 tons of potash salts were produced by the Northern India Salt Revenue Department at Nurpur in the Salt Range. The pit's-mouth value of the output is stated to be Rs. 422 (£42).

Pyrites. During the year under consideration 100 tons of pyrites were produced in Mysore.

Samarskite. 2½ cwt. of samarskite valued at Rs. 101 were won from the Sankara mica mine in Nellore.

Steatite. The output of steatite was less than half what it was during 1918, falling from 4,538 tons to 2,135 tons valued at Rs. 64,986 (£6,498) in 1919.

TABLE 34.—*Quantity and value of Steatite produced in India during 1918 and 1919.*

—	1918.			1919.		
	Quantity.	Value. (Rupee = 1s. 4d.)		Quantity.	Value. (Rupee = 2s.)	
	Tons.	Rs.	£	Tons.	Rs.	£
Bihar and Orissa— Mayurbhanj .	40	3,500	233	45	3,400	340
Central Provinces— Jubbulpore .	3,492·8	61,038	4,069	1,452	27,539	2,754
Madras— Bellary . .	44·5	220	15	...	...	...
Karnul . .	10·1	1,650	110	4	662	66
Nellore . .	51	3,272	218	74	4,762	476
Salem . .	642·8	13,630	909	450·6	15,990	1,599
Mysore . .	·1	5	...	10	163	16
United Provinces— Hamirpur .	247	31,661	2,111	95	12,150	1,215
Jhansi . .	10	650	43	4	320	32
Total .	**4,538·3**	*1,15,626*	*7,708*	**2,134·6**	*64,986*	*6,498*

IV.—MINERAL CONCESSIONS GRANTED.

TABLE 35.—*Statement of Mineral Concessions granted during 1919.*

ASSAM.

District.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Cachar .	(1) J. Blair, Esq. . .	Mineral oil . .	P. L. .	114·3	4th March 1919.	1 year.
Do. .	(2) The Burma Oil Company, Limited.	Oil	P. L. .	8,377·6	15th September 1919.	Do.
Do. .	(3) J. M. Barry, Esq. .	Oil and Coal .	P. L. .	934·4	10th November 1919.	Do
Khasi and Jaintia Hills.	(4) The Khasia Hills Prospecting and Mining Syndicate, Ltd. .	Minerals other than mineral oils.	P. L. .	7,142 4	11th March 1919.	Do.
Do. .	(5) Lieutenant-Colonel E. P. R. Gilman, V.D., J.P.	Do. .	P. L. .	5,760	18th February 1919.	Do.
Lakhimpur	(6) The Assam Oil Company.	Oil	P. L. .	10,240	1st April 1919	Do.
Do. .	(7) Do. .	Do. . . .	P. L. .	2,080	3rd July 1919	Do.
Do. .	(8) Do. .	Do. . . .	M. L. . (renewal)	2,560	1st January 1917.	25 years.
Do. .	(9) Do. .	Do. . . .	M. L. . (renewal.)	2,560	Do. .	Do.

BALUCHISTAN.

District.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Kalat .	(10) The Burmah Oil Co., Ltd. of Rangoon.	Oil	P. L. .	24,960	18th December 1918.	1 year.
Do. .	(11) The Indo-Burmah Petroleum Co. of Rangoon through their Agents Messrs. Steel Bros. & Co.	Do.	P. L. .	17,020	20th May 1919.	Do.
Do. .	(12) The Burmah Oil Co. of Rangoon.	Do.	P. L. .	3,200	1st September 1919.	Do.
Zhob . .	(13) Manager, Baluchistan Chrome Co., Ltd.	Chromite . .	P. L. .	60	1st September 1919.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

BIHAR AND ORISSA.

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Hazaribagh	(14) Messrs. Hoare Miller & Co.	Mica . . .	M. L. .	160	4th February 1919.	30 years.
Do. .	(15) Chhattoo Ram .	Do. . . .	P. L. .	117·89	12th October 1918.	1 year.
Do. .	(16) B. N. Daw . .	Do. . . .	P. L. .	200	13th March 1919.	Do.
Do. .	(17) Dwijendra Nath Mukherji.	Do. . . .	P. L. .	58	26th April 1919.	Do.
Do. .	(18) The Mica Mining and Manufacturing Co., Ltd.	Do. . . .	P. L. .	892	11th March 1919.	Do.
Do. .	(19) N. N. Sumanto .	Do. .	P. L. .	400	19th February 1919.	Do.
Do. .	(20) Babu Probodh Chandra Mukharji.	Do. . . .	M. L. .	80	29th April 1919.	30 years.
Do. .	(21) Babu P. C. Roy .	Do. . . .	P. L. .	80	15th June 1919.	1 year.
Do. .	(22) Babu Kiran Shashi Chattarji.	Do. . . .	P. L. .	160	4th June 1919.	Do.
Do. .	(23) Babu Banka Behari Choudhury.	Do. . . .	P. L. .	221	28th June 1919.	Do.
Do. .	(24) Messrs. Jagarnath Roshan Lal.	Do. . . .	M. L. .	120	23rd August 1919.	30 years.
Sambalpur .	(25) Seth Puranmal Marwari.	Do. . . .	P. L. .	5,849·79	28th August 1919.	1 year.
Do. .	(26) Debi Prosad Misra .	Coal . . .	P. L. .	2,376·99	Do. .	Do.
Do.	(27) Mr. T. P. Yeoman .	Oxide of iron .	P. L. .	57	22nd March 1919.	Do.
Santal Parganas.	(28) Bhudhar Chandra De.	Coal . . .	M. L. .	·99	1st April 1919.	2 years.
Do. .	(29) Do. .	Do. . . .	M. L. .	·99	Do. .	Do.
Do. .	(30) Do. .	Do. . . .	M. L. .	1	Do. .	Do.
Do. .	(31) Bansi Ram Marwari	Do. . . .	M. L. .	·33	Do. .	Do.
Do. .	(32) Do. .	Do. . . .	M. L. .	1·9	Do. .	Do.
Do. .	(33) Jamuna Prasad Marwari.	Do. . . .	M. L. .	2·6	Do. .	Do.
Do .	(34) Bhudhar Chandra De.	Do. . . .	M. L. .	3·9	Do. .	Do.
Do. .	(35) Binode Bihari De .	Do. . . .	M. L. .	2·15	Do. .	Do.
Do.	(36) Jardine Skinner & Co.	Do. . . .	P. L. .	5,158·48	Do.	Do.
Do. .	(37) The Villiers & Co., Ltd.	Do. . . .	P. L. .	5,081·26	Do. .	1 year.

P. L.=*Prospecting Licence.* M. L.=*Mining Lease.*

BIHAR AND ORISSA—*concld.*

DISTRICT.	Grantee.	Mineral	Nature of grant.	Area in acres.	Date of commencement.	Term.
Santal Parganas.	(38) Shital Prashad Marwari.	Coal . . .	M. L. .	66	1st April 1919	15 years.
Do. .	(39) Babu Madhab Chandra De.	Do. . . .	M. L. .	2	1st July 1919	1 year and 9 months.
Singhbhum	(40) Mr. A. C. Moitra .	Gold and galena	P. L. . (renewal.)	1,330	22nd August 1918.	1 year.
Do.	(41) Messrs. Bird & Co..	General license .	P. L. .	26,240	1st August 1919.	Do.
Do.	(42) The Bengal Iron and Steel Co., Ltd.	Manganese and iron ore	P. L. . (renewal.)	992	21st December 1918.	6 months.
Do. .	(43) The Bengal Iron and Steel Co., Ltd.	Iron ore. . .	P. L. .	512	3rd July 1919	1 year.
Do.	(44) Messrs. Byramjee Postonjee & Co.	Do. . . .	P. L. .	1,798·4	22nd December 1919.	Do.
Do. .	(45) Mr. A. C. Moitra .	Gold and galena .	P. L. . (renewal.)	1,330	22nd August 1919.	10 months.

BOMBAY.

Belgaum .	(46) Messrs. Tata and Sons, Ltd.	Bauxite (Aluminium ore).	P. L. . (renewal.)	1,087·4	24th May 1919.	2 years.
Do. .	(47) Do. .	Do. .	P. L. .	797·5	7th May 1919	1 year.
Do. .	(48) Do. .	Do. .	P. L. .	160	Do. .	Do.
Do. .	(49) Do. .	Do. .	P. L. .	249·6	Do. .	Do.
Do. .	(50) Do. .	Do. .	P. L. .	50·85	Do. .	Do.
Do. .	(51) Do. .	Do. .	P. L. .	377·57	Do. .	Do.
Kaira. .	(52) Khan Bahadur Mohmedalli Abdul Kadar.	Manganese . .	P. L. .	79·82	20th August 1919.	Do.

BURMA.

Akyab .	(53) Messrs. The Indo-Burmah Petroleum Co., Ltd.	Mineral oil . .	P. L. . (renewal.)	1,280	22nd April 1919.	2 years.
Do. .	(54) Messrs. The Burmah Oil Co., Ltd.	Do. . .	P. L. .	3,620	17th October 1919.	1 year.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Amherst .	(55) Mr. Mirza Mahomed Sadeq.	All minerals (except oil).	P. L. .	1,280	8th February 1919.	1 year.
Do. .	(56) Saw Eu Hoke .	Do. .	P. L. .	426·66	27th February 1919.	Do.
Do. .	(57) Chew Whee Shain .	Do. .	P. L. .	640	15th February 1919.	Do.
Do. .	(58) Maung Choon .	Do. .	P. L. .	3,036·16	12th February 1919.	Do.
Do. .	(59) Maung Po Thaing .	Do. .	P. L. .	2,560	15th February 1919.	Do.
Do. .	(60) L. Htain Whet .	Do. .	P. L. .	2,560	13th February 1919.	Do.
Do. .	(61) Do. .	Do. .	P. L. .	96	Do. .	Do.
Do. .	(62) Ma Shwe Bwa .	Do. .	P. L. .	960	17th March 1919.	Do.
Do. .	(63) Maung Kyin Sein .	Do. .	P. L. .	640	15th January 1919.	Do.
Do. .	(64) Mr. W. A. Henry .	Do. .	P. L. .	1,920	7th February 1919.	Do.
Do. .	(65) Mr. M. Shawloo .	Do. .	P. L. .	640	21st January 1919.	Do.
Do. .	(66) L. Ah Choy . .	Do. .	P. L. .	280	24th February 1919.	Do.
Do. .	(67) Maung Wan . .	Do. .	P. L. .	814	17th February 1919.	Do.
Do. .	(68) Mr. V. Palmgren .	Do. .	P. L. .	1,920	20th June 1919.	Do.
Do. .	(69) L. Ah Choy . .	Do. .	P. L. .	640	8th May 1919	Do.
Do. .	(70) U Tha Zan . .	Do. .	P. L. .	4,160	7th May 1919	Do.
Do. .	(71) Do. . .	Do. .	P. L. .	1,280	Do. .	Do.
Do. .	(72) Do. . .	Do. .	P. L. .	512	Do. .	Do.
Do. .	(73) Do. . .	Do. .	P. L. .	338	10th June 1919.	Do.
Do. .	(74) Mrs. M. M. Hla Oung.	Do. .	P. L. (renewal.) .	640	5th September 1917.	2 years.
Do. .	(75) P. Murugasen Pillay	Do. .	P. L. .	640	5th August 1919.	1 year.
Do. .	(76) Mr. A. M. Morris .	Do. .	P. L. .	320	Do. .	Do.
Do. .	(77) Messrs. T. D. Findlay & Son.	Do. .	P. L. .	640	Do. .	Do.
Do.	(78) Maung Po Thaing .	Do. .	P. L. .	640	28th August 1919.	Do.

P. L. = *Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Amherst	(79) Dr. K. S. Kanga	All minerals (except oil).	P. L.	640	5th August 1919.	1 year
Do.	(80) Maung San Win	Do.	P. L.	640	27th September 1919.	Do.
Do.	(81) Messrs. T. D. Findlay & Son.	Do.	P. L.	640	9th July 1919	Do.
Do.	(82) Ma Twe	Do.	P. L.	1,920	27th September 1919.	Do.
Do.	(83) Maung Myat Hein, Mr. Felix Boog, M. H. Hamadanee and M. A. Hosain.	Do.	P. L. (renewal.)	640	23rd April 1919.	Do
Do.	(84) Mrs. M. M. Hla Oung.	Do.	P. L. (renewal.)	850	20th May 1919.	Do.
Do.	(85) Ma Thein Nwe	Do.	P. L. (renewal.)	1,280	3rd May 1919	Do.
Do.	(86) Dr. M. Shawloo	Do.	P. L. (renewal.)	640	12th July 1919.	Do.
Do.	(87) Ma Thin Hlaing	Do.	P. L.	640	8th December 1919.	Do.
Do.	(88) Maung San Win	Do.	P. L.	640	27th November 1919.	Do.
Do.	(89) Dr. M. Shawloo	Do.	P. L.	160	22nd November 1919.	Do.
Do.	(90) Maung Tarak and Maung On Maung.	Do.	P. L.	960	13th November 1919.	Do.
Do.	(91) Maung Saw Maung and Ma Kywe.	Do.	P. L.	1,824	Do.	Do.
Do.	(92) L. Ah Ngoon	Do.	P. L.	320	Do.	Do.
Do.	(93) Mr. F. A. Boog and two others.	Do.	P. L. (renewal.)	737·28	1st August 1919.	Do.
Do.	(94) Mr. F. A. Boog and three others.	Do.	P. L. (renewal.)	213·33	14th November 1919.	Do.
Do.	(95) Do.	Do.	P. L. (renewal.)	128	13th December 1919.	Do.
Do.	(96) K.P.N.K. Narainan Chetty.	Do.	P. L. (renewal.)	640	Do.	Do.
Bhamo	(97) D. A. Ahuja	Do.	P. L.	5,516·8	28th November 1919.	Do.
Do.	(98) Messrs. The Tavoy Tin Syndicate, Ltd.	All minerals (except oil and jade).	P. L.	6,400	22nd December 1919.	Do.
Henzada	(99) Mr. L. D'Attaides	All minerals (except oil).	P. L. (renewal.)	4,736	11th May 1919.	2 years.
Do.	(100) Do.	Do.	P. L. (renewal.)	499·52	30th May 1919.	Do.

P. L. = *Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Henzada .	(101) Maung Kyi . .	All minerals (except oil).	P. L. .	392·50	19th November 1919.	1 year.
Katha .	(102) Messrs. Jamal Bros. & Co.	Do.	P. L. .	23,040	2nd December 1918.	Do
Do. .	(103) The Hon'ble Mr. Lim Chin Tsong.	Do. .	P. L. .	2,572·8	20th August 1919.	Do.
Do. .	(104) Do. .	Do. .	P. L. .	4,857·6	8th September 1919.	Do.
Do. .	(105) Do. .	Do. .	P. L. .	5,760	11th September 1919.	Do.
Do. .	(106) Maung Aung .	Gold . . .	P. L. . (renewal.)	2,752	9th January 1919.	2 years.
Do. .	(107) Mr. R. E. Smith .	All minerals (except oil).	P. L. . (renewal.)	3,200	16th April 1919.	1 year.
Do. .	(108) Mr. J. A. Begbei .	Do. .	P. L. . (renewal.)	3,200	13th August 1919.	Do.
Do. .	(109) Mr. J. F. Crisp .	Do. .	P. L. .	3,200	29th December 1919.	Do.
Do. .	(110) The Hon'ble Mr. Lim Chin Tsong.	Do. .	P. L. .	1,171·20	12th December 1919.	Do.
Do. .	(111) Mr. T. Ba Thwin .	All minerals (except oil and jade).	P. L. .	3,392	12th November 1919.	Do.
Do. .	(112) Mr. Lim Kar Chang.	All minerals (except oil).	P. L. .	3,200	29th December 1919.	Do.
Kyaukpyu .	(113) U Doe Kaing .	Mineral oil . .	P. L. .	640	26th December 1918	Do.
Kyaukse .	(114) Maung Ko . .	All minerals (except oil).	P. L. .	1,656·32	2nd August 1919.	Do.
Magwe .	(115) Messrs. The Burma Oil Co., Ltd.	Mineral Oil.	P. L. .	3,840	23rd March 1919.	2 years.
Do. .	(116) Mr. Sassoon Solomon.	Do. . .	P. L. . (renewal).	208·10	21st February 1919.	1 year.
Do. .	(117) Messrs. The Union Oil Co. of Burma, Ltd.	Do. .	P. L. .	20,480	28th October 1919.	Do.
Do. .	(118) Messrs. The Burmah Oil Co., Ltd.	Do. . .	P. L. . (renewal).	2,259·2	10th December 1919.	2 years.
Mandalay	(119) Mr. M. G. H. Surty	Silver and lead .	P. L. .	2,355·2	28th March 1919.	1 year.
Mergui .	(120) Saw Lein Lee .	Wolfram and tin .	M. L. .	646·98	25th February 1916.	30 years.
Do. .	(121) Maung Ne Gyi	All minerals (except oil).	M. L. .	383·13	22nd June 1915.	Do.
Do. .	(122) Mr. D. D. Mukerjee	Tin and Wolfram	P. L. .	194·56	15th December 1918.	1 year.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Mergui .	(123) Mr. Chan Elliam .	All minerals (except oil).	P. L. .	1,126·40	27th February 1919.	1 year.
Do. .	(124) Do. . .	Do. .	P. L. .	1,141·76	Do. .	Do.
Do. .	(125) Miss S. M. G. Penny	Do. . .	P. L. .	3,527·68	25th March 1919.	Do.
Do. .	(126) Tan Po Chit .	Tin and Wolfram	P. L. .	1,176·64	6th January 1919.	Do.
Do. .	(127) Maung Pe Kin .	Tin, Wolfram and allied minerals.	P. L. .	788·48	5th February 1919.	Do.
Do. .	(128) Maung Kyin Bu .	Tin . . .	P. L. .	409·60	Do. .	Do.
Do. .	(129) Mr. G. H. Hand .	Tin, gold and allied minerals.	P. L. .	1,720·32	31st March 1919.	Do.
Do. .	(130) Maung San Moe .	Tin and Wolfram	P. L. .	286·72	24th February 1919.	Do.
Do. .	(131) Maung Po . .	Tin . . .	P. L. .	547·84	31st March 1919.	Do.
Do. .	(132) Yew Shwe Ni	All minerals (except oil).	P. L. . (renewal).	1,449	29th January 1919.	6 months.
Do. .	(133) Maung Kyin Bu .	Tin . . .	P. L. . (renewal).	349·44	5th February 1919.	1 year.
Do. .	(134) Maung Po Thaik .	Tin and Wolfram	P. L. . (renewal).	486·4	13th February 1919.	Do.
Do. .	(135) Maung Pe Kin .	Wolfram, tin and allied minerals.	P. L. . (renewal).	250·88	5th February 1919.	Do.
Do. .	(136) Maung Po . .	Do. . .	P. L. . (renewal).	256	24th December 1918.	Do.
Do. .	(137) Mr. J. F. Leslie .	Wolfram and allied minerals.	P. L. . (renewal).	220·16	21st February 1919.	Do.
Do. .	(138) Do. . .	Do. . .	P. L. . (renewal).	512	26th February 1919.	Do.
Do. .	(139) Mr. A. S. Mahomed	All minerals (except oil).	P. L. . (renewal).	1,013·76	5th January 1919.	Do.
Do. .	(140) Ma Shwe Ma and Hoe Cheng Kiat.	Wolfram and tin	M. L. .	167·35	3rd December 1915.	30 years.
Do. .	(141) Mr. D. D. Mukerjee	All minerals (except oil).	P. L. .	2,304	19th March 1919.	1 year.
Do. .	(142) Lim Shain . .	Do. .	P. L. .	778·24	30th July 1919.	Do.
Do. .	(143) Messrs. Wightman & Co.	Tin . . .	P. L. .	3,114·02	1st January 1919.	Do.
Do. .	(144) Mr. A. M. G. Forbes	Do. . .	P. L. .	988·16	21st August 1919.	Do.
Do. .	(145) Lim Shain . .	All minerals (except oil).	P. L.	665·60	31st July 1919.	Do.

P. L.=*Prospecting Licenses*, M. L.=*Mining Lease*.

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Mergui .	(146) Mr. A. H. Noyes .	Wolfram and tin	P. L. .	640	19th March 1919.	1 year.
Do. .	(147) Messrs. The Rangoon Wolfram Co., Ltd.	All minerals (except oil).	P. L. .	1,459·2	20th August 1919.	Do.
Do. .	(148) Mr. Charles Ellis .	Tin . .	P. L. .	701·44	5th May 1919	Do.
Do. .	(149) Mr. M. E. Bymeah	All minerals (except oil).	P. L. .	317·44	12th August 1919.	Do.
Do. .	(150) Mr. Low Boon Teck	Do. . .	P. L. .	890·88	30th July 1919.	Do.
Do. .	(151) Mr. A. H. Noyes .	Wolfram and tin .	P. L. .	2,739·20	1st August 1919.	Do.
Do. .	(152) Mr. S. Crawshaw .	All minerals (except oil).	P. L. .	640	26th September 1919.	Do.
Do. .	(153) U Shwe I. . .	Wolfram and tin .	P. L. .	271·36	25th July 1919.	Do.
Do.	(154) Maung San Dun .	All minerals (except oil).	P. L. .	343·04	Do.	Do.
Do. .	(155) Mr. T. Greenhow .	Wolfram and tin .	P. L. .	1,463	29th July 1919.	Do.
Do. .	(156) Maung Kya Tun .	All minerals (except oil).	P. L. .	640	26th September 1919.	Do.
Do. .	(157) Y Gwan Swee .	Tin and wolfram .	P. L. .	112·64	30th August 1919.	Do.
Do. .	(158) Mr. A. M. G. Forbes	Tin . . .	P. L. .	640	21st August 1919.	Do.
Do. .	(159) Mr. S. V. Norris .	Do. . .	P. L. .	2,560	31st August 1919.	Do.
Do. .	(160) Mr. L. A. Maing .	All minerals (except oil).	P. L. .	1,971·20	30th July 1919.	Do.
Do. .	(161) Mr. Hoe Cheng Kiat.	Do. . .	P. L. .	604·16	Do. .	Do.
Do. .	(162) Messrs. Marshall Cotterell & Co., Ltd.	Do. . .	P. L. .	1,530·88	30th September 1919.	Do.
Do. .	(163) Mr. G. H. Hand .	Wolfram and tin .	P. L. (renewal).	2,150·40	1st November 1918.	Do.
Do. .	(164) The Hlaygadaung Concession.	All minerals (except oil).	P. L. (renewal).	3,200	19th December 1918.	Do.
Do. .	(165) Maung Pan On .	Do. . .	P. L. (renewal).	153·60	20th March 1919.	Do.
Do. .	(166) Mr. M. Haniff .	Do. . .	P. L. (renewal).	350·72	25th March 1919.	Do.
Do. .	(167) Messrs. Bulloch Bros. & Co., Ltd.	Do. . .	P. L. (renewal).	442·88	3rd January 1919.	Do.

P. L.=*Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Mergui .	(168) Yew Shwe Ni .	Wolfram and tin .	P. L. (renewal).	1,775·52	20th April 1919.	1 year.
Do. .	(169) Lim Shain . .	Do. . .	P. L. (renewal).	250·00	20th May 1919.	Do.
Do.	(170) Mr. M. Haniff .	All minerals (except oil).	P. L. (renewal).	1,054·72	30th July 1919.	Do.
Do. .	(171) Lim Shain . .	Wolfram and tin .	P. L. (renewal).	517·12	16th August 1919.	Do.
Do. .	(172) Do. . .	All minerals (except oil).	P. L. (renewal).	450·56	Do. .	Do.
Do. .	(173) Do. . .	Wolfram and tin .	P. L. (renewal).	517·36	Do. .	Do.
Do. .	(174) Do. . .	Do. . .	P. L. (renewal).	404·48	Do. .	Do.
Do. .	(175) Mr. A. D. Keith	Do. . .	P. L. .	1,344	20th July 1919.	Do.
Do. .	(176) Mr. F. Fitzherbert	Do. . .	P. L. .	460·80	4th October 1919.	Do.
Do. .	(177) Messrs. The Indo-Burma Tin Corporation, Ltd.	Tin . . .	P. L. .	148·48	25th November 1919.	Do.
Do. .	(178) Mr. S. Crawshaw .	All minerals (except oil).	P. L. .	3,194·88	30th November 1919.	Do.
Do. .	(179) Maung Po . .	Do. . .	P. L. .	793	29th October 1919.	Do.
Do. .	(180) Messrs. Marshall Cotterell & Co.	Do. .	P. L. .	910·48	28th October 1919.	Do.
Do. .	(181) Mr. W. H. Olivant	Do. . .	P. L. .	665·60	25th October 1919.	Do.
Do. .	(182) Lim Shain . .	Do. . .	P. L. .	476·16	1st November 1919.	Do.
Do. .	(183) Messrs. Wightman & Co., Ltd.	Tin . . .	P. L. .	800	5th December 1919.	Do.
Do. .	(184) Messrs. Marshall Cotterell & Co., Ltd.	All minerals (except oil).	P. L. .	2,302·88	10th November 1919.	Do.
Do. .	(185) Messrs. Wightman & Co., Ltd.	Tin . . .	P. L. .	10	8th November 1919.	Do.
Do. .	(186) Maung Po . .	All minerals (except oil).	P. L. .	665·60	4th December 1919.	Do.
Do. .	(187) Mr. H. G. Mathews	Wolfram and tin .	P. L. .	2,539·52	12th December 1919.	Do.
Do. .	(188) Mr. Mahomed Esoof Bhymeah.	All minerals (except oil).	P. L. .	414·72	1st December 1919.	Do.
Do. .	(189) Mr. O. F. Misquith	Do. . .	P. L. .	1,587·20	27th November 1919.	Do.

P. L.=*Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Mergui .	(190) Mr. Thomas Greenhow.	Tin . . .	P. L. .	501·76	9th December 1919.	1 year.
Do. .	(191) C. Po Kun . .	All minerals (except oil).	P. L. .	977·92	17th December 1919.	Do.
Do. .	(192) Messrs. Wightman & Co., Ltd.	Coal . . .	P. L. .	400	5th December 1919.	Do.
Do. .	(193) Do. . .	Tin . . .	P. L. .	158·72	9th December 1919.	Do.
Do. .	(194) Messrs. The Hpaungdaw Prospecting Co., Ltd.	All minerals (except oil).	P. L. (renewal).	1,409·60	30th July 1919.	Do.
Do. .	(195) Do. . .	Do. . .	P. L. (renewal).	1,976·52	Do. .	Do.
Do. .	(196) Mr. W. H. Olivant	Tin and tungsten ores.	P. L. (renewal).	517·12	27th September 1919.	Do.
Do. .	(197) Messrs. The Rangoon Wolfram Co., Ltd.	All minerals (except oil).	P. L. (renewal).	1,203·20	9th September 1919.	Do.
Do. .	(198) Mr. H. H. Bateman	Wolfram and tin .	P. L. (renewal).	1,824	17th September 1919.	Do.
Do. .	(199) Do. . .	Wolfram . .	P. L. (renewal).	640	27th September 1919.	Do.
Do. .	(200) Do. . .	Wolfram and tin .	P. L. (renewal).	480	Do. .	Do.
Do. .	(201) Ho Cheng Kiat .	All minerals (except oil).	P. L. (renewal).	588·80	14th November 1919.	Do.
Do. .	(202) Maung Choon .	Do. . .	P. L. (renewal).	25·37	22nd November 1919.	Do.
Do. .	(203) Messrs. The Mergui Tin Dredging Co., Ltd.	Tin and wolfram .	P. L. (renewal).	2,150·40	1st November 1919.	Do.
·abu .	(204) Mr. Esmail Esoof Esmail.	Mineral oil . .	P. L. .	320	8th February 1919.	Do.
Do. .	(205) Maung Tun Aung Gyaw.	Coal . . .	P. L. .	620	28th January 1919.	Do.
Do. .	(206) Yeo Eng Byan .	Do. . .	P. L. .	1,542	Do. .	Do.
Do. .	(207) Mr. Mahomed Golam Hussein Surty.	Do. . .	P. L. .	4,857·6	Do. .	Do.
Do. .	(208) Messrs. The Bombay-Burma Trading Corporation, Ltd.	Mineral oil .	P. L. (renewal).	336	12th November 1918.	2 years.
Do.	(209) Messrs. The Yomah Oil Co., Ltd.	Coal . . .	P. L. .	480	1st April 1919.	1 year.
Do. .	(210) Maung Tun Aung Gyaw.	Do. . .	P. L. .	1,280	Do. .	Do.
Do. .	(211) Maung Ba Thi .	Do. . . .	P. L. .	2,560	2nd May 1919	Do.

P. L.=*Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Minbu .	(212) Maung Ba Thi .	Coal . .	P. L. .	620	2nd May 1919	1 year.
Do. .	(213) Messrs. The Yomah Oil Co., Ltd.	Mineral oil . .	P. L. .	2,570·24 Blocks 4P, 8P, 12P, 24P, and part of 11P of the Minbu Oil Field.	11th April 1919.	Do.
Do. .	(214) Messrs. The Indo-Burma Petroleum Co., Ltd.	Do. . .	P. L. (renewal).	1,692	12th January 1919.	2 years.
Do. .	(215) Maung Tha Ya .	Coal . . .	P. L. .	640	11th August 1919.	1 year.
Do. .	(216) M. E. Bhymeah & Co.	Mineral oil. .	P. L. .	320 (Western half of block 1. S. in the Minbu Oil Field.)	21st August 1919.	Do.
Do. .	(217) Yeo Eng Byan .	Coal . . .	P. L. .	1,432	28th May 1919.	Do.
Do. .	(218) Maung Tun Aung Gyaw.	Do. . .	P. L. (renewal).	640	4th April 1919.	2 years.
Myingyan .	(219) Maung Hmon and Maung Thin.	Mineral oil . .	P. L. .	400	2nd June 1919	1 year.
Do. .	(220) Mr. Baij Nath Singh.	Do. . .	P. L. (renewal).	11,897 6	27th August 1919.	2 years.
Do. .	(221) Messrs. The Burma Oil Co., Ltd.	Do. .	P. L. (renewal).	1,280	7th May 1919	Do.
Do. .	(222) Messrs. The Union Oil Co., of Burma, Ltd.	Do. . .	P. L. .	6,720	17th September 1919.	1 year.
Do. .	(223) Maung Tha Ya .	All minerals .	P. L. .	167·75	18th November 1919.	Do.
Do. .	(224) Maung Kyi . .	Mineral oil . .	P. L. .	31·50	14th November 1919.	Do.
Myitkyina .	(225) Mr. R. C. J. Swinhoe.	Silver and copper	P. L. .	640	2nd January 1919.	Do.
Do. .	(226) Mr. H. F. Leslie .	Gold and platinum	P. L. .	2,931·20	15th January 1919.	Do.
Do. .	(227) Messrs. The Burma Gold Dredging & Co., Ltd.	Gold and iridio platinum	P. L. .	3,200	3rd February 1919.	Do.
Do. .	(228) Mr. H. F. Leslie .	Gold . . .	P. L. .	640	2nd January 1919.	Do.
Do. .	(229) Mr. A. J. Bealo .	All minerals (except oil).	P. L. .	4,851·20	9th December 1919.	Do.
Pakokku .	(230) Messrs. Balthazar and Son.	Mineral oil . .	P. L. .	640	9th May 1919.	Do.

P. L. = *Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Pakokku .	(231) Messrs. Balthazar and Son.	Mineral oil . .	P. L. .	1,280	9th May 1919	1 year.
Do. .	(232) Messrs. The British Burma Petroleum Co., Ltd.	Do. . .	M. L. .	1,280	5th May 1919.	30 years.
Do. .	(233) Do. . .	Do. . .	P. L. .	960	16th May 1919.	1 year.
Do. .	(234) Messrs. The Rangoon Oil Co., Ltd.	Do. . .	P. L. .	1,068·8	19th May 1919.	Do.
Do. .	(235) Do. . .	Do. . .	P. L. .	624	Do. .	Do.
Pakokku Hill Tracts.	(236) M. J. C. Galstaun	All minerals (except oil).	P. L. (renewal).	3,840	9th September 1919.	Do.
Prome .	(237) Ma Nyein Hla .	Mineral oil . .	P. L. .	123	25th August 1919.	Do.
Do. .	(238) Esoof Abdul Shakoor Bros.	Coal . . .	P. L. .	2,668·8	2nd December 1919.	Do.
Do. .	(239) Maung Pe Tok and Maung Myat Thin.	Mineral oil .	P. L. . (renewal).	320	28th October 1919.	Do.
Ruby Mines	(240) Ko Ko Gyi . .	All minerals (except oil).	P. L. .	7,680	23rd June 1919.	Do.
Do. .	(241) Ma Shwe Bwin	Copper ore . .	P. L. . (renewal).	640	14th May 1919.	Do.
Do. .	(242) Messrs. Balthazar & Son.	All minerals (except oil).	P. L. .	2,560	9th August 1919.	Do.
Do. .	(243) Mr. S. S. Halkar .	Mica . . .	P. L. . (renewal).	41	21st June 1919.	Do.
Salween .	(244) Mr. B. H. Hardinge	All minerals (except oil).	P. L. .	1,920	12th March 1919.	Do.
Do. .	(245) Mr. S. Crawshaw .	Do. . .	P. L. .	3,220	Do. .	Do.
Shwebo .	(246) Mr. Y. A. Ganny .	Do. . .	P. L. .	200	15th January 1919.	Do.
Do. .	(247) Messrs. The Burma Oil Co., Ltd.	Mineral oil . .	P. L. .	7,040	27th September 1919.	Do.
Do.	(248) Messrs. The Indo-Burma Petroleum Co., Ltd.	Do. . .	P. L. . (renewal).	1,280	20th November 1919.	2 years.
Southern Shan States.	(249) Maung San Hein .	Lead . .	P. L. .	1,280	17th February 1919.	1 year.
Do. .	(250) Mr. M. A. S. Jamal	All minerals (except oil).	P. L. .	3,520	18th January 1919.	Do.
Do. .	(251) Maung Ba Cho .	Do. . .	P. L. .	640	10th February 1919.	Do.
Do. .	(252) Maung Kya Ywet	Do. . .	P. L. . (renewal).	640	12th September 1918.	Do.
Do. .	(253) Sawbwa of Kēngtūng.	Gold . . .	P. L. . (renewal).	1,440	27th December 1918.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Southern Shan States.	(254) Sawbwa of Kēngtōng.	Gold . . .	P. L. (renewal).	1,920	27th December 1918.	1 year.
Do. .	(255) Mr. W. H. Cowling	Do. . . .	P. L. .	10,560	27th June 1919.	Do.
Do. .	(256) Ma Ngwe Nyun .	Do. . .	P. L. .	640	13th June 1919.	Do.
Do. .	(257) Mr. S. E. Solomon	Antimony and associated minerals.	P. L. .	640	28th June 1919.	Do.
Do. .	(258) Maung Kya Ywet	Lead and silver .	M. L. (renewal).	2·1	1st September 1917.	5 years.
Do. .	(259) Ma Chit Su . .	All minerals (except oil).	P. L. (renewal).	640	9th October 1918.	2 years.
Do. .	(260) Saw Lein Lee .	Do. . .	P. L. .	599	5th September 1919.	1 year.
Do. .	(261) Maung Tun Maung	Do. . .	P. L. (renewal).	320	14th June 1919.	Do.
Do. .	(262) Mr. W. H. Cowling	Do. . .	P. L. .	2,880	10th December 1919.	Do.
Tavoy .	(263) Ong Hoe Kyin .	Do. . .	P. L. .	845	3rd March 1919.	Do.
Do. .	(264) Tavoy Tin Syndicate.	Do. . .	P. L. .	2,099	8th January 1919.	Do.
Do. .	(265) Do. . .	Do. . .	P. L. .	1,782	Do. .	Do.
Do. .	(266) Messrs. Tata Sons, Ltd.	Do. .	P. L. .	584	8th February 1919.	Do.
Do. .	(267) Maung Ba Oh .	Do. . .	P. L.	274	13th January 1919.	6 months.
Do. .	(268) Mr. H. G. Mathews	Do. .	P. L. .	937	1st February 1919.	Do.
Do. .	(269) Maung Tun . .	Do. . .	P. L. .	422	18th November 1918.	1 year.
Do. .	(270) Mr. C. Beadon .	Do. . .	P. L. .	2,768	3rd January 1919.	6 months.
Do. .	(271) Do. . .	Do. . .	P. L. .	4,137	Do. .	Do.
Do. .	(272) Do. . .	Do. . .	P. L. . .	159	28th March 1919.	1 year.
Do. .	(273) Messrs. Steel Bros. & Co., Ltd.	Do. . .	P. L. .	2,386	5th March 1919.	6 months.
Do. .	(274) Do. . .	Do. . .	P. L. .	1,742	10th January 1919.	Do.
Do. .	(275) Messrs. Booth & Milne.	Do. . .	P. L. .	2,365	11th February 1919.	1 year.
Do. .	(276) Do. . .	Do. . .	P. L. .	410	4th March 1919.	6 months.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Tavoy .	(277) Tavoy Wolfram, Ltd.	All minerals (except oil).	P. L. .	174	9th January 1919.	1 year.
Do. .	(278) Maung Lu Pe .	Do. . .	P. L. .	497	13th January 1919.	6 months.
Do. .	(279) Messrs. Maung Min Gyaw Bros. & Co.	Do. . .	P. L. .	576	5th February 1919.	Do.
Do. .	(280) Mr. P. M. Haines .	Do. . .	P. L. .	709	6th March 1919.	1 year.
Do. .	(281) Maung Sein Khaing	Do. . .	P. L. . (renewal).	1,182	8th August 1918.	Do.
Do. .	(282) Maung Po Gywe .	Do. . .	P. L. . (renewal).	486	6th August 1918.	Do.
Do. .	(283) Messrs. The High Speed Steel Alloys Mining Co., Ltd.	Do. . .	P. L. . (renewal).	1,163	11th August 1918.	Do.
Do. .	(284) Quah Cheng Tock	Do. . .	P. L. . (renewal).	988	3rd September 1918.	Do.
Do. .	(285) Maung Tun Mya .	Do. . .	P. L. . (renewal).	558	9th September 1918.	Do.
Do. .	(286) Maung Po U .	Do. . .	P. L. . (renewal).	1,920	24th September 1918.	Do.
Do. .	(287) Maung Ba Don .	Do. . .	P. L. . (renewal).	282	11th November 1918.	Do.
Do. .	(288) Mr. A. E. O. Mahomed Yusuf.	Do. . .	P. L. . (renewal).	415	16th November 1918.	Do.
Do. .	(289) Maung Sein Khaing.	Do. . .	P. L. . (renewal).	494	23rd November 1918.	Do.
Do. .	(290) Maung Me . .	Do. . .	P. L. . (renewal).	358	30th November 1918.	Do.
Do. .	(291) Eu Kya Ban .	Do. . .	P. L. . (renewal).	660	20th November 1918.	6 months.
Do. .	(292) Khoo Tun Byan .	Do. . .	P. L. . (renewal).	148	30th November 1918.	Do.
Do. .	(293) Ong Hoe Kyin .	Do. . .	P. L. . (renewal).	179	13th December 1918.	Do.
Do. .	(294) Messrs. The Bombay-Burma Trading Corporation, Ltd.	Do. . .	P. L. . (renewal).	708	10th October 1918.	Do.
Do. .	(295) Messrs. Steel Bros. & Co., Ltd.	Do. . .	P. L. . (renewal).	1,422	21st December 1918.	1 year.
Do. .	(296) Maung Mya Pe .	Do. .	P. L. . (renewal).	469	26th December 1918.	6 months.
Do. .	(297) Mr. Naltram Rambux.	Do. . .	P. L. . (renewal).	240	4th January 1919.	1 year.
Do. .	(298) Ma Mya Yin .	Do. .	P. L. . (renewal).	1,030	21st December 1918.	6 months.

P. L.—*Prospecting License.*

BURMA—*contd.*

District.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Tavoy .	(299) Messrs. Steel Bros. & Co., Ltd.	All minerals (except oil).	P. L. . (renewal).	620	6th January 1919.	6 months.
Do. .	(300) Maung E Zin .	Do. . .	P. L. . (renewal).	435	15th February 1919.	1 year.
Do. .	(301) Maung Po Hnan .	Do. . .	P. L. . (renewal).	589	Do. .	Do.
Do. .	(302) Messrs. The Tavoy Concessions, Ltd.	All minerals (except oil) and precious stones.	M. L. .	676·60	23rd April 1918.	30 years.
Do. .	(303) Quah Cheng Tock	Wolfram and tin .	M. L. .	660·73	1st August 1916.	Do.
Do. .	(304) Lim Kyee Yan .	All minerals (except oil) and precious stones.	M. L. .	380·10	11th January 1917.	Do.
Do. .	(305) Messrs. The High Speed Steel Alloys Mining Co., Ltd.	All minerals (except oil).	P. L. .	3,442	14th August 1918.	6 months.
Do. .	(306) Do. . .	Do. . .	P. L. .	806	21st May 1919.	Do.
Do. .	(307) Mr. A. R. H. Ady	Do. . .	P. L. .	402	1st April 1919	1 year.
Do. .	(308) Mr. G. Willison .	Do. . .	P. L. .	640	24th April 1919.	Do.
Do. .	(309) Messrs. Tata Sons, Ltd.	Do. . .	P. L. .	304	3rd May 1919.	Do.
Do. .	(310) Quah Cheng Gwan	Do. . .	P. L. .	300	4th April 1919	Do.
Do. .	(311) Maung Ba Oh .	Do. . .	P. L. .	1,024	Do. .	6 months.
Do. .	(312) Do. . .	Do. . .	P. L. .	407	19th June 1919.	Do.
Do. .	(313) Messrs. Foucar & Co., Ltd.	Do. . .	P. L. .	1,822	26th June 1919.	1 year.
Do. .	(314) Mr. G. Willison .	Do. . .	P. L. . (renewal).	807	24th February 1918.	Do.
Do. .	(315) Quah Cheng Gwan	Do. . .	P. L. . (renewal).	1,003	3rd September 1918.	Do.
Do. .	(316) Maung Saw Hlaing	Do. . .	P. L. . (renewal).	548	2nd January 1919.	Do.
Do. .	(317) Khoo Zun Nee .	Do. . .	P. L. . (renewal).	739	7th December 1918.	6 months.
Do. .	(318) Maung Ngwe Thi .	Do. . .	P. L. . (renewal).	548	14th December 1918.	Do.
Do. .	(319) Ma Mo Thu . .	Do. . .	P. L. . (renewal).	389	14th June 1918.	Do.
Do. .	(320) Ma Kin . .	Do. . .	P. L. . (renewal).	710	19th June 1918.	1 year.
Do. .	(321) Messrs. Osman Musti Khan & Co.	Do. . .	P. L. . (renewal).	551	26th February 1919.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Tavoy .	(322) Quah Cheng Gwan	All minerals (except oil).	P. L. (renewal).	190	1st March 1919.	1 year.
Do. .	(323) Messrs. Osman Musti Khan & Co.	Do. . .	P. L. (renewal).	747	10th February 1919.	6 months.
Do. .	(324) Maung Po Hnan .	Do. . .	P. L. (renewal).	640	26th March 1919.	1 year.
Do. .	(325) Messrs. Osman Musti Khan & Co.	Do. . .	P. L. (renewal).	297	30th April 1919.	Do.
Do. .	(326) Mr. A. E. O. Mahomed Yusuf.	Do. . .	P. L. (renewal).	487	9th April 1919.	6 months.
Do. .	(327) Maung Ba Don .	Do. . .	P. L. (renewal).	84	22nd April 1919.	1 year.
Do. .	(328) Maung Sein Thwe	Do. . .	P. L. (renewal).	256	9th April 1919.	6 months.
Do. .	(329) C. Soo Don . .	Do. . .	P. L. (renewal).	640	23rd April 1919.	Do.
Do. .	(330) Messrs. The Rangoon Wolfram Co., Ltd.	Do. . .	P. L. (renewal).	1,725	9th May 1919.	1 year.
Do. .	(331) Messrs. Tata Sons, Ltd.	Do. . .	P. L. .	282	3rd May 1919.	Do.
Do. .	(332) Messrs. The Tavoy Tin Syndicate.	Do. . .	P. L. .	2,752	1st September 1919.	Do.
Do. .	(333) Do. . .	Do. . .	P. L. .	1,894	Do. .	Do.
Do. .	(334) Do. . .	Do. . .	P. L. .	3,802	Do. .	Do.
Do. .	(335) Messrs. The Tavoy Syndicate.	Do. . .	P. L. .	1,644	Do. .	Do.
Do. .	(336) Messrs. The Tavoy Tin Syndicate.	Do. . .	P. L. .	1,769	Do. .	Do.
Do. .	(337) Mr. A. R. H. Ady	Do. . .	P. L. .	410	10th September 1919.	Do.
Do. .	(338) Maung Maung .	Do. . .	P. L. .	404	26th August 1919.	Do.
Do. .	(339) Mr. H. G. Mathews	Do. . .	P. L. .	4,057	1st July 1919.	6 months.
Do. .	(340) Messrs. The Bombay Burma Trading Corporation, Ltd.	Do. . .	P. L. .	839·68	22nd July 1919.	1 year.
Do. .	(341) Mr. G. Lovell .	Do. . .	P. L. .	118	30th September 1919.	Do.
Do. .	(342) S. Boon Thi .	Do. . .	P. L. .	1,088	15th September 1919.	Do.
Do. .	(343) C. Soo Don . .	Do. . .	P. L. .	1,387	24th September 1919.	Do.

P. L. = *Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Tavoy .	(344) Maung Maung .	All minerals (except oil).	P. L. .	638	26th August 1919.	1 year.
Do. .	(345) Quah Cheng Gwan	Do. . .	P. L. . (renewal).	640	9th January 1919.	Do
Do. .	(346) Messrs. The Bombay Burma Trading Corporation, Ltd.	Do. . .	P. L. . (renewal).	860	19th March 1919.	Do.
Do. .	(347) Messrs. The Tavoy Wolfram, Ltd.	Do. . .	P. L. . (renewal).	543	26th April 1919.	Do.
Do. .	(348) Mr. F. G. Fitzherbert.	Do. . .	P. L. . (renewal).	389	20th May 1919.	Do.
Do. .	(349) Mr. C. Beadon .	Do. . .	P. L. . (renewal).	3,674	3rd July 1919.	Do.
Do. .	(350) Maung Po Myee .	Do. . .	P. L. . (renewal).	179	25th May 1919.	Do.
Do. .	(351) Mr. C. Beadon .	Do. . .	P. L. . (renewal).	2,371	3rd July 1919.	Do.
Do. .	(352) Mr. A. R. H. Ady	Do. . .	P. L. . (renewal).	809	28th June 1919.	Do.
Do. .	(353) Messrs. Foucar & Co., Ltd.	Do. . .	P. L. . (renewal).	460	1st July 1919.	Do.
Do. .	(354) Do. . .	Do. . .	P. L. . (renewal).	476	27th August 1919.	Do.
Do. .	(355) Messrs. The Indo-Burma Tin Corporation, Ltd.	Do. . .	P. L. . (renewal).	410	4th September 1919.	Do.
Do. .	(356) Maung Min Gyaw Bros.	Do. . .	P. L. . (renewal).	483	5th August 1919.	6 months.
Do. .	(357) Quah Cheng Tock	Do. . .	P. L. . (renewal).	988	3rd September 1919.	1 year.
Do. .	(358) Messrs. Tata Sons, Ltd.	Do. . .	P. L. .	2,312	24th October 1919.	Do.
Do. .	(359) Messrs. The Indo-Burma Tin Corporation, Ltd.	Do. . .	P. L. .	1,827	14th November 1919.	6 months.
Do. .	(360) Maung Ni Toe .	All minerals (except oil and jade).	P. L. .	1,772	1st December 1919.	Do.
Do. .	(361) Maung Ba On .	Do. . .	P. L. .	312	17th October 1919.	1 year.
Do. .	(362) Quah Cheng Tock	All minerals (except oil).	P. L. .	657	24th October 1919.	Do.
Do. .	(363) Maung Maung .	Do. . .	P. L. .	256	20th October 1919.	Do.
Do. .	(364) Do. . .	Do. . .	P. L. .	1,059	4th November 1919.	Do.

P. L.=*Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Tavoy .	(365) Eu Shwe Swai .	All minerals (except oil).	P. L. .	353	1st December 1919.	1 year.
Do. .	(366) Ong Hoe Kyin .	Do. . .	P. L. .	1,113	19th November 1919.	Do.
Do. .	(367) Maung Kya Tun .	Do. . .	P. L. .	586	4th December 1919.	6 months.
Do. .	(368) Messrs. Bulloch Bros. & Co., Ltd.	Do. . .	P. L. .	640	18th December 1919.	Do.
Do. .	(369) Maung Po Swe .	Do. . .	P. L. .	617	20th October 1919.	Do.
Do. .	(370) Gunpat Rai Kutwal.	Do. . .	P. L. . (renewal).	384	16th December 1918.	1 year.
Do. .	(371) Do. . .	Do. . .	P. L. . (renewal).	333	13th May 1919.	Do.
Do. .	(372) Messrs. Osman Musti Khan & Co.	Do. . .	P. L. . (renewal).	747	10th August 1919.	Do.
Do. .	(373) Maung Po Gaung .	Do. . .	P. L. . (renewal).	230	14th August 1919.	Do.
Do. .	(374) Quah Cheng Gwan	Do. . .	P. L. . (renewal).	1,003	3rd September 1919.	Do.
Do. .	(375) The Hon'ble Mr. Lim Chin Tsong.	Do. . .	P. L. . (renewal).	320	12th October 1919.	Do.
Do. .	(376) A. E. O Mahomed Yusuf.	Do. . .	P. L. . (renewal).	487	9th October 1919.	6 months.
Thaton .	(377) Maung Paung .	Do. . .	P. L. .	607·50	18th January 1919.	1 year.
Do.	(378) Foo Beng Seng .	Do. . .	P. L. .	2,022·4	3rd January 1919.	Do.
Do. .	(379) Khing Beng Chong	Do. . .	P. L. .	2,009·6	15th January 1919.	Do.
Do. .	(380) Maung Chit Maung	Do. . .	P. L. .	307·2	9th January 1919.	3 months and 2 days.
Do. .	(381) Maung E Cho .	Do. . .	P. L. . (renewal).	793·6	8th December 1918.	1 year.
Do. .	(382) Maung Khaing .	Do. .	P. L. . (renewal).	153·6	7th February 1919.	Do.
Do.	(383) Do. . .	Do. . .	P. L. . (renewal).	1,094·4	29th January 1919.	Do.
Do. .	(384) The Hon'ble Mr. Lim Chin Tsong.	Do. . .	P. L. .	742·4	7th May 1919	Do.
Do. .	(385) Maung Kyi . .	Do. .	P. L. .	1,241·6	9th May 1919	Do.
Do. .	(386) C. Chan Shwe .	Do. . .	P. L. .	640	5th May 1919	Do.
Do. .	(387) Maung Pe Gyi .	Do. . .	P. L. . (renewal).	1,920	23rd July 1918.	Do.

P. L.=*Prospecting License.*

BURMA—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Thaton .	(388) Tan Kin Chye .	All minerals (except oil).	P. L. . (renewal).	691·2	31st August 1918.	1 year.
Do. .	(389) Ong Ba Wet and Tan Kin Chye.	Do. . .	P. L. . (renewal).	576	13th February 1919.	Do.
Do. .	(390) Maung Pu . .	Do. . .	P. L. .	601·6	20th October 1919.	Do.
Thayetmyo	(391) Messrs. The London-Rangoon Trading Co., Ltd.	Mineral oil .	P. L. .	4,576	13th December 1918.	Do.
Do. .	(392) Do. . .	Do. . .	P. L. .	2,880	26th November 1918.	Do.
Do. .	(393) Do. . .	Do. . .	P. L. .	1,920	Do. .	Do.
Do. .	(394) Do. . .	Do. . .	P. L. .	9,600	8th January 1919.	Do.
Do. .	(395) Do. . .	Do. . .	P. L. . (renewal).	9,574·4	13th December 1918.	2 years.
Do. .	(396) Mrs. H. V. Murray	Do. . .	P. L. . (renewal).	3,200	12th November 1918.	Do.
Do. .	(397) Messrs. The British Burma Petroleum Co., Ltd.	Do. . .	M. L. .	94·72	18th June 1918.	30 years.
Do. .	(398) Messrs. The Indo-Burma Petroleum Co., Ltd.	Do. . .	P. L. .	4,680	31st March 1919.	1 year.
Do. .	(399) Messrs. The London-Rangoon Trading Co., Ltd.	Do. . .	P. L. . (renewal).	2,880	10th April 1919.	2 years.
Do. .	(400) Do. . .	Do. . .	P. L. .	11,520 (Blocks 48, 44 and 45 of the Minhla Oil Field and an undemarcated area of 15 square miles).	14th June 1919.	1 year.
Do. .	(401) Ma Saw Hein .	Do. . .	P. L. .	460	22nd April 1919.	Do.
Do. .	(402) Messrs. The London-Rangoon Trading Co., Ltd.	Do. . .	P. L. . (renewal).	2,560 (Blocks 26 and 27, the western half of blocks 9, 25 and 28 and the eastern half of block 30).	13th July 1919.	2 years.
Toungoo .	(403) Mr. J. Curri .	All minerals (except oil).	P. L. .	1,920	15th May 1919.	1 year.
Do. .	(404) Mr. H. J. Davies .	Do. .	P. L. .	747·52	17th November 1919.	Do.

P. L.—*Prospecting License.* M. L.—*Mining Lease.*

BURMA—*concld.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Upper Chindwin.	(405) Messrs. The Indo-Burma Petroleum Co., Ltd.	Mineral oil . .	P. L. . (renewal.)	12,800	12th September 1918.	2 years.
Yamethin .	(406) Mr. W. H. Heard-White.	All minerals (except oil).	P. L. .	640	31st January 1919.	1 year.
Do. .	(407) Messrs. H. Abdul Shakoor Hajee Cassim & Sons.	Do. .	P. L. .	4,268·8	6th February 1919.	Do.
Do. .	(408) Maung Tun Mya .	Do. .	P. L. .	531·2	22nd February 1919.	Do.
Do. .	(409) Mr. Tan Ba Thwin	Do. .	P. L. .	652·8	27th March 1919.	Do.
Do. .	(410) Do. .	Do. .	P. L. .	1,152	Do.	Do.
Do. .	(411) Maung Ba Tin .	Do. .	P. L. .	1,337·6	30th June 1919.	Do.
Do. .	(412) Messrs. B. M. Kharwar & Co.	Do. .	P. L. . (renewal.)	1,715·2	15th January 1919.	2 years.
Do. .	(413) Messrs. H. Abdul Shakoor Hajee Cassim & Sons.	Do. .	P. L. .	1,779·2	26th July 1919.	1 year.
Do. .	(414) Messrs. B. M. Kharwar.	Do. .	P. L. . (renewal.)	1,369·6	20th May 1919.	Do.
Do. .	(415) Maung Kyi . .	Do. .	P. L. . (renewal.)	582·4	18th May 1919.	Do.
Do. .	(416) L. Ah Lye . .	Do. .	P. L. . (renewal.)	1,600	21st August 1919.	Do.

CENTRAL PROVINCES.

Balaghat .	(417) Seth Shriram .	Manganese . .	P. L. . (renewal.)	348	13th September 1918.	6 months.
Do. .	(418) Do. .	Do. . .	P. L. .	128	17th February 1919.	1 year.
Do. .	(419) Do. .	Do. . .	P. L. . (renewal.)	45	30th September 1918.	6 months.
Do. .	(420) Do. .	Do. . .	P. L. .	496	17th February 1919.	1 year.
Do. .	(421) Do. .	Do. . .	P. L. .	395	Do. .	Do.
Do. .	(422) Do. .	Do. . .	P. L. .	77	Do. .	Do.
Do. .	(423) Do. .	Do. . .	P. L. .	1	Do. .	Do.
Do. .	(424) Do.	Do. . .	P. L. .	2	Do. .	Do.
Do. .	(425) Do. .	Do. . .	P. L. .	11	Do. .	Do.

P. L. = *Prospecting License.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Balaghat .	(426) Seth Shriram .	Manganese . .	P. L. .	1	17th February 1919.	1 year.
Do. .	(427) Do. .	Do. . .	P. L. .	2	Do. .	Do.
Do. .	(428) Mr. C. S. Harris .	Copper and bauxite.	P. L. (renewal.)	12	1st February 1919.	6 months.
Do. .	(429) Messrs. Tata Sons, Ltd.	Bauxite . .	P. L. (renewal.)	68	31st December 1918	2 years.
Do. .	(430) Do. .	Do. . .	P. L. (renewal.)	107	Do. .	Do.
Do. .	(431) Do. .	Do. . .	P. L. (renewal.)	66	1st February 1919.	Do.
Do. .	(432) Do. .	Do. . .	P. L. (renewal.)	96	31st December 1918.	Do.
Do. .	(433) Do. .	Do. . .	P. L. (renewal.)	533	1st February 1919.	Do.
Do.	(434) Do. .	Do. . .	P. L. (renewal.)	151	Do. .	Do.
Do. .	(435) Do. .	Do. . .	P. L. (renewal.)	525	Do. .	Do.
Do. .	(436) Do. .	Do . .	P. L. (renewal.)	26	Do.	Do.
Do. .	(437) Do. .	Do. . .	P. L. (renewal.)	20	Do. .	Do.
Do. .	(438) Do. .	Do. . .	P. L. (renewal.)	116	Do. .	Do.
Do. .	(439) Do. .	Do. . .	P. L. (renewal.)	93	Do. .	Do.
Do. .	(440) Do. .	Do. . .	P. L. (renewal.)	64	Do.	Do.
Do. .	(441) Khan Bahadur Byramji Pestonji.	Manganese . .	P. L. .	136	31st March 1919.	1 year.
Do. .	(442) Central Provinces Prospecting Syndicate.	Do. . .	M. L. .	13	1st March 1919.	Will expire with the original lease, dated the 22nd December 1902, to which it is supplementary.
Do. .	(443) Pandit Kripashanker.	Do. . .	M. L. .	44	2nd January 1919.	Will expire with the original lease, dated the 29th April 1918, to which it is supplementary.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Balaghat	(444) Mr. M. B. Chopra	Manganese	P. L.	101	26th March 1919.	1 year.
Do.	(445) Khan Bahadur Byramji Pestonji.	Do.	P. L. (renewal.)	52	27th May 1919.	5 months.
Do.	(446) Do.	Do.	P. L.	173	7th June 1919.	1 year.
Do.	(447) Do.	Do.	P. L.	128	Do.	Do.
Do.	(448) Messrs. Tata Sons, Ltd.	Bauxite	P. L. (renewal.)	28	28th June 1919.	2 years.
Do.	(449) Do.	Do.	P. L. (renewal.)	16	7th May 1919	Do.
Do.	(450) Do.	Do.	P. L. (renewal.)	781	5th May 1919	Do.
Do.	(451) Do.	Do.	P. L. (renewal.)	40	1st August 1919.	Do.
Do.	(452) Do.	Do.	P. L. (renewal.)	69	Do.	Do.
Do.	(453) Do.	Do.	P. L. (renewal.)	77	Do.	Do.
Do.	(454) Do.	Do.	P. L. (renewal.)	1,365	27th August 1919.	Do.
Do.	(455) Do.	Do.	P. L. (renewal.)	187	1st August 1919.	Do.
Do.	(456) Do.	Do.	P. L. (renewal.)	469	Do.	Do.
Do.	(457) Do.	Do.	P. L. (renewal.)	27	21st May 1919.	Do.
Do.	(458) Do.	Do.	P. L. (renewal.)	187	Do.	Do.
Do.	(459) Do.	Do.	P. L.	56	Do.	Do.
Do.	(460) Do.	Do.	P. L.	44	Do.	Do.
Do.	(461) Do.	Do.	P. L.	412	Do.	Do.
Do.	(462) Do.	Do.	P. L.	118	Do.	Do.
Do.	(463) Mr. M. B. Dadabhoy, C.I.E.	Manganese	P. L.	118	17th May 1919.	1 year.
Do.	(464) Pandit Rewashankar.	Do.	P. L.	186	11th June 1919.	Do.
Do.	(465) Shriram Seth	Do.	M. L.	70	17th July 1919.	30 years.
Do.	(466) Do.	Do.	P. L.	17	27th August 1919.	1 year.
Do.	(467) Do.	Do.	P. L.	13	20th September 1919.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Balaghat .	(468) Shriram Seth .	Manganese . .	P. L. .	5	20th September 1919.	1 year.
Do. .	(469) Do. .	Do. . .	P. L. .	131	Do. .	Do.
Do. .	(470) K. B. Byramji Pestonji.	Do. .	M. L. .	20	2nd August 1919.	5 years.
Do. .	(471) Do. .	Do. . .	M. L. .	4	Do. .	Do.
Do. .	(472) Do. .	Do. . .	M. L. .	13	Do. .	Do.
Do.	(473) Do. .	Do. . .	M. L. .	15	Do. .	Do.
Do. .	(474) Do. .	Do. . .	M. L. .	13	Do. .	Do.
Do. .	(475) Do. .	Do. . .	M. L. .	25	Do. .	Do.
Do. .	(476) Do.	Do. . .	M. L. .	18	26th August 1919.	Do.
Do. .	(477) Do.	Do. . .	M. L. .	22	2nd August 1919.	Do.
Do. .	(478) Do. .	Do. . .	M. L. .	4	Do. .	Do.
Do. .	(479) Do. .	Do. . .	M. L. .	3	Do. .	Do.
Do.	(480) Do. .	Do. . .	P. L. . (renewal.)	552	27th August 1919.	6 months.
Do. .	(481) Do. .	Do. . .	M. L. .	20	2nd August 1919.	5 years.
Do. .	(482) Do. .	Do. . .	M. L. .	11	Do. .	Do.
Do. .	(483) Baboo Kripashankar.	Do. . .	M. L. .	19	9th August 1919.	Do.
Do. .	(484) Do. .	Do. . .	M. L. .	88	Do. .	Do.
Do. .	(485) Pandit Rewashankar.	Do. . .	M. L. .	41	2nd July 1919.	15 years.
Do. .	(486) Do. .	Do. . .	M. L. .	36	Do. .	10 years.
Do. .	(487) Messrs. Bahmansha Fouzdar Brothers.	Do. . .	P. L. . (renewal.)	131	4th September 1919.	6 months.
Do. .	(488) Messrs. Tata Iron and Steel Co., Ltd.	Do. . .	M. L. .	678	30th July 1919.	5 years.
Do. .	(489) Messrs. Tata Sons, Ltd.	Bauxite .	P. L. .	7,187	2nd August 1919.	1 year.
Do. .	(490) Do. .	Do. . .	P. L. .	650	Do. .	Do.
Do. .	(491) Do. .	Do. . .	P. L. .	964	Do. .	Do.
Do. .	(492) Do. .	Do. . .	P. L. .	188	Do. .	Do.
Do. .	(493) Do. .	Do. . .	P. L. .	125	Do. .	Do.
Do. .	(494) Do. .	Do. .	P. L. .	242	Do. .	Do.
Do. .	(495) Do. . .	Do. . .	P. L. .	397	Do. .	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Balaghat .	(496) Messrs. Tata Sons, Ltd.	Bauxite . .	P. L. .	119	2nd August 1919.	1 year.
Do. .	(497) Do. .	Do. . .	P. L. .	91	Do. .	Do.
Do. .	(498) Do. .	Do. . .	P. L. .	628	Do. .	Do.
Do. .	(499) Do. .	Do. . .	P. L. .	316	Do. .	Do.
Do. .	(500) Do. .	Do. . .	P. L. .	188	Do. .	Do.
Do. .	(501) Do. .	Do. . .	P. L. .	125	Do. .	Do.
Do. .	(502) Seth Gowardhandas.	Manganese . .	P. L. .	70	27th August 1919.	Do.
Do. .	(503) Messrs. M. D'Costa and Goredutt Ganeshlal.	Do. . .	P. L. .	53	2nd July 1919.	Do.
Do. .	(504) Mr. C. S. Harris .	Do. . .	P. L. .	528	27th August 1919.	Do.
Do. .	(505) Do. .	Do. . .	P. L. .	61	Do. .	Do.
Do. .	(506) Do. .	Do. .	P. L. .	14	Do. .	Do.
Do. .	(507) Shri Ram Seth .	Do. . .	P. L. .	142	18th October 1919.	Do.
Do. .	(508) Do. .	Do. . .	P. L. .	85	21st December 1919.	Do.
Do. .	(509) Do. .	Do. . .	P. L. .	4	Do. .	Do.
Do. .	(510) Khan Bahadur Byramji Pestonji.	Do. . .	P. L. .	422	18th October 1919.	Do.
Do. .	(511) Do. .	Do. . .	P. L. .	59	Do. .	Do.
Do. .	(512) Do. .	Do. . .	M. L. .	18	28th October 1919.	5 years.
Do. .	(513) Do. .	Do. . .	M. L. .	4	Do. .	Do.
Do. .	(514) Do. .	Do. . .	M. L. .	2	Do. .	Do.
Do. .	(515) Do. .	Do. . .	M. L. .	58	2nd October 1919.	Do.
Do. .	(516) Do. .	Do. . .	M. L. .	21	25th Novem- 1919.	Do.
Do. .	(517) Pandit Kripashankar. .	Do. . .	P. L. .	48	8th November 1919.	1 year.
Do. .	(518) Do. .	Do. . .	M. L. .	76	28th October 1919.	15 years.
Do. .	(519) Messrs. Tata Sons, Ltd.	Bauxite . .	P. L. . (renewal.)	387	13th December 1919.	2 years.
Do. .	(520) Do. .	Do. . .	P. L. . (renewal.)	213	Do. .	Do.
Do. .	(521) Do. .	Do. . .	P. L. . (renewal.)	522	Do. .	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Balaghat	(522) Rajputana Minerals Syndicate, Ltd.	Manganese	P. L.	911	17th December 1919.	1 year.
Do.	(523) Mr. C. S. Harris	Copper	M. L.	127	17th October 1919.	30 years.
Do.	(524) Do.	Manganese	M. L.	30	25th September 1919.	Do.
Do.	(525) Do.	Do.	P. L.	21	10th November 1919.	1 year.
Do.	(526) Messrs. Lalbehari Ram Charan.	Do.	P. L.	212	18th October 1919.	Do.
Do.	(527) Do.	Do.	P. L.	42	Do.	Do.
Do.	(528) Do.	Do.	P. L.	3	Do.	Do.
Do.	(529) Do.	Do.	P. L.	3	21st November 1919.	Do.
Betul	(530) Shaikh Shahabuddin.	Graphite	M. L.	57	2nd August 1919.	30 years.
Do.	(531) Mr. M. R. Dixit, Barrister-at-Law, Nagpur.	Do.	M. L.	231	6th August 1919.	Do.
Do.	(532) Seth Lakhmichand.	Lead	P. L.	177·28	1st December 1919.	1 year.
Bhandara	(533) Khan Bahadur Byramji Pestonji.	Manganese	P. L. (renewal.)	17	27th February 1919.	6 months.
Do.	(534) Mr. Shriram Seth	Corundum	P. L.	32	27th July 1919.	1 year.
Do.	(535) Do.	Manganese	P. L.	30	9th August 1919.	Do.
Do.	(536) Seth Gowardhandas.	Do.	P. L. (renewal.)	27	20th November 1919.	Do.
Do.	(537) Shri Ram Seth	Do.	M. L.	40	4th October 1919.	5 years.
Chanda	(538) Mr. M. B. Dadabhoy, C.I.E.	Coal	P. L.	2,208	12th May 1919.	1 year.
Do.	(539) Mr. Padamsy Narsibhai.	Do.	P. L.	453	2nd June 1919.	Do.
Do.	(540) Messrs. Hajibhoy Lalji & Co., Bombay.	Do.	P. L.	218	26th September 1919.	Do.
Do.	(541) Messrs. Jagjivan Vallabhdas Padamsy & Co., Bombay.	Do.	M. L.	360	8th December 1919.	30 years.
Do.	(542) Do.	Do.	M. L.	771	Do.	Do.
Chhindwara	(543) Babu Kripashankar.	Do.	P. L.	417	28th February 1919.	1 year.
Do.	(544) Sheikh Shahabuddin.	Do.	P. L.	1,452	4th March 1919.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Chhindwara.	(545) Rao Sahib D. Lakshminarain.	Manganese .	P. L.	237	19th May 1919.	1 year.
Do.	(546) Do.	Do.	P. L.	82	7th June 1919.	Do.
Do.	(547) Khan Bahadur Byramji Pestonji.	Do.	P. L.	517	17th June 1919.	Do.
Do.	(548) Mir Aslam Khan	Coal	P. L.	588	23rd June 1919.	Do.
Do.	(549) The Pench Consolidated Coal Co., Ltd.	Do.	M. L.	463	30th July 1919.	30 years.
Do.	(550) Messrs. Shaw Wallace & Co.	Do.	M. L.	455	Do.	Do.
Do.	(551) Do.	Do.	M. L.	442	Do.	Do.
Do.	(552) Do.	Do.	M. L.	214	Do.	Do.
Do.	(553) Messrs. H. Verma and M. Kanhaiya Lal of Chhindwara.	Do.	M. L.	268	29th July 1919.	Will expire with the original lease, dated 7th June 1916 to which it is supplementary, *i.e.*, on 7th June 1946.
Do.	(554) Messrs. Byramji Pestonji & Co.	Do.	M. L.	1,485	12th August 1919.	30 years.
Do.	(555) Do.	Do.	M. L.	436	26th August 1919.	Do.
Do.	(556) Do.	Do.	M. L.	492	Do.	Do.
Do.	(557) Rai Bahadur Bissesardas Daga and others of Kamptee.	Manganese-ore	M. L.	174	10th July 1919.	15 years.
Do.	(558) Mr. B. V. Buti of Nagpur.	Do.	M. L.	4	8th September 1919.	30 years.
Do.	(559) Indian Manganese Co., Ltd., Nagpur.	Do.	P. L.	284	4th July 1919.	1 year.
Do.	(560) Do.	Do.	P. L.	1,008	Do.	Do.
Do.	(561) Mr. B. V. Buti of Nagpur.	Manganese .	M. L.	133·49	21st October 1919.	30 years.
Do.	(562) Mir Aslam Khan of Nagpur.	Coal	P. L.	567·55	1st December 1919.	1 year.
Do.	(563) Messrs. A. H. Vasudeo Rao and Brothers of Nagpur.	Do.	P. L.	25·64	3rd November 1919.	Do.

P. L.—*Prospecting License.* M. L.—*Mining Lease.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Chhindwara	(564) Mr. B. V. Buti of Nagpur.	Coal . . .	P. L. .	75·97	7th October 1919.	1 year.
Do. .	(565) Messrs. H. Verma and Munshi Kanhaiya-lal of Chhindwara.	Do. . . .	P. L. .	243·14	20th November 1919.	Do.
Do. .	(566) Mr. B. V. Buti of Nagpur.	Manganese . .	P. L. .	185·46	11th December 1919.	Do.
Do. .	(567) Do. .	Coal . . .	P. L. .	306·00	4th December 1919.	Do.
Jubbulpore	(568) Mr. C. Stanley Harris.	Manganese . .	P. L. .	94	15th May 1919.	Do.
Do. .	(569) Mr. Venkat Ramanna.	Bauxite . .	P. L. .	317	13th June 1919.	Do.
Do. .	(570) Mr. J. C. Wilson .	Manganese, copper and mica.	P. L. .	874	12th May 1919.	Do.
Do. .	(571) Mr. George Forrester.	Bauxite . .	P. L. .	30	17th September 1919.	Do.
Do. .	(572) D. B. Balabhdas, Mannulal and Kanhaiya Lal	Iron, manganese, tin, zinc and silver.	P. L. .	266	10th July 1919.	Do.
Do. .	(573) Do. .	Do. .	P. L. .	268	3rd September 1919.	Do.
Do. .	(574) Do. .	Do. .	P. L. .	412	10th July 1919.	Do.
Do. .	(575) Diwan Bahadur Ballabhdas, Manoolal Kanhaiyalal of Jubbulpore.	Do .	P. L. .	592·14	10th November 1919.	Do.
Do. .	(576) Messrs. Byramji Pestonji of Nagpur.	Manganese . .	M. L. .	15·97	25th November 1919.	5 years.
Nagpur .	(577) Mr. Laxman Rao Damodhar Lele.	Do. . .	P. L. .	94	31st March 1919.	1 year.
Do. .	(578) Mr. T. Cooverji Bhoja.	Do. . .	P. L. .	80	27th March 1919.	Do.
Do. .	(579) Do. .	Do. . .	P. L. .	128	Do. .	Do.
Do. .	(580) Do. .	Do. . .	P. L. .	160	Do. .	Do.
Do. .	(581) Do. .	Do. . .	P. L. .	33	Do. .	Do.
Do. .	(582) Mr. G. E. Bright .	Do. . .	P. L. .	561	28th March 1919.	Do.
Do. .	(583) Do. .	Do. . .	P. L. .	1,082	Do. .	Do.
Do. .	(584) Khan Bahadur Byramji Pestonji.	Do. . .	P. L. .	329	22nd March 1919.	Do.
Do. .	(585) Do. .	Do. . .	P. L. .	400	Do. .	Do.
Do. .	(586) Rao Saheb D. Laxminarayan.	Do. . .	P. L. .	620	27th March 1919.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Nagpur .	(587) Rao Saheb D. Laxminarayan.	Manganese .	P. L. .	58	27th March 1919.	1 year.
Do. .	(588) Do. .	Do. . .	P. L. .	462	Do. .	Do.
Do. .	(589) Messrs. Lalbehari and Ramcharan.	Do. . .	P. L. .	243	28th March 1919.	Do.
Do. .	(590) Mr. M. B. Dadabhoy, C.I.E.	Coal . . .	P. L. .	3,381	26th May 1919.	Do.
Do. .	(591) Messrs. A. H. Wasudeo Rao and A. Damodhar Rao.	Manganese . .	M. L. .	49	27th May 1919.	30 years.
Do. .	(592) Do. .	Do. . .	M. L. .	10	Do. .	Do.
Do. .	(593) Messrs. Bahmansha Fouzdar Brothers.	Do. . .	M. L. .	40	25th June 1919.	Do.
Do. .	(594) Do. .	Do. . .	M. L. .	30	13th May 1919.	Do.
Do. .	(595) Do. .	Do. . .	M L. .	28	Do. .	Do.
Do. .	(596) Do. .	Do. . .	M. L. .	5	25th June 1919.	Do.
Do .	(597) Do. .	Do. . .	P. L. .	205	14th May 1919.	1 year.
Do. .	(598) Do. .	Do. . .	P. L. . (renewal.)	56	4th April 1919.	3 months.
Do. .	(599) Messrs. Goredutt Ganesh Lal and M. D'Costa.	Do. . .	M. L. .	27	20th June 1919.	10 years.
Do. .	(600) Messrs. Lalbehari and Ramcharan.	Do. . .	M. L. .	13	12th June 1919.	30 years.
Do. .	(601) Do. .	Do. . .	M. L. .	27	Do. .	Do.
Do. .	(602) Messrs. Ramprasad Lakshminarayan.	Do. . .	P. L. .	19	30th April 1919.	1 year.
Do. .	(603) Rao Sahib D. Lakshminarayan.	Do. . .	P. L. .	530	19th May 1919.	Do.
Do. .	(604) Do .	Do. . .	P. L. .	450	Do. .	Do.
Do. .	(605) Mir Aslam Khan .	Do. . .	P. L. .	68	24th June 1919.	Do.
Do. .	(606) Do. .	Do. . .	P. L. .	47	9th June 1919.	Do.
Do. .	(607) Do. .	Do. . .	P. L. .	28	14th May 1919.	Do.
Do. .	(608) Do. .	Do. . .	P. L. .	56	24th June 1919.	Do.
Do. .	(609) Do. .	Do. . .	P. L. .	130	22nd May 1919.	Do.
Do. .	(610) Do.	Do. . .	P. L. .	163	Do. .	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*contd.*

District.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Nagpur .	(611) Mir Aslam Khan .	Manganese . .	P. L. . (renewal.)	111	18th May 1919.	8 months.
Do. .	(612) Mr. G. E. Bright .	Do. . .	P. L. .	28	22nd June 1919.	1 year.
Do. .	(613) Rai Bahadur Bisesardas Daga.	Do. .	P. L. . (renewal.)	219	30th July 1919.	7 months
Do. .	(614) The Central India Mining Co., Ltd.	Do. . .	M. L. .	2	4th August 1919.	30 years.
Do. .	(615) Do. .	Do. . .	M. L. .	35	12th July 1919.	10 years.
Do. .	(616) R. S. D. Laxminarayan.	Do. . .	M. L. .	37	8th July 1919.	30 years.
Do. .	(617) Do. .	Do. . .	M. L. .	49	Do. .	Do.
Do. .	(618) Do. .	Do. . .	P. L. .	56	26th August 1919.	1 year.
Do. .	(619) Mir Aslam Khan .	Do. . .	M. L. .	17	4th September 1919.	10 years.
Do. .	(620) Do. .	Do. . .	M. L. .	206	Do. .	Do.
Do. .	(621) Do. .	Do. . .	M. L. .	69	Do. .	Do.
Do. .	(622) Do. .	Do. . .	M. L. .	31	Do. .	15 years.
Do. .	(623) Do. .	Do. . .	P. L. .	25	10th July 1919.	1 year.
Do. .	(624) Do. .	Do. . .	P. L. .	176	Do. .	Do.
Do. .	(625) Do. .	Do. . .	P. L. .	52	1st August 1919.	6 months
Do. .	(626) K. B. Byramji Pestonji.	Do. . .	M. L.	27	26th August 1919.	5 years.
Do. .	(627) R. B. Bisesardas Daga.	Do. . .	P. L. .	219	28th June 1919.	8 months.
Do. .	(628) Ramkrishnapuri Gosai.	Do. . .	P. L. .	75	25th September 1919.	1 year.
Do. .	(629) Do. .	Do. . .	P. L. .	110	Do. .	Do.
Do. .	(630) Rao Sahib D. Laxminarayan.	Do. . .	P. L. .	272	11th October 1919.	Do.
Do. .	(631) Mr. Venkat Ramanna.	Do. . .	P. L. .	300	7th October 1919.	Do.
Do. .	(632) Mir Aslam Khan, Contractor.	Do. . .	M. L. .	49	18th November 1919.	30 years.
Do. .	(633) Mr. Laxman Damodar Lele.	Do. . .	M. L. . .	16	5th November 1919.	Do.
Do.	(634) Do. .	Do. . .	M. L. .	7	Do. .	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

CENTRAL PROVINCES—*concld.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Nagpur	(635) Mr. Ramkrishnapuri Gosai.	Manganese	P. L.	131	2nd December 1919.	1 year
Do.	(636) Do.	Do.	P. L.	40	Do.	Do.
Do.	(637) Do.	Do.	P. L.	29	Do.	Do.
Narsingpur	(638) Mr. J. Reid	Coal	P. L.	1,844	2nd January 1919.	Do.
Raipur	(639) Debiprasad Benia	Copper	P. L. (renewal.)	586	7th February 1919.	Up to 31st December 1919.
Saugor	(640) Mr. Pragnarayan, B.A., LL.B., Pleader, Agra.	Iron pyrites, Sulphur and iron.	P. L.	75	5th September 1919.	1 year.
Do.	(641) Rao Bahadur Damodar Rao Shrikhande, Pleader of Damoh.	Copper	P. L.	254	11th December 1919.	Do.
Seoni	(642) Messrs. Byramji Pestonji of Nagpur.	Mica	P. L.	411·60	13th October 1919.	Do.
Yeotmal	(643) Muhamad Anwar Pasha, minor by guardian Munshi Sheikh Alimuddin of Chikhla	Coal	M. L.	205	30th August 1919.	30 years.
Do.	(644) Mr. M. B. Dadabhoy, Barrister-at-Law, Nagpur.	Do.	M. L.	592	Do.	25 years, 1 month and 15 days.
Do.	(645) Do.	Do.	M. L.	372	13th August 1919.	30 years.

MADRAS.

Anantapur.	(646) B. P. Sesha Reddi.	Barytes	P. L.	2·84	13th July 1919.	1 year.
Do.	(647) A. Ghose, Esq.	Do.	P. L.	56·90	27th July 1919.	Do.
Do.	(648) Agent, Anantapur Gold Fields (Ltd.).	Gold	P. L.	3,604·81	8th October 1919.	Do.
Kurnool	(649) B. P. Sesha Reddi.	Barytes	P. L.	19·13	20th September 1919.	Do.
Do.	(650) Do.	Do.	P. L.	8·06	Do.	Do.
Do.	(651) A. Ghose, Esq.	Do.	P. L.	65	18th September 1919.	Do.
Do.	(652) Do.	Do.	P. L.	1·73	Do.	Do.
Do.	(653) Do.	Do.	P. L.	7·78	Do.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

MADRAS—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Kurnool .	(654) B. P. Sesha Reddi.	Barytes . .	P. L. .	4·20	16th August 1919.	1 year.
Do. .	(655) A. Ghose, Esq. .	Do. . .	P. L. .	86	18th September 1919.	Do.
Do. .	(656) B. P. Sesha Reddi.	Do. . .	P. L. .	0·80	20th September 1919.	Do.
Do. .	(657) Do. .	Do. . .	P. L. .	12·50	Do. .	Do.
Do. .	(658) B. Pulla Reddi .	Do. . .	P. L. .	1·40	16th August 1919.	Do.
Do. .	(659) Do. .	Do. . .	P. L. .	0·80	Do. .	Do.
Do. .	(660) Do. .	Do. . .	P. L. .	3·30	Do. .	Do.
Do. .	(661) A. Ghose, Esq. .	Do. . .	P. L. .	1·00	18th September 1919.	Do.
Do. .	(662) B. P. Sesha Reddi.	Do. . .	P. L. .	13 50	20th September 1919.	Do.
Do. .	(663) A. Ghose, Esq. .	Do.	P. L. .	32·30	23rd December 1919.	Do.
Do. .	(664) Do.	Do. .	P. L. .	21 80	16th October 1919.	Do.
Do. .	(665) Do. .	Do. . .	P. L. .	1·15	5th December 1919.	Do.
Do. .	(666) Do. .	Do . .	P. L. .	2·88	16th October 1919.	Do.
Do. .	(667) Do. .	Do. . .	P L. .	2·62	5th December 1919.	Do.
Do. .	(668) Do. .	Do. .	P. L. .	6·00	23rd December 1919.	Do.
Do. .	(669) Do. .	Do. . .	P. L. .	295·30	Do. .	Do.
Do. .	(670) Do. .	Do. . .	P. L. .	0·98	5th December 1919.	Do.
Do. .	(671) Do. .	Do. . .	P. L. .	6·05	23rd December 1919.	Do.
Nellore .	(672) P. K. Vengama Nayudu.	Mica . .	M. L. .	19·97	11th October 1918.	30 years.
Do. .	(673) N. Raghavalu Naicker.	Do. . .	P. L. .	3·38	31st January 1919.	1 year.
Do. .	(674) G. Venkatachalam Chetti.	Do. . . .	M. L. .	27·86	7th December 1918.	30 years.
Do. .	(675) C. H. Jefferson .	Do. . . .	M. L. .	1·10	3rd October 1918.	Do.
Do. .	(676) Messrs. Startin & Co.	Do. . . .	M. L. . (This lease is in extension of the one already held by the company.)	30·74	15th September 1918.	For the unexpired portion of the period of the original lease.

P. L.=*Prospecting License*. M. L.=*Mining Lease.*

MADRAS—*contd.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Nellore	(677) P. Venkataswami Chetti.	Mica	P. L.	48·28	18th March 1919.	1 year.
Do.	(678) N. Raghavalu Naicker.	Do.	P. L.	10·22	7th November 1918.	Do.
Do.	(679) T. Venkatasubba Rao.	Do.	P. L.	18·65	13th December 1918.	Do.
Do.	(680) K. Penchulu Reddi	Do.	M. L.	89·05	24th October 1918.	30 years.
Do.	(681) P. Venkata Narapa Reddi.	Do.	M. L.	82·43	12th August 1918.	Up to 1st August 1944.
Do.	(682) K. Adinarayana Reddi.	Do.	M. L.	121·98	9th October 1918.	Up to 4th April 1947.
Do.	(683) Messrs. W. A. Beardsell & Co.	Do.	M. L.	308·27	3rd February 1917.	30 years.
Do.	(684) Do.	Do.	M. L.	182·96	Do.	Do.
Do.	(685) Do.	Do.	M. L.	305·24	Do.	Do.
Do.	(686) Do.	Do.	M. L.	76	Do.	Do.
Do.	(687) K. Penchelu Reddi	Do.	P. L.	13·41	1st July 1919	1 year.
Do.	(688) P. Venkataswami Chetti.	Do.	P. L.	2·68	18th April 1919.	Do.
Do.	(689) N. Raghavalu Nayakar.	Do.	M. L.	9·41	14th December 1918.	30 years.
Do.	(690) V. K. M. K. R. Karuppan Chetti.	Do	P. L.	24·62	26th February 1919.	1 year.
Do.	(691) G. Subrahmanyam	Do.	P. L.	145·46	1st October 1919.	Do.
Do.	(692) Indur Subbarami Reddi.	Do.	P. L.	30·09	28th July 1919.	Do.
Do.	(693) G. Gopalakrishnayya.	Do.	P. L.	136·86	31st July 1919.	Do.
Do.	(694) Moolji Govindjee	Do.	P. L.	20	8th April 1919.	Do.
Do.	(695) V. Rami Reddi	Do.	P. L.	10·05	2nd June 1919.	Do.
Do.	(696) B. V. Subba Reddi	Do.	P. L.	5·05	Do.	Do.
Do.	(697) V. K. M. K. R. Karuppan Chetti.	Do.	P. L.	0·32	24th May 1919.	Do.
Do.	(698) K. Venkatasubbayya.	Do.	P. L.	12·89	6th August 1919.	Do.
Do.	(699) G. V. Subba Reddi	Do.	P. L.	43·30	1st October 1919.	Do.

P. L.=*Prospecting License.* M. L.=*Mining Lease.*

MADRAS—*concld.*

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Nellore	(700) Indupur Subbarami Reddi.	Mica	P. L.	31·26	20th September 1919.	1 year.
Do.	(701) V. Venkatasubbayya.	Do.	P. L.	1·61	29th September 1919.	Do.
Do.	(702) V. K. M. K. R. Karuppan Chetti.	Do.	P. L. (renewal).	13·65	Not stated.	Not stated.
Do.	(703) R. K. Subbaraghava Ayyar.	Do.	P. L.	10·25	6th November 1919.	1 year.
Do.	(704) N. Viraraghavayya	Do.	P. L.	3·17	9th October 1919.	Do.
Do.	(705) N. Raghavalu Nayakar.	Do.	P. L.	37·40	12th July 1919.	Do.
Trichinopoly	(706) Messrs. Stanes & Co., Coimbatore.	Phosphatic nodules	M. L.	Blocks nos. 3 and 6 in the survey map of 1862 and 1895.	The date on which the lessee begins operations.	5 years.

PUNJAB.

DISTRICT.	Grantee.	Mineral.	Nature of grant.	Area in acres.	Date of commencement.	Term.
Attock	(707) The Attock Oil Co., Ltd.	Mineral oil	P. L.	3,264	3rd September 1919	1 year
Jhelum	(708) R. S. L. Thakar Dass Ramji Das of Dandot.	Coal	P. L.	830·7	11th April 1918.	Do.

P. L. = *Prospecting License.* M. L. = *Mining Lease.*

SUMMARY.

PROVINCE.	Prospecting Licenses.	Mining Leases.	Total of each Province.
Assam	7	2	9
Baluchistan	4	..	4
Bihar and Orissa	19	13	36
Bombay	7	..	7
Burma	355	9	364
Central Provinces	160	69	229
Madras	48	13	61
Punjab	2	..	2
Total of each kind and Grand total, 1919	**602**	**106**	**708**
TOTAL for 1918	675	44	719

CLASSIFICATION OF LICENSES AND LEASES.

TABLE 36.—*Prospecting Licenses and Mining Leases granted in Assam during 1919.*

DISTRICT.	1919.		
	No.	Area in acres.	Mineral.
Prospecting Licenses.			
Cachar	2	8,491·9	Mineral oil.
Do.	1	934·4	Oil and coal.
Khasi and Jaintia Hills	2	12,902·4	Minerals other than mineral oils.
Lakhimpur	2	12,320	Oil.
TOTAL	7	...	
Mining Leases.			
Lakimpur	2	5,120	Oil.

TABLE 37.—*Prospecting Licenses and Mining Leases granted in Baluchistan during 1919.*

DISTRICT.	1919.		
	No.	Area in acres.	Mineral.
Prospecting Licenses.			
Kalat	3	46,080	Oil.
Zhob	1	60	Chromite.
TOTAL	4	...	

TABLE 38.—*Prospecting Licenses and Mining Leases granted in Bihar and Orissa during 1919.*

DISTRICT.	1919. No.	1919. Area in acres.	1919. Mineral.
Prospecting Licenses.			
Hazaribagh	8	2,128·89	Mica.
Sambalpur	1	5,849·79	Do.
Do.	1	2,376·99	Coal.
Do.	1	57	Oxide of iron.
Santal Parganas	2	10,239·74	Coal.
Singhbhum	2	2,660	Gold and galena.
Do.	1	26,240	General license.
Do.	1	992	Manganese and iron-ore.
Do.	2	2,310·4	Iron-ore.
TOTAL	19	...	
Mining Leases.			
Hazaribagh	3	360	Mica.
Santal Parganas	10	79·86	Coal.
TOTAL	13	...	

TABLE 39.—*Prospecting Licenses and Mining Leases granted in Bombay during 1919.*

DISTRICT.	1919. No.	1919. Area in acres.	1919. Mineral.
Prospecting Licenses.			
Belgaum	6	2,722·92	Bauxite.
Kaira	1	79·82	Manganese.
TOTAL	7	...	

TABLE 40.—*Prospecting Licenses and Mining Leases granted in Burma during 1919.*

DISTRICT.	1919.		
	No.	Area in acres.	Mineral.
Prospecting Licenses.			
Akyab	2	4,900	Mineral oil.
Amherst	42	41,095·43	All minerals (except oil).
Bhamo	1	5,516·8	Do.
Do.	1	6,400	All minerals (except oil and jade).
Henzada	3	5,628·02	All minerals (except oil.)
Katha	9	50,201·60	Do.
Do.	1	2,752	Gold.
Do.	1	3,392	All minerals (except oil and jade).
Kyaukpyu	1	640	Mineral oil.
Kyaukse	1	1,656·32	All minerals (except oil).
Magwe	4	26,787·30	Mineral oil.
Mandalay	1	2,355·2	Silver and lead.
Mergui	21	21,790·12	Wolfram and tin.
Do.	38	43,313·65	All minerals (except oil).
Do.	3	1,295·36	Wolfram, tin and allied minerals.
Do.	13	10,929·46	Tin.
Do.	1	1,720·32	Tin, Gold and allied minerals.
Do.	2	732·16	Wolfram and allied minerals.
Do.	1	400	Coal.
Do.	1	517·12	Tin and tungsten ores.
Do.	1	640	Wolfram.
Minbu	5	5,238·24	Mineral oil.
Do.	10	14,671·6	Coal.
Myingyan	5	20,329·10	Mineral oil.
Do.	1	167·75	All minerals.
Myitkyina	1	640	Silver and copper.
Do.	1	2,931·20	Gold and platinum.
Do.	1	3,200	Gold and iridio platinum.
Do.	1	640	Gold.
Do.	1	4,851·20	All minerals (except oil).
Pakokku	5	4,572·8	Mineral oil.
Pakokku Hill Tracts	1	3,840	All minerals (except oil).
Prome	2	443	Mineral oil.
Do.	1	2,668·3	Coal.
Ruby Mines	2	10,240	All minerals (except oil).
Do.	1	640	Copper ore.
Do.	1	41	Mica.

TABLE 40.—*Prospecting Licenses and Mining Leases granted in Burma during 1919*—contd.

DISTRICT.	1919.		
	No.	Area in acres.	Mineral.
Prospecting Licenses—*contd.*			
Salween	2	5,140	All minerals (except oil).
Shwebo	1	200	Do.
Do.	2	8,320	Mineral oil.
Southern Shan States	1	1,280	Lead.
Do.	7	9,239	All minerals (except oil).
Do.	4	14,560	Gold.
Do.	1	640	Antimony and associated minerals.
Tavoy	123	116,509·78	All minerals (except oil).
Do.	2	2,084	All minerals (except oil and jade).
Thayetmyo	11	53,850	Mineral oil.
Toungoo	2	2,667·52	All minerals (except oil).
Upper Chindwin	1	12,800	Mineral oil.
Yamethin	11	15,628·8	All minerals (except oil).
TOTAL	355	...	
Mining Leases.			
Mergui	2	814·33	Wolfram and tin.
Do.	1	983·13	All minerals (except oil).
Pakokku	1	1,280	Mineral oil.
Southern Shan States	1	2·1	Lead and Silver.
Tavoy	2	1,056·79	All minerals (except oil and precious stones).
Do.	1	660·73	Wolfram and tin.
Thayetmyo	1	94·72	Mineral oil.
TOTAL	9	...	

TABLE 41.—*Prospecting Licenses and Mining Leases granted in the Central Provinces during 1919.*

DISTRICT.	1919. No.	1919. Area in acres.	1919. Mineral.
Prospecting Licenses.			
Balaghat	41	5,927	Manganese.
Do.	1	12	Copper and bauxite.
Do.	43	18,083	Bauxite.
Betul	1	177·28	Lead.
Bhandara	3	74	Manganese.
Do.	1	32	Corundum.
Chanda	3	2,874	Coal.
Chhindwara	8	3,765·30	Do.
Do.	6	2,313·46	Manganese.
Jubbulpore	1	94	Do.
Do.	2	356	Bauxite.
Do.	1	874	Manganese, copper and mica.
Do.	4	1,538·14	Iron, Manganese, tin, zinc and silver.
Nagpur	39	7,854	Manganese.
Do.	1	3,381	Coal.
Narsingpur	1	1,844	Do.
Raipur	1	586	Copper.
Saugor	1	75	Iron pyrites, sulphur and iron.
Do.	1	254	Copper.
Seoni	1	411·60	Mica.
TOTAL	160	...	
Mining Leases.			
Balaghat	27	1,375	Manganese.
Do.	1	127	Copper.
Betul	2	288	Graphite.
Bhandara	1	49	Manganese.
Chanda	2	1,131	Coal.
Chhindwara	8	4,255	Do.
Do.	3	311·49	Manganese.
Jubbulpore	1	15·97	Do.
Nagpur	21	774	Do.
Yeotmal	3	1,169	Coal.
TOTAL	69	...	

TABLE 42.—*Prospecting Licenses and Mining Leases granted in Madras during 1919.*

District.	1919.		
	No.	Area in acres.	Mineral.
Prospecting Licenses.			
Anantapur	2	59·74	Barytes.
Do.	1	3,604·81	Gold.
Kurnool	23	596·23	Barytes.
Nellore	22	640·60	Mica.
TOTAL .	48	...	
Mining Leases.			
Nellore	12	1,255·01	Mica.
Trichinopoly	1	Blocks Nos. 3 and 6 in the Survey map of 1862 and 1895.	Phosphatic nodules.

TABLE 43.—*Prospecting Licenses and Mining Leases granted in the Punjab during 1919.*

District.	1919.		
	No.	Area in acres.	Mineral.
Prospecting Licenses.			
Attock	1	3,264	Mineral oil.
Jhelum	1	839·7	Coal.
TOTAL .	2	...	

RESULTS OF A REVISION OF SOME PORTIONS OF DR. NOETLING'S SECOND MONOGRAPH ON THE TERTIARY FAUNA OF BURMA. BY E. VREDENBURG, *Superintendent, Geological Survey of India.* (With one text figure.)

CONTENTS.

I.—STRATIGRAPHICAL DISTRIBUTION OF THE FAUNAS DEALT WITH BY DR. NOETLING.

(1) Introductory: the Pegu system as classified respectively by Theobald and by Noetling.

THE post-eocene Tertiary fauna of Burma has been dealt with by Dr. Noetling in two monographs, the first of which was published in 1895 in Volume XXVII of the Memoirs of the Geological Survey of India, the second, in 1901, in the Palæontologia Indica, new series, Volume I.

The specimens dealt with in the first monograph were collected by Dr. Noetling principally at Yenangyat and at Minbu. To these, in the second memoir, were added a number of specimens collected by Dr. Noetling at Singu, together with some collections previously brought by Theobald from Lower Burma principally from Kama, a town situated on the right or western bank of the Irrawadi, about midway between Prome and Thayetmyo.

The inclusion of Theobald's collections from Lower Burma, while revealing a number of fossil forms of great geological interest, led to consequences which were not altogether happy from the stratigraphical point of view. Without re-visiting the type-sections in Lower Burma, Noetling amended Theobald's classification in a manner which has given rise to a great deal of confusion. The post-eocene beds of Burma were classified by Theobald into two main divisions, a lower one, the Pegu Group, named after the Pegu range or Pegu Yoma, and an upper one, the Fossil Wood Group (*Rec. Geol. Surv. Ind.*, 1869, Vol. II, pp. 79, 80). The Fossil Wood Group, as originally defined, included marine strata in its lower portion, and freshwater beds at its upper limit. To remedy what appeared to be an inconsistency, Noetling, in Upper Burma, discarded the name "Fossil Wood Group," and distinguished the exclusively fresh-water upper beds under the name of "Irrawadi Group," retaining the name "Pegu Division" for the underlying beds mainly of marine origin. Noetling took it for granted that the Irrawadi Group or Irrawadi Series of Upper Burma coincides exclusively with the uppermost freshwater portion of Theobald's "Fossil-Wood Group" of Lower Burma. The researches of Dr. Stuart in Lower Burma, which will again be alluded to in a subsequent part of this review, have thrown great doubt upon this conclusion, for the marine beds in the lower part of

Theobald's "Fossil Wood Group" of Lower Burma may possibly be contemporaneous with some of the fresh-water strata in the Irrawadi Series of Upper Burma. Several geologists have drawn attention to the fact that the marine sequence, in the Irrawadi region of Burma, becomes gradually curtailed in a northern direction, owing to the encroachment of the fresh-water facies, especially amongst the later Tertiary formations. Mr. Cotter's researches on this subject are, particularly convincing (*Rec. Geol. Surv. Ind.*, Vol. XLIV, p. 166, Vol. XLVII, p. 63; *Journ. As. Soc. Bengal*, new ser., Vol. XIV, p. 609). During the earlier stages of geological investigation in Burma, the existence of these variations of facies were unknown to Noetling, and, *a fortiori*, to Theobald. Some of the strata constituting the southern part of the Pegu Yoma, in which Theobald discovered the conspicuous forms of oysters described by Noetling as *Ostrea promensis* and *Ostrea peguensis*, which will again be referred to in the sequel, included in the Pegu Group in the geological map published by Theobald, are possibly contemporaneous with a portion of Noetling's Irrawadi Series, and almost certainly contemporaneous with a portion of Theobald's own Fossil Wood Group as defined in the Prome and Thayetmyo region. Thus, instead of representing two superposed geological units, the Pegu and Irrawadi divisions, in the light of recent research, may eventually prove to be partly vicarious.

Nevertheless, the question is not yet fully elucidated, and, whatever may be the exact relationships of the Pegu and Irrawadi divisions, these designations correspond, over large areas, to well defined types, the interpretation of which, by different geologists, has not seriously varied.

Where Noetling's scheme is particularly unfortunate, is in the re-distribution of the subdivisions originally established by Theobald within the Pegu Group. The lowest beds, mainly shaly, were distinguished by Theobald as the Sitsayan Shales (*Mem. Geol. Surv. Ind.*, 1874, Vol. X, p. 269), the remainder, with a considerable admixture of sandstones, constituting the Prome beds (*loc. cit.*, p. 270). The upper part of the Prome division, where studied by Theobald, includes some richly fossiliferous bands. Noetling re-defined the Prome division so as to include the Sitsayan Shales and the unfossiliferous or less fossiliferous lower portion of Theobald's original Prome beds. All the richly fossiliferous marine strata of Upper Burma in the region of the oil-fields were united with those previously recognized by Theobald in various parts of Lower Burma to constitute a "Yenangyoung Stage" (*Rec. Geol. Surv. Ind.*, 1895, Vol. XXVIII, p. 64), eventually regarded by Noetling as newer than the totality of the re-defined "Prome Stage" or "Promeian." Not only does the amended scheme introduce a serious source of confusion by reversing the use of the term "Prome," with which Theobald designated the newer part of the Pegu Group, while Noetling, on the contrary, applied it to the older part, but recent research has shown, beyond the possibility of further doubt, that some of the richly fossiliferous strata in the region of the oil-fields, included in Noetling's "Yenangyoungian," are on the same geological horizon as part of the Sitsayan Shales, while the "Yenangyoungian" includes, at the same time, the newest marine strata recognised in Lower Burma, those constituting Noetling's "zones of *Ostrea promensis* and *Ostrea peguensis*", which are perhaps as late in age as a portion of the Irrawadi Series of Upper Burma. Consequently, the fossil fauna described by Noetling as the fauna of the Yenangyoungian is, in reality, the aggregate fauna of the entire Pegu System. Unintentionally though it may be, the term "Yenangyoungian" is practically synonymous with the term Pegu Group or Pegu System and is decidedly unsatisfactory. We shall therefore avoid much confusion if we adopt the recommendation of Dr. Pascoe (*Mem. Geol. Surv. Ind.*, Vol. XL, p. 16) in discarding the further use of the term "Yenangyoungian." The terms "Pegu" and "Irrawadi" are very useful as designations for some of the major divisions. Some re-adjustment of their definition may eventually become necessary, though an attempt at a more precise demarcation than that at present in use, may wisely be postponed until the geological study of the region has made further progress. For the present, the Pegu System may be taken to correspond essentially with the marine facies of the post-eocene Tertiary in the eastern part of the Arakan Yoma, in the Pegu Yoma, and in the intervening Irrawadi valley.

(2) Mutual relationships of the principal fossiliferous layers of Yenangyat, Minbu, Singu, and Kama.

If now we turn our attention to the minor details of the classification, we find that two causes of error have affected Dr. Noetling's conclusions regarding the vertical distribution of the fossiliferous layers in the region personally studied by him in greatest detail, that is, in the petroliferous anticlines of Upper Burma. The anticlines had not yet been surveyed in detail, and the thicknesses of exposed strata were generally greatly under estimated. Moreover, Dr. Noetling's interpretation of the stratigraphy is founded on the assumption, now known to be erroneous, that the uppermost petroliferous layers in the several petroliferous anticlines occupy the same stratigraphical level.

Since the conditions for the storage of petroleum depend on the existence of an unbroken anticlinal roof, it naturally follows that strata which have long been exposed, even if originally petroliferous, must have lost their petroleum contents. Noetling's division of the pre-Irrawadi beds of Upper Burma into an underlying petroliferous and overlying non-petroliferous portion, merely coincides respectively with the exposed and subterranean portions of the beds. The uppermost exposed zones of the beds underlying the Irrawadi Series at Yenangyoung, Singu, and Yenangyat, undoubtedly belong approximately to the same geological horizon. If we take into account the great differences of thickness of pre-Irrawadi strata in these three regions, we must necessarily conclude that the petroliferous beds of Yenangyoung (apart, naturally, from some of those that may have been reached in the deepest borings) are exposed at Singu, where, from the mere fact of their being exposed, they must be non-petroliferous, and that the petroliferous beds of Singu are exposed at Yenangyat where they have, in their turn, become non-petroliferous. Therefore, the uppermost petroliferous layers occupy widely divergent stratigraphical horizons respectively at each of these three localities. It is therefore incorrect to estimate the stratigraphical position of any layer by measuring upwards, as has been done by Noetling, from the newest petroliferous horizon at the separate localities. Considering the undoubted correspondence between the upper exposed portions of the pre-Irrawadi beds in the several areas, a correct approximation can only be obtained by measuring the thicknesses of the strata downwards from the base of the Irrawadi Series. A still closer approximation is obtainable where, as in the Singu-Yenangyat region, there is actually a stratigraphical continuity between the exposed strata of the upper portion of the pre-Irrawadi beds, and where, therefore, datum lines can be selected at a lower horizon than the base of the Irrawadi Series.

Judging from Mr. Sethu Rama Rao's detailed surveys, the thickness of pre-Irrawadi strata exposed at Singu is about 3,000 feet, of which the lower 1,500 feet contain numerous intercalations of marine fossiliferous layers, some of which yielded the Singu fossils dealt with by Noetling in his second monograph. A number of successive fossiliferous bands have been separately mapped by Mr. Sethu Rama Rao who has, at the same time, obtained representative collections of their fossil contents. Up to the present, no differences have been observed in the faunas of these successive bands other than might depend on differences of facies. Various species occur indifferently at almost all horizons, sometimes in the lowest as well as in the uppermost fossiliferous beds. For the present, therefore, the fauna may be treated as representing a single palæontological stage. The specimens dealt with by Noetling were principally obtained from two layers constituting the so-called "zones of *Meiocardia metavulgaris* and *Mytilus nicobaricus*" situated respectively at about 1,000 feet and 1,500 feet above the lowest exposed horizon.

By combining the detailed surveys of the late Mr. Grimes and of Mr. Sethu Rama Rao, the thickness of strata at Yenangyat, according to various modes of interpreting the correspondence between individual layers in the Singu and Yenangyat areas, is to be estimated at from slightly less than 4,000 feet, to slightly more than 5,000 feet. The main fossiliferous layer examined by Dr. Noetling at Yenangyat, the so-called "zone of *Paracyathus coeruleus*," is situated at about 50 feet or less above the lowermost exposed beds. Even therefore by adopting a minimum estimate for the total thicknesses of exposed pre-Irrawadi beds at Yenangyat, the main fossiliferous layer must be situated at a much lower horizon than the fossiliferous stage of Singu.

There is reason to believe that a stratigraphical gap exists between the Irrawadi and pre-Irrawadi beds in the region of the oil-fields, although its existence has been questioned. Whether or not the existence of the stratigraphical gap be accepted, the succession along the western undisturbed flank of the Singu-Yenangyat anticline, at least in its more southern portion, seems very regular, without clear indications of erosion unconformity. Certain characteristic variegated kaolinic strata occupy a constant position at the upper limit of the pre-Irrawadi beds. Yet, due caution is evidently necessary in a region where a stratigraphical gap is at least suspected, and it is gratifying therefore to observe that, not only have the characteristic boundary beds been followed from the Singu to the Yenangyat region, but that the evidence deduced from them is corroborated by the identification of some of the fossiliferous bands of

Singu in the Yenangyat region. A general account of the stratigraphy has been published by Dr. Pascoe (*Mem. Geol. Surv. Ind.*, Vol. XL, pp. 104-114). Mr. Sethu Rama Rao's detailed surveys have fully confirmed the wide discrepancy of level between the main fossiliferous bed of Yenangyat and the oldest fossiliferous beds exposed at Singu.

The Minbu anticline, owing to the distance at which it is situated from Singu and Yenangyat, is less directly comparable. Here again, nevertheless, the general sequence of pre-Irrawadi beds appears to be essentially the same. Reckoning downwards from the base of the Irrawadi Series, the horizon of the fossiliferous layers that yielded the specimens dealt with by Noetling must be situated at a level somewhat lower than the lowest fossiliferous layers exposed at Singu, and intermediate between the fossiliferous stage of Singu and the main fossiliferous layer of Yenangyat. The character of the fauna confirms this conclusion as it is somewhat intermediate between that of Yenangyat and that of Singu.

In ascending order, the succession of the three principal faunas of Upper Burma is therefore the following :—

1 Yenangyat. 2 Minbu. 3 Singu.

We still have to determine the relative position of the fourth standard fauna, that of Kama. In order to estimate the position of the fossiliferous beds of Kama relatively to those of the oil-fields, we must rely chiefly on the character of the fauna. The revision of the Burmese Tertiary fauna upon which I am engaged at present, has yielded results so distinct as to leave room for no further hesitation. While the Yenangyat, Minbu and Singu faunas are related to that of the Nari of western India and exhibit an oligocene character, the Kama fauna is distinctly miocene and is related to the Gàj fauna of western India. The Kama fauna must therefore be regarded as newer than the newest marine faunas of the oil-fields. The detailed evidence for this conclusion will be found in Parts II to IV of the present work. In addition to the data furnished by the faunistic characters, the conclusion is also corroborated by other circumstances which will be briefly alluded to further on. For the present, if we accept the relative age of the Kama fauna as sufficiently secure, let us consider the consequences of this attribution in relation to the succession of strata exposed in the Prome and Kama region.

Apart from the rocks attributed to the "nummulitic," the oldest stratigraphical unit recognised by Theobald in this region is an assemblage consisting principally of shales which were distinguished as the Sitsayan shales after the name of a town situated on the right bank of the Irrawadi about half way between Kama and Prome. (*Mem. Geol. Surv. Ind.*, Vol. X. 1874, p. 269). Theobald did not detect any fossils in the Sitsayan Shales. At the type-locality, Sitsayan, I obtained, in 1913, close to the landing-place, specimens of fish teeth and scales, and of shells belonging to the genera *Capulus*, *Corbula*, *Pecten*, exhibiting the general facies of the fauna of the oil-fields, but not sufficiently well preserved for a thoroughly secure determination. Opposite Prome, the Sitsayan Shales are overlaid by Theobald's division "A" of the Prome Series, about 1,500 feet thick, consisting of alternating shales and sandstones, the sandstones somewhat prevailing. Immediately overlying the upper limit of division "A" is a highly fossiliferous layer about 5 feet thick, containing abundant specimens of a species of *Cytherea*. This layer was distinguished by Theobald as the "*Cytherea promensis* bed or Prome sandstone." (*Rec. Geol. Surv. Ind.*, Vol. II, 1869, p. 80). The strata overlying the *Cytherea promensis* bed again consist of alternating shales and sandstones, but this time with a prevalence of shales. They are imperfectly seen opposite Prome because the section is interrupted by the course of the Irrawadi. They are well exposed at Kama where they contain a particularly fossiliferous horizon designated by Theobald as the Kama Clay or Kama Shale (*Rec. Geol. Surv. Ind.*, Vol. II, 1869, p. 273). These fossiliferous clay beds are situated at about 700 to 1,000 feet above the uppermost limit of division "A". They are not visible at Prome, because, as remarked by Theobald, their stratigraphical position must carry their outcrop into the bed of the Irrawadi opposite that city. A considerable thickness of marine strata further overlies the horizon of the Kama Clay.

We must now observe that, if we accept the age of the fauna of the Kama Clay as newer than that of the newest well-characterised marine fauna of the oil-fields, the stratigraphical position of the Sitsayan shales, relatively to the succession observed in the oil-fields, is fixed within rather narrow limits. The available palæontological data have fully established the miocene character of the Kama Clay which is undoubtedly newer than the newest marine fauna of Singu which still maintains an oligocene character. The interpretation that best suits the symmetry of the sequence at Kama and at Singu-Yenangyat is the one suggested in the present review, according to which the upper limit of Theobald's division "A" would lie at about the level of the newest marine fossiliferous beds of Singu. This would place the equivalent of the main fossiliferous horizon of Kama at 700 to 1,000 feet above that of the newest marine fossiliferous beds of Singu. The upper limit of the Sitsayan shales of the Kama region would then approximately coincide with the horizon of the oldest beds exposed at Singu. Accordingly, the principal fossiliferous horizon of Minbu might occupy an approximately central position within the Sitsayan Stage, within which the Yenangyat main fossiliferous horizon, though at a lower level, would still be included.

As the Kama fauna, from its constitution, must be regarded as newer than the newest Singu fauna, we are not at liberty to depart very much in a downward direction from the hypothesis here advocated. The Kama horizon must still be placed above the newest marine fossiliferous horizon of Singu. Even if we displace it as much as 500 feet below the position here accepted as most probable, and if, therefore, we lower the presumed equivalents of the Sitsayan Shales by that same amount, we shall merely bring the Minbu main horizon into the upper zones of the Sitsayan Stage and give a more central position, within the Sitsayan Stage, to the Yenangyat fauna. Even if purely gratuitous suppositions of variations of thickness were brought into play, we would fail to exclude from the Sitsayan Stage the Yenangyat main fossiliferous horizon, unless we accepted a most unwarranted degree of stratigraphical variation. With the data at present available, the most that could be obtained by forcing downwards the horizon of the Kama Clay to a somewhat improbable extent, would be to shift the main centre of gravity of the Sitsayan Stage from the Minbu to the Yenangyat horizon, a difference of no serious consequence in the general scheme of the succession.

If, on the contrary, we raise the equivalent level of the Kama Clay in the Singu section much higher than is regarded as probable in the present enquiry, the horizon of the Sitsayan Shales will be made to encroach upon the Singu marine fossiliferous stage, and the Sitsayan horizon will be raised to the uppermost limit of the oligocene. Such a supposition deviates so widely from ascertained facts that a serious discussion may be regarded as superfluous.

We should keep in mind that the terms "sandstones" and "shales" frequently used in describing the divisions of the pre-Irrawadi beds of this region, are relative only, and merely refer to the preponderance of one or other of these elements. In most instances, rigidly defined boundaries of the subdivisions have not been demarcated in the present state of the survey and could not be established without a vast amount of minutely detailed work. Yet the main divisions are recognisable, and if, in a preliminary scheme, they are accepted as stratigraphical stages, they will be of use in attempting to unify the geology of this important and interesting region.

The conclusions regarding the age of the Kama Clay relatively to the fossiliferous beds of the oil-fields were at first based entirely upon the results of a careful re-examination of the Kama fauna. The geological surveys of Upper and Lower Burma have not yet been continuously connected. Nevertheless we now possess evidence both of a palæontological and stratigraphical character which further corroborates the conclusions originally arrived at from merely faunistic considerations.

In the type-locality, at Kama, the fossils yielded by the Kama Clay are neither very numerous nor very well preserved. Yet they are readily determinable, and include a number of species amply sufficient to provide sound data for comparison with other fossiliferous occurrences. In the country situated east of the eastern or left bank of the Irrawadi, at some distance to the north-east of Thayetmyo, Mr. Sethu Rama Rao has discovered a number of outcrops where the Kama Clay assumes the character of a typical "Pleurotoma-shale" with a molluscan fauna of bewildering richness. The specimens are admirably preserved, sometimes even showing traces of their original colours. The richest localities are: Tittabwe (19° 31′, 95°, 28′), Thanga (19° 32′, 95° 23′), Myaukmigon (19° 31′, 95° 24′), Myauktin (19° 26′, 95° 22′), Dalabe (19° 37′, 95° 17′). Mr. Sethu Rama Rao has estimated that these highly fossiliferous layers are situated at about 1,200 feet below the base of the beds attributed to the Irrawadi Series. In the region under consideration they constitute the highest readily recognisable horizon of the pre-Irrawadi beds. Several years will be necessary to complete the study of the astonishingly rich fauna yielded by these beds, but the description is already far enough advanced to yield thoroughly reliable data. The examination of the Siphonostomata is practically complete. These include no less than 155 fully identified species of which complete descriptions already exist in manuscript. In the Kama fauna of the type-locality, 22 Siphonostomata have been securely identified, of which three only, *Clavatula munga*, *Drillia kamaensis*, and *Eburna lutosa* have not been recognised in the richly fossiliferous outcrops of eastern Thayetmyo[1]. The proportion of identical species is therefore so great as to imply complete identity between the fossiliferous clays exposed at Kama and those discovered by Mr. Sethu Rama Rao in eastern Thayetmyo. We can safely assert that, in eastern Thayetmyo, the Kama Clay occupies a high horizon in the pre-Irrawadi succession.

Along both banks of the Irrawadi, in a northern direction from Thayetmyo to Singbaungwe (19° 43′, 95°12′), wherever the lowest beds locally exposed become visible as the results of anticlinal structures, the late Mr. Bion and Mr. Sethu Rama Rao have recognised a highly characteristic layer distinguished by the presence of three particular species belonging to the genera *Dendrophyllia*, *Schizaster* and *Nucula*. The *Dendrophyllia* and the *Nucula* agree specifically with some fossils yielded by the lowest fossiliferous beds exposed at Singu, so that Mr. Bion and Mr. Sethu Rama Rao came to the conclusion that the oldest beds exposed in the anticlines in the country to the north and north-east of Thayetmyo belong to the same horizon as the oldest beds exposed at Singu. Strata approximately on the horizon of the *Dendrophyllia* bed are exposed along an anticlinal rise at Leptanzeik (19° 24′, 95° 14′) about six miles north of Thayetmyo. They have yielded three determinable Siphonostomata :—

Terebra quettensis n. sp.,
Surcula fusus n. sp.,
Tritonidea Martiniana n. sp.

Terebra quettensis cf. Vredenburg, Descriptions of Mollusca from the Post-Eocene Tertiary formation of North-Western India ; Cephalopoda, Opisthobranchiata, Siphonostomata. (*Mem. Geol. Surv. Ind.*, unpublished volume), a characteristic fossil of the Nari of Baluchistan, is one of the commonest fossils of the Singu fauna. The extraordinary, and very easily recognisable shell designated as *Surcula fusus*, an illustrated full description of which will shortly appear, is known

[1] *Eburna lutosa*, a species still living, is known from the *Ostrea latimarginata* beds of the Pyalo anticline, east of the Irrawadi, almost opposite Kama, at a somewhat higher horizon than the Kama Clay.

from Payagyigon (20° 43′, 95° 4′) in the Gwegyo anticline of Upper Burma (see: Cotter, *Rec. Geol. Surv. Ind.*, Vol. XXXVI, p. 131, Vol. XXXVII, p. 230), where it occurs amidst a fauna of the Minbu type. *Tritonidea Martiniana* is one of the commonest fossils of Yenangyat, Minbu, and Singu, and of many other localities yielding the fauna of the oil-fields.

The Siphonostomatous fauna of Leptanzeik, scanty though it may be, is thoroughly characteristic and entirely corroborates the conclusions arrived at by Mr. Bion and Mr. Sethu Rama Rao in placing the oldest beds exposed in the anticlines upon a horizon at least as low as that of the lowest beds exposed at Singu. We may, therefore, observe that, amongst the pre-Irrawadi beds of the country situated to the north and north-east of Thayetmyo, the newest zones include beds containing the fauna of the Kama Clay, while the oldest exposed zones contain the typical fauna of the oil-fields of Upper Burma. We have, therefore, the direct evidence of visible superposition in confirmation of the conclusions arrived at from a study of the faunistic characters.

It is not possible, at present, to estimate accurately the exact thickness of strata intervening between the equivalents of the Kama Clay and the *Dendrophyllia-Schizaster* zone in eastern Thayetmyo, because the precise degree to which the measurements are affected by subsidiary synclinal and anticlinal rolls cannot be exactly ascertained in the present state of the survey. The intervening thickness must certainly be reckoned by thousands of feet. The succession is particularly clear at about the latitude of Nyaungbintha (19° 35′, 95° 14′) situated on the east or left bank of the Irrawadi about nineteen miles north of Thayetmyo and about five miles west by south of Dalabe. The latter place has already been mentioned as one of the richly fossiliferous localities discovered by Mr. Sethu Rama Rao as yielding the Kama Clay fauna. From Nyaungbintha which occupies an anticlinal axis where the *Dendrophyllia-Schizaster* zone is well exposed, the section continually ascends to Dalabe. Making the most generous allowance for the possible influence of undetected rolls of the strata, the intervening thickness cannot be less than 2,500 feet and may be more. Not only has the superposition of the Kama horizon on that of the fossiliferous zones of the oil-fields been established in eastern Thayetmyo beyond all possibility of further doubt, but the available thickness of intervening beds is amply sufficient to allow the parallelism which we propose to recognise between the stratigraphical succession in the Prome-Kama region and that recognised in the region of the oil-fields of Upper Burma. In view of the great thickness of strata which, in eastern Thayetmyo, intervene between the equivalents of the Kama Clay and the *Dendrophyllia-Schizaster* zone, the latter must correspond approximately with the upper limit of the Sitsayan Shales. At the same time, the *Dendrophyllia-Schizaster* zone, on faunistic evidence, is known to correspond approximately with the lowest beds exposed at Singu. We are once more, therefore, led to the conclusion that the Sitsayan Shales essentially coincide with the strata underlying the Singu fossiliferous marine stage, and must coincide essentially with the Yenangyat-Minbu horizons.

We have noticed that, in the neighbourhood of Kama, the Sitsayan shales are succeeded by a thickness of about 1,500 feet of strata containing a considerable proportion of sandstones, which constitute division "A" of the Prome beds of Theobald's classification. If we are right in identifying the Yenangyat-Minbu main fossiliferous horizons with the Sitsayan Shales, then the Singu fossiliferous stage must coincide with Theobald's division "A" of the Kama section. Like Theobald's division "A", the Singu fossiliferous stage includes a thickness of about 1,500 feet of strata.

Dr. Murray Stuart has published a detailed geological map of the neighbourhood of Kama, in which, as a consequence of a misinterpretation of Theobald's original description, the position of the Kama Shale has been misplaced. (*Rec. Geol. Surv. Ind.*, Vol. XXXVIII, Pl. 23). In this map the outcrop of the Kama Clay is shown about two miles to the north-west of Kama, while the rock at Kama itself is referred to the "Upper Prome" as interpreted by Stuart, therefore to the beds which, in Stuart's revised scheme of classification, should underlie the Kama Clay. According to Theobald, the type-outcrop of the Kama Clay or Kama Shales is situated along the banks of the Irrawadi "under" Kama (*Mem. Geol. Surv. Ind.*, Vol. X, p. 273). There are a few obscure exposures *above* Kama, but these could not be spoken of as *under*. The beds mapped by Stuart as "Kama Clays" outcrop at a considerable distance from the Irrawadi river, and, if they were visible along its banks, their strike would carry the exposure above Kama and not below. Theobald's type-exposure must therefore be sought below Kama, and is still recognisable along the slopes of a pagoda-crowned ridge close to the Irrawadi, at a short distance from the town in a south by east direction. The true position of the type-outcrop was recognised by

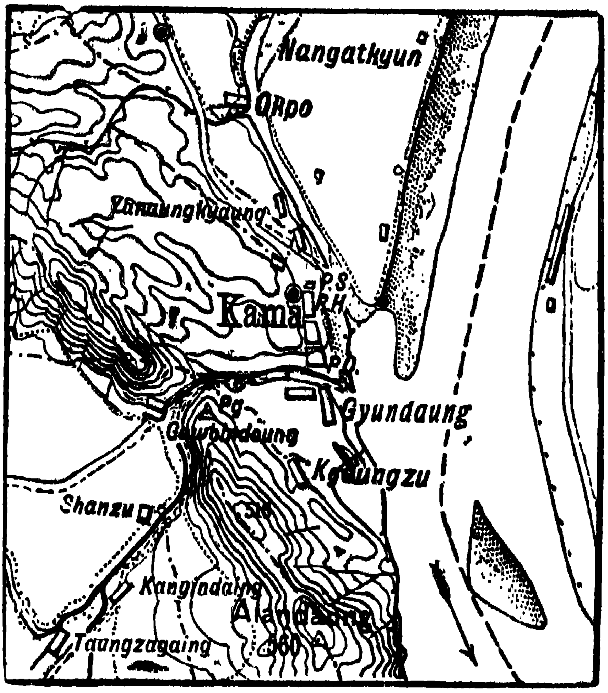


FIG. 1.—Map of the country round Kama, showing Theobald's type outcrop of the Kama clay (scale 1in. = 1m.)

Dr. Stuart on re-visiting Kama, although too late to introduce this correction on the published map and report. There are several (two at least) relatively narrow bands of shale, probably each of them less than fifty feet in thickness, intercalated amongst thick-bedded sandstones with an aggregate thickness of some 300 feet. That any of these bands should separately correspond with Noetling's so-called "zones of *Arca Theobaldi* and *Parallelipipedum prototortuosum*" is more than unlikely. The fossils from the several bands, all of which corrrespond specifically with forms already obtained by Theobald, all exhibit similar lithological characters which agree with those of the specimens in Theobald's collection. Theobald did not separate into distinct zones the specimens in his collection which must have been gathered from the talus slope where alone there is a moderately abundant supply, but where the shells from different layers are mixed.

According to Dr. Noetling, the fragments of enclosing rock attached to specimens which he refers to the "zone of *Arca Theobaldi*" are of a bluish-green colour, while the rock associated with the specimens referred to the "zone of *Parallelipipedum prototortuosum*" is more yellowish. The yellowish colour, at Kama as elsewhere, characterises those fragments of rock that are more weathered. The Kama fauna must be treated as representing a single palæontological zone.

The rocks to the north-west of Kama which Dr. Stuart, on the map already referred to, has erroneously referred to the Kama Shales are situated, stratigraphically, 1,000 feet or more above the level of Theobald's Kama Clay. They consist principally of ill-exposed coarse grits in which the only recognisable fossils are large specimens of *Ostrea latimarginata* and otoliths. Dr. Stuart informs me that these belong perhaps to the lower beds of his Akauktaung Series. We shall again allude to this question. (See below, pages 251 ff.)

The recognition of the *Ostrea latimarginata* horizon to the north-west of Kama is of the greatest importance since it brings the Kama sequence into complete harmony with that observed by Mr. Davies in the Pyalo anticline on the opposite bank of the Irrawadi, which has already been commented upon in a previous number of these Records (Vol. XXXVIII, p. 128). According to the stratigraphical details recorded by Mr. Davies, *Ostrea latimarginata*, in the Pyalo anticline, occurs some 900 or 1,000 feet above the beds containing the Kama Clay fauna alluded to by Mr. Davies as the fauna of the "zone of *Parallelipipedum prototortuosum*." This, in its turn, was considered by Mr. Davies to be situated about 500 or 600 feet above the upper limit of Theobald's Division "A." This is in total agreement with the succession ascertained at Kama where the Kama Clay lies at a horizon estimated as between 700 to 1,000 feet above the upper limit of Theobald's Division "A," shown on Dr. Stuart's map as "Lower Prome Series," while, about 800 to 1200 feet above the Kama clay, occurs the zone of *Ostrea latimarginata* shown on the same map as "Kama Clays."

Allusion has already been made to the fact that the fauna of the Kama clay is equivalent to the Gàj fauna. In western India, *Ostrea latimarginata* characterises the Upper Gàj. We may therefore conclude that the Kama horizon corresponds with a portion of the Lower Gàj, while the *Ostrea latimarginata* zone of the neighbourhood of Pyalo and Kama, which we may provisionally distinguish as the Pyalo zone or Pyalo stage, must coincide with the Upper Gàj.

In the notice above alluded to, previously published in these Records, I stated that *Ostrea latimarginata* characterises the horizon of the Kama Clay. This notice was written before I had visited Kama, and the stratigraphical references were made in accordance with the scheme founded on the data then available. I hasten to add that the geological boundaries indicated on Dr. Stuart's map are perfectly accurate in all the localities which I have visited in the neighbourhood of Kama; the necessary amendment merely affecting the interpretation of the subdivisions.

If, upon Dr. Stuart's map, we plot the type-locality of the Kama Clay according to the position above indicated, we find that the map entirely corroborates Theobald's detailed account of the Prome beds in the Kama and Prome region; for we then observe that the trend of the Kama Clay will approximately bisect the outcrop of the division mapped by Stuart as "Upper Prome." If we follow this division southward from Kama towards Prome, we will observe that the outcrop of the Kama Clay must necessarily fall within the bed of the Irrawadi opposite Prome, exactly in the position inferred by Theobald.

The recognition of the true horizon of the beds characterised by *Ostrea latimarginata*, or, as we may provisionally call it, the Pyalo Stage, adds another palæontological argument to the stratigraphical evidence in favour of regarding Theobald's Division "A" as the equivalent of the Singu fossiliferous stage; for the infraposition of the Kama Clay beneath the zone of *Ostrea latimarginata*, taken in connection with its faunistic relationship to the Gàj, necessarily places it on the level of the Lower Gàj. As the Sitsayan Shales correspond with the Yenangyat-Minbu fossiliferous beds which contain a fauna of Nari character, presumably referable to the Lower Nari, there only remains the intervening Division "A" to represent the Upper Nari. We have already shown that the Singu fossiliferous stage, from stratigraphical as well as from palæontological evidence must also be regarded as equivalent to the Upper Nari. We have therefore every reason to regard the Singu fossiliferous stage of Upper Burma and Division "A" of Lower Burma as equivalent.

It will be noticed that the succession recorded in the present review conflicts with the conclusions arrived at in 1910 by Dr. Stuart who then regarded the Kama fauna as older than that of the oil-fields. Dr. Stuart's opinion which, at that time, was fully shared by Mr. Cotter and by myself, was founded on a study of the material then available, which clearly showed that the Kama fauna widely differs from that of the oil-fields of Upper Burma and cannot be intercalated amongst any of the fossiliferous zones then recognised in Upper Burma (*Rec. Geol. Surv. Ind.*, Vol. XXXVIII, p. 287). The Kama Clay, therefore, differs in age from the totality of the marine fossiliferous sequence of the oil-fields of Upper Burma, and must be either newer or older than the fossiliferous series of Upper Burma. The evidence then available seemed to indicate an older age. The study of the molluscan post-eocene faunas had at that time scarcely been commenced, while the available collections of fossils from Burma were still relatively scanty. To Dr. Stuart is due the credit of having for the first time clearly detected the autonomy of the Kama fauna, while the present amendment to the stratigraphical conclusions that were arrived at more than ten years ago is the result of the study of a vastly increased amount of palæontological and stratigraphical data.

Although the relative position of the Kama fauna can no longer be doubted, we may nevertheless, in the light of the now available data, enquire into the possible consequences of an acceptance of the original conclusion as to the supposed position of the Kama horizon below that of the fossiliferous series of the oil-fields.

Throughout the area surveyed in the neighbourhood of Ngape, in the Minbu district, Mr. Cotter observed a band of shales which is situated, on an average, some 5,000 feet below the base of the Irrawadi Series, and which contains the various fossil species of the Yenangyat-Minbu fauna. These shales and their equivalents, which have received various local names, such as "Padaung Clay" (*Rec. Geol. Surv. Ind.*, Vol. XLIV, p. 165), "Kinmungyon Shales" (*Rec. Geol. Surv. Ind.*, Vol. XLV, p. 249), were originally regarded by Cotter (*Rec. Geol. Surv. Ind.*, Vol. XLI, p. 224), as the probable representatives of the Sitsayan Shales. All reasonable doubt as to this correlation has been removed by the data now available. Along the further northward extension of the same belt, from Ngape to Ngahlaindwin, numerous detailed sections surveyed by the late Mr. Bion, by Mr. Cotter, Mr. Cunningham Craig, Mr. Lewer, Dr. Porro, Mr. Sethu Rama Rao, and other able geologists, have revealed the continuous outcrop of this same shale band, invariably at the same stratigraphical horizon, and invariably containing the Yenangyat-Minbu fauna.

Between the lower limit of these shales and the upper limit of the undoubtedly eocene rocks constituting the Yaw Stage of Mr. Cotter, there intervene some 3,000 feet of strata, largely arenaceous, which Mr. Cotter has distinguished as the Shwezetaw Sandstone (*Rec. Geol. Surv. Ind.*, Vol. XLIV, p. 165; *Journ, As. Soc. Bengal*, new ser., Vol. XIV, p. 416), The Shwezetaw Stage is poorly fossiliferous. The only securely identified fossil so far known from that horizon is a large *Ampullina* closely related to *Ampullina crassatina.* It is, therefore, a species of oligocene facies. Underlaid as it is by undoubtedly upper eocene beds and overlaid by undoubtedly oligocene strata, presumably referable to the middle oligocene, the Shewezetaw Stage can only be lower oligocene. This conclusion accords with the characters of the solitary, well-preserved fossil which it has, so far, yielded.

If, then, the Kama Clay were older than the main fossiliferous beds of the petroliferous anticlines, we should be compelled to regard it as the equivalent of the Shezetaw Stage. Stratigraphically, the possibility of this supposition is now disposed of by the researches of Mr. Bion and Mr. Sethu Rama Rao in Eastern Thayetmyo where the Kama fauna clearly overlies the fauna of the oil-fields. Palæontologically, the now well established miocene character of the Kama fauna also renders this supposition untenable.

From whatever point of view we may consider the problem with the data now available, we are always led to the same result: the fauna of Kama is not older than that of the petroliferous anticlines of Upper Burma, but is, on the contrary, newer.

In thus amending our previous conclusions, it is but fair to note that many points that appear self-evident at the present day were involved in obscurity ten years ago. Mr. Cotter's description of the Ngape section which marks the first great advance in the later progress of the study of Burmese geology, was published two years after Dr. Stuart's valuable survey of the Prome and Kama region. Both stratigraphically and palæontologically the study of Tertiary geology in Burma and in other parts of continental India has advanced enormously during the last ten years; while, thanks to the researches of many able scientists, amongst whom we may specially mention Tobler, Douvillé, Miss Provale, Miss Osimo, Rutten, Schepman, and especially Mr. and Mrs. Martin, the same period has witnessed a quite unparalled advance in the study of the Tertiary formations of the Indian archipelago. For Java in particular, it is no exaggeration to say that the magnificient results of Mr. and Mrs. Martin's expedition of 1910, have established the stratigraphy of the Tertiary in that region on as sound a basis as that of some of the best known Tertiary regions of Europe, and have marked the commencement of a new era in the study of the Tertiary Geology of the East-Indies. We are also only just beginning to realize the vast importance of Cossmann's study of the late Tertiary formation of Karikal.

Under the circumstances, the radical change at which we have arrived in our present conception of the stratigraphical relationship of the Kama zone implies no disparagement of the excellent work performed by the able pioneers who have first contributed precise data towards the unravelling of this difficult problem. We may now take it as settled beyond the possibility of further doubt that the Kama fauna is newer than any of the three main faunas of the petroliferous region. The true sequence, in ascending order, of the four principal faunas dealt with by Noetling is therefore as follows:—

1. Yenangyat.
2. Minbu.
3. Singu.
4. Kama.

These remain the four standard post-eocene faunas of Burma, upon a comparison with which we have to depend for the more or less successful classification of all the post-eocene formations of that region.

During the last decade, considerable progress has been made in the study of the post-eocene molluscan faunas of Burma and western India. The completion of this research will require many years, but the greater part of the Siphonostomata amongst the gastropods have been described, and some of the results are already in course of publication. In connection with this investigation, a considerable portion of Noetling's monograph of the post-eocene fauna of Burma has been revised, and the object of the present note is to place on record the amendments necessitated in Noetling's determinations.

The number of forms now identified from amongst the post-eocene Siphonostomata of Burma greatly exceeds that of the determinable representatives of that group amongst the collections studied by Noetling. We hope that an opportunity will soon arise for discussing the stratigraphical and palæontological results of their study. The Tertiary faunas of Burma occupy a position of unique importance in the geology of Asia, as forming the most efficient link that we possess for comparing the stratigraphy of the Indian Archipelago and Philippines with that of Europe; for it contains numerous forms in common, on the one hand, with the Tertiary faunas of the Eastern Islands, and, on the other hand with the Tertiary faunas of western India; and, while the faunistic connection of the Tertiary formations of the Archipelago with those of Europe, is practically *nil*, the faunas of western India, during the periods coinciding with the marine transgressions, especially in the middle eocene and lower oligocene, exhibit a considerable intermingling with the European faunas, the exact equivalence of the Tertiary sequence in western India being thereby established on a secure basis. Consequently the faunas of western India afford now a means of identifying the formations of Burma with a degree of precision hitherto unknown; and these, in their turn, afford now a most useful clue to the interpretation of the geology of the Indian Archipelago.

For the present, it will be sufficient to indicate what are the main conclusions so far arrived at. The Yenangyat and Minbu faunas are closely connected with the lower Nari fauna of western India, the age of which is either lower oligocene, or more probably middle oligocene. The beds containing the Minbu-Yenangyat fauna are separated from the lower limit of the oligocene by the whole thickness of the Shwezetaw sandstone, and, from the upper limit of the oligocene, by the whole thickness of the Singu fossiliferous stage. Their age may safely, therefore, be regarded as approximately middle oligocene, that is, approximately Stampian, the Minbu fauna being situated nearer to the upper limit of the Stampian than the fauna of Yenangyat.

The Singu fauna, as shown by the stratigraphy, is newer than the Yenangyat-Minbu horizon. It is still closely related to the Nari fauna, though it shows a certain admixture of forms characterising the Gàj of western India, or the Burmese equivalents of the Gaj, It is therefore, faunistically somewhat intermediate between the Lower Nari and the Gàj, and evidently occupies a correspondingly intermediate stratigraphical position coinciding with that of the Upper Nari.

The Kama zone is unquestionably the equivalent of the Lower Gàj of western India and of the Rembang Series of Java.

(3) Dr. Noetling's "Zones."

(*a*) PRELIMINARY REMARKS.

We may next enquire into the relative stratigraphical position of the various "zones" of Noetling's nomenclature. Noetling has endeavoured to distinguish, both in Lower and in Upper Burma, a number of palæontological zones, each of which has been named after a particular species. These species have not been selected according to the principle generally recognised in stratigraphical classifications, whereby a particular division should be characterised by a form whose range is truly restricted to that particular division. If we consult the lists of fossils published by Noetling, we will frequently observe that a certain form is recorded from so-called zones other than the one bearing the name of the particular fossil, Either then the supposed zones are not well-defined stratigraphical units, or else the forms selected are not true zone-fossils. Noetling's method is to name the supposed zone after a form that happens to be particularly abundant at the locality yielding the fauna under consideration. This method cannot lead to any useful results. As has been judiciously remarked by Dr. Stuart (*Rec. Geol. Surv. Ind.*, Vol. XXXVIII, p. 264), a species such as *Cytherea erycina* which is living at the present day, cannot be used as a characteristic zone-fossil for a particular subdivision of the miocene; for, if the species already existed in miocene times,. its existence obviously was continued throughout every intervening stage down to the present epoch. We may mention *en passant* that the form thus designated by Noetling does not coincide with the living shell to which it has been referred. A preliminary examination of the available specimens has shown that they are closely related to another living form, *Cytherea florida* Lam, though it is uncertain whether they are specifically identical. Until an opportunity arises for a complete study of this shell, it will be wise, when referring to it, to continue to use Theobald's original designation of *Cytherea promensis*. At any rate, the shell does not characterise solely Theobald's "*Cytherea promensis* bed or Prome sandstone," for it is just as abundant in the Kama zone and in the overlying zone of *Ostrea latimarginata*, and perhaps even higher. Dr. Stuart has already commented on the extensive range of this species (*Rec. Geol. Surv. Ind.*, Vol. XXXVIII, p. 263).

While recognising that the designations adopted by Noetling for the various zones are unsatisfactory, we must nevertheless enquire into their stratigraphical and palæontological value.

Dr. Noetling has established two sets of zones respectively for Lower and Upper Burma. The zones of Lower Burma, in the order regarded by Dr. Noetling as their probable ascending succession are the following :—

(7) Zone of *Turritella acuticarinata.*
(6) Zones of *Ostrea peguensis* and *Ostrea promensis.*
(5) Zones of *Arca Theobaldi.*
(4) Zone of *Parallelipipedum prototortuosum.*
(3) Zone of *Pholas orientalis.*
(2) Zone of *Aricia humerosa.*
(1) Zone of *Cytherea erycina.*

In Upper Burma, seven zones containing marine fossils were defined, the sequence of which, in ascending order, was supposed to be as follows :—

(7) Zone of *Cardita tjidamarensis.*
(6) Zone of *Mytilus nicobaricus.*
(5) Zone of *Meiocardia metavulgaris.*
(4) Zone of *Dione dubiosa.*
(3) Zone of *Cancellaria martiniana.*
(2) Zone of *Paracyathus cœruleus.*
(1) Zone of *Anoplotherium birmanicum.*

To these was added an estuarine bed, the so-called "zone of *Cyrena Crawfurdi*" regarded as equivalent to the zone of *Cardita tjidamarensis* or to the zone of *Mytilus nicobaricus.*

Out of these fifteen "zones," six have already been dealt with in the foregoing pages : these are zones 4 and 5 of Lower Burma, the so-called zones of *Parallelipipedum prototostuosum* and *Arca Theobaldi* which represent the Kama Clay ; and, in Upper Burma, zones 2, 3, 5 and 6, of which zone 2, the so-called "zone of *Paracyathus cœruleus*" represents the main fossiliferous layer of Yenangyat, zone 3, the so-called "zone of *Cancellaria Martiniana*" coincides with the main fossiliferous horizon of Minbu, while zones 5 and 6, the so-called zones of *Meiocardia metavulgaris* and *Mytilus nicobaricus,* coincide with two of the principal fossiliferous layers of the Singu fossiliferous stage.

There still remain to be considered five of the Lower Burma zones, those numbered 1, 2, 3, 6 and 7 in the above tabulated list and four zones from Upper Burma, those numbered 1, 4 and 7 together with the "zone of *Cyrena Crawfurdi.*"

(*b*) THE "ZONE OF *Turritella acuticarinata.*"

Several of these zones must be definitely or provisionally discarded. We must, in the first place, entirely leave out of account zone 7 of Lower Burma, the so-called "zone of *Turritella acuticarinata,*" from which no fossils are available, of which the exact locality is ill-defined, the exact horizon uncertain, and the designation of which rests on the mere surmise that the fossil referred to by Theobald in his allusion to certain beds of which the exact locality is not recorded (*Mem. Geol. Surv. Ind.*, Vol. X, pp. 275, 281), may be a particular form of *Turritella* which occurs abundantly at many spots in the Tertiary beds of Burma, and which Dr. Noetling has referred to *T. acuticarinata* Dunker. Even if the surmise should prove to be correct, the form in question has an extremely extensive geological range and is quite useless by itself for fixing the age of the strata in which it may occur.

(*c*) THE "ZONE OF *Pholas orientalis.*"

There are two other so-called zones represented by fossils from Lower Burma for which the exact locality is unknown, though there appears to be reason to believe that the specimens were obtained from the neighbourhood of Thayetmyo. They are represented by two different sets of fossils for which Noetling established the so-called zones of *Pholas orientalis* and *Aricia humerosa.*

In attempting to refer these so-called zones to their correct stratigraphical horizons, we have no other guide but the fossil collections. The sequel of the present note will show that, even amongst the figured specimens of the collections dealt with by Noetling, there are numerous instances in which forms belonging to one species have been referred to different species or even genera, or else in which, conversely, forms belonging to several species or even genera have been referred to a single species. From this it necessarily follows that no reliance can be placed upon the lists of fossils published by Noetling for the different fossiliferous occurrences, especially when they refer to unfigured forms as they often do to a large extent. It is necessary to check every identification, a course which, for the unfigured forms is often unpracticable, as the specimens are often not available, or else frequently consist of specifically indeterminable fragments. The Museum contains many unfigured specimens from Noetling's and Theobald's collections that have either been labelled by Noetling himself, or else have been determined by comparison with the descriptions in Noetling's second monograph. Whenever there has arisen an occasion of referring to these collections, numerous errors of identification have been detected.

We must, therefore, entirely disregard Noetling's published lists, and we can depend on no other data but the figured specimens or such unfigured specimens as have been critically examined. At present, we are not acquainted with a single recognisable fossil from the so-called zone of *Pholas orientalis*. Eventually some characteristic forms may perhaps be recognized after the critical examination of the Tertiary Lamellibranchiata has been completed. For the present, the so-called "zone of *Pholas orientalis*" must be provisionally discarded.

(*d*) THE "ZONE OF *Aricia humerosa*."

From the so-called "zone of *Aricia humerosa*" we are at present acquainted with only three forms the specific determination of which may be regarded as sufficiently secure. These are:—

Conus Ickei Martin,
Clavilithes seminudus Noetl.
Cypræa singuensis.

The form last named is the one erroneously identified by Noetling as "*Aricia humerosa*." *Conus Ickei* has not been found elsewhere in Burma, and occurs in Java at an unknown geological horizon, *Clavilithes seminudus* occurs in Burma at every horizon from the Yenangyat zone to the Kama zone. For determining the age of the fauna, there only remains, therefore, *Cypræa singuensis*, the most characteristic fossil of the Singu fossiliferous stage. As will be shown in the descriptions of the fossil Cypræidæ of India which we hope shortly to publish, *Cypræa singuensis* is a true zone-fossil. It is undoubtedly a mutation of a form which will be described as *Cypræa iravadica* which characterises the Minbu horizon. The so-called "zone of *Aricia humerosa*" is newer, therefore, than the age of the Yenangyat-Minbu fauna, and equally so than that of the Sitsayan Shales. The upper limit of the vertical distribution of *Cypræa singuensis* is not known at present, and, from the data at present available, we cannot fix with absolute accuracy the level of the so-called "zone of *Aricia humerosa.*" Noetling placed it provisionally above the horizon of the *Cytherea promensis* bed. The presence of *Cypræa singuensis* rather suggests that it belongs to Theobald's Division "A" underlying the horizon of the *Cytherea promensis* bed, since it has been shown that the Division "A" is the equivalent of the Singu fossiliferous stage. In assigning to the so-called "zone of *Aricia humerosa*" an age newer than that of the *Cytherea promensis* bed, Noetling was influenced by Theobald's statement that Division "A" is unfossiliferous. We know now, from the researches of Dr. Stuart (*Rec. Geol. Surv. Ind.*, Vol. XXXVIII, p. 263) that this horizon contains fossils, though none of them have been sufficiently closely examined to be made use of for purposes of stratigraphical comparison. There appears to be some reason for believing that the fossils of the so-called "zone of *Aricia humerosa*" were obtained in the neighbourhood of Thayetmyo; an occurrence which favours the conclusion that they may belong to a horizon older than that of the *Cytherea promensis* bed, for we know that the neighbourhood of Thayetmyo undoubtedly includes outcrops of strata older than that particular bed. The type-locality of *Lepidocyclina Theobaldi* is undoubtedly close to Thayetmyo. I vainly sought to recover the type-locality of this important species in 1913. The original outcrop may have been hidden or destroyed since the time of Theobald's survey, but Theobald's indication of its situation admits of no ambiguity. The fossil is said to occur "in a hardish sandstone on the bank of the Irrawadi, a little above the lime-hill (*Mem. Geol. Surv. Ind.*, Vol. X, p. 175), the "lime-hill" in question being the hill containing limestone and also coal which is situated close to the Irrawadi, about four miles south by west of Thayetmyo. From Mr. Cotter's survey of the Ngape section, we know that *Lepidocyclina Theobaldi* is the characteristic zone-fossil of the horizon containing the Yenangyat-Minbu fauna corresponding with the horizon of the Sitsayan Shales (*Rec. Geol. Surv. Ind.*, Vol. XLI, p. 232). Close to Thayetmyo there are, therefore, exposures of rocks coinciding with the horizon of the Sitsayan Shales and consequently older than the Singu fossiliferous stage, not to mention the "lime-hill" itself which is apparently eocene.

Moreover, we have already observed that, north of Thayetmyo, the oldest beds exposed in the neighbourhood of the Irrawadi include the *Dendrophyllia-Schizaster* zone, regarded by the late Mr. Bion and by Mr. Sethu Rama Rau as approximately equivalent to the base of the Singu Stage. Six miles north of Thayetmyo, at Leptanzeik, there occurs a fossil fauna related to that of Singu.

There is every reason, therefore, to believe that the equivalent of the Singu fossiliferous stage is extensively exposed near Thayetmyo. The fossils of the so-called "zone of *Aricia humerosa*" may very well, therefore, have been obtained from that horizon. That they may have been obtained, as suggested by Noetling, from a level higher than that of the *Cytherea promensis* bed is certainly possible, but it is far more probable that they belong to the horizon of the Singu fossiliferous stage.

(*e*) THE "ZONE OF *Cytherea erycina.*"

As already explained, Noetling's "zone of *Cytherea erycina*" corresponds with Theobald's "*Cytherea promensis* bed" of which the horizon is well known, as this stratum immediately rests upon the uppermost bed of Theobald's division "A". Since this division "A" is regarded as the equivalent of the Singu fossiliferous stage, the *Cytherea promensis* bed is either equivalent to the uppermost zone of the Singu fossiliferous stage, or belongs to a slightly higher level.

As has already been explained (see above, page 244), the fossil after which this zone has been named does not correspond with *Cytherea erycina*, but is closely related to *Cytherea florida* if not specifically identical. For the present it must be designated as *Cytherea promensis.* Moreover it is not a true zone-fossil, since it has an extensive vertical range.

Up to the present, only three forms have been securely identified from the *Cytherea promensis* bed :—

Conus (*Lithoconus*) *odengensis* var. *birmanica*,
Ancilla (*Sparella*) *birmanica*,
Melongena (*Pugilina*) *præponderosa.*

These designations will be defined in the second and third parts of the present note.

Conus odengensis is represented by a form which does not correspond either with the typical form occurring in the Kama horizon, or with the variety *avaënsis* which characterises the Minbu and Singu horizons. *Ancilla birmanica* has been obtained by Mr. Sethu Rama Rau at Myauktin from beds which are on the horizon of the Kama Clay. *Melongena præponderosa* is known from the Minbu and Singu horizons, and from the equivalents of the Kama Clay.

The small fauna at present identified is, therefore, uncharacteristic, yet it is consistent with the stratigraphical position of the bed.

(*f*) THE ZONES OF *Ostrea peguensis* AND *Ostrea promensis*.

Noetling was not acquainted with the original locality of the fossils which he designated as *Ostrea peguensis* and *O. promensis*, and which, owing to a fancied difference in the appearance of the rock adhering to the specimens, he referred to two possibly distinct zones.

As already stated on a previous occasion (*Rec. Geol. Surv. Ind.*, Vol. XLI, pp. 37, 40), the locality of the fossil described as *Ostrea promensis* is known from a label in Theobald's hand-writing. The specimens were obtained from the southern Pegu Yoma, about 50 miles north by west of Rangoon. There is no label with the specimens described as *Ostrea peguënsis* which were probably obtained from the same bed at the same locality. The note above alluded to, further established the specific identity of *Ostrea peguënsis* and *Ostrea promensis* respectively with *Ostrea Virleti* Desh, and *Ostrea digitata* Eichw., both of which occur in the Mekran Series of Balúchistàn.

Ostrea Virleti and *Ostrea digitata* both occur in the Akauktaung Series which has been regarded as possibly a marine equivalent of the fresh-water Irrawadi Series of Upper Burma. The data for fixing the equivalence of the Irrawadi Series are rather scanty. Correctly identified fossils are known from one locality only, Yenangyoung, where, distributed through the lower 2,000 feet of the Irrawadi Series, there occur mammalian remains which, according to the valuable researches of Dr. Pilgrim (*Rec. Geol. Surv. Ind.*, Vol. XL, p. 196), indicate the horizon of the "Middle Siwalik", equivalent to the Pontian. The uppermost pre-Irrawadi strata of Yenangyoung are undoubtedly the same as those of Singu. The characteristic variegated kaolinic clays which distinguish the upper horizons of the pre-Irrawadi beds at Singu and in the southern part of the Yenangyat anticline, and which have already been alluded to (see above page 229) are also observed at Yenangyoung. If the uppermost pre-Irrawadi beds of Singu are the same as those of Yenangyoung, we are justified in identifying corresponding beds at both localities by measuring downwards from the base of the Irrawadi Series. We must therefore conclude that the base of the Irrawadi Series at Yenangyoung is situated at about 1,500 feet above the equivalents of the highest level of the Singu fossiliferous stage. We have already observed that the Singu fossiliferous stage is not newer than oligocene. As the base of the Irrawadi Series already contains a fauna of uppermost miocene age, there must be a stratigraphical gap of some importance below the Irrawadi Series, unless we suppose that practically the whole of the miocene is compressed within the 1,500 feet of strata intervening between the summit of the Singu fossiliferous stage and the base of the Irrawadi Series, a contingency which, although possible, is improbable in view of the considerable average development of the various geological stages in the Irrawadi region of Burma.

Let us now consider what are the available data for estimating the age of the Akauktaung Series of Lower Burma. The two characteristic species of Dr. Noetling's "zones of *O. peguensis* and *O. promensis*," that is *O. Virleti* and *O. digitata* have both been discovered together by Dr. Stuart near Yethyauksan (18° 26′, 95° 21′), some five miles north of Pauktaing in Henzada (*Rec. Geol. Surv. Ind.*, Vol. XLI, p. 245). According to Dr. Stuart's surveys, the Akauktaung Series is unconformable to the beds containing the fauna of the Kama Clay. Dr. Stuart is of opinion that the *Ostrea latimarginata* beds of Kama and Pyalo may represent a basal member of the Akauktaung Series, but that this supposition needs further confirmation. *Ostrea latimarginata* and the fossils associated with it cannot, therefore, safely be taken into account in attempting to estimate the equivalence of the Akauktaung Series. As securely identified species safely referable to the Akauktaung beds, there only remain then the four species of *Ostrea* recorded by Dr. Stuart (*loc. cit. suprá*), namely *O. Virleti*, *O. digitata*, *O. gingensis*, and a form probably referable to *O. crassicostata*. All four of these forms are amongst the characteristic fossils of the lower zone of the Mekran Series of Balúchistán which it is proposed, in a separate note, to distinguish as the Talar Stage, after the richly fossiliferous beds of the Talar Pass, along the northern flanks of the Talar mountains, some 50 miles north-east of Gwádar. The evidence afforded by their presence clearly encourages the supposition that the Akauktaung Series partly coincides with the Talar Stage. *Ostrea gingensis* is a form of wide stratigraphical range occurring at all horizons of the miocene. *Ostrea Virleti* and *O. digitata* are not known from any strata that can unhesitatingly be referred to an age as low as burdigalian. Formerly, the beds now classified in the Talar Stage of western India were attributed by me to the middle miocene, and were thought to reach downwards to the limit of the burdigalian. The study of the rich fauna of gastropods from the Talar Stage has now advanced far enough to make this view untenable. The proportion of living species is so great that the Talar fauna cannot be regarded as older than Pontian. It approximately corresponds with the horizon of the Odeng beds of Java of which it contains, in extreme abundance, the most characteristic species, *Melongena ponderosa.*

If we admit the equivalence of the *O. Virleti* and *O. digitata* beds of the Akauktaung Series with the Talar Stage, the interpretation of their position in the Burmese sequence becomes very simple: they must evidently then correspond with the Irrawadi beds of Upper Burma, the lower portion of which contains, at Yenangyoung, a vertebrate fauna the age of which has been determined by Dr. Pilgrim as Pontian (*Rec. Geol. Surv. Ind.*, Vol. XL, p. 196). This is indeed the conclusion originally arrived at by Dr. Stuart.

We must nevertheless take into consideration the possibility that the *Ostrea latimarginata* beds of Kama and Pyalo may represent a basal member of the Akauktaung Series. So far as can be judged from our present experience, *O. latimarginata* characterises an older horizon than *O. Virleti* and *O. digitata*. Dr. Stuart informs me of having found, in Henzada, a fragment of a valve of *O. latimarginata* together with the usual *Ostrea* species of the Akauktaung beds, though under circumstances which do not preclude the possibility of its being a derived fossil. Future research may enable us to modify our views as to the distribution of these various species of *Ostrea*. For the present, we are justified in believing that the range of *O. latimarginata* on the one hand, and, on the other hand, the range of *O. Virleti* and *O. digitata* do not mutually encroach upon one another, and that strata characterised by *O. latimarginata* must be older than other strata characterised by *O. Virleti* and *O. digitata*.

Dr. Stuart has discovered *O. Virleti* and *O. digitata* in the basal members of the Akauktaung Series at Yethyauksan, the locality already alluded to. This observation need not necessarily conflict with the admission into the Akauktaung Series of the *O. latimarginata* beds of Kama and Pyalo, for in a series of such great thickness as the Akauktaung beds, the basal members need not be necessarily everywhere on the same horizon. If the *O. latimarginata* beds of Kama and Pyalo really belong to the Akauktaung Series, all that we need suppose is that the base of the series is more curtailed at Yethyauksan than at Kama and Pyalo. This interpretation affects the geological age of the Akauktaung Series in so far as we cannot attribute an age newer than middle miocene to the strata with *O. Virleti* and *O. digitata* since we must allow for a sufficiently close connection with the *O. latimarginata* beds, regarded as burdigalian. According to this interpretation, the *O. Virleti* and *O. digitata* horizon of the Akauktaung Series would be approximately equivalent to the stratigraphical gap below the Irrawadi Series of Upper Burma. The *O. Virleti* and *O. digitata* beds of the Akauktaung Series would then correspond with the Tjilanang Series of Java rather than with the Odeng beds. The Akauktaung Series attains a considerable thickness, as much as 4,000 feet, so that, even if we adopt this interpretation, its upper portion, at least, would still probably coincide with a portion of the Irrawadi Series of Upper Burma.

The choice between these two alternative interpretations has a very important bearing upon the nature of the basal unconformity of the Akauktaung Series. If the unconformity is situated below the zone of *O. latimarginata*, the stratigraphical gap must have become extremely reduced or even completely obliterated at Kama and at Pyalo where *O. latimarginata*, a species which we regard as characterising the Upper Gâj, is separated by several hundred feet of underlying strata from the Kama Clay fauna which we consider to be referable to the Lower Gâj; a disposition which does not necessitate the assumption of any unconformity. On this interpretation, the basal unconformity of the Akauktaung Series, extremely pronounced in Henzada, must become greatly reduced and finally obliterated when followed northward.

If, on the contrary, the unconformity is situated above the horizon of *O. latimarginata*, the reduction of the unconformity in a northern direction from Henzada towards Prome must be less pronounced. Although the base of the Akauktaung Series would still rest upon oligocene strata in Henzada and upon miocene strata at Prome, yet the upper limit of the stratigraphical gap would remain at an approximately uniform level and the basal unconformity of the Akauktaung Series in Lower Burma would essentially coincide with the basal unconformity of the Irrawadi Series in Upper Burma.

The latter interpretation has the advantage of greater simplicity, for it necessitates the supposition of only one main unconformity in the post-eocene Tertiary stratigraphy of the Irrawadi region, while there is scarcely any escape from the necessity of admitting two important unconformities if the basal Akauktaung unconformity is situated below the zone of *Ostrea latimarginata*, unless we postulate, for the Tertiary strata of the Irrawadi basin, a degree of inconstancy in lateral development which is not supported by the details of the data at present available.

In any case, whatever may be the final result of further stratigraphical and palæontological studies, the now well ascertained fact must remain that the beds with *O. Virleti* and *O. digitata* are undoubtedly newer than the horizon of the Kama Clay. Noetling's "zones of *Ostrea peguënsis* and *O. promensis*" are therefore undoubtedly newer than the "zones of *Arca Theobaldi* and *Parallelipipedum prototortuosum*."

(*g*) THE "ZONE OF *Dione dubiosa*."

According to Noetling, there occurs both at Yenangyat and at Singu, a fossiliferous horizon which has been designated as the "zone of *Dione dubiosa*" and which is said to occupy the same stratigraphical level at both localities. Judging from the detailed surveys of the late Mr. Grimes and of Mr. Sethu Rama Rau, the so-called "zone of *Dione dubiosa*" of Yenangyat, Grimes" "Signal Hill Sandstone," is situated at a considerably lower horizon than its supposed equivalent of Singu, the difference of stratigraphical level amounting perhaps to as much as 1,000 feet. The supposed zone, therefore, would have to be rejected as built up from two widely diverging horizons.

Nevertheless, we must take it as established beyond all possibility of a doubt that an error has crept into Noetling's account of the Singu and Yenangyat zones. On page 33 of his monograph in the Palæontologia Indica, Noetling gives a list of four fossils supposed to characterise the "zone of *Dione dubiosa*" of Singu. On page 35, the same list of four fossils is again exactly reproduced as characterising the "zone of *Dione dubiosa*" of Yenangyat. That, amongst such scanty faunas, the only forms identified should, in either case, be exactly the same species, is incredible. That the repetition of the list is due to an error of compilation becomes a certainty as soon as we refer to the descriptive portion of the monograph : the locality of every one of the four species is invariably mentioned as Yenangyat, not once as Singu. In transcribing the details of the Yenangyat and Singu sequence, the account of the Yenangyat "zone of *Dione dubiosa*" appears to have been inadvertently repeated in the Singu section.

The supposed "zone of *Dione dubiosa*" of Singu, therefore, does not exist. At Yenangyat there occurs, in all probability, a poorly fossiliferous zone some 400 or 500 feet above the main fossiliferous layer. Pending fuller stratigraphical and palæontological information, this zone may be provisionally discarded.

(*h*) THE "ZONE OF *Cardita tjidamarensis*"

According to Noetling, the so-called zone of *Cardita tjidamarensis* of Singu has yielded no other recognizable fossil besides the one species after which it has been named, the specific attribution of which has never been critically verified. The supposed zone is therefore palæontologically negligible, and, moreover, as it is situated only 100 feet above the so-called "zone of *Mytilus nicobaricus*," it would probably, in any case, constitute nothing more than a mere appendage of the latter.

For all practical purposes, the so-called "zone of *Cardita tjidamarensis*" may, for the present, be discarded.

(*i*) THE "ZONE OF *Anoplotherium birmanicum*."

The so-called "zone of *Anoplotherium birmanicum*" was regarded by Noetling as the oldest of the fossiliferous zones in Upper Burma. Its estimated stratigraphical position occurs at about 1,300 feet below the summit of the Pegu System as exposed in the Yenangyoung anticline. The variegated shales and sands at the upper limit of the exposed Pegu beds of the Yenangyoung anticline are also observed at Singu, and, as we have already noticed (see above, pages 228, 250), the upper part of the stratigraphical sequence must be identical at Singu and Yenangyoung, According to the thicknesses calculated from available surveys, the fossiliferous band constituting Noetling's so-called "zone of *Cardita tjidamarensis*" must be situated about 1,400 feet below the uppermost horizon of the Pegu sequence as exposed at Singu [1]. The so-called "zone of *Cardita tjidamarensis*" must therefore occupy a somewhat lower horizon than the so-called "zone of *Anoplotherium birmanicum.*" Therefore, the so-called "zone of *Anoplotherium birmanicum,*" instead of being the oldest fossiliferous zone in the Pegu System as developed in Upper Burma, represents, on the contrary, the newest bed with marine fossils observed by Dr. Noetling in that region.

As already explained (see above, page 228) the succession in Upper Burma and the mutual equivalence of the strata exposed in the several anticlines have been misinterpreted by Noetling under the erroneous impression that the petroliferous layers are everywhere of one age.

The fossils obtained from the so-called "zone of *Anoplotherium birmanicum*" are said to have been obtained from a conglomerate layer six inches thick in a petroleum well at a depth of 150 feet from the surface. Remains of fresh-water, marine, or estuarine fish, of terrestrial and fluviatile reptiles, of terrestrial mammalia, of marine lamellibranches and of corals are mentioned as having been found together in this one layer. One of the corals was referred to the living *Paracyathus cæruleus* Dure. A list of bivalve species was published in Noetling's monograph of 1901. It is extremely doubtful whether these mollusca were specifically determinable, for already in 1895, when they had been determined only generically, they were said to be "only casts or moulds," and it was stated that "nothwithstanding repeated coatings of varnish, they have, in the damp climate of Calcutta, almost entirely crumbled to pieces with considerable efflorescence." (*Rec. Geol. Surv. Ind.*, Vol. XXVIII, p. 69).

[1] This amount is essentially based on those estimates according to which the total thickness of strata exposed at Singu amounts to 3,000 feet, a figure which has been accepted by Dr. Pascoe (*Mem. Geol. Surv. Ind.*, Vol. XL., p. 107). Other estimates give, for the total thickness, somewhat lower values, varying from 2,400 to 2,700 feet. By combining the maximum estimates of the Yenangyoung sequence with the minimum estimates at Singu, the "zone of *Anoplotherium birmanicum*", instead of occurring at a higher level than the "zone of *Cardita tjidamarensis,*" would be lowered approximately to the level of the "zone of *Meiocardia metavulgaris.*" This interpretation is improbable as it would necessitate the supposition that the richly fossiliferous horizon of the "zone of *Mytilus nicobaricus,*" which is remarkably constant over a vast area in Singu and Yenangyat, is also fully exposed in Yenangyoung, where it would be mostly unfossiliferous, or else would only contain local bands of fragmentary fossils (see Pascoe, *Rec. Geol. Surv. Ind.*, Vol. XXXVI, pp. 135 ff.). In any case, the position of the "zone of *Anoplotherium birmanicum*" would be affected only to a minor extent, and would still remain connected with the same palæontological and stratigraphical sub-stage.

The mammalian teeth were referred by Noetling, in 1895, to *Antilope* and to *Anthracotherium silistrense*, an association that might indicate an upper miocene age. In 1901, the specimens were referred to *Anoplotherium* which would imply an approximately upper eocene age for the beds containing them. In 1910 (*Rec. Geol. Surv. Ind.*, Vol. XL, p. 196), Dr. Pilgrim identified the specimens as the molars of Tragulidæ, one of them being generically referred to *Dorcatherium*, an identification consistent with a miocene or perhaps upper oligocene age. If we are justified in identifying the Singu fossiliferous stage with Theobald's division "A" of Lower Burma, the so-called "zone of *Anoplotherium birmanicum*" which is situated at a horizon about 100 or 200 feet higher than the upper limit of the marine fossiliferous beds of the Singu stage, must belong approximately to the same level as the so-called "zone of *Cytherea erycina*" which overlies Theobald's division "A" in Lower Burma.

(*j*) THE "ZONE OF *Cyrena Crawfurdi*."

Connected with the variegated clays and sands which occupy the uppermost pre-Irrawadi strata at Yenangyoung, there occur locally some estuarine beds containing the shells which Noetling has described as *Cyrena Crawfurdi* and *Cyrena kodoungensis*. The same variegated beds are observed at the uppermost limit of the pre-Irrawadi beds at Singu, and there can be no doubt that the upper beds of Singu correspond with those of Yenangyat. Under the erroneous impression that the true equivalence of the Singu and Yenangyat succession is to be sought in the petroliferous beds of both localities, Noetling came to the conclusion that the *Cyrena* bed of Yenangyoung is approximately on a level with the newest fossiliferous bands recognized at Singu. This equivalence cannot be accepted if the beds exposed at Yenangyoung correspond with the uppermost beds exposed at Singu. Since we have every reason to admit the equivalence of the uppermost pre-Irrawadi beds at both localities, the *Cyrena* bed of Yenangyoung must belong to a horzion situated about 1,400 or 1,500 feet above that of the newest fossiliferous bands of Singu. If we are justified in identifying the Singu fossiliferous stage with Theobald's division "A" of the Prome region, and if the thicknesses of strata are even approximately the same in the Prome-Thayetmyo neighbourhood and in the region of the petroliferous anticlines—a reasonable enough supposition considering that the intervening distance is less than 100 miles,—then the bed must be situated some 1,400 or 1,500 feet above the horizon corresponding to that of the *Cytherea promensis* beds, and the Cyrena bed of Yenangyoung may correspond with a horizon even higher than that of the Kama Clay, perhaps as high as the beds which, in the marine facies, are characterised by the presence of *Ostrea latimarginata*.

In the Yenangyat region, the researches of Mr. Sethu Rama Rau have revealed the existence of some very interesting fresh-water beds which certainly occur above the marine fossiliferous Singu stage, although we cannot determine their exact stratigraphical equivalence relatively to the *Cyrena* beds of Yenangyoung. They contain a giant form of *Batissa* which has been referred to *Batissa kodoungensis*, from which, nevertheless, it appears to differ specifically as will be shown in Part II of the present study. A specimen of this giant species from the neighbourhood of Palanyon, obtained from the eastern flank of the Minbu anticline, has already been figured by Dr. Pascoe (*Rec. Geol. Surv. Ind.*, Vol. XXXVI, Pl. XX, fig. 2). The species may be distinguished as *Batissa Sethuramæ*. According to Mr. Sethu Rama Rau, the beds containing these giant shells in the Yenangyat anticline, are laterally continuous with those yielding the remarkable gastropod described by Dr. Annandale as *Taia* (*Rivularioides*) *spinifera*. (*Rec. Geol. Surv. Ind.*, Vol. L, p. 238). We cannot be too grateful to Dr. Annandale for his investigations of the difficult fresh-water fossil faunas of India. In Burma in particular, a full knowledge of the fresh-water and estuarine molluscan faunas may eventually prove of great assistance in elucidating the vexed question of the exact equivalence of the marine and fresh-water beds.

In conclusion, the *Cyrena Crawfurdi* bed of Yenangyoung may be equivalent to the horizon of the Kama Clay, or, more probably perhaps, to that of the zone of *Ostrea latimarginata*.

(*k*) SUMMARY.

Omitting such "zones as must be definitely or provisionally discarded, the stratigraphical succession of Dr. Noetling" "zones" may be tabulated as follows:

Zones of *Ostrea peguënsis* and *Ostrea promensis*.	Pontian or Vindobonian.	Probably the marine equivalents of the Irrawadi Series; probably equivalent to the Talar Stage of the Mekran Series and to the Odeng beds of Java; or else

		mainly intermediate in age between the zone of *Ostrea latimarginata* and the Irrawadi Series and, if so, equivalent to the Nahan, to the Lower Manchhar, and, in Java, to the Tji Lanang series.
Zone of *Cyrena Crawfurdi* .	Perhaps Burdigalian.	Perhaps the estuarine equivalent of the Pyalo beds with *Ostrea latimarginata* and of the Upper Gáj of western India, as well as of the Njalingdung beds of Java, or else one stage lower and equivalent to the Kama beds and Lower Gáj.
Zones of *Arca Theobaldi* and *Parallelipepedum prototortuosum*.	Approximately Aquitanian.	Kama zone equivalent to the Rembang beds of Java and to the Lower Gáj.
Zone of *Anoplotherium birmanicum*. Zone of *Cytherea erycina*.	......	Probably equivalent to the horizon of junction of the Nari and Gaj, or to the base of the Lower Gáj.
Zones of *Mytilus nicobaricus* and *Meiocardia metavulgaris*, with probably the zone of *Aricia humerosa*.	Approximately Chattian.	Equivalent to the Upper Nari.
Zone of *Cancellaria Martiniana*.	Approximately Upper Stampian.	Sitsayan horizon, equivalent to the Lower Nari.
Zone of *Paracyathus cœruleus*.	Approximately . Stampian.	

This table does not agree with the stratigraphical statement published by Dr. Stuart in a previous volume of these Records (Vol. XLI, p, 253) for which I am personally to a large extent responsible. The vastly increased accumulation of trustworthy data that have become available during the last ten years (see above, page 241) sufficiently accounts for the amendments here introduced.

II.—REVISION OF SOME OF THE FORMS FIGURED IN DR. NOETLING'S SECOND MONOGRAPH.

The preparation of a re-cast of Dr. Noetling's second monograph would need the work of a life-time. If we consider that scarcely one-third of the forms dealt with by Dr. Noetling have as yet been revised, we may realize the magnitude of the task that still awaits us. Nevertheless, a very useful purpose can be served by tabulating the results of the investigation of all those forms that have, so far, been critically examined.

Noetling regarded many of the Burmese fossils as predecessors of living forms, or else as descendants of eocene species, and gave expression to this opinion by prefixing, respectively, the greek terms *proto* and *neo* to the usually Latin names of the supposed related species. The result is frequently unfortunate, as the forms in question often belong to other genera than those with which they have been compared, with the result that many of Noetling's designations are not only meaningless, but misleading.

In the following notes, all these forms which, so far, have been critically examined, are referred to according to the pages of Dr. Noetling's second monograph. The revised synonymy will constitute Part III of the present notice.

Forms dealt with by Noetling and not mentioned in the following pages have not yet been critically examined. Forms mentioned without any comment require no amendment.

PARACYATHUS CŒRULEUS Duncan, p. 102.

In his first monograph, in 1895, Noetling described and figured a fossil from Yenangyat which he regarded as specifically identical with the living *Paracyathus cœruleus* and which, in 1901, was selected as a characteristic fossil for the so-called "zone of *Paracyathus cœruleus*" at Yenangyat. It is needless to comment on the selection as a zone-fossil for a division of the Tertiary, of a form regarded as specifically identical with one living at the present day, all the more so as Noetling himself has deprived the supposed species of any possible stratigraphical value by recording it from five more of the so-called "zones." These five occurrences are tabulated, on page 103 of the monograph of 1901, in a list from which only the supposed type-occurrence at Yenangyat has been omitted.

That the Yenangyat fossil bears no resemblance to the living species to which it has been referred is obvious from the illustrations to Noetling's first monograph of 1895, where the Yenangyat coral and the living species have been figured side by side (*Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, Pl. I, figs. 1, 2). Although, in 1901, the talented artist who prepared the illustrations to the monograph of 1895 was blamed for the apparent specific discrepancy, yet Noetling did not again venture on this direct comparison in the second monograph in which fossil specimens only were figured one from Yenangyat (the same which had previously been figured in 1895) and one from the so-called "zone of *Cancellaria Martiniana*" of Minbu.

My former pupil, Mr. Harendra Mohan Lahiri, has carefully examined all the Yenangyat and Minbu specimens referred by Dr. Noetling to *Paracyathus cœruleus.* There is not a single specimen in a state of preservation such as will allow a definite specific diagnosis. Nevertheless, enough can be made out to ascertain that the Yenangyat and Minbu forms differ specifically from one another, and that both are specifically distinct from the living species.

The characters which differentiate these fossils from one another and from the living form have been ascertained by Harendra Mohan Lahiri. The Yenangyat form is considered to be closely related to certain fossil forms from the upper eocene of Australia, such as *Paracyathus tasmanicus* and *P. supracostatus.*

EUPSAMMIA REGALIS, Alcock, p. 103.

The specimen thus identified by Dr. Noetling has also been carefully examined by Harendra Mohan Lahiri. Like the Yenangyat and Minbu specimens of *Paracyathus*, it is in a state of preservation that renders it totally unfit for a specific diagnosis. It bears no relation to the living form to which it has been referred by Noetling, for it apparently belongs to the sub-genus or genus *Balanophyllia*, while *Eupsammia regalis* is a typical member of the genus *Eupsammia.*

CLYPEASTER DUNCANIANUS, p. 105.

Although there are a few connections between the floor and roof of the test towards the margin, I have failed to detect the characteristic internal pillars of *Clypeaster.* The closed ambulacral petals with their extremely broad poriferous zones, and the extremely crowded minute tuberculation are totally unlike anything with which I am acquainted within the genus *Clypeaster.* The fragment is almost certainly not a *Clypeaster*, but is too imperfect either for generic or for specific determination.

OSTREA PEGUËNSIS, p. 107.

This is *Ostrea Virleti* Desh. (See *Rec. Geol. Surv. Ind.*, Vol. XLI, p. 36).

OSTREA PROMENSIS, p. 109.

This is *Ostrea digitata* Eichw. var. *Rohlfsii* Fuchs. (See *Rec. Geol. Surv. Ind.*, Vol. XLI, p. 37).

CYRENA (BATISSA) KODOUNGENSIS, p. 183.

When first describing this species, in 1901, Noetling noticed that it was the largest fossil *Cyrena* recorded at that time. Since then, almost every large fossil *Cyrena* that has been found in Burma seems accordingly to have been referred, as a matter of course, to *Batissa kodoungensis.* Nevertheless, as has already been pointed out (see above, page 258), we must not confound the Khodaung shell with another still larger form, which is known from the southern part of the Yenangyat anticline, and from the neighbourhood of Palanyon along the eastern limb of the Minbu anticline. The largest specimen of *Batissa kodoungensis* in Noetling's collection has a height of 75mm. Specimens of even larger size were observed by Dr. Pascoe east of Khodaung. The shape of the shell, as restored by Dr. Noetling, is sub-orbicular, with practically median umbo. The sub-orbicular character of the outline is confirmed by the measurements published by Dr. Pascoe who records 115 + 101mm. as the largest specimen observed near Khodaung (*Rec. Geol. Surv. Ind.*, Vol. XXXVI, p. 144). The length, therefore, only slightly exceeds the height, and the measurements recorded by Dr. Pascoe imply an approximately circular shell.

It should be mentioned that the Khodaung shell must attain even larger dimensions than those of the largest measured specimen, for one of the fragments figured by Dr. Pascoe (*vol. cit. suprá*, Pl. XIX, fig. 2) must have belonged to a specimen measuring about 130 + 120mm.

The figure of the Palanyon specimen published by Dr. Pascoe (*vol. cit. supra*, Pl. XX, fig. 2) will show at a glance that the length of this shell reaches nearly twice the largest measured dimension recorded for the Khodaung species, that, instead of exhibiting a sub-orbicular outline, it is elongate, with the length considerably exceeding the height, and that the umbo is greatly shifted forward. (We should remember that, to save space, the drawing here referred to has been placed obliquely). Several of the specimens from the Yenangyat region attain the same colossal dimensions as the Palanyon specimen. One individual, of relatively moderate size, which owing to its good state of preservation, best displays the true shape of the species, measure 124 + 96 + 51mm. The height therefore is equal to less than four-fifths of the length. The hinge-plate, in the Yenangyat shells, is taller than in *Batissa kodoungensis*, the cardinal teeth generally less obliquely disposed in Noetling's illustration of the left valve of *Batissa kodoungensis*, the cardinal tooth designated as 2 *a* is shown as practically vertical. In reality, it has a steep slope directed posteriorly downward (opisthocline). The corresponding tooth in the Yenangyat form has a pronounced slope in the opposite direction. The other elements of the hinge are much more oblique in *Batissa kodoungensis* than in any of the Yenangyat specimens.

If, as there is reason to think, Mr. Dalton has correctly referred to *Batissa kodoungensis* the magnificent specimen of a right valve represented in figures 1 and 2, Plate LVI of Volume LXIV of the Quarterly Journal of the Geological Society, the exact locality and horizon of which are unfortunately unknown, then the right valve of that species is characterised by a bifid central cardinal tooth. In the Yenangyat form, the corresponding tooth is entire. Mr. Dalton's specimen measures 100 + 96mm., and is, therefore, even more orbicular than the one recorded by Dr. Pascoe. Unfortunately, we are not acquainted with the hinge of the right valve in the Khodaung shell. Until we can obtain a right valve from Khodaung, there must subsist some uncertainty as to whether *Batissa kodoungensis* is identical with the species described by Mr. Dalton.

At any rate, the contrast between the left valve of *Batissa kodoungensis* and the corresponding valve of the Yenangyat shell suffices to establish the specific distinctness of the latter. As already mentioned above (page 258), I wish to dedicate this magnificent shell to Mr. Sethu Rama Rau, under the name of *Batisa Sethuramæ*. It is the largest *Batissa* on record, extinct or recent, exceeding in size even the colossal *Cyrena ingens* Dautzenberg (*Journ. Conch.*, Vol. XLVIII, p. 105, Pl. V), at present living in the New Hebrides, the largest known specimen of which measures 150 + 120 + 102 mm. This recent form is readily distinguished from *Batissa Sethuramæ* by its relatively much greater thickness and by a very different build of the hinge.

From the observations above discussed, it will be noticed that there still remain a number of uncertain points in connection with the large Burmese fossil shells. The conclusions at present arrived at may be summarised as follows:

1stly, the characters ascertained in the South-Yenangyat shells preclude their specific union with the Khodaung shells in spite of our incomplete knowledge of the latter.

2ndly, if the specimens described by Mr. Dalton eventually prove to belong approximately to the same stratigraphical horizon as the Khodaung shell, they may be safely accepted as plesiotypes, and the species *Batissa kodoungensis* may be re-defined in accordance with their characters.

3rdly, if the specimens described by Mr. Dalton are eventually shown to differ widely in age from the Khodaung shell, their specific reference to the latter would not be sufficiently justified, and they should be classified, provisionally at least, under a different specific name.

4thly, in the latter alternative, unless better material than at present available can be obtained from Khodaung, the species *Batissa kodoungensis* must remain un-identifiable, although the name may still be used to designate the large shell occurring at Khodaung.[1]

CYRENA (BATISSA) CRAWFURDI, p. 184.

At its type-locality, near Minlindaung, in the southern part of the Yenangyoung anticline, this shell is moderately variable. Its characters have been sufficiently clearly defined by Dr. Noetling.

The fossils from various parts of Burma that have been referred to *Batissa Crawfurdi* frequently represent a separate species, distinguished by its tall triangular shape, narrow umbo occupying a median or even slightly posterior situation, its relatively short hinge-plate, and by the presence of a distinct though rounded bend extending from the umbo to the postero-ventral edge; between this bend and the posterior margin, the surface is steep and flattened, and carries one or two blunt radial ridges. The species attains much larger dimensions than *B. Crawfurdi*, from which it is distinguished by its tall and triangular outline, the different po-

[1] The name of the locality has been spelt "Kodoung", "Kodaung", and "Khodaung." The shell was described as *Cyrena kodoungensis*, and we should adhere to this name. So far as possible, alterations in the orthography of a specific name should always be avoided as they complicate the nomenclature and especially impair the usefulness of alphabetical references.

sition of the umbo which, in *B. Crawfurdi*, occupies an anterior position, the shorter hinge-plate, and the characters of the posterior surface which, in *B. Crawfurdi*, is rounded and does not clearly exhibit the radial ridges above mentioned. These various differences invariably distinguish *B. Crawfurdi*, even in the most exceptionally elevated specimens.[1]

A specimen of the form under consideration, obtained near Beme in the Yenangyoung anticline at a stratigraphical level situated some 300 feet below that of the "zone of *Cyrena Crawfurdi*," has been figured by Dr. Pascoe (*Rec. Geol. Surv. Ind.*, Vol. XXXVI, Pl. XIX, fig. 5), who has already noticed that it probably represents a new species (*loc. cit.*, p. 145). We may distinguish this form as *Batissa birmanica.* It is accompanied, near Beme, by another form which, instead of being, like *B. birmanica*, taller than *B. Crawfurdi*, is, on the contrary, more depressed. Dr. Pascoe has named it *B. Crawfurdi* var. *yedwinensis.* The sub-central position of its umbo seems to exclude the possibility of a specific identity with *Batissa Crawfurdi*, and it may preferably be treated as a distinct species under the name of *Batissa yedwinensis* Pascoe. It is therefore omitted from the synonymy of *Batissa Crawfurdi* in Part III of the present study.

The precise limits of the stratigraphical range of *Batissa Crawfurdi* cannot exactly be determined at present. Outside of the Yenangyoung anticline, the only specimens at present known that seem to be referable to *Batissa Crawfurdi* were collected by Mr. Cotter on the road one mile south-west of Myin-ngan (21° 38', 94° 28' one-inch sheet 84 K 6) in the northern part of the Pakokku district where the pre-Irrawadi beds are, to a considerable extent, invaded by the fresh-water facies.

Batissa birmanica undoubtedly has a wide stratigraphical range and probably extends downwards at least to a horizon equivalent to the upper limit of the Singu fossiliferous stage: for instance, the specimens obtained by Mr. Sethu Rama Rau in the stream section of the Taungmachaung tributary west of Kamedaung (20° 49', 94° 24') in the Ngahlaingdwin area occur at about 1,400 feet below the base of the Irrawadi Series.

[1] The specimen illustrated by Noetling in figure 3, Plate XI of the second monograph exhibits an exceptionally elevated outline, the apparent character of which is, nevertheless, much exaggerated owing to the circumstance that the posterior portion of the shell is broken.

Batissa Crawfurdi and *Batissa birmanica* both exhibit, along the edge of the lateral teeth, the characteristic striations of the genus *Batissa.*

The distribution of the various forms of fossil Cyrenidæ at present recognised in Burma is perhaps connected with different local conditions of salinity. Thus, in the Taungmachaung exposure above alluded to, *Batissa birmanica* is accompanied by a brackish fauna including *Telescopium*, *Vicarya*, and *Cytherea.* Specimens obtained by Mr. Cotter half-a-mile west of Kayingyauk (20° 40′, 94° 26′) also in the Ngahlaingdwin region, at a horizon which may also approximately correspond with the upper limit of the Singu fossiliferous stage, are apparently associated with *Arca*, *Turcica*, *Paracyathus*, etc. The Kayingyauk bed is probably the southern extension of the Taungmachaung bed. On the contrary, *Batissa Sethuramæ*, in South-Yenangyat, occurs in the same bed as the fresh-water *Taia spinosa.* There is, at present, no evidence as to the conditions of salinity connected with the occurrence of *Batissa Crawfurdi.*

CYRENA (BATISSA) PETROLEI, p. 188.

The type of *Cyrena petrolei*, like that of *Cyrena Crawfurdi*, is from the neighbourhood of Minlindaung. Noetling has not recorded any strictly precise character by means of which it would be possible to distinguish the form designated as *Cyrena petrolei* from the type of *Cyrena Crawfurdi.* The large series of shells now available from Minlindaung cannot be sorted into two separate forms as they exhibit every possible intermediate gradation between extremes of height or thickness of outline, thickness of shell, and relative coarseness or delicacy of hinge. The form "*petrolei*" must therefore be discarded.

CALLIOSTOMA BLANFORDI, p. 253.

Two species are figured under this name in Noetling's second monograph. Those illustrated in figures 6 to 8, Plate xvii, correspond with *Trochus Blanfordi* as described and figured in Noetling's first monograph. The specimen shown in figure 5 of the same plate is different, and should constitute the type of another species which may be distinguished as *Calliostoma singuënse.*

Calliostoma singuënse attains considerably larger dimensions than the genuine *Calliostoma Blanfordi.* The spire-whorls of *Calliostoma Blanfordi* are much more concave than those of *Calliostoma sing-*

uënse. At early stages of growth, both forms are quadricarinate. While, however, the posterior keel in *Calliostoma Blanfordi*, is immediately contiguous to the suture, there intervenes a small space in *Calliostoma singuënse.* In both species, the second keel is the feeblest, the fourth, the most prominent; not, as stated by Noetling, the third, a statement contradicted by his own illustrations. On the later spire-whorls of *Calliostoma Blanfordi*, there invariably appears a secondary granulated keel bisecting the posterior interval, and almost always a similar secondary keel similarly bisecting the next interval; so that the later spire-whorls nearly always exhibit as many as six keels, and never less than five. A similar change takes place in *Calliostoma singuënse*, but only in the posterior interval, so that there are never more than five keels, and the subsidiary keel is relatively much less prominent than in *Calliostoma Blanfordi.* Moreover, owing to the great difference in size between the two species, *Calliostoma singuënse* still shows only four keels at a size equal to that of the full-grown specimens of *Calliostoma Blanfordi.*

The base is totally different in both species. In addition to a thick peripheral granulated keel, the base of *Calliostoma Blanfordi* exhibits an extremely beautiful ornamentation consisting of thirteen concentric granulated keels alternating in two sizes. On the base of *Calliostoma singuense*, there are ten concentric, smooth, flat bands, exhibiting an imbricated or stepped disposition, each band being separated from the next outer one by a small declivity facing outward.

TURRITELLA ANGULATA Sow., p. 272.

TURRITELLA SIMPLEX Jenkins, p. 273.

The form figured by Noetling is specifically identical with *T. angulata.* The Javanese fossil first described by Jenkins as *T. simplex* probably also belongs to the same species, though this identification needs to be verified.

TURRITELLA ACUTICARINATA Dunker, p. 274.

The specimens thus identified by Noetling also correspond with *T. angulata.* Martin has expressed the opinion that they do not coincide with the Javanese *T. acuticarinata* which, therefore, may represent a different species.

TURRITELLA sp., p. 277.

This form, of which we now possess well-preserved specimens, may be distinguished as *T. Noetlingi.*

TURRITELLA AFFINIFORMIS, p. 277.

This is *Turritella Magnasperula* Sacco.

RIMELLA CRISPATA Sow., p. 288.

The figured specimens differ specifically from the form to which they have been referred, and may be designated as *Rimella promensis.* They are distinguished from *Rimella crispata* by the thinness of the spiral incisions, the almost conical outline of the spire-whorls, the smoothness of the ribs, the absence of crenulations along the outer margin of the outer lip, and finally the elongate shape and small size.

CYPRÆA GRANTI d'A. and H., p. 290.

This shell does not bear the slightest resemblance to *C. Granti* d'Archiac (*not* d'Archiac *et* Haime) which is synonymous with *C. nasuta* Sow., itself a variety of *C. prunum* Sow., a *Cypræa sen. str.* The fossil erroneously referred by Noetling to *C. Granti* belongs to the very peculiar group of extinct forms which includes *C. Duclosiana* Bast. and several other Tertiary species, which it is proposed to distinguish as a section *Cypræotrivia.* The Burmese species may be distinguished as *Cypræa* (*Cypræotrivia*) *Oppenheimi.*

ARICIA HUMEROSA Sow., p. 291.

This shell differs from the Gáj fossil to which it has been referred by Noetling. It may be distinguished as *Cypræa* (*Bernayia*) *singuënsis.* The main difference resides in the disposition of the aperture, invariably almost straight in *Cypræa singuënsis,* while it is rather strongly bent in *Cypræa humerosa.* The depressed dorsal area of *Cypræa humerosa* is much larger than that of *C. singuënsis* and is centrally situated instead of being shifted posteriorly; consequently, the anterior transverse ridge is situated much further anteriorly in *Cypræa humerosa.*

TRIVIA SMITHI Martin, p. 293.

This remarkable shell does not belong to the same group as the Javanese species to which it has been referred by Noetling. It may be distinguished as *Trivia Noetlingi.* It is undoubtedly a fossil representative of the singular group of shells constituted by the two Mexican forms *T. radians* Linn. and *T. Solandri* Gray. In general shape it comes nearest to *T. radians*, but is readily distinguished by its smaller size and by its less numerous, narrower ribs.

CASSIS D' ARCHIACI, p. 294.

The specific name was already preoccupied as early as 1851 by Bellardi. (*Mem. Soc. Geol. Fr.*, 2d ser., Vol. IV, p. 224, Pl. xiv; figs. 3, 5). The shell may be distinguished as *Cassidea birmanica.*

SEMICASSIS PROTOJAPONICA, p. 295.

This shell is a *Tritonium.* We cannot perpetuate an absurdity by maintaining the specific name "*protojaponicum.*" In Noetling's first monograph, the shell was described and figured as *Cassidaria dubia* Noetling. It may therefore be known as *Tritonium* (*Lampusia*) *dubium* [Noetling].

GALEODA MONILIFERA, p. 297.

Under this name Noetling has illustrated two different forms which agree specifically with *Cassidaria echinophora* Linn., from which they cannot be separated otherwise than varietally. The variety designation *monilifera* may be retained for the specimen figured in Plate xix, fig. 16. The second specimen, shown in fig. 17 of the same plate, may be distinguished as *Cassidaria echinophora* var. *promensis.* It is distinguished from the variety *monilifera* by its broad ribbon-shaped bands without any trace of spiral subdivisions.

ONISCIDIA MINBUENSIS, p. 297.

This exceedingly remarkable shell belongs to the sub-genus *Loxotaphrus* of *Cyrtochetus*, of which *Phos variciser* Tate, from the Tertiary of Australia, has been hitherto the only recognized species. The resemblance between the Burmese and Australian forms is so close as to suggest their possible identity.

FICULA THEOBALDI, p. 298.

Two different forms have been figured by Noetling under that name. The one shown in fig. 21, Pl. xix, agrees exactly with *Pirula condita* Brongniart. The other specimen, shown in fig. 20, though closely allied, may be regarded as constituting a variety *singuënsis*, in which the spiral threads as well as the axial ribs are thicker than in the typical form.

FICULA sp., p. 299.

This form, which is now represented by numerous well preserved specimens, may be distinguished as *Pirula promensis*. It belongs to the same group as the fossil *Pirula pamotanensis* Martin from Java and the living *Pirula Investigatoris* of the Indian Ocean, but is readily distinguished by the peculiar ornamentation of the body-whorl in which the extremely exaggerated breadth of the spiral and axial ribs reduces the intervening spaces to small square depressions.

TRITON NEASTRIATULUS, p. 301.

This shell is a *Hindsia*. The specific name, founded on a fancied resemblance to *Tritonium striatulum* Lam., is, therefore, most unfortunate.

TRITON PARDALIS, p. 302.

This is also a *Hindsia*.

TRITON NEACOLUBRINUS, p. 304.

This shell is a *Hindsia* and is therefore totally unrelated to *Tritonium* (*Sassia*) *colubrinum* Lam.

PERSONA GAUTAMA, p. 305.

This shell is without any relationship whatever to the Tritonidæ. It belongs to *Peristernia*, a sub-genus of *Lathyrus*.

RANELLA PROTOTUBERCULARIS, p. 306.

Two separate species have been illustrated under this name in Noetling's second monograph. The one shown in fig. 9, Pl. xx, had previously been described and figured in Noetling's first monograph under the name of *Ranella tubercularis* Lam., evidently a *lapsus* for *Ranella bitubercularis*. It would be necessary therefore, to alter the name used in the second monograph to *Ranella protobitubercularis*; but as there never was any species described with the specific name "*tubercularis*," either by Lamarck or any other author, we may just as well designate the Burmese shell as *Ranella tubercularis* Noetling.

The species illustrated in figure 8 of the same plate, may be distinguished as *Ranella antiqua*. Compared with *Ranella tubercularis*, it is larger though it generally has fewer spire-whorls, and is distinguished by a more rounded aperture. The varices of *Ranella tubercularis* frequently do not correspond from one whorl to another during the later stages of growth, while they always coincide in *Ranella antiqua*.

Compared with *Ranella bitubercularis* Lam. of which it is evidently a pre-mutation, *Ranella antiqua* is uniformly smaller, with fewer spire-whorls.

RANELLA ELEGANS Beck, p. 309.

This shell differs specifically and even sectionally from Beck's type which is an *Apollon s. str.* It may be distinguished as *Ranella* (*Pseudobursa*) *promensis*. This beautiful shell closely recalls, in shape and ornamentation, *Ranella foliata* Desh., *R. margaritula* Desh., and *R. crumena* Lam., from all of which it is clearly distinguished by the peculiar tubular structure of the posterior apertural channel, corresponding with that exhibited in *Ranella bufonia* [Gmelin], the genotype of *Pseudobursa* Rovereto. The anterior canal, nevertheless, is nearly vertical, slightly oblique to the left of the shell as in *Ranella crumena*, not to the right as in *Ranella bufonia*, and the shell is perhaps genetically related to the point of parting between the sections *Apollon s. str.* and *Pseudobursa*.

EBURNA PROTOZEYLANICA, p. 310.

This shell cannot be specifically distinguished from *E. jutosa* Lam., from which its smaller dimensions entitle to be separated at most as a variety for which the utterly misleading name "*protozeylanica*" is, of course, quite inadmissible.

FUSUS SEMINUDUS, p. 312.

The specific name is preoccupied in the genus *Fusus* by a species of Deshayes; as, however, the Burmese shell is a *Clavilithes*, in which genus the specific name is not preoccupied, it may be maintained.

FUSUS VERBEEKI Martin, p. 313.

This fossil does not correspond with the Javanese fossil to which it has been referred by Noetling, but rather with *Clavilithes seminudus* [Noetl.] The shell assumes a rather different appearance according as to whether the callosity usually characterising the full-grown stage has been developed or not. Amongst the Burmese specimens, there are individuals, practically of maximum dimensions, apparently adult, in which the callosity has never been developed, and others, much smaller, in which it assumes the most exaggerated proportions. Both modes of development occur together and are connected by every intermediate gradation. With only a small amount of material at his disposition, Noetling came to the conclusion that these two modes or stages of development characterise different species, one of which was described as new under the name of *Fusus seminudus*, while the specimens with a large callosity were referred to *Fusus Verbeeki* Martin. It is now certain that all the Burmese specimens belong to a single species which, however closely related to *Clavilithes Verbeeki*, must be regarded as a distinct species, or at least a very pronounced variety, the main difference being the much smaller size of the Burmese form which is like a miniature edition of *Clavilithes Verbeeki* of which it perhaps represents an ancestral pre-mutation.

In *Clavilithes Verbeeki*, the axial ribs disappear at a relatively eariler stage of growth than in *Clavilithes seminudus*, for, while, in *Cl. seminudus*, the axial ribs cease only either on the two last whorls, or more generally only on the last one, in *Cl. Verbeeki*, the three last spire whorls are without axial ribs. If, instead of comparing corresponding stages of development, we compare actual dimensions of growth, it will be observed, nevertheless, that the ribs usually persist up to a much larger size in *Cl. Verbeeki* as a consequence of the usually much larger size of that species.

FASCIOLARIA NODULOSA SOW., p. 314.

Under this name Noetling has figured three specimens, none of which coincide with the Gáj fossil to which the specimens have been referred. Those reproduced in pl. xx, fig. 16 and pl. xxi, fig. 11 represent a *Lathyrus* and, therefore, bear no relation to the Gáj fossil which is a *Siphonalia.* The species may be distinguished as *Lathyrus indicus.* It is the earliest example so far known of the group of *Lathyrus Lynchi* [Basterot] (genus *Polygona* Schumard), abundantly represented in the miocene of Europe, and surviving in the deep-water *Lathyrus infundibulum* [Gmelin] of the West-Indies. It is extraordinarily closely related to *Lathyrus infundi-*

bulum, but has broader ribs and taller whorls. The European miocene species of this group are generally more angulated.

The specimen represented in pl. xx, fig. 17, is a *Siphonalia*, but differs from the Gáj species, and may be distinguished as *Siphonalia (Kelletia) iravadica*. It is smaller and less elongate than the living *Siphonalia Kelletii*, with a broader spire, and lacks the distinct umbilicus of the living shell.

PYRULA PUGILINA Born, p. 315.

This shell is clearly a pre-mutation of the living *Melongena pugilina*, and illustrates the difficulties of nomenclature experienced when a connected succession of mutations is observed through the successive stages of the Tertiary. The Burmese fossil scarcely differs specifically from the upper miocene or pliocene *Melongena ponderosa* Mart., which, in its turn can scarcely be regarded as differing more than varietally from the living *M. pugilina*; yet, when the Burmese shell is compared with the living form, it cannot possibly be maintained in the same species. For the sake of convenience it may be distinguished as *Melongena (Pugilina) praeponderosa.* It is distinguished both from *Melongena ponderosa* and from the recent shell, by its constantly wider-spaced spines. The obliteration of the spines, restricted to a portion of the body-whorl in *Melongena præponderosa*, usually also invades a portion of the spire in *Melongena ponderosa*. The spire of *Melongena præponderosa* is generally more elongate than that of *M. ponderosa* and *M. pugilina*. The internal walls of the living shell and, probably, of *Melongena ponderosa*, are smooth instead of lirate as in the Burmese fossil which, moreover, is generally somewhat smaller than the living shell and especially than *M. ponderosa.*

PYRULA BUCEPHALA Lam., p. 317.

Under this name, two species, belonging to different genera, have been figured, neither of which coincides with Lamarck's species. The one shown in pl. xxi, fig. 3, corresponds with Noetling's *Pyrula pseudobucephala* and is a *Melongena*. The other, shown in fig. 4, is a *Vasum*. So far as can be judged from published illustrations, good specimens of the Burmese shell coincide in every smallest detail with *Melongena basilica* Bellardi from the oligocene of Liguria. The fossil should therefore be known as *Vasum basilicum* [Bellardi].

The interior of the Ligurian shell has been neither figured nor described, and we are not in a position, therefore, to ascertain whether it contains the characteristic spiral folds of *Vasum.* If the one shell were truly a *Melongena* and the other a *Vasum*, we would be in presence of a most astounding example of mimicry, and, if that were so, the name "*basilicum*" might well be maintained for the Burmese shell to recall such an astonishing resemblance.

PYRULA PSEUDOBUCEPHALA, p. 318.

As already mentioned, amongst the specimens erroneously referred to *Melongena bucephala*, the one represented in pl. xxi, fig. 3, belongs to this species.

MUREX ARRAKANENSIS, p. 319.

This species belongs to the sub-genus *Chicoreus.*

MUREX (?) TCHIHATCHEFFI d'A. and H., p. 320.

Two different forms, neither of which coincides with d'Archiac and Haime's species, have been figured under this name in Noetling's second monograph. The inclusion of the specimen represented in fig. 9, pl. xxi, is due to an oversight, as Dr. Noetling expressly states (p. 321) that "no other specimens have come under examination in addition to the one described in my previous memoir." The second specimen, represented in fig. 9 is in a much better state of preservation than the one described in the first monograph and represented in fig. 8 of the second monograph. It may be taken as the type of a species *Murex* (*Muricantha*) *iravadicus*, and is now represented in the Calcutta collection by numerous good specimens. The specimen shown in fig. 8 is to be regarded as a variety *yenanensis* or perhaps even a distinct species. Attention may be drawn to the fact that, whereas the Burmese shells belong to the subgenus *Muricantha*, *Murex Tchihatcheffi* is a member of the section *Haustellum* of *Murex s. str.* As represented by the type of the proposed species, in pl. xxi, fig. 9 of Noetling's monograph, *Murex iravadicus* seems scarcely distinguishable specifically from *Murex Dannebergi* Beyrich of the lower oligocene of Germany. Judging from the available illustrations, the Indian fossil has more sharply delineated, narrower spiral threads. *Murex Grooti* Jenkins, from the miocene of Java, is also closely related, but its spiral decoration is apparently coarser.

The specimen represented by fig. 8, pl. xxi, of Noetling's monograph may provisionally be regarded as a variety *yenanensis* distinguished by the sharper posterior angulation of the whorls, the somewhat more numerous varices, and, apparently, the more profuse and more delicate spiral threads.

VOLVARIA BIRMANICA, p. 322.

VOLUTA DENTATA Sow., p. 324.

The shell does not coincide with the Gáj fossil to which Noetling has referred it, but represents a distinct species which is dedicated to the memory of the late Mr. Jacobs of Yenangyoung as *Athleta* (*Volutospina*) *Jacobsi.* This beautiful shell resembles *Voluta muata* Desh. from the upper eocene of the Paris basin. The European species lacks the very characteristic double convexity of the base exhibited by the Burmese shell; its spire, instead of exhibiting a tendency to assume an extraconic outline as in *Athleta Jacobsi*, rather tends to be conoidal.

OLIVA (STREPHONA) RUFULA Duclos, p. 326.

The figures in Noetling's monograph do not represent an *Oliva* but an *Olivella* which may be distinguished as *Olivella minbuensis.* The description and measurements refer largely to specimens of *Olivancillaria nebulosa* Lam. var. *pupa* Sow. from Singu.

Olivella minbuensis appears to be closely related to *Olivella leucozonias* Gray from Senegal, the spire of which, compared with that of the fossil, is somewhat longer, as is generally the case with most of the living forms. The insufficiently described and figured *Olivella brevis* Bellardi from the miocene of Piedmont (*Moll. terr. terz. Piem. e Lig.*, pt. 3, p. 213, pl. xii, fig. 34) exhibits some similarity in shape.

ANCILLARIA *cf.* VERNEDEI Sow., p. 327.

The discovery of better preserved specimens has shown that this shell is not an *Ancilla s. str.* and therefore not related to the much larger *A. Vernedei*, but a *Sparella* which may be distinguished as *A.* (*Sparella*) *birmanica.*

Compared with *Ancilla indica* from the Nari of Sind, *Ancilla birmanica* has a slightly shorter spire and a slightly longer body-whorl. The outline of the last spire-whorl is more continuous with that of the body-whorl in the Sind shell than in the Burmese one. The earlier whorls of the Burmese shell are more distinctly divided off from one another by grooved pseudo-sutures, and the apex is more conoidal. Lastly the Sind fossil lacks the feeble angulation of the whorls which characterises *Ancilla birmanica.* Both the Sind and Burma fossils are related to the living *Ancilla mamillata* Hinds of the Indo-Pacific regions which has a more inflated body-whorl.

CANCELLARIA NEAVOLUTELLA Noetl., p. 328.

This is *Rimella javana* Martin.

CANCELLARIA PSEUDOCANCELLATA Noetl., p. 330.

This is a *Merica.*

CANCELLARIA DAVIDSONI d'A. and H., p. 331.

This shell is a *Hindsia.* It differs specifically from d'Archiac and Haime's *Triton Davidsoni* which is also a *Hindsia* and which corresponds with *Fusus granosus* Sow., its correct name being, therefore, *Hindsia granosa* [Sow.]. The Burmese shell may be distinguished as *Hindsia birmanica.*

Hindsia birmanica somewhat resembles *Hindsia pardalis* Noetl. from which it is distinguished by its larger dimensions, its vertically more compressed shape, its relatively thinner main spiral threads, the presence, in the intervals, of fine striations and the inconstant development or absence of threads of a second order, the persistence in thickness of the axial ribs on the body-whorl, the less prominent varices. In general appearance, *Hindsia birmanica* closely recalls the living *Hindsia nivea* [Gmelin], but it has a shorter canal and is clearly distinguished by the well-defined, relatively narrow apertural varix instead of the broad, somewhat indefinite swollen zone which characterises the forms belonging to the group of *Hindsia nivea.*

CANCELLARIA MARTINIANA, p. 332.

As already noticed by Dalton (*Quart. Journ. Geol. Soc.*, Vol. LXIV, pp. 619, 630), this shell is a *Tritonidea.*

TEREBRA PROTOMYUROS, p. 335.

This form belongs to the section *Myurella.*

STRIOTEREBRUM UNICINCTUM, p. 336.

This is *Terebra samarangana* Martin.

STRIOTEREBRUM BICINCTUM Mart., p. 337.

This is not the Javanese form described by Martin. It corresponds with the previously mentioned *Terebra* (*Myurella*) *protomyuros* Noetling.

It may here be mentioned that Martin's specific designation was pre-employed in 1843 by Hinds (*Proc. Zool. Soc. p. 150*). The Javanese species described by Martin, which occurs also in Burma, may be distinguished as *Terebra Martini.*

TEREBRUM PROTODUPLICATUM, p. 338.

TEREBRUM SMITHI Mart., p. 339.

This is not the Javanese fossil described by Martin. It corresponds with Noetling's *Subula* sp., p. 341. It may be distinguished as *Terebra* (*Subula*) *Noetlingi.*

TEREBRUM sp. 1, p. 340.

The badly preserved specimen from Yenangyat figured by Noetling probably corresponds with a species which has been described from north-western India as *Terebra* (*Myurella*) *quettensis*, and which occurs abundantly at Singu.

SUBULA sp., p. 341.

As already mentioned, this is a form erroneously referred to *Terebra Smithi* Martin, which may be distinguished as *T. Noetlingi.*

PLEUROTOMA KARENAICA, p. 344.

This is a *Surcula.*

SURCULA FEDDENI, p. 346.

Under this name two species have been illustrated in Noetling's second monograph. The specimens shown in figures 22 and 23, pl. xxii, correspond respectively with the type of *Fasciolaria Feddeni* and with one of the specimens referred to *Drillia interrupta* in the first monograph. The specimen shown in fig. 24 of the same plate represents a different species which may be distinguished as *Surcula scala.*

There is a close resemblance between *Surcula scala* and *Surcula Lamarcki* Bellardi from the tortonian of Piedmont. The anterior contraction of the anterior slope is much more pronounced in the Piedmontese species, with the result that its body-whorl lacks the characteristic angulation circumscribing the base of *Surcula scala.*

GENOTIA IRRAVADICA, p. 347.

CLAVATULA MUNGA, p. 347.

This form belongs to the section *Perrona.*

CLAVATULA FULMINATA Kiener, p. 349.

This shell does not correspond with Kiener's species. It is a pre-mutational variety of a form which occurs abundantly in lower Burma at a horizon equivalent to that of the Kama Clay. Though it would seem more logical to take the older form as the type, the abundance and fine preservation of the specimens of the later fossil make it more convenient to adopt as the typical form. The shell described and figured by Noetling may be distinguished therefore as *Clavatula* (*Perrona*) *birmanica* var. *singuensis.*

CLAVATULA PROTONODIFERA, p. 350.

DRILLIA YENANENSIS, p. 353.

This shell belongs to the genus *Pleurotoma*, in which Noetling had correctly classified it when publishing his first monograph. It is a member of the section *Hemipleurotoma.*

DRILLIA PROTOINTERRUPTA, p. 354.

Three different species have been figured under this name. The first figure (fig. 8, pl. xxiii) may be accepted as representing the type. The name is unfortunate as the shell bears no resemblance to *D. interrupta* Lam. The second form (fig. 9) belongs to the sub-genus *Crassispira* and may be distinguished as *Drillia* (*Crassispira*) *Cotteri.* The third form (fig. 10) is also a *Crassispira* and may be distinguished as *Drillia* (*Crassispira*) *kamaënsis.*

Drillia Cotteri closely resembles *Drillia Geslini* Desm. from the miocene of Piedmont, which is distinguished by its much larger dimensions.

Drillia kamaënsis bears some resemblance to *Drillia sinensis* Hinds, living in the eastern seas, and also known in a fossil condition from the Upper Tertiary of Karikal, from which the Burmese fossil is clearly distinguished by its more prominent and broader ribs. From *Drillia kachensis*, fossil in the miocene of Kachh, it is distinguished by its relatively lower spire-whorls and much shorter body-whorl. It also resembles *Drillia semisulcata* Bellardi from the Helvetian of Piedmont, which is larger than the Burmese fossil, with a somewhat taller body-whorl and slightly more crowded axial ribs.

DRILLIA PROMENSIS, p. 355.

This species belongs to the sub-genus *Crassispira.*

DRILLIA PROTOCINCTA, p. 356.

D. madiunensis Martin, 1906, is identical.

CONUS LITERATUS Linn., p. 359.

Under this name, Noetling has illustrated three specimens (pl. xxiii, figs. 12-14), none of which agree with the Linnean species. Two of the specimens (figs. 12, 14) correspond with *C.* (*Lithoconus*) *Ickei* Martin. The remaining specimen, which is immature, probably corresponds with Noetling's *Conus avaënsis,* which may be regarded as a variety of *Conus odengensis* Martin.

CONUS (RHIZOCONUS) MALACCANUS Hwass, p. 360.

This shell, although closely related to *C. malaccanus,* is specifically distinct, and corresponds with *C.* (*Lithoconus*) *ineditus* Michelotti.

CONUS AVAËNSIS, p. 362.

Two different forms have been figured under this name. The first one (pl. xxiii, fig. 15) corresponds with one of the forms included by Noetling under *C. literatus,* regarded as a variety of *Conus odengensis* Martin. The second one (fig. 16) also appears to be specifically identical with *C. odengensis* and may be distinguished as a variety *birmanica.*

In the variety *avaënsis*, the outer lip exhibits a somewhat broader convexity next to the posterior angulation than is observed in the type. Moreover, while the greater part of the outer lip is practically vertical in the type, it is distinctly, though not strongly, oblique in the variety under consideration. The spiral decoration of the base is more restricted to the anterior third of the body-whorl than in the type; it is more effaced than in the type, and, at the same time, more even, consisting of shallow, rather close-set grooves of the same width as the raised intervals.

In the variety *birmanica*, the later spire-whorls, when seen from above, intead of gradually increasing as in the type and in the variety *avaënsis*, appear to be all approximately of the same width, conveying the impression, at first sight, that the whorls are narrower and more crowded than in the type, while, in reality their number is the same. The disposition of the outer lip and of the spiral ornamentation of the base coincides with that observed in the variety *avaënsis*.

CONUS YULEIANUS, p. 363.

There is some doubt as to whether this beautiful shell should be classified as a *Leptoconus* or *Lithoconus*. The specific identity of one of the specimens figured in Noetling's monograph (pl. xxiii, fig. 21) is doubtful.

CONUS HANZA, p. 364.

Two species have been figured under this name, one of which (pl. xxiii, fig. 23) corresponds with the previously described *Conus* (*Leptoconus*) *Bonneti* Cossmann. The other specimen (fig. 24) remains as the type of *C.* (*Leptoconus*) *hanza* which is distinguished from *Conus Bonneti* by its smaller dimensions, its much more ventricose body-whorl, and the absence of a rim to the spire-whorls.

CONUS PROTOFURVUS, p. 365.

Two specimens belonging to separate species have been figured under this name in Noetling's second monograph. The first specimen (pl. xxiii, fig. 25) represents the type of *C.* (*Lepto'onus*) *protofurvus*, the second corresponds with the living *Conus* (*Leptoconus*) *vimineus* Reeve.

CONUS GALENSIS, p. 366.

This species belongs to the section *Conospira*.

III.—REVISED SYNONYMY OF THE FORMS CRITICALLY RE-EXAMINED FROM DR. NOETLING'S SECOND MONOGRAPH.

TEREBRA (DUPLICARIA) PROTODUPLICATA Noetling.

1901. *Terebrum protoduplicatum* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 338, pl. xxii, fig. 17.

Kama.

TEREBRA (SUBULA) NOETLINGI n. sp.

1895. *Terebra fuscata* Brocc. *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 39, pl. ix, figs. 3, 4.

1901. *Terebrum smithi* K. Martin *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 339, pl. xxii, fig. 18.

1901. *Subula* spec. Noetling, *Pal. Ind.*, new ser., Vol. 1, part 3, p. 341, pl. xxii, fig. 20.

Both the figured specimens are from Minbu.

TEREBRA (NODITEREBRA) SAMARANGANA Martin.

1884. *Terebra samarangana* Martin, *Samml. des geol. Reichsmus* in Leiden, ser. I, Vol. III, p. 75, pl. v, fig. 78.

1901. *Strioterebrum unicinctum* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 336, pl. xxii, fig. 16.

Kama.

TEREBRA (MYURELLA) PROTOMYUROS Noetling.

1901. *Strioterebrum protomyuros* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 335, pl. xxii, fig. 14.

1901. *Strioterebrum bicinctum* Martin *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 337, pl. xxii, fig. 15.

The figured specimens are both from Kama.

TEREBRA (MYURELLA) QUETTENSIS n. sp.

? 1901. *Terebrum*, spec. 1, Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 340, pl. xxii, fig. 19.

The figured specimen, the identification of which is somewhat doubtful is from Yenangyat. The species is known to occur abundantly at Singu.

CLAVATULA PROTONODIFERA Noetling.

1895. *Pleurotoma Voysei*[1] d'Arch. and Haime *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 40, pl. ix, fig. 5.

1901. *Clavatula protonodifera* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 350, pl. xxiii, figs. 3, 4.

Minbu and Singu.

[1] Misprinted " Voysesi " and attributed to d'Archiac instead of d'Archiac and Haime in Noetling's first monograph, and misprinted " Voyesi " in the second.

CLAVATULA (PERRONA) BIRMANICA n. sp. var. SINGUENSIS.

1901. *Clavatula fulminata* Kiener *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 349, pl. xxiii, fig. 2.

Singu.

CLAVATULA (PERRONA) MUNGA Noetling.

1901. *Clavatula munga* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 347, pl. xxiii, fig. 1.

Kama.

SURCULA KARENAICA [Noetling.]

1901. *Pleurotoma* (*s. s.*) *karenaica* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 344, pl. xxii, fig. 21.

Kama.

SURCULA (PLEUROFUSIA) FEDDENI Noetling.

1895. *Fasciolaria feddeni* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 35, pl. viii, fig. 4.

1895. *Pleurotoma* (*Drillia*) *interrupta* Lam. *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 41, pl. x, fig. 1 (*non* fig. 2 = *Drillia protointerrupta*).

1901. *Surcula Feddeni* Noetling, *Pal Ind.*, new ser., Vol. I, part 3, p. 346, pl. xxii, figs. 22, 23 (*non* fig. 24 = *Surcula scala*).

The figured specimens are both from Yenangyat. The existence of this species at Minbu and Singu has also been ascertained.

SURCULA (PLEUROFUSIA) SCALA n. sp.

1901. *Surcula Feddeni* Noetling (*pars*), *Pal. Ind.*, new ser., Vol. I, part 3, pl. xxii, fig. 24 (*non* fig. 22, 23 = *Surcula Feddeni*).

Kama.

PLEUROTOMA (HEMIPLEUROTOMA) YENANENSIS Noetling.

1895. *Pleurotoma yenanensis* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 42, pl. x, fig. 3.

1901. *Drillia yenanensis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 353, pl. xxiii, fig. 5.

Yenangyat.

A variety of this same species is known from the Nari beds of Sind.

DRILLIA PROTOCINCTA Noetling.

1901. *Drillia protocincta* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 356, pl. xxiii, figs. 6, 7.

1906. *Pleurotoma* (*Drillia*) *madiunensis* Martin, *Samml. des geol. Reichsmus.* in Leiden, new ser., Vol. I, p. 296, pl. xliii, fig. 707.

Kama.

DRILLIA PROTOINTERRUPTA Noetling.

1895. *Pleurotoma (Drillia) interrupta* Lam. *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 41, pl. x, fig. 2 (*non* fig. 1 = *Surcula Feddeni*).

1901. *Drillia protointerrupta* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 354, pl. xxiii, fig. 8 (*non* fig. 9 = *Drillia Cotteri*, *nec.* fig. 10 = *Drillia kamaënsis*).

Minbu.

DRILLIA (CRASSISPIRA) KAMAËNSIS n. sp.

1901. *Drillia protointerrupta* Noetling (*pars*). *Pal. Ind.*, new ser., Vol. I, part 3, p. 354, pl. xxiii, fig. 10 (*non* fig. 8 = *Drillia protointerrupta*, *nec.* fig. 9, = *Drillia Cotteri*).

Kama.

DRILLIA (CRASSISPIRA) PROMENSIS Noetling.

1901. *Drillia promensis* Noetling, *Pal. Ind.*, new ser., Vol. I, p. 355, pl. xxiii, fig. 11.

Kama.

DRILLIA (CRASSISPIRA) COTTERI n. sp.

1901. *Drillia protointerrupta* Noetling (*pars*). *Pal. Ind.*, new ser., Vol. I, part 3, p. 354, pl. xxiii, fig. 9 (*non* fig. 8 = *Drillia protointerrupta*, *nec.* fig. 10 = *Drillia kamaënsis*).

Kama.

GENOTIA IRAVADICA Noetling.

1895. *Pleurotoma (Cryptoconus) irravadicus* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 41, pl. ix, fig. 6.

1901. *Genota irravadica* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 347, pl. xxii, figs. 25, 26.

The figured specimens are both from Minbu.

CONUS (CONOSPIRA) GALENSIS Noetling.

1901. *Conus galensis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 366, pl. xxiii, fig. 27.

Yenangyat.

CONUS (LEPTOCONUS) PROTOFURVUS Noetling.

1895. *Conus (Leptoconus) marginatus Sowerby sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 43, pl. x, fig. 8.

1901. *Conus (Leptoconus) protofurvus* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 365, pl. xxiii, fig. 25 (*non* fig. 26 = *Conus vimineus* Reeve).

Yenangyat.

CONUS (LEPTOCONUS) VIMINEUS Reeve.

? **1844.** *Conus aculeatus* Reeve, Monograph of the genus Conus, pl. xliv, sp. 240.

1849. *Conus vimineus* Reeve. Monograph of the genus Conus, suppl. pl. vii, sp. 269.

1895. *Conus vimineus* Reeve. Martin, *Samml. des geol. Reichsmus. in Leiden*, new ser., Vol. I, p. 16, pl. ii, figs. 23-25.

1895. *Conus palabuanensis* Martin, *Samml. des geol. Reichsnus. in Leiden*, new ser., Vol. I, p. 16, pl. ii, fig. 26.

1900. *Conus (Chelyconus) subvimineus* Cossmann, *Journ. Conch.*, Vol. XLVIII, p. 64, pl. iv, figs. 47, 48.

1901. *Conus (Leptoconus) protofurvus* Noetling (*pars*). *Pal. Ind.*, new ser., Vol. I, part 3, p. 365, pl. xxiii, fig. 26 (*non* fig. 25 — *Conus protofurvus*).

Kama.

This shell also occurs in the Upper Tertiary of Karikaland in the Mekran beds of Baluchistan.

CONUS (LEPTOCONUS) BONNETI Cossmann.

1900. *Conus (Leptoconus) Bonneti* Cossmann, *Journ. Conch.* Vol. XLVIII, p. 59, pl. iv, figs. 15, 16.

1901. *Conus hanza* Noetling (*pars*). *Pal. Ind.*, new ser., Vol. I, part 3, p. 364, pl. xxiii, fig. 23 (*non* fig. 24 — *Conus hanza*).

Kama.

Also in the Upper Tertiary of Karikal.

CONUS (LEPTOCONUS) HANZA Noetling.

1901. *Conus hanza* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 364, pl. xxiii, fig. 24 (*non* fig. 23 — *Conus Bonneti*).

Kama.

CONUS (LEPTOCONUS) YULEIANUS Noetling.

1901. *Conus yuleianus* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 363, pl. xxiii, fig. 22 (? fig. 21).

The fairly well preserved specimen shown in fig. 22, which must be regarded as the type, is from Kama. The incomplete specimen shown in fig. 21, of which the specific identity is doubtful, is from the so-called "zone of *Aricia humerosa*" presumably near Thayetmyo.

CONUS (LITHOCONUS) ODENGENSIS Martin.

1895. *Conus odengensis* Martin, *Samml. des geol. Reichsmuseums in Leiden*, new ser., Vol. I, p. 19, pl. iii, figs. 39—44.

? **1906.** *Conus madurensis* Martin, *Samml. des geol. Reichs-Mus. in Leiden*, new ser., Vol. I, p. 288, pl. xlii, fig. 690.

Typical examples of this shell are extremely abundant in Burma at a horizon equivalent to that of the Kama clay, but are not represented amongst the fossils figured by Noetling. The same form also occurs in the Gàj beds of Kachh.

CONUS (LITHOCONUS) ODENGENSIS var. AVAËNSIS Noetling.

1901. *Conus literatus* Linn. *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 359, pl. xxiii, fig. 13 (*non* fig. 12, 14 – *Conus Ickei*).

1901. *Conus avaënsis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 362, pl. xxiii, fig. 15 (*non* fig. 16 – var. *birmanica*).

The type of *Conus avaënsis* is from Singu. An immature specimen from the so-called "zone of *Aricia humerosa*" presumably near Thayetmyo, apparently belongs to this same form which has also been recognized at Minbu.

CONUS (LITHOCONUS) ODENGENSIS var. BIRMANICA.

1901. *Conus avaënsis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 362, pl. xxii, fig. 16 (*non* fig. 15 -- var. *avaënsis*).

Zone of *Cytherea promensis* opposite Prome.

CONUS (LITHOCONUS) INEDITUS Michelotti.

1861. *Conus ineditus* Michelotti, Et. mioc. inf. Italie septentrionale, p. 105, pl. xii, figs. 11, 12.

1893. *Lithoconus ineditus* Micht., Sacco, *Moll. terr. terz. Pieme. Lig.*, XIII, p. 26, pl. iii, figs. 16—24.

1895. *Conus malaccanus* Hwass *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 42, pl. x, figs. 4-7.

1901. *Conus* (*Rhizoconus*) *malaccanus* Hwass *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 360, pl. xxiii, figs. 17-20.

The specimens figured by Noetling are all from Minbu. The species occurs abundantly also at Singu, and also in the Nari beds of western India.

CONUS (LITHOCONUS) ICKEI Martin.

1901. *Conus* (*Lithoconus*) *literatus* Linn. *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 359, pl. xxiii, figs. 12, 14 (*non* fig. 13 *Conus odengensis*).

1906. *Conus Ickei* Martin, *Samml. des geol Reichs-Mus. in Leiden*, new ser., Vol. I, p. 289, pl. xlii, fig. 692.

The specimens figured by Noetling are both from the so-called "zone of *Aricia humerosa*" presumably near Thayetmyo.

MERICA PSEUDOCANCELLATA [Noetling].

1895. *Cancellaria cancellata* Lam. *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 39, pl. ix, fig. 2.

1901. *Cancellaria pseudocancellata* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 330, pl. xxii, fig. 10.

Yenangyat.

OLIVELLA MINBUENSIS n. sp.

1895. *Oliva djocdjocartæ* K. Martin *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 38, pl. ix, fig. 1.

1901. *Oliva* (*Strephona*) *rufula* Duclos *sec.* Noetling, (*pars*)., *Pal. Ind.*, new ser., Vol. I, part 3, p. 326, pl. xxii, figs. 4, 5.

The specimens figured by Noetling are both from Yenangyat. The species also occurs at Minbu.

ANCILLA (SPARELLA) BIRMANICA n. sp.

1901. *Ancillaria* cf. *Vernedei* Sow. Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 327, pl. xxii, fig. 6.

The figured specimen is from the *Cytherea promensis* bed opposite Prome.

ATHLETA (VOLUTOSPINA) JACOBSI n. sp.

1895. *Voluta dentata* Sow. *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 37, pl. viii, figs. 8-10.

1901. *Voluta dentata* J. de C. Sowerby *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 324, pl. xxi, figs. 14, 15, pl. xxii, figs. 1-3.

The figured specimens are from Yenangyat and Minbu. The species also occurs at Singu.

VOLVARIA BIRMANICA Noetling.

1895. *Volvaria birmanica* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 37, pl. viii, fig. 7.

1901. *Volvaria birmanica* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 322, pl. xxi, fig. 11.

Minbu.

CLAVILITHES SEMINUDUS Noetling.

1895. *Clavella djocdjocartæ* K. Martin *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 33, pl. vii, figs. 5-7.

1901. *Fusus seminudus* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 312, pl. xx, figs. 12, 13, (*non Fusus seminudus* Deshayes).

1901. *Fusus verbeeki* [1] Martin *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 313, pl. xx, figs. 14, 15.

The figured specimens are from Minbu, and from the so-called "zone of *Aricia humerosa*," presumably near Thayetmyo. The species also occurs abundantly at Yenangyat, at Singu, and at the horizon of the Kama clay.

[1] Mis-spelt "*Verbecki*."

LATHYRUS INDICUS n. sp.

1895. *Fasciolaria nodulosa sec.* Noetling (*pars*)., *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 34, pl. viii, figs. 1, 2, (*non* fig. 3 = *Siphonalia iravadica*).

1901. *Fasciolaria nodulosa* J. de C. Sowerby *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 314, pl. xx, fig. 16, pl. xxi, fig. 1, (*non* pl. xx, fig. 17 = *Siphonalia iravadica*).

The almost undeterminable fragments figured by Noetling are from Yenangyat. The species is well represented at Minbu.

LATHYRUS (PERISTERNIA) GAUTAMA [Noetling].

1901. *Persona gautama* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 305, pl. xx, figs. 6, 7.

Kama.

VASUM BASILICUM [Bellardi].

1872. *Myristica basilica* Bellardi, *Moll. terr. terz. Piemonte e Liguria*, parte I, p. 158, pl. x, figs. 4, 5.

1900. *Melongena* (*Myristica*) *basilica* Bell., Rovereto, *Ill. moll. tongr.*, p. 170.

1901. *Pyrula bucephala* Lam. *sec.* Noetling (*pars*)., *Pal. Ind.*, new ser., Vol. I, part 3, p. 317, pl. xxi, fig. 4 (*non* fig. 3 = *Pyrula pseudobucephala* Noetling).

1904. *Melongena* (*Myristica*) *basilica* Bell.—Sacco, *Moll. terr. terz. Piem. e. Lig.* parte XXX, p. 32.

Singu.

MELONGENA PSEUDOBUCEPHALA Noetling.

1901. *Pyrula bucephala* Lank. *sec.* Noetling (*pars*)., *Pal. Ind.*, new ser., Vol. I, part 3, p. 317, pl. xxi, fig. 3, (*non* fig. 4 = *Vasum basilicum*).

1901. *Pyrula pseudobucephala* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 316, pl. xxi, figs. 5, 6.

Singu.

MELONGENA (PUGILINA) PRÆPONDEROSA n. sp.

1901. *Pyrula pugilina* Born *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 315, pl. xxi, fig. 2.

The figured specimen is from the zone of *Cytherea promensis* opposite Prome. The same form occurs at Minbu and Singu.

SIPHONALIA (KELLETIA) IRAVADICA n. sp.

1895. *Fasciolaria nodulosa* Sow. *sec.* Noetling (*pars*)., *Mem. Geol. Surv. Ind.*, Vol. XXVII, pl. viii, fig. 3 (*non* figs. 1, 2 = *Lathyrus indicus*).

1901. *Fasciolaria nodulosa* J. de Carle Sowerby *sec.* Nœtling (*pars*)., *Pal. Ind.*, new ser., Vol. I, part 3, p. 314, pl. xx, fig. 17 (*non* pl. xx, fig. 16, *nec. pl.* xxi, fig. 1 = *Lathyrus indicus*).

Minbu.

CYRTOCHETUS (LOXOTAPHRUS) MINBUENSIS [Noetling].

1895. *Cassidaria minbuensis* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 28, pl. vi, fig. 4.

1901. *Oniscidia minbuensis* Nœtling, *Pal. Ind.*, new ser., Vol. I, p. 296, pl. xix, figs. 18, 19.

Minbu.

TRITONIDEA MARTINIANA [Nœtling].

1895. *Nassa cautleyi* d'Archiac *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 32, pl. vii, figs. 2-4.

1901. *Cancellaria martiniana* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 332, pl. xxii, figs. 11-13.

1908. *Cantharus Martinianus* Nœtling—Dal on. *Quart. Journ. Geol. Soc.*, Vol. LXIV, pp. 619, 630, pl. iv, figs. 6, 7.

The figured specimens are from Minbu. The same species also occurs abundantly at Singu, and, according to Noetling, at Yenangyat.

EBURNA LUTOSA Lamarck, var.

1790. *Eburna lutosa* Lamarck. Encycl., pl. cccci, fig. 4.

1849. *Eburna lutosa* Lam. – Reeve., Monograph of the genus Eburna, pl. sp.

1881. *Eburna lutosa* Lam.,—Tryon. *Man. Conch.*, Vol. III, p. 211, pl. lxxxii, fig. 465.

1901. *Eburna protozeylanica* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 310, pl. xx, fig. 11.

Kama.

MUREX (CHICOREUS) ARAKANENSIS Noetling.

1895. *Murex arrakanensis* Noetling. *Mem. Geol. Surv. Ind.*, Vol. XXVII, part I, p. 36, pl. viii, fig. 5.

1901. *Murex arrakanensis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 319, pl. xxi, fig. 7.

Minbu.

MUREX (MURICANTHA) IRAVADICUS n. sp.

1901. *Murex* (?) *tchihatcheffi* d' Archiac and Haime *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 320, pl. xxi, fig. 9.

The figured specimen is from Yenangyat. The species also occurs at Minbu.

MUREX IRAVADICUS var. YENANENSIS n. var. vel species distinguenda.

1895. *Murex tchihatcheffi* d'Archiac and Haime *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 36, pl. viii, fig. 5.

1901. *Murex* (?) *tchihatcheffi* d'Archiac and Haime *sec.* Nœtling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 320, pl. xxi, fig. 8.

Yenangyat.

TRITONIUM (LAMPUSIA) DUBIUM [Noetling].

1895. *Cassidaria dubia* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 27, pl. vii, figs. 2, 3.

1901. *Semicassis protojaponica* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 295, pl. xix, fig. 15.

Minbu.

HINDSIA BIRMANICA n. sp.

1895. *Triton* (*Simpulum*) *davidsoni* d'Archiac and Haime *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 29, fig. 6.

1901. *Cancellaria davidsoni* d'Archiac and Haime *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 331, pl. xix, fig. 23, pl. xx, fig. 1.

Minbu.

HINDSIA NEASTRIATULA [Noetling].

1895. *Triton pardalis* Noetling (*pars*), *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 30, pl. vi, fig. 8*a* (*non* figs. 7, 8 - *Hindsia pardalis*).

1901. *Triton neastriatulus* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 301, pl. xx, figs. 2, 3.

The figured specimens are from Yenangyat. The species also occurs at Minbu.

HINDSIA PARDALIS [Noetling.]

1895. *Triton pardalis* Noetling (*pars*), *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 30, pl. vi, figs. 7, 8 - (*non* fig. 8*a* - *Hindsia neastriatula*).

1901. *Triton pardalis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 302, pl. xx, fig. 5.

Minbu.

The locality "Kama" mentioned by Noetling is founded on an erroneous identification of a specimen of *Hindsia neacolubrina.*

HINDSIA NEACOLUBRINA [Noetling.]

1901. *Triton neacolubrinus* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 304, pl xx. fig. 4.

Kama.

RANELLA TUBERCULARIS Noetling.

1895. *Ranella tubercularis* "Lam."—Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, pl. vii, fig. 1.

1901. *Ranella prototubercularis* Noetling (*pars*), *Pal. Ind.*, new ser., Vol. I, part 3, p. 306, pl. xx, fig. 9 (*non* fig. 8 - *Ranella antiqua*).

Minbu.

Also in the Nari beds of Sind.

RANELLA ANTIQUA n. sp.

1901. *Ranella prototubercularis* Noetling (*pars*), *Pal. Ind.*, new ser., Vol. I, part 3, p. 306, pl. xx, fig. 8 (*non* fig. 9 = *Ranella tubercularis*).

Kama.

RANELLA (PSEUDOBURSA) PROMENSIS n. sp.

1901. *Ranella elegans* Beck *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 309, pl. xx. fig. 10.

Kama.

CASSIDEA BIRMANICA n. sp.

1895. *Cassis* d'Archiaci Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 27, pl. vi, fig. 1.

1901. *Cassis d' Archiaci* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 294, pl. xix, fig. 14 (*non*) *Cassis Archiaci* Bellardi, *Mem. Soc. Geol. Fr.*, 2nd ser., Vol. IV (1851), p. 224, pl. xiv, figs. 3, 5.

Minbu.

This species also occurs at Singu.

CASSIDARIA ECHINOPHORA [Linn.] var. MONILIFERA Noetling.

1901. *Galeoda monilifera* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 297, pl. xix, fig. 16 (*non* fig. 17 = var. *promensis*).

Singu.

CASSIDARIA ECHINOPHORA [Linn.] var. PROMENSIS n. var.

1901. *Galeoda monilifera* Noetling (*pars*)., *Pal. Ind.*, new ser., Vol. I, part 3, p. 297, pl. xix, fig. 17 (*non* fig. 16 = var. *monilifera*).

Kama.

PIRULA CONDITA Brongniart.

1823. *Pirula condita* Brongniart, *Mem. terr. sed. sup. Vicentin*, p. 75, pl. vi, fig. 4.

1891. *Ficula condita* Brongn.—Sacco, *Moll. terr. terz. Piem. e Lig.*, VIII, p. 23, pl. i, figs. 27-32.

1895. *Ficula theobaldi* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 28, pl. vi, fig. 5.

1901. *Ficula theobaldi* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 298, pl. xix, fig. 21.

The figured specimen is from Yenangyat. The locality "Minbu" mentioned in Noetling's second monograph is doubtful. Amongst Noetling's specimens, the shells from Minbu referred by Noetling to "*Ficula Theobaldi*" belong to another species, *Pirula concinna* Beyrich, of which they constitute a local variety.

Pirula condita occurs in the Nari beds of Sind and Baluchistan, and is one of the commonest fossils of the oligocene and miocene of Europe.

PIRULA CONDITA Brongn. var. SINGUENSIS n. var.

1901. *Ficula theobaldi* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 298, pl. xix, fig. 20.

Singu.

PIRULA PROMENSIS n. sp.

1901. *Ficula* spec. Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 299, pl. xix, fig. 22,

Kama.

CYPRÆA (BERNAYIA) SINGUENSIS n. sp.

1901. *Aricia humerosa* Sow. *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 291, pl. xix, fig. 11.

The figured specimen is from the so-called "Zone of *Aricia humerosa*," presumably from the neighbourhood of Thayetmyo. The same form occurs abundantly at Singu.

CYPRÆA (CYPRÆOTRIVIA) OPPENHEIMI n. sp.

1895. *Cypræa granti* d'Arch. *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 25, pl. v, fig. 12.

1901. *Cypræa granti* d'Archiac and Haima *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 290, pl. xix, fig. 12.

The figured specimen is from Minbu. The species also occurs at Yenangyat.

TRIVIA NOETLINGI n. sp.

1895. *Trivia smithi* Martin *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 26, pl. v, fig. 13.

1901. *Trivia smithi* Martin *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 293, pl. xix, fig. 13.

Yenangyat.

RIMELLA (DIENTOMOCHILUS) JAVANA Martin.

1879. *Rostellaria javana* Martin, *Tertiarschichten auf Java*, p. 50, pl. ix, fig. 7.

1895. *Rostellaria javana* Martin, *Samml. des geol. Reichs-Mus. in Leiden*, Vol V, pp. 57-59.

1899. *Rostellaria (Rimella) javana* Martin, *Samml. des geol. Reichs-Mus. in Leiden*, new, ser., Vol. I, p. 192, pl. xxx, figs. 445, 446.

? 1899. *Rostellaria (Rimella) spinifera* Martin. *Samml. des geol. Reichs-Mus. in Leiden*, new ser., Vol. I, p. 192, pl. xxx, figs. 447, 448.

1901. *Cancellaria neavolutella* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 328, pl. xxii, figs. 7, 8.

Kama.

RIMELLA (DIENTOMOCHILUS) PROMENSIS n. sp.

1901. *Rimella crispata* Sow. *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 288, pl. xix, figs. 9, 10.

Kama.

TURRITELLA ANGULATA J. de C. Sowerby.

1839. ***Turritella angulata*** **J. de C. Sowerby,** ***Trans. Geol. Soc. Lond.*****, 2nd ser., Vol. V, p. 328, pl. xxvi, fig. 7.**

1854. ***Turritella angulata*** **J. de C. Sow.** *D'Archiac and Haime, Descr. an. foss. gr. numm. Inde,* **p. 294, pl. xxvii, figs. 6-9.**

1901. ***Turritella angulata*** **J. de C. Sow. Noetling,** ***Pal. Ind.*****, new ser., Vol. I, part 3, p. 272, pl. xviii, figs. 13-15.**

1901. ***Turritella simplex*** **Jenk.** ***sec.*** **Noetling,** ***Pal. Ind.*****, new ser., Vol. I, part 3, p. 273, pl. xviii, figs. 1-4.**

1901. ***Turritella acuticarinata*** **Dunk.** ***sec.*** **Noetling,** ***Pal. Ind.*****, new ser., Vol. I, part 3, p. 274, pl. xviii, figs. 5-7.**

non ***Turritella angulata*** **Sow.** ***sec.*** **Cossmann and Pissarro,** ***Pal. Ind.*****, new ser., Vol. III, part 1, p. 59, pl. vi, figs. 3-5 (1909).**

Turritella angulata, an extremely variable species, is one of the commonest fossils in the Gáj beds of Kachh, Sind and Kathiawar, where forms identical with those referred by Noetling to *T. simplex* and *T. acuticarinata* occur abundantly and are connected by every possible gradation with one another and with the typical form first described by Sowerby.

The lower eocene fossil from the Ranikot beds of Sind referred by Cossmann and Pissarro to *T. angulata* is specifically different, and may be distinguished as *T. Ranikoti.* It is much more elongate than the majority of specimens of *T. angulata* and is smaller and much less variable. The outline of the whorls posteriorly to the keel exhibits a double curvature which is never seen in *T. angulata.* The posterior slope, in the lower eocene form, always carries two conspicuous spiral threads which are invariably delicately granulated,[1] a character never observed in *T. angulata.*

Amongst the specimens figured by Noetling, those of which the locality is known are from Singu and from Kama.

TURRITELLA NOETLINGI n. sp.

1901. ***Turritella*** **spec. Noetling,** ***Pal. Ind.*****, new ser., Vol. I, part 3, p. 277, pl. xvii, fig. 8.**

Kama.

[1] This character is not well shown in the originally figured types because they are in a weathered condition.

TURRITELLA MAGNASPERULA Sacco.

1895. *Turritella (Haustator) magnasperula* Sacco, *Moll. terr, terz. Piem. e Lig.*, parte XIX, p. 18, pl. i, figs. 65, 66.

1895. *Turritella affinis* d'A. and H. *sec.* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, pl. v, fig. 4.

1901. *Turritella affiniformis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 277, pl. xviii, fig. 9.

The specimen figured by Noetling is from Minbu. The species also occurs abundantly at Singu. It is also known from the oligocene beds of Balúchistán and of Liguria.

CALLIOSTOMA BLANFORDI Noetling.

1895. *Trochus blanfordi* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1, p. 10 pl. iv, figs. 3, 4.[1]

1901. *Calliostoma blanfordi* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 253, pl. xvii, figs. 6-8; (*non* fig. 5 — *C. singuënse*).

Yenangyat, Minbu.

CALLIOSTOMA SINGUËNSE n. sp.

1901. *Calliostoma blanfordi* Noetling (*pars*), *Pal. Ind.*, new ser., Vol. I, part 3, p. 253, pl. xvii, fig. 5; (*non* figs. 6-8 — *C. Blanfordi*).

Singu.

BATISSA CRAWFURDI Noetling.

1895. *Batissa crawfurdi* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 9, pl. ii, figs. 1-4, pl. III, fig. 1.

1895. *Batissa petrolei* Noetling, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 11, pl. ii, fig. 5, pl. iii, figs. 2, 3.

1901. *Cyrena (Batissa) crawfurdi* Noetling, *Pal. Ind.*, new ser., Vol. 1, part 3, p. 184, pl. xi, figs. 3-8.

1901. *Cyrena (Batissa) petrolei* Noetling, *Pal. Ind.*, new ser., Vol. 1, part 3, p. 188, pl. xi, figs. 9-11.

At the uppermost limit of the pre-Irrawadi beds in the southern part of the Yenangyoung anticline.

BATISSA KODOUNGENSIS Noetling.

1901. *Cyrena (Batissa) kodoungensis* Noetling, *Pal. Ind.*, new ser., Vol. 1, part 3, p. 183, pl. xi, fig. 1.

1908. *Batissa kodaungensis* Noetling (*pars*).—Pascoe, *Rec. Geol. Surv. Ind.*, Vol. XXXVI, p. 144, pl. xix, figs. 1, 2, (*non* pl. xx, fig. 2 — *Batissa Sethuramæ*).

? 1908. *Batissa kodoungensis* Noetling.—Dalton, *Quart. Journ. Geol. Soc.*, Vol. LXIV, p. 624, pl. lvi, figs. 1, 2.

East of Khodaung, Yenangyoung anticline; also probably at an unknown locality in the region of the upper Yaw.

[1] Not figs. 1, 2. as erroneously recorded in the synonymy of Noetling's second monograph.

OSTREA DIGITATA Eichwald var. ROHLFSII Fuchs.

1879. *Ostrea Rohlfsii* Fuchs, *Denkschr. d. k. Akad. d. W., m.-n. Cl.*, XLI, part 2, p. 106, pl. vi, figs. 5-8.

1883. *Ostrea digitalina* Eichw., var *Rohlfsii* Fuchs, *Pal.* XXX, p. 44, pl. xii, figs. 3-6, p. 61, pl. xxii, figs. 1-3.

1901. *Ostrea promensis* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 109, pl. 88, fig. 3, pl. iii, figs. 1, 2.

1912. *Ostrea digitalina* Eichw., var. *Rohlfsii* Fuchs, Vredenburg, *Rec. Geol. Surv. Ind.*, Vol. XLI, p. 38, pl. vi, figs. 1-4.

Khayu Chaung (properly Keyu Chaung 17° 29′, 96° 3′) between the Pazwundaung Chaung and the Kenbati Chaung, southern Pegu Yoma.

Kenbati (properly Kinpadi 17° 30′, 96° 1′) coincides with the locality designated as "Keng-pa-dee" on the map attached to Theobald's geological description of Pegu in Volume X of the Memoirs of the Geological Survey of India. The locality of Theobald's specimens is therefore situated about 50 miles north by west of Rangoon.

The species is known to occur in the Akauktaung Series.

OSTREA VIRLETI Deshayes.

1832. *Ostrea Virleti* Deshayes, *Exp. scient. Mor.*, III, part 1, p. 123, 2nd ser., Geol., pl. v, figs. 1, 2,

1879. *Ostrea Virleti* Desh.—Fuchs, *Denkschr. d. k. Akad. d. W., math.-nat. Cl.*, Vol. XLI, part 2, p. 106, pl. iv, figs. 1-9.

1879. *Ostrea hyotis* Linn. *sec.* Martin, *Tertiarsch. auf Java*, p. 125, pl. xxi, figs. 1, 2.

1883. *Ostrea Virleti* Desh.—Fuchs, *Pal.*, XXX, p. 43, pl. ix, figs. 1-6, pl. x, figs. 1-4; p. 61.

1901. *Ostrea peguënsis* Noetling.—*Pal. Ind.*, new ser., Vol. I, part 3, p. 107, pl. ii, figs. 1, 2.

Probably from the same locality as *Ostrea digitata.* This species is also known to occur in the Akauktaung Series.

IV.—STRATIGRAPHICAL LIST OF THE FOSSILS SPECIFICALLY IDENTIFIED AND CONCLUDING REMARKS.

We shall conclude this review with a tabular statement of the forms revised up to date, omitting only those that are specifically or generically undeterminable. The table shows the distribution of the several species in the four principal faunas dealt with in the preceding pages, namely those of Yenangyat, Minbu, Singu, and Kama, approximately coinciding, as already explained, respectively with the lower and upper Stampian, Chattian, and Aquitanian stages. Separate columns are not given for the *Cytherea promensis* bed, the so-called "Zone of *Aricia humerosa*" and the zone of *Ostrea digitata* and *O. Virleti* on account of the small number of species recognized from those horizons. The so-called "zone of *Aricia humerosa*" is indicated in the column of "other occurrences" with the designation "Thayetmyo," the zone of *Ostrea digitata* and *O. Virleti* with the designation "Akauktaung horizon." The zone of *Cyrena Crawfurdi* of the Yenangyoung anticline is indicated with the designation "Yenangyoung."

Apart even from hitherto unpublished species, the list by no means exhausts the number of forms now identified from the Tertiary of Burma, especially amongst the Siphonostomata, and therĕfore conveys a very inadequate idea of the constitution of the Burmese Tertiary fauna which we hope to discuss more fully on some future occasion. Several of the species of the following list not recorded in the columns respectively assigned to the Minbu and Singu faunas are now known to occur at those localities. In preparing the following list, no specimens have been taken into account other than those in the collections dealt with by Noetling. The object of the present notice, as already stated, is to record the amendments that have been found necessary in Dr. Noetling's monograph so far as it has been critically examined. It is hoped that the publication of the results already arrived at may increase the usefulness of Dr. Noetling's work.

SYSTEMATIC LIST SHOWING THE DISTRIBUTION OF THE REVISED SPECIES.

—	YENANGYAT (Stampian.)	MINBU (Upper Stampian.)	SINGU (Chattian.)	KAMA (Aquitanian.)	Other occurrences.
Terebra (Duplicaria) protoduplicata Noetl.				—	
T. (Subula) Noetlingi n. sp. . .		—			
T. (Noditerebra) samarangana Mart.				—	

SYSTEMATIC LIST SHOWING THE DISTRIBUTION OF THE REVISED SPECIES—*contd.*

——	YENANGYAT (Stampian.)	MINBU (Upper Stampian.)	SINGU (Chattian.)	KAMA (Aquitanian.)	Other Occurrences.
T. (*Myurella*) *protomyuros* Noetl. .				—	
,, *quettensis* . .					Nari of Balúchistán.
Clavatula protonodifera Noetl. .		—	—		
C. (*Perrona*) *birmanica* n. sp. var. *singuënsis*			—		
C. (*Perrona*) *munga* Noetl. . .				—	
Surcula karenaica [Noetl.] . .				—	
S. (*Pleurofusia*) *Feddeni* Noetl. .	—	—	—		
,, *scala* n. sp. .				—	
Pleurotoma (*Hemipleurotoma*) *yenanensis* Noetl.	—				Nari of Sind.
Drillia protocincta Noetl. . .				—	
,, *protointerrupta* Noetl. . .		—			
D. (*Crassispira*) *kamaënsis* n. sp. .				—	
,, *promensis* Noetl. .				—	
,, *Cotteri* n. sp. .				—	
Genotia iravadica Noetl. . .		—			
Conus (*Conospira*) *galensis* Noetl. .	—				
C. (*Leptoconus*) *protofurvus* Noetl. .	—				
,, *vimineus* Reeve. .				—	Karikal and Mokran.
,, *Bonneti* Cossm. .				—	Karikal.
,, *hanza* Noetl. .				—	
,, *Yuleianus* Noetl. .				—	? Thayetmyo.

SYSTEMATIC LIST SHOWING THE DISTRIBUTION OF THE REVISED SPECIES—*contd.*

—	YENANGYAT (Stampian.)	MINBU (Upper Stampian.)	SINGU (Chattian.)	KAMA (Aquitanian.)	Other Occurrences.
C. (Lithoconus) odengensis Mart. .				—	Gáj of Kachh.
,, ,, var. *avaënsis* Noetl.		—	—		? Thayetmyo.
,, ,, var. *birmanica* n. var.					*Cytherea promensis* bed.
,, *ineditus* Micht. .		—	—		Nari of Sind, oligocene of Liguria.
,, *Ickei* Mart . .					Thayetmyo.
Merica pseudocancellata [Noetl.] .	—				
Olivella minbuensis n. sp. . .	—	—			
Ancilla (Sparella) birmanica n. sp. .					*Cytherea promensis* bed.
Athleta (Volutospina) Jacobsi n. sp.	—	—	—		
Volvaria birmanica Noetl. . .		—			
Clavilithes seminudus Noetl. . .	—	—	—	—	Thayetmyo.
Lathyrus indicus n. sp. . .	—	—			
L. (Peristernia) Gautama [Noetl.] .				—	
Vasum basilicum [Bell.] . .			—		Oligocene of Liguria.
Melongena pseudobucephala Noetl. .			—		
M. (Pugilina) praeponderosa n. sp. .		—	—		*Cytherea promensis* bed.
Siphonalia (Kelletia) Iravadica .		—			
Cyrtochetus (Loxotaphrus) minbuensis [Noetl.]		—			
Tritonidea Martiniana [Noetl.]	—	—	—		

SYSTEMATIC LIST SHOWING THE DISTRIBUTION OF THE REVISED SPECIES—*contd.*

—	YENANGYAT (Stampian.)	MINBU (Upper Stampian.)	SINGU (Chattian.)	KAMA (Aquitanian.)	Other Occurrences.
Eburna lutosa Lam. var. . .				—	
Murex (*Chicoreus*) *arakanensis* Noetl.		—			
M. (*Muricantha*) *iravadicus* n. sp. .	—	—			
M. ,, ,, var. *yenanensis* n. var	—				
Tritonium (*Lampusia*) *dubium* [Noetl.]		—			
Hindsia birmanica n. sp. . .		—			
,, *neastriatula* [Noetl.] .	—	—			
,, *pardalis* [Noetl.] . .		—			
,, *neacolubrina* [Noetl.] .				—	
Ranella tubercularis Noetl. . .		—			Nari of Sind.
,, *antiqua* n. sp. . . .				—	
R. (*Pseudobursa*) *promensis* n. sp. .				—	
Cassidea birmanica n. sp. . .		—			
Cassidaria echinophora [Linn.] var. *monilifera* Noetl.			—		
Cassidaria echinophora [Linn.] var. *promensis* n. var.				—	
Pirula condita Brongn . . .	—				Nari of western India, oligocene and miocene of Europe.
,, ,, var. *singuënsis* n. var.			—		
,, *promensis* n. sp. . .				—	
Cypraea (*Bernayia*) *singuënsis* n. sp.			—		Thayetmyo.

SYSTEMATIC LIST SHOWING THE DISTRIBUTION OF THE REVISED SPECIES—*concld.*

—	YENANGYAT (Stampian.)	MINBU (Upper Stampian.)	SINGU (Chattian.)	KAMA (Aquitanian.)	Other Occurrences.
C. (Cypraeotrivia) Oppenheimi n. sp.	—	—			
Trivia Noetlingi n. sp. . . .	—				
Rimella (Dientomochilus) javana Mart.				—	
Rimella (Dientomochilus) promensis n. sp.				—	
Turritella angulata Sow. . .			—	—	Gáj of western India.
„ *Noetlingi* n. sp. . .				—	
„ *magnasperula* Sacco.		—	—		Nari of Balúchistán.
Calliostoma Blanfordi Noetl. . .	—	—			
„ *singuënse* n. sp. . .			—		
Batissa Crawfurdi Noetl. . .					Yenangyaung.
„ *kodoungensis* Noetl. . .					Yenangyaung.
Ostrea digitata Eichw. var. *Rohlfsii* Fuchs.					Akauktaung horizon, Mekran beds.
Ostrea Virleti Desh					Akauktaung horizon, Mekran beds.

Incomplete though it may be, the foregoing list illustrates some interesting features in the distribution of the species. The independence of the Kama fauna compared to the three other faunas, as had already been noticed by Dr. Stuart, is particularly evident. The Singu fauna, with 17 species, is intercalated between the Minbu and Kama faunas, including 27 species each, and therefore of equal relative importance; yet, it contains no less than 9 fully identical forms in common with the Minbu fauna, and only 2 in common with that of Kama, the latter figure rising to four if we also take varieties into consideration. It has even more species in common with the Yenangyat fauna from which only 18 forms have been identified, than with the Kama fauna, the instances of full identity with Yenangyat amounting to 4, and with Kama, as already mentioned, to not more than 2. If, in addition to instances of full identity, we also take into account species represented by varietal modifications, the number of identical species in the Singu fauna rises to 4, as already mentioned, when compared with that of Kama, and 5, when compared with that of Yenangyat. The difference in the degree of relationship cannot altogether be attributed to differences of facies, for, while the Singu fauna certainly corresponds with shallower conditions of deposition than the deep-sea fauna of Kama, the bathymetric conditions of the Minbu and especially of the Yenangyat fauna do not widely differ from those of Kama.

The intermediate position of the Minbu fauna relatively to those of Yenangyat and Singu is indicated by the approximately equal proportion of common species on both sides: 10 with the Yenangyat fauna, 9 with that of Singu.

Amongst the forms dealt with by Noetling that have, so far, been examined, only one, *Clavalithes seminudus*, is common to the four faunas.

It may be noticed that out of 43 species constituting the aggregate fauna of Yenangyat, Minbu and Singu, there are six that occur also in the Nari beds of western India, which are known to be of oligocene age. Two of these, *Conus ineditus* and *Turritella magnasperula*, are characteristic oligocene fossils in Europe, while *Pirula condita* occurs abundantly in Europe, both in the oligocene and miocene. Another form, *Vasum basilicum*, not known in western India, also characterises the oligocene of Europe. These characteristic oligocene forms are fairly equally distributed through the three faunas of Yenangyat, Minbu and Singu. Attention may also be drawn to the genus *Volvaria*, not known in Europe in beds newer than oligocene.

The oligocene age of the Yenangyat-Minbu-Singu fauna cannot admit of any doubt.

Amongst the forms from the Yenangyat-Minbu-Singu fauna enumerated in the foregoing list, there is only one instance of full identity with a Gáj fossil, *Turritella angulata*, only found in the newest subdivision, the Singu stage. *Conus odengensis*, also a Gáj species, is represented at Minbu and Singu by a different variety.

Amongst the Kama fossils of the foregoing list, there are two instances of full identity with the Gáj fauna of western India: *Conus odengensis* and *Turritella angulata.* Four species, *Terebra samarangana, Drillia protocincta, Conus odengensis,* and *Rimella javana,* occur in the Tertiary beds of Java, either at the horizon of the Gáj in the Rembang and Njalindung Series, or at newer horizons. *Conus Bonneti* and *Conus vimineus* are known from the Upper Tertiary beds of Karikal, the latter being known also from the Mekran Series.

The foregoing list includes three species still living, *Conus vimineus, Eburna lutosa, Cassidaria echinophora,* all three of which are known in the Kama fauna, while the form last named is also known in the fauna of Singu. The proportions of living forms reckoned from a fauna represented only by a small number of species are apt to mislead, and a full discussion of the relationship of the fauna to that of the present day will best be deferred to a future occasion when fuller lists of species can be taken into consideration.

The present revision affords important data in support of the extremely interesting conclusions arrived at by Mr. Cotter regarding the gradual deepening, in a southern direction, of the basin in which were deposited the Tertiary strata of the Irrawadi region. This question has been ably discussed in several of Mr. Cotter's valuable contributions to the geology of Burma. (See especially: *Rec. Geol. Surv. Ind.,* Vol. XLIV, p. 166, Vol. XLVII, p. 63 and map, pl. i, *Journ. As. Soc. Beng.,* new ser., Vol. XIV, pp. 609 ff.). In whatever manner we may interpret the equivalence of the marine Akauktaung beds, their presence in Lower Burma constitutes a powerful argument in support of the conclusions established by Mr. Cotter, for, if they coincide with the stratigraphical gap below the Irrawadi Series of Upper Burma, they represent, in Lower Burma, the persistence of a marine basin when the region further north must have emerged; or, if, as is more probable, the marine Akauktaung beds are equivalent to the fresh-water Irrawadi Series, they obviously indicate, in southern Burma, a deeper lie of the earth's crust than further north during the period of their deposition.

The facts discussed in Parts I and II of the present study have demonstrated the contemporaneity of the estuarine *Batissa* beds of the petroliferous anticlines of Upper Burma with the marine beds of either the Kama or Pyalo stage further south. Mr. Cotter has already commented on the lateral variation of facies in a northerly direction which affects "the Kama Clay, a formation which is represented by sands or conglomerates without well preserved fossils in Minbu." (*Journ. As. Soc. Beng.*, new ser., Vol. XIV, 1918, p. 414).

We wish particularly to draw attention to the fact that Mr. Cotter's conclusion regarding the emergence of the Arakan Yoma in eocene times (*Journ. As. Soc. Beng.*, new ser., Vol. XIV. p. 412), entirely corresponds with Dr. Tobler's conclusions regarding the period of upheaval of the Barissan Range which constitutes its southern extension in Sumatra. (*Tijdschr. van het koninkl. nederl. aardrijkskundig genootsch.*, *Jaarg.* 1906, p. 292, and concluding general tabular statement). At as early a period as the eocene, the great longitudinal depression constituted by the Irrawadi basin, the sea of Pegu, and the lowlands of East-Sumatra, already existed as an elongated area of subsidence between the two concentric orographic elements Naga-Arakan-Andaman-Nicobar-Barissan and Shan-Malacca-Banka, and was already more or less continuously separated from the Indian Ocean by the Arakan-Barissan line of upheaval.

NOTE ON THE MARINE FOSSILS COLLECTED BY MR. PINFOLD IN THE GARO HILLS. BY E. VREDENBURG, *Superintendent, Geological Survey of India.* (With Plates 8 and 9.)

CONTENTS.

INTRODUCTION.

IN a previous communication (*Rec. Geol. Surv. Ind.*, Vol. L, p. 126), Mr. Pinfold has given the stratigraphical details regarding the occurrence of the interesting tertiary fossils which he has been so good as to place at my disposal for study.

The fossils collected by Mr. Pinfold were obtained from two localities of which the more easterly is near the banks of the Sumeswari river, one mile and a half south-west of the village of Bagmara. the more westerly, four miles north of the town of Dalu. The rock containing the fossils is of a blue colour weathering to yellowish green, and varies from a clay to an impure argillaceous and calcareous fine-grained sandstone, with minute grains of quartz and mica. The rock from Dalu is generally more arenaceous than that from Bagmara.

The organic remains are mostly those of mollusca with delicate shells, such as might have lived at a depth of some thirty fathoms. There are also shark's teeth and otoliths.

The shells are mostly fragmentary and include specifically undeterminable specimens of *Conus, Oliva, Murex, Natica, Solarium, Calyptræa, Arca, Pecten, Ostrea, Lucina, Dosinia, Venus, Tellina,* in addition to which the following nine forms have been specifically identified :—

Terebra protomyuros Noetl.
Surcula promensis n. sp., var. *silistrensis*.
Drillia protocincta Noetl.
,, *tjemoroënsis* Mart. var.
Mitra chinensis Gray, var. *subscrobiculata* d'Orb.
Siphonalia subspadicea n. sp.
Turritella Pinfoldi n. sp.
,, *angulata* Sow.
Calliostoma promense n. sp.

DESCRIPTION OF FOSSILS.

The following notes are concerned with the species enumerated in the foregoing list.

Several of the forms obtained by Mr. Pinfold belong to species hitherto unpublished, which are described in detail below.

TEREBRA (MYURELLA) PROTOMYUROS Noetling.

1901. *Terebra protomyuros* Noetling.—*Pal. Ind.*, new ser., Vol. I, part 3, p. 335, pl. xxii, fig 14.

1901. *Strioterebrum bicinctum* Mart. *sec.* Noetling.—*Pal. Ind.*, new ser., Vol. I, part 3, p. 337, pl. xxii, fig. 15.

non Terebra bicincta Hinds, 1843.

non Terebra bicincta Martin, 1879.

The Bagmara specimens correspond with the typical form from Burma. The fossil referred by Noetling to *Terebra bicincta* Martin belongs to the same species as the type of *T. protomyuros*, though the Javanese *T. bicincta* also exists in Burma and may be distinguished as *Terebra Martini* its specific name being pre-employed.

Occurrence.—Bagmara.

SURCULA PROMENSIS n. sp.

Pl. VIII. figs. 1-3.

Both the localities explored by Mr. Pinfold have yielded specimens of a handsome *Surcula* which corresponds specifically with a fossil from the Kama horizon of Burma, although exhibiting some slight differences which may entitle it to rank as a variety. The Burmese specimens are more complete than those from the Garo hills, and it will be convenient to describe them as representing the typical form.

Description.—Fairly large, ventricose, with broad conical spire measuring half the total height, and with broad body-whorl rapidly contracted anteriorly into a stem of medium length, rather tortuous at its extremity. The apex is missing in all the available specimens. The number of whorls following the protoconch should probably be ten. Their height is equal to two-fifths of their breadth, the maximum thickness being situated close to the anterior margin, or even, at the earliest stages of growth, coinciding with it. The linear, inconspicuous, finely wavy sutures, are surrounded by a moderately broad, moderately prominent raised band which, at the earliest stages of growth, is divided into two very unequal portions, of which the anterior one, which is the broader and more prominent, constitutes a torus-shaped spiral thread, while the narrower posterior portion fits tightly round the anterior margin of the preceding whorl, the ribs or nodosities of which account for the fine waviness of the sutures. With increasing growth the portion nearest the suture becomes divided by a groove, and fine spiral lines are developed on the anterior torus-shaped portion, which gradually widens till it separates into several narrow threads, the sub-divisions of the posterior portion also assuming the appearance of thin threads, till, in full-grown specimens, the entire circumsutural band assumes the appearance of a moderately broad, rather flat rim bearing six or seven contiguous spiral threads of irregularly alternating dimensions, amongst which the original disposition of the earlier whorls is no longer recognisable. Slight nodosities are observed on the circumsutural band of some specimens.

At the earliest stages of growth, the portion of the whorls situated between the circumsutural band and the anterior margin has the shape of a slightly quirked ogee (inverted when the shell is placed with apex upward); the concave and convex portions are about equal. With increasing growth the concave portion increases considerably in relative height at the expense of the anterior portion. At the same time, its degree of curvature decreases, and it assumes the appearance of a broad, slightly concave, conical shape. The anterior portion, now reduced to the condition of an anterior marginal swelling, becomes feebly convex, almost cylindrical, slightly contracted towards the anterior margin. Numerous thin, rod-like, short ribs, rather strongly oblique and anteriorly antecurrent, narrower than the intervening spaces, decorate the anterior band. They have a tendency to swell at their posterior terminations along the margin of the concave band. On the last spire-whorl these swollen terminations tend to assume more definitely the appearance of distinct nodes, anteriorly to which the original ribs tend to lose their individuality through bifurcation. Delicate spiral threads, usually broader than the intervening spaces, or even quite contiguous and separated by mere linear furrows, cover the entire surface of the anterior marginal swelling and of the concave band. On the second spire-whorl beyond the protoconch, their number is four or five on the anterior marginal swelling, and about the same on the concave band. With increasing growth their relative number increases more on the concave band than on the anterior marginal swelling, in consequence of the alteration in the relative width of these two elements, until, on the last spire-whorl of full-grown specimens, there may be as many as eleven spiral threads on the anterior marginal swelling and fifteen on the concave band. In some specimens more than in others, they alternate more or less regularly in two sizes. Those decorating the anterior marginal swelling are always much broader than the intervals, while, in exceptional cases, they may become narrower than the intervals on the concave band at later stages of growth. All the spiral ornaments are elegantly decussated by the lines of growth which are steeply antecurrent or even, at later stages of growth, normal to the posterior suture, and which form, near the posterior margin of the concave band, a deep sinus, anteriorly to which they are very oblique and anteriorly antecurrent, curved with forwardly directed convexity, and reach the anterior margin antecurrently.

The large body-whorl measures five-sevenths of the total height. Anteriorly to the posterior part of the body-whorl which corresponds in shape with the spire-whorls, the base contracts rapidly with a very flat outline connected by a broad concavity with the terminal stem, which is of medium length, tapering in an anterior direction. It is terminated by a truncation oblique towards the right of the shell, the accretions to which constitute a steeply winding, slightly bulging zone in consequence of which the extremity of the stem is slightly deflected dorsally and towards the left of the shell. Over the posterior portion of the body-whorl, corresponding with the spire-whorls, the ornamentation is the same as on the last spire-whorl, the ribs being reduced to delicate oblique nodes along the angulation that divides the posterior slightly concave slope from the anterior convexity. Anteriorly, from the level of the suture to the terminal zone of accretions, the whole surface is decorated with spiral threads alternating fairly regularly in three orders, those of the first order being always particularly conspicuous, the difference in the degree of prominence between them and the threads of the second order being much more marked than the difference between the threads of the second and third order. The two first principal threads anteriorly to the level of the suture are slightly more prominent than any of the other principal threads of the body-whorl. All the principal threads of the body-whorl are elegantly granulated by the intersections with the raised lines of growth. The lines of growth are antecurrent anteriorly as far as the more anterior of the two particularly prominent threads above mentioned, anteriorly to which they are vertical up to the margin of the terminal twisted zone. The terminal zone has a strongly scaly structure, which to a great extent confuses and obliterates the thin, crowded, raised spiral lines with which it is decorated.

The large aperture is broadly lanceolar, posteriorly angulated, anteriorly contracted into the oblique terminal canal. The columella is oblique, with a broad convex bend opposite the entrance to the canal, anteriorly to which it becomes still more oblique towards the left of the shell up to its termination. The columellar lip is extremely thin, rather ill-defined at its posterior termination. The outer lip, normal to the suture, is strongly prominent anteriorly to the rather broad sinus. The internal walls of the shell carry rather wide-spaced, delicate, sharply defined revolving liræ.

Dimensions.

	mm.
Height	35
Thickness	16
Height of spire	18
Height of body-whorl	24

Occurrence.—Kyaungon, Myaukmigon, Thanga.

Comparison with other species.—This is undoubtedly a premutation of *Surcula javana* Linn. (*S. nodifera* Lam.), of the eastern seas from Malacca to Japan, compared with which the Burmese fossil is somewhat smaller with a slightly broader spire. Its sinus band is decidedly broader, more distinctly concave, and not so sharply marked off from the posterior circumsutural rim and the anterior circle of nodes. The Burmese fossil is further distinguished by the granulations of the body-whorl and by the internal liræ.

In several of its characters, such as the relatively feeble prominence of the anterior nodes, the granulations of the base, and the internal liræ, this shell agrees with some of the fossil varieties of *Surcula javana* described by Martin from Java (*Samml. des geol. R.-Mus. in Leiden*, new ser., Vol. I, p. 27, fig. 67), which represent therefore an intermediate link between the Burmese fossil and the living species.

The fossil specimen of *Surcula javana* described by Cossmann from Karikal (1900, *Journ. Conch.*, Vol. XLVIII, p. 33, pl. iii, fig. 8) agrees with the recent form in the absence of granulations from the base, though it still recalls the Burmese and Javanese fossils owing to the feeble prominence of the anterior nodes. It seems evident that a continuous history of the development of the recent species is recorded by these successive fossil occurrences.

SURCULA PROMENSIS var. SILISTRENSIS.

Pl. VIII, fig. 4.

Compared with the Burmese type, the Garo specimens are distinguished by a slightly narrower shape and slightly more crowded nodes along the anterior swelling of the whorls. In some specimens from both the localities explored by Mr. Pinfold, the nodes disappear entirely on the last spire-whorl and body-whorl, while the spiral threads over the entire surface of the last spire-whorl and the corresponding part of the body-whorl become very conspicuous and uniform; such specimens constituting a local race which might be distinguished as *dimorpha.* In some specimens the circumsutural swelling maintains its unsymmetrical bipartite disposition up to the termination of the spire, and even on the body-whorl where it constitutes an almost uniform, flat, band, with only some feeble threads or striations distributed over the original main divisions; this disposition being observed only in such specimens in which the anterior nodes remain well developed throughout the whole shell. In accordance with the peculiar smoothness of the circumsutural swelling, such specimens never exhibit any posterior nodes, while the circumsutural swelling is slightly nodular at early stages of growth in some specimens of the race *dimorpha.*

All the other characters described from the Burmese specimens are exactly reproduced in the shells from the Garo Hills. It should be noticed that, in the race *dimorpha*, in spite of the absence of nodes anteriorly to the sinus-band on the body-whorls the base is as distinctly granulated as in the other races or varieties. Owing to the friability of the Garo specimens, it is not possible to clear the interior of the shells of their rocky contents; fortunately one of the specimens exhibits, on the rocky infilling, a distinct internal cast of the inner walls of the body-whorl, showing that they are lirate just as in the Burmese specimens.

Owing to their slightly narrower shape, the Garo specimens approach *Surcula javana*, in general outline, more than the Burmese shells; this being counterbalanced by the complete disappearance of the nodes at later stages of growth in the race *dimorpha*, the ornamentation of which thereby differs from that of *Surcula javana* more than that of the Burmese form. The Garo form is a collateral development relatively to the Burmese species, and does not constitute an intermediate link between the Burmese form and *Surcula javana.*

Dimensions.—The following are the restored measurements of a specimen from the neighbourhood of Bagmara:—

	mm.
Height	50
Thickness	18
Height of spire	24
Height of body-whorl	32

Occurrence.—Bagmara, Dalu.

DRILLIA PROTOCINCTA Noetling.

1901. *Drillia protocincta* Noetling.—*Pal. Ind.*, new ser., Vol. I, part 3, p. 356, pl. xxiii, figs. 6, 7.

1906. *Pleurotoma* (*Drillia*) *madiumensis* Martin.—*Samml. des geol. Reichsmus. in Leiden*, n. F., Vol. I, p. 296, pl. XLIII, fig. 707.

The specimens from the Garo hills are well preserved and strictly correspond with the Burmese and Javanese fossils.

Occurrence.—Dalu.

DRILLIA (BRACHYTOMA) TJEMOROENSIS Martin, var.

1906. *Pleurotoma* (*Drillia*) *tjemoroënsis* Martin.—*Samml. des. geol. Reichsmus. in Leiden*, n. F., Bd. I, p. 295, pl. xliii, fig. 705.

This species is abundantly represented in Burma by a variety which differs from the solitary Javanese type owing to its slightly less numerous ribs. It is also represented, in the collection from the Garo hills, by a specimen which agrees with the Burmese variety.

Occurrence.—Dalu.

MITRA CHINENSIS Gray, var. SUBSCROBICULATA, d'Orbigny.

1839. *Mitra chinensis Gray.*—Beechey's Voyage, p. 125, pl. xxxv, fig. 2.

1839. *Mitra scrobiculata* Brocchi ?—J. de C. Sowerby, *Trans. Geol. Soc. Lond.*, 2nd ser., Vol. V, pl. xxvi, fig. 23.

1852. *Mitra subscrobiculata* d'Orbigny. Prodr. *Pal.* Vol. III, p. 54, No. 922.

Mr. Pinfold's collection contains a specimen of a *Mitra* identical with the above quoted fossil from Kachh, first described by Sowerby. Like the Kachh form, the specimen from the Garo hills differs from the living *Mitra chinensis* by the smaller size of the full-grown condition, and the more slender outline at equal dimensions.

Occurrence.—Bagmara.

SIPHONALIA (KELLETIA) SUBSPADICEA n. sp.

Pl. IX, fig. 6.

Medium-size, moderately ventricose, with moderately broad conical spire, slightly contracted at the sutures, equal to nearly half the total height.

The protoconch is broken in the solitary available specimen. It is followed by five spire-whorls, the height of which is equal to two-fifths of their width, the maximum thickness being situated quite close to the anterior margin. They exhibit a continuous almost even convexity except quite close to the posterior margin where the outline is inflected, through a short concavity, into a short nearly vertical surface closely fitting round the anterior sportion of the preceding whorl. There is sometimes a feeble angulation close to the anterior margin. The sutures are linear, inconspicuous, slightly wavy. The whorls are decorated with almost vertical ribs, the exact number of which cannot be ascertained on the first two whorls following the protoconch on account of the surface of the shell being weathered. On each of the three last spire-whorls, their number is eleven. They are convex and somewhat narrower than the intervening spaces. In addition to the axial ribs, the whorls carry, at first, seven well-defined spiral threads, narrower than the intervals. The most posterior thread encircles the posterior suture, the most anterior one almost coincides with the anterior margin. The second thread, counting from the posterior margin, forms the anterior limit of the steep narrow circumsutural region. The sixth tread, that is, the second counting from the anterior margin, coincides with the slight anterior angulation of the convexity. On the penultimate spire-whorl, the number of spiral threads increases to ten on account of the development of intercalary threads of a second order, bisecting each of the three more anterior primary intervals, which are somewhat wider than the three posterior intervals. On the last spire-whorl, an intercalary thread also appears in the fourth interval counting from the anterior margin, thereby raising the total number of spiral threads to eleven. The lines of growth are crowded, evenly distributed, extremely delicate, antecurrent to the posterior suture, normal to the anterior margin.

The large body-whorl measures five-sevenths of the total height. The posterior portion of the body-whorl is similar in outline to the spire-whorls of which it forms the continuation. Anteriorly to the level of the suture, the surface contracts gradually with a moderate convexity continuous with that corresponding to the convex surface of the spire-whorls; the main portion of the body-whorl thereby acquiring a globose or ovoid outline, anteriorly connected, by means of a shallow concavity, with the anterior stem which is slightly tortuous in consequence of the steeply twisted zone of accretions of the terminal notch. The axial ribs, on the body-whorl, are much wider-spaced than on the spire-whorls, their total number amounting only to eight. In an anterior direction they disappear before reaching the concave zone of the base, with the exception of the last rib accompanying the aperture, which is more prominent than the others, and reaches the anterior stem. The two or three last ribs previous to the terminal rib exhibit a slight tendency to become spinose at the level of the angulation continued from the anterior portion of the spire-whorls. The spiral ornamentation of the last spire-whorl is continued, without any change, over the corresponding portion of the body-whorl. Anteriorly to the level of the suture, the whole of the convex portion of the base is ornamented with spiral threads regularly alternating in two orders of magnitude, and so distributed that, of the six primary intervals that separate the threads of the first order, the three most posterior ones are of the same width as the adjacent primary intervals continued from the spire-whorls, while the three more anterior ones are much wider.

The spacing again contracts on the concave zone, which carries three threads of the first order, with only very fine, indistinct raised lines bisecting the intervals. On the terminal stem, the alternation in two well-developed orders is once more resumed, with a total number of seven or eight threads as far as the terminal twisted zone, which only carries slightly scaly accretions of the terminal notch, without distinct spiral ornaments. The lines of growth, on the posterior portion of the body-whorl coinciding with the spire-whorls, are disposed in the same way as on the spire. Anteriorly to the level of the suture, they are vertical as far as the concave zone where they become anteriorly retrocurrent, the obliquity increasing on the anterior stem, till they become transverse on the terminal twisted zone which they cross with a shallow sinuosity corresponding to the anterior termination of the canal.

The aperture, greatly obscured in the solitary available specimen, by a rocky incrustation that cannot be safely removed, is oval-lanceolar, abruptly contracted anteriorly into a narrow canal steeply oblique anteriorly towards the left, slightly curved with concavity turned to the right, and slightly deflected dorsally. The columella exhibits a bend opposite the origin of the canal, anteriorly to which it shares the steep obliquity of the canal anteriorly towards the left, while, posteriorly to the bend it is at first steeply oblique in the opposite direction, and merges, by means of a gentle curvature, into the base of the penultimate whorl. The columellar lip is almost entirely concealed, but is evidently not thickened. The most posterior portion of the outer lip is antecurrent to the suture; the greater part of its course is straight and vertical, becoming anteriorly retrocurrent only on approaching the anterior termination of the shell. Externally it is thickened, almost throughout its entire length, by the prominent terminal rib. Its sharp margin is frilled by the terminations of the spiral ornaments, the lines of growth becoming slightly squamose in the immediate neighbourhood of the margin. The internal characters of the outer lip are entirely concealed.

Dimensions.

	mm.
Height	28
Thickness	14
Height of spire	13
Height of body-whorl	20

Occurrence.—Dalu.

Comparison with other species.—This shell belongs to a group of upper tertiary and recent eastern forms, all of which are very closely related to one another, including *Siphonalia nodulosa* [J. de C. Sow] from the miocene of Kachh, a very closely related mutation, as yet unpublished, from the upper miocene or pliocene of the Mekran, *S. tjibaliungensis* Martin, from the pliocene of Java, and the recent species *S. spadicea* [Reeve], from Japan, *S. fusoides* [Reeve] also from Japan, *S. modificata* [Reeve] from Japan and Lower California, and *S. varicosa* [Chemn.], of unknown habitat. Amongst all these species, the recent *S. spadicea* comes nearest to the above-described fossil which is practically identical in shape, but is distinguished by the increased spacing of the axial ribs on the body-whorl, while the spiral decoration of the base is finer and more crowded in the living form than in the fossil. The above-described fossil also resembles *Siphonalia nodulosa* from the miocene of Kachh, but it is more slender than the Kachh form, and its axial ribs are narrower relatively to the intervening spaces.

TURRITELLA PINFOLDI n. sp.

Pl. IX, figs. 9-11.

Medium size, very elongate. The spire is equal to five-sixths of the total height. The protoconch is missing in all the available specimens. The number of spire-whorls following the protoconch is about sixteen. Their height is equal to three-fifths of their thickness, the maximum width being situated close to the anterior margin. The general outline of each whorl expands with a steep conical surface from the posterior margin to the region of maximum width, beyond which the short remaining space as far as the anterior margin contracts also with a conical surface, opposed to the first, and of somewhat wider angle. Each whorl carries three narrow prominent keels, one of which coincides with the zone of maximum thickness. The linear sutures lie in the concave depression between the most anterior keel of one whorl and the most posterior keel of the next whorl. Of the intervals between the three keels the more anterior one is distinctly the widest in some specimens in which the more posterior interval is equal to the space between the posterior keel and the suture. In other specimens there is scarcely any difference between the two intervals, in which case the space between the posterior keel and the suture is wider than the posterior interval. Along the anterior margin of each whorl is a thread much less prominent than the keels, half concealed by the posterior edge of the next following whorl. The concave surface in which lies the suture, and the concave intervals between the keels, are divided into a multitude of extremely fine threads, visible only with the aid of a lens, separated from one another by linear incisions. Amongst these minute threads, the one bisecting the space between the posterior keel and the suture, is often slightly more prominent than the remainder. A similar disposition, though less marked, may sometimes be observed also in the intervals between the keels. The lines of growth are oblique, slightly curved, with forwardly facing concavity; they are strongly antecurrent to the posterior suture, retrocurrent, though less obliquely, towards the anterior margin.

The body-whorl measures one-quarter of the total height. The portion forming the continuation of the spire exhibits the same outline as the spire-whorls and is followed by a short, rapidly contracted, broadly conical base. The ornamentation of the spire is continued over the portion corresponding with the spire-whorls. The anterior, half-concealed thread of the spire-whorls, on running free of the suture, circumscribes the base which carries some fine spiral threads.

The rounded aperture is incompletely preserved, the columella and columellar lip being broken in all the available specimens. The outer lip is very oblique, antecurrent to the suture.

Dimensions.—The following are the approximate restored measurements :—

	mm.
Height	66
Thickness	17
Height of spire	54
Height of body-whorl	14

Occurrence.—Bagmara, Dalu; Myaungu in Upper Burma.

Variability.—The specimens from the Garo hills mostly have the intervals between the keels distinctly unequal, while they are subequal in the specimens from Burma. The shells from both regions agree in all other characters.

Comparison with other species.—The only tertiary three-keeled forms that are as elongate, or even more elongate than the above-described shell, are *Turritella ægyptiaca* Mayer-Eymar, from the

Lower Lybian of Egypt, and *T. Hollandi* C. and P., from the lower eocene of Sind, which is perhaps the same species. These lower eocene shells are distinguished by their more evenly convex whorls, the maximum thickness of which coincides with the central keel, not, as in the Garo and Burma fossil with the anterior keel[1] *Turritella tricarinata* Brochi, fossil from the miocene and pliocene of Europe, living in the seas of Europe and West Africa, also has the whorls more evenly convex, while its general outline is somewhat less elongate than that of the shell above-described. The recent three-keeled species, *Turritella trisulcata* Lam. (Red Sea), *T. cingulata* Sow. (Valparaiso), *T. cornea* Lam. (Europe) are more broadly conical than the shell under consideration.

TURRITELLA ANGULATA J. de C. Sowerby.

1839. *Turritella angulata* J. de C. Sowerby.—*Trans. Geol. Soc. Lond.*, 2nd ser., Vol. V, pl. xxvi, fig. 7.

1854. *Turritella angulata* J. de C. Sow.—D'Archiac and Haime, *Descr. an. foss. gr. numm. Inde*, p. 294, pl. xxvii, figs. 6-9.

1901. *Turritella angulata* J. de C. Sow.—Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 272, pl. xviii, figs. 13-15.

1901. *Turritella simplex* Jenk. *sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 273, pl. xviii, figs. 1-4.

1901. *Turritella acuticarinata* Dunk. *sec.* Noetling *Pal. Ind.*, new ser., Vol. I, part 3, p. 274, pl. xviii, figs. 5-7.

non Turritella angulata Sow., *sec.* Cossmann and Pissarro, *Pal. Ind.*, new ser., Vol. III, part 1, p. 59, pl. vi, figs. 3-5 (1909).

Turritella angulata, an extremely variable species, is one of the commonest fossils in the Gáj beds of Kachh, Sind and Kathiawar, where forms identical with these referred by Noetling to *T. simplex* and *T. acuticarinata* occur abundantly and are connected by every possible gradation with one another and with the typical form first described by Sowerby. Martin (*Samml. des Geol. R.-Mus. in Leiden*, new ser., Vol. I, p. 226) does not agree with Noetling's reference of one of the Burmese forms to *T. acuticarinata* which is apparently a smaller shell than *T. angulata*, but accepts the identification of the form referred to *T. simplex*. Whether or not Noetling's *T. simplex* may correspond with the Javanese type of this species, it is certainly identical with the Burmese form referred to

[1] In Paleontographica, Vol. XXX, part 3, Oppenheim has represented two specimens, Pl. xxii, fig. 29, and Pl. xxiii. fig. 14, which agree with Mayer-Eymar's diagnosis of *Turritella ægyptiaca*. There appears to have been some confusion as regards the specimen represented by fig. 15, pl. xxiii, also referred to the same species, but which is a broadly conical shell, perhaps a *Mesalia*.

T. acuticarinata with which it is connected by numerous intermediate forms, and, as already explained, both the Burmese forms are identical with *T. angulata.* That the Javanese *T. simplex* may also belong to the same variable species seems plausible, but this question has not been fully investigated. It is also doubtful whether *T. angulata* is truly distinct specifically from the living *T. duplicata* Linn., but this is also a question that needs further study.

As already mentioned (see above, page 292), the lower eocene fossil from the Ranikot beds of Sind referred by Cossmann and Pissarro to *T. angulata* is specifically different, and may be distinguished as *T. Ranikoti.*

Amongst the shells from the Garo hills, many specimens correspond with the typical *T. angulata*, while others assume the bicarinate disposition of the form which Noetling has referred to *T. acuticarinata.*

Occurrence.—Bagmara, Dalu.

In Burma the species occurs throughout the Singu, Kama, and Pyalo stages, and also probably at higher horizons. In Western India it abounds in the Gáj beds and perhaps occurs in the Mekran.

CALLIOSTOMA PROMENSE n. sp.

Pl. VIII, fig. 5. Pl. IX, figs. 7, 8.

Medium size, moderately broad, slightly extraconic.

The protoconch, broken in all the available specimens, is followed by eight spire-whorls, the height of which is equal to one-quarter of their width at later stages of growth, and somewhat more in the earlier part of the spire in consequence of its extraconic shape. Leaving out of consideration the raised spiral ornaments, the conical or sometimes very feebly convex outline of the whorls is practically continuous from one whorl to another. The sutures are linear, shallow, inconspicuous. The whorls are beautifully decorated with four equidistant granulated keels of which the first and last respectively correspond with the posterior and anterior margins, so that the marginal keels of successive whorls are directly in contact with one another, being separated merely by the shallow line of the suture. On the four or five earliest whorls following the protoconch, the first, third and fourth keels, counting from the posterior margin, are subequal, while the second one is slightly narrower. On the later spire-whorls, the anterior marginal keel becomes much broader and much more prominent than the three others which are narrower than the intervening spaces; there scarcely remains any difference in width between the second keel and the first and third. On the first five whorls following the protoconch, the spaces between the keels carry delicate oblique ribs, posteriorly antecurrent, connecting the granules of adjacent keels. On the later spire-whorls, the intervals between the keels are smooth, with extremely fine, crowded, strongly oblique, straight lines of growth, antecurrent to the posterior suture, retrocurrent to the anterior margin.

The body-whorl consists of two portions, one of which constitutes the continuation of the spire-whorls, and is connected at a sharp angle with the nearly flat base, the outline of which remains quite straight up to the axis in the majority of specimens, while occasionally the surface is slightly hollowed towards the axis, though without the formation of an umbilicus, the axis being solid throughout. In the majority of specimens, the portion of the body-whorl forming the continuation of the spire corresponds exactly in shape and ornamentation with the last spire-whorl. In a few of the largest specimens, all the granulated keels, on approaching the aperture, decrease considerably in width and prominence; at the same time the posterior margin becomes relatively slightly contracted, so that the suture is no longer in immediate contact with the anterior keel of the preceding whorl. As, at the same time, the posterior keel of the body-whorl, in consequence of its contraction, leaves a narrow space between its posterior edge and the posterior margin, the suture, unlike what is observed on the spire, is separated, on both sides, by a small space, from the adjacent keels. The atrophy of the keels is accompanied by the appearance of some rudimentary, ill-defined spiral threads in the two posterior spaces, while the third keel may be duplicated by a narrow subsidiary granulated keel immediately contiguous to it on its anterior side.

In some specimens the anterior granulated keel of the body-whorl is separated from the base by a deep narrow furrow, followed, concentrically towards the axis, at close intervals by three more furrows; the marginal furrow and the next one being atrophied in some specimens, and sometimes the next furrow also, in which case there remains but the last furrow, separated from the circumference by a flat space. In every specimen, this is invariably followed, towards the axis, by five more furrows at subequal or gradually increasing intervals, the last furrow being deeper and broader than the others, sometimes with a small spiral thread along its floor. A flat, broad spiral keel separates this last furrow from the axial-portion. All these concentric furrows are crossed by a second set of radiating furrows, disposed at regular intervals, strongly curved, with forward facing concavity, with a truly radial direction where they cross the innermost keel, becoming more and more oblique towards the periphery where they seem almost tangential. As there are no intercalations in this radiating set, the spacing becomes very close towards the axis, the innermost keel thereby acquiring a granulated appearance. The lines of growth follow the same direction as the radiating furrows; across the narrow space between the innermost keel and the columella or columellar lip, they become strongly oblique and retrocurrent towards the axis. Spiral grooves separate the narrow space just mentioned, on one side from the granulated keel, on the other side from the axial callosity.

The very oblique aperture is oval, with the greater diameter extending from the axis of the shell to the angulation of the base. The flattened columella is separated by a shallow groove from the callosity that fills the axis of the shell. Its anterior termination, and therefore its junction with the outer lip is missing in all the available specimens. The outer lip is mostly straight and strongly oblique. The interior walls are not lirate. The inner layer of the shell is brilliantly iridescent.

Dimensions.

	mm.
Height	20
Thickness	19
Height of spire	14
Height of body-whorl	10

There are also larger specimens, up to 22mm. in diameter.

Occurrence.—Dalu; also in Lower Burma, at Kyudawon and Myauktin.

Remark.—This easily recognisable species is represented in the Garo collection by a single fragment, readily identifiable in spite of its imperfect condition. Its base is decorticated and has consequently lost the shallower grooves, though the innermost granulated keel is still recognisable, but the characteristic ornamentation of the spire is well preserved, the transition from the decoration of the earlier to that of the later whorls being particularly distinct. The fragment is too incomplete for illustration, and the foregoing description has been based principally on the Burmese specimens.

Comparison with other species.—Amongst quadricarinate species of Trochidæ, the only one that might be related to the remarkably beautiful shell above-described, is *Trochus fragum* Philippi, of unknown habitat, if indeed it is a *Calliostoma* (Pilsbry suggests that it may be a *Thalotia*). The ornamentation of the spire decidedly resembles that above-described, but the ornamentation of the base is quite different. *Trochus australis* Broderip, from Australia, is more elongate than the form under consideration, and there appears to be a space between the posterior keel and the suture, so that the marginal keels of adjacent whorls do not come into contact as in the shell under consideration.

In both his monographs concerning the Tertiary fauna of Burma, Noetling has described and figured, under the name of *Trochus Blanfordi* or *Calliostoma Blanfordi*, certain fossils which bear some relation to the shell under consideration (1895, *Mem. Geol. Surv. Ind.*, p. 16, pl. iv, figs. 3, 4; 1901, *Pal. Ind.*, new ser., Vol. I, p. 253, pl. xvii, figs. 5-8). The figures representing these fossils in both monographs are inaccurate. The description in the first monograph is precise and accurate, that in the second monograph is inexact. The species was established in 1895 upon certain specimens from Minbu and Yenangyat. With these, in the second monograph, in 1901, was united a second form, occurring at a somewhat higher horizon, at Singu, represented in fig. 5, pl. xvii, (*loc. cit.*), which is possibly a mutation of the Minbu and Yenangyat form, but which differs so conspicuously that it cannot be conveniently included in the same species. It may be distinguished as *Calliostoma singuënse*. In order to compare these fossils with the shell under consideration, it is necessary to indicate in what characters they differ from one another. Although the question has already been dealt with (see above, page 266), I here repeat the differential characters so as to avoid cross-references. *C. singuënse* attains considerably larger dimensions than the genuine *C. Blanfordi*. The spire-whorls of *C. Blanfordi* are much more concave than those of *C. singuënse*. At early stages of growth, both forms are quadricarinate; only, while the posterior marginal keel, in *C. Blanfordi*, as in *C. promense*, is immediately contiguous to the suture, there intervenes a small space in *C. singuënse*. In both species, as in *C. promense*, the second keel is the feeblest, the fourth, the most prominent; not, as stated by

Noetling, the third, a statement contradicted by his own illustrations. On the later spire-whorls of *C. Blanfordi* there invariably appears a secondary granulated keel bisecting the posterior interval, and almost always a similar secondary keel similarly bisecting the next interval; so that the later spire-whorls nearly always exhibit as many as six keels, and never less than five. A similar change takes place in the later spire-whorls of *C. singuënse*, but only in the posterior interval, so that there are never more than five keels, and the subsidiary keel is relatively much less prominent than in *C. Blanfordi*. Moreover, owing to the great difference in size between the two species, *C. singuënse* still shows only four keels at a size equal to that of the full-grown specimens of *C. Blanfordi*. Noetling never detected the presence of a fifth keel in the Singu specimens. In 1895, when dealing with the genuine *Trochus Blanfordi*, from Yenangyat and Minbu, Noetling quite correctly stated that, in addition to the two anterior main keels, " there are from two to four revolving lines of very regular small round tubercules," (*loc. cit.*, p. 16), which correctly makes up a total varying according to the stage of growth, from four to six. In 1901, Noetling was perplexed at observing only four keels on the Singu shells, and amended his original description by stating that " at least a specimen from Yenangyat distinctly shows a larger number than four " (*loc. cit.*, p. 254).

The base is totally different in both the species figured by Noetling, and, in both of them totally differs from that of the shell from Kyudawon and Myauktin. In addition to a thick peripheral granulated keel, the base of *C. Blanfordi* exhibits an extremely beautiful ornamentation consisting of thirteen concentric granulated keels alternating in two sizes. On the base of *C. singuënsis*, there are ten concentric, smooth, flat bands, exhibiting an imbricated or stepped disposition, each band being separated from the next outer one by a small declivity facing outward.

It has been necessary to dwell at length upon the characters of these shells in order clearly to establish their distinctness from the Kyudawon and Myauktin fossil, this being one of the many unfortunate instances in which Noetling has based his conclusions upon material in a state of preservation totally unfit for study.

I may now observe that *C. Blanfordi* is distinguished from *C. promense* by its concave whorls; while, both in *C. Blanfordi* and *C. singuënse* the spire-whorls are relatively taller, and therefore fewer than in *C. promense.* Intercalary granulated keels are never developed in *C. promense*: the occasional duplication of the third keel on the body-whorl being caused, not by intercalation, but by the addition of a small contiguous band on the anterior side of the keel, therefore in the anterior space, precisely that which never carries any subsidiary ornaments, in either of the two other forms, not even in *C. Blanfordi.* The system of intersecting furrows on the base of *C. promense* differs so completely from the granulated keels of *C. Blanfordi* and from the imbricated smooth bands of *C. singuënse*, as to need no further comparison.

AGE OF THE FAUNA.

1. Tertiary sequence in Burma.

In attempting to define the age of the fossils above described, it is necessary briefly to summarise what is already known of the succession of Tertiary beds in the various provinces of the East-Indies.

The region nearest to the Garo hills in which a definite succession has been established is Burma. The succession of the post-eocene formations of Burma has already been discussed in the present volume (see principally page 243). By combining the sequence of post-eocene beds already discussed with the classification of the eocene established by Mr. Cotter (*Journ. As. Soc. Bengal*, new ser., Vol. XIV, p. 415), we obtain the following scheme :—

12. Irrawadi Series, sandstones and clays, about 6,000 ft.	Akauktaung series, probable marine equivalents of the Irrawadi Series, sandstones and shales, about 4,000 ft.	Pliocene and Pontian (? with Vindobonian).
11. Pyalo stage, sandstones, pebble-beds, shales, about 1,500 ft. (perhaps a basal member of the Akauktaung series).		Approximately Burdigalian.
10. Kama stage, shales and sandstones, about 1,500 to 2,000 ft.		Approximately Aquitanian.
9. Singu stage, sandstones and shales, about 1,500 ft. . .		Approximately Chattian.
8. Sitsayan stage, principally shales, with subordinate sandstones, 1,500 to 3,000 ft.		Approximately Stampian.
7. Shwezetaw stage, mostly sandstone, about 3,000 ft. . .		Approximately Lattorfian.

6. Yaw stage, largely shales, about 1,500 to 2,000 ft.	Upper eocene.
5. Pondaung stage, principally sandstone, 3,000 ft. and more	
4. Tabyin stage, principally shales, about 5,000 ft.	Eocene.
3. Tilin stage, principally sandstones, 2,000 to 5,000 ft.	
2. Laungshe stage, principally shales, 9,000 to 12,000 ft.	
1. Paunggyi or Swelegyin stage, principally pebble-beds, 2,000 to 4,000 ft.	

As I have already had occasion to notice (see, above, page 259), I wish again to draw attention to the disagreement between this list and a stratigraphical table which was published in these same "Records" ten years ago, for which I am largely responsible (Vol. XLI, p. 253). As already mentioned, the great advance of knowledge realised during the intervening years accounts for these discrepancies. In every branch of scientific research, we should always bear in mind the dictum so felicitously expressed by Professor Daly (Igneous Rocks and their Origin, 1914, page xxii): "Science is built on a long succession of mistakes."

2. Tertiary sequence in North-Western India.

The only other area in the East-Indies where the Tertiary has been classified with the same fulness of detail as in Burma, is the north-western region of India, including Kachh, Sind and Baluchistan. Throughout this region, the classification first established by Blanford in 1876 (*Rec. Geol. Surv. Ind.*, Vol. IX, p. 9) is applicable over a vast extent of country. The only amendment to Blanford's scheme that has seemed necessary is the intercalation of the Laki division between the Ranikot and Khirthar.

Owing to the absence of any observed direct stratigraphical continuity either with the other members of the marine succession or with the fresh-water Manchhar beds, the exact position of the Mekran beds remained uncertain in Blanford's scheme. These beds have yielded a rich fauna, the study of which is now far enough advanced to supply precise indications of their age.

The Mekran beds include a total thickness of several thousand feet of strata in which fossiliferous layers occur at many horizons. The stratigraphical investigations so far carried out are not sufficiently detailed to refer these various fossiliferous horizons to their relative levels respectively to one another. The isolated local faunulas are usually not sufficiently abundant to establish a distinct succession from faunistic considerations. Certain fossiliferous beds constituting the Gwádar peninsula undoubtedly belong to one of the highest horizons, while the lowest fossiliferous horizon so far recognised is that exposed at the northern end of the Talar pass, on the road from Kej to Gwádar, along the northern foot of the Talar mountains, some fifty miles north-east of Gwádar. This is, fortunately, the richest fauna at present available and is very useful, therefore, in affording a lower limit to the age of the Mekran Series. The Talar fauna can clearly be shown to coincide with the Odeng fauna of Java, not only on account of its containing identical species, one of which is the highly characteristic mutational form *Melongena ponderosa* Martin, a valuable zone-fossil, but also on account of the proportion of living species, which closely corresponds with that observed in the Odeng fauna when reckoned for an individual zoological group taken by itself. The entire molluscan fauna has not yet been critically examined, but, reckoning from what is already known of it, the proportion of living forms is probably not far from 40 *per cent.* The Odeng gastropoda examined by Martin up to the year 1900 gave a proportion of living species of 42 *per cent.* (*Samml. des geol. Reichsmus. in Leiden*, ser. I, Vol. VI, p. 161). The Odeng beds are placed by Martin at the limit of miocene and pliocene, therefore at about the level of the Pontian. We may take it as sufficiently established that the Talar beds, the lowest fossiliferous beds at present known in the Mekran Series, are approximately of Pontian age.

The various local faunulas other than the Talar fauna, are, as already mentioned, too scanty to furnish severally useful data for reckoning the age of the beds by means of the proportion of living forms; yet, taken together, the fossils from these various localities constitute a rich fauna, which, when united with the Talar fauna, give an aggregate proportion of living forms of 50 *per cent.* or more. As the Talar fauna considered by itself, does not contain more than 40 *per cent.* of living forms, it is clear that, in order to make up an average of 50 *per cent.*, some of the later Mekran beds must yield a fauna with even more than 50 *per cent.* of living forms, probably as much as 60 *per cent.* In accordance, therefore, with Blanford's original surmise, the Mekran Series undoubtedly contains pliocene beds. Indeed, the newest beds probably reach high into the pliocene.

Although, with the stratigraphical data at present available, I cannot draw exact lines of demarcation between the various zones of the Mekran Series, yet, for general purposes, I may conveniently distinguish two stages: a lower Talar stage, approximately coinciding with the Pontian, and an upper Gwádar stage generally representing the pliocene.

The Mekran Series consists almost entirely of alternations of shales and sandstones, with some pebble-beds at the upper horizons. This is also generally the constitution of the fresh-water Manchhar beds of Sind. The Upper Nari consists largely of sandstones. The lowest division of the eocene of Sind, the Lower Ranikot, also consists of shales and sandstones. All the other divisions, throughout a vast belt of territory extending through a portion of Baluchistan and Sind, known as the calcareous zone, consist chiefly of limestones and calcareous shales (*Rec. Geol. Surv. Ind.*, Vol. XXXVIII, p. 190). As in some parts of southern Java, we are evidently here in the presence of a region which, during a vast succession of ages, scarcely received any detrital sediments, and in which the sedimentary formations are almost entirely of organic origin (cf. Martin, *Samml. des geol. Reichsmus. in Leiden*, ser. 1, Vol. IX, p. 143). In other parts of Baluchistan, throughout the region in which the rocks assume the "flysch" character, sandstones become abundant at the various horizons represented chiefly by limestones in the calcareous zone. Owing to these lateral changes of facies, the lithological constitution of the various divisions has not been entered in the following list of formations, from which the thicknesses have also been omitted owing to their great range of variation:—

TERTIARY SEQUENCE IN NORTH-WESTERN INDIA.

Marine.		Fresh-water.	Approximate age.
7. MEKRAN SERIES.	Gwádar stage with abundant *Pecten Vasseli*.	Upper Manchhar coinciding with the Upper Siwalik.	Pliocene.
	Talar stage with *Melongena ponderosa*, *Ostrea digitata*, *O. Virleti*.	Middle Manchhar generally coinciding with the Middle Siwalik.	Pontian.
	(Representatives not observed).	Lower Manchhar coinciding generally with the Nahan.	Vindobonian.

Marine.	Fresh-water.	Approximate age.
6 (*b*). Upper Gáj with *Ostrea latimarginata*.	Bugti beds, corresponding to part of the Murrees.	Burdigalian.
Chiefly marine.		
6(*a*). Lower Gaj with *Lepidocyclina marginata*.	......	Aquitanian.
5(*b*). Upper Nari with *Lepidocyclina dilatata*.	......	Chattian.
5(*a*). Lower Nari with *Lepidocyclina dilatata* and *Nummulites intermedius*.	......	Stampian.
4. Poorly fossiliferous massive limestones of the Mula pass; elsewhere a stratigraphical gap.	......	Lower oligocene and upper eocene.
3. Khirthar with large nummulites and large assilines.	......	Lutetian.
2. Laki with *Nummulites atacicus* and *Assilina tattænsis*.	......	Lybian.
1(*b*). UPPER RANIKOT. Zone 4, with *Nummulites planulatus*	......	Upper Cuisian.
1(*b*). UPPER RANIKOT. Zone 3, with small nummulites and small assilines.	......	Lower Cuisian.
1(*b*). UPPER RANIKOT. Zone 2, with operculines.	}	{ London Clay.
1(*b*). UPPER RANIKOT. Zone 1, with *Calyptrophorus indicus*.	}	{ Woolwich and Reading beds.
1(*a*). Lower Ranikot (fresh-water except at base).	}	{ Thanet sands.

I wish once more to draw attention to the conclusion, already expressed on previous occasions (*Rec. Geol. Surv. Ind.*, Vol. XXXIV, pp. 86, 177) that a study of Indian Tertiary geology undoubtedly reveals the presence of a vastly developed intercalary stage, the Laki, intervening between the equivalents of the Cuisian and Lutetian, and corresponding with neither. It is equivalent to the Lybian stage of Egypt. In the Paris basin it corresponds to a stratigraphical gap between the Cuisian and Lutetian, first recognised by Lemoine, who has given the name of "Laonnian" to the scanty fresh-water or brackish representative of the missing zone, occasionally occurring as discontinuous patches (1911, Géologie du Bassin de Paris, p. 220).

In Burma, the eocene divisions below the Pondaung stage have, as yet, yielded very few characteristic fossils, and their exact age is still uncertain. The equivalence of the post-eocene in Burma and in north-western India, in its main lines at least, is now established beyond any possible further doubt, and may be tabulated as follows :—

NORTH-WESTERN INDIA.			BURMA.	
UPPER MANCHHAR	Mekran Series.	Gwádar stage.	Irrawadi Series, upper part.	Perhaps upper part of Akauktaung Series.
MIDDLE MANCHHAR.	Mekran Series.	Talar stage .	Irrawadi Series, lower part.	Probably lower part of Akauktaung Series.
	Lower Manchhar . .		Not observed .	Part of Akauktaung Series.
	Upper Gáj . . .		Pyalo stage .	
	Lower Gáj . . .		Kama stage	
	Upper Nari . . .		Singu stage.	
	Lower Nari . . .		Sitsayan stage	
	Massive limestones of Mula pass.		Shwezetaw stage.	
	Massive limestones of Mula pass.		Yaw stage.	
	Massive limestones of Mula pass.		Pondaung stage.	

3. Tertiary sequence in Java.

Omitting the rather vaguely demarcated "Fossil-wood group" and the subsequently defined Irrawadi Series, Theobald's "Pegu

Group" essentially coincides with the post-eocene portion of the Tertiary of Burma. The corresponding beds in Java constitute Martin's "Java group" (*Samml. d. g. R.-M. in Leiden*, ser. 1, Vol. VI, p. 240). In the Java group, the "lower miocene," including the Rembang Series (1912, *Samml. des geol. Reichsmus. in Leiden*, ser. 1, Vol. 8, p. 153) and Njalingdun series (1911, *loc. cit.*, pp. 18, 22), corresponds with the Kama and Pyalo stages with both of which it has many species in common. The "upper miocene" includes the Tji Lanang series (1911, *loc. cit.*, pp. 11, 48) with the extraordinarily rich fauna collected by Junghuhn, which has become classical from Martin's first great monograph, "Die Tertiärschichten auf Java," in which a very large proportion of the described species belong to this stage.

The typical pliocene of Java is the Sondé series (*loc. cit.*, p. 191) which very closely corresponds, faunistically, with the Mekran beds of north-western India and with the rich fauna of Karikal so admir ably described by Cossmann. The fauna of Odeng seems to re present a passage zone between the "upper miocene" and "pliocene" (*Samml. d. geol. Reichsmus. in Leiden*, ser. 1, Vol. VI, pp. 178, 190), corresponding approximately in age with the Pontian. As already remarked, the Odeng fauna closely corresponds with the Talar fauna of the Mekran.

Regarding the Kendeng beds which overlie the Sondé Series, and which have yielded remains of *Stegodon*, *Elephas*, and of the far-famed *Pithecanthropus*, there may be perhaps some slight uncer tainty as to whether they might correspond with the uppermost zone of the Siwalik. The general consensus of opinion seems to be in favour of a true pleistocene age, and there is good reason for concluding that the Kendeng beds are approximately equivalent to the Narbada stage of India.

Fossiliferous equivalents of the oligocene have not been met with in Java. The "Java-Group" is underlaid by the Nanggulan Series of upper eocene age corresponding with the Yaw stage of Burma.

The following table indicates the approximate parallelism of the three most completely defined schemes of the later tertiary succession of the East-Indies, respectively in Burma, in Java, and in North-Western India.

—	Burma.		Java.	North-Western India.	
	Fresh-water.	Marine.		Fresh-water.	Marine.
Pleistocene	Plateau-gravel		Kendeng Series	Raised beaches and other equivalents of the Narbada Series.	
Pliocene	Irrawadi Series, upper part.	?	Sondé Series	Upper Manchhar and Upper Siwalik.	Gwádar stage.
Pontian	Irrawadi Series, lower part.	Akauktaung Series (in part at least).	Odeng beds	Middle Manchhar and Middle Siwalik.	Talar stage.
Vindobonian	Not recognised or perhaps partly represented by the Akauktaung Series.		Tji Lanang Series	Lower Manchhar or Nahan.	Not known.
Burdigalian		Pyalo stage	Njalingdun Series	Bugti beds corresponding to part of the Murrees.	Upper Gáj.
Aquitanian		Kama stage	Rembang Series		Lower Gáj.
Chattian		Singu stage	Not identified		Upper Nari.
Stampian		Sitsayan stage			Lower Nari.
Lattorfian		Shwezetaw stage		Massive limestones of the Mula pass.	
Upper Eocene		Yaw stage	Nanggulan Series		

4. Equivalence of the Garo Tertiary.

Amongst the specifically recognisable fossils of the Garo hills, the following are known to occur also in other parts of the East-Indies :—

Terebra protomyuros,
Surcula promensis,
Drillia protocincta,
,, *tjemoroënsis* var.,
Mitra chinensis var. *subscrobiculata*,
Turritella Pinfoldi,
,, *angulata*,
Calliostoma promense.

Amongst these eight species, *Terebra protomyuros*, *Surcula promensis*, and *Calliostoma promense* have hitherto been met with only in the Kama beds of Burma. *Surcula promensis* is represented, in the Garo hills, by the variety *silistrensis*, but, as already explained, this appears to be a collateral variety, not a mutation. *Drillia protocincta* occurs in the Kama beds of Burma and in the pliocene Sondé series of Java. *Drillia tjemoroënsis* var. characterises the Kama stage of Burma. The type is found in Java at Sangiran (Kali Tjemoro), in beds the exact horizon of which has not been recorded, but which may be pliocene; the Garo and Burma form representing, however, a separate variety. *Mitra chinensis* is the only undoubted living species recognised in the fauna of the Garo hills, where it is represented by the variety *subscrobiculata* characteristic of the Gáj of Kachh. *Turritella Pinfoldi*, at Myaungu (20° 31′, 94° 21′), in the Minbu district of Burma, occurs in beds which contain *Ostrea latimarginata* and which, therefore, must be referable to the Pyalo stage. *Turritella angulata* occurs in the Singu, Kama, and Pyalo beds of Burma, perhaps also at higher horizons. In western India, it is found in the Gáj and perhaps in the Mekran series. As already mentioned, its specific distinctness from the living *Turritella duplicata* is not quite certain.

If we now analyse the evidence afforded by these fossils, *Turritella angulata* only indicates that the Garo fauna is newer tertiary. All the other species point to the Kama-Pyalo or Gáj as the age of the Garo fossils. One form, *Turritella Pinfoldi*, has, hitherto, been met with only in the Pyalo stage coinciding with the upper Gáj. The absence of any undoubted oligocene forms, and the presence of *Drillia protocincta* which is known to extend into the pliocene, further suggest more particularly the Pyalo stage or the upper limit of the Gáj as the most probable horizon, which would be in keeping with the very likely supposition that the Karaibari exposure, described in 1821 by Scott and Colebrooke, is the western extension of the Sumeswari beds. One of the Karaibari mammalia, *Anthracotherium silistrense*, probably occurs in the Lower Manchhar of Sind. The Kamlial horizon, at the base of the Manchhar, immediately resting on the Gáj, is regarded by Pilgrim as possibly synchronous with the Sansan fauna which de Lapparent places astride of the limit between Lower Miocene and Vindobonian, therefore just about the upper limit of the Gáj. We may therefore conclude that the age of the Sumeswari fauna is probably the same as that of the Pyalo beds, at the upper limit of the Gáj, at the upper limit therefore of the Lower Miocene.

Out of a total of nine recognisable species in the Garo fauna, one only, *Mitra chinensis* var. *subscrobiculata*, is considered certainly to be specifically identical with a living shell. This would give eleven *per cent.* as the proportion of living forms. On the supposition that *Turritella angulata* is identical with *T. duplicata*, the proportion would become twenty-two *per cent.* No precise signification can be attributed to figures derived from so small a total, though they are within the limits of the proportions observed for the lower miocene molluscan faunas of Burma, Java, and Western India, which, according to the horizon, facies, and generic constitution, vary from about 7 *per cent.* to about 25 *per cent.*

Other occurrences of Tertiary Fossils in North-Eastern India.

The interesting collections obtained by Mr. Pinfold in the Garo hills constitute the first and only instance in which precise data have become available regarding the age of any of the later tertiary formations in the districts to the North of Burma, including Assam, the Sylhet region and the neighbouring countries. Indeed, with the exception of the neighbourhood of Cherra-Poonjee and Shillong, there is practically no spot where any of the rocks can be accurately dated. Fossils have been recorded only from a small number of localities, and have not been fully studied.

The nearest spot to the localities examined by Mr. Pinfold, from which newer tertiary fossils have been obtained, is along the Karaibari hills, between the western extremity of the Garo hills and the Brahmaputra.

A small thickness of horizontal or slightly undulating sandstones and clays which were exposed at low water along the banks of the Brahmaputra about a hundred years ago, but have not been observed since, yielded some littoral marine fossils together with mammalian remains (Colebrooke and Scott, *Trans. Geol. Soc. London*, 2nd ser., Vol. I, p. 132).

The mammalian remains have been studied by Pentland, Falconer and Cautley, Pomel, and Lydekker, and have been referred to two species which have been named *Anthracotherium silistrense* Pentland and *Chœromeryx silistrensis* [Pentland]. Remains specifically identical with *Anthracotherium silistrense*, or at least very closely related, have been recorded from the Lower Manchhar of Sind, at a horizon therefore not very different from that of the Gáj beds. The species has an extensive vertical range, and, of itself, would not suffice to fix the date of the bed otherwise than as miocene. Nevertheless, the fact that the only other mammalian species recorded from the same bed is also an anthracotheroid, communicates a relatively ancient appearance to the fauna. The most conspicuous amongst the mollusca from Karaibari are large oyster-shells, now preserved at the British Museum, which, on a casual inspection, appeared to me to coincide with Gáj forms. Unfortunately, I did not take note of their characters. The small thickness of sandstone overlying the bed with littoral and mammalian remains is recorded to have yielded fossil wood.

There is reason to think that the Karaibari exposure, which is in the direct continuation of a line passing through the Bagmara and Dalu exposures, may be a western continuation of the strata studied by Mr. Pinfold, and, like them, may correspond with the Pyalo beds of Burma and the Upper Gáj beds of Sind, but the question needs further investigation.

In the Khasia hills, east of the region examined by Mr. Pinfold, the undulating stratification of the Garo hills gives place to a sharp flexure, north of which the strata are practically horizontal, while, south of the bend, they dip south at high angles. Identical horizons, when recognisable on both sides of the bend, are represented by a much greater thickness of strata on the southern than on the northern side, indicating a rapid deepening of the basin of deposition in a southern direction. Amongst the horizontally stratified deposits of the plateau, on the northern side of the flexure, the undoubtedly eocene beds include two subdivisions, recognisable from their nummulites, and corresponding respectively with the Laki of Lybian age, and the Khirthar of Lutetian age, as developed in north-western India. The Sylhet limestone, on the southern side of the flexure, is a rock containing abundant large nummulites of Khirthar

Overlying the undoubted eocene of the plateau, is the Nongkulang Hill Series (Godwin-Austen, 1869, *Journ. As. Soc., Bengal,* Vol. XXXVIII, (2), p. 23) which must not be confounded with the Nanggulan Series of Java (see Martin, 1912, *Samml. des geol. Reichs-Mus. in Leiden,* ser., 1, Vol. IX, p. 111, with complete bibliography; also, 1914, neue Folge, Vol. II, part 4) though it is by no means impossible that both series may be contemporaneous.

The Nongkulang Hill Series of the Khasia hills is described by Godwin-Austen as consisting of marine strata unconformably overlying the eocene. The Nongkulang fossils were first examined by Stoliczka, who stated that " none of the species, so far as recognisable, appear to be identical with those known from the nummulitic beds of the same district " (*Rec. Geol. Surv. Ind.*, Vol. II, p. 10). The Nongkulang Hill Series, in the West Khasia hills, is overlaid by a considerable thickness of beds which Godwin-Austen attributes entirely to the Nahan; this same assimilation being extended to the entire succession of later Tertiary beds in the Garo hills, including even their uppermost strata; and also to the greater portion of the vast thickness of later Tertiary beds along the southern border of the Jaintia hills, with the exception of some uppermost irregularly bedded clays and conglomerates regarded by Godwin-Austen as perhaps the equivalents of the Siwalik proper (*loc. cit.*, p. 153). The fossils collected by Mr. Pinfold occur in the uppermost zones of the Tertiary beds in the Garo hills, and, since their palæontological characters indicate the age of the Upper Gáj or Pyalo beds, it follows that the entire succession of Upper Tertiary beds in the Garo hills must be, even at its upper limit, somewhat older than the Nahan; while as the horizon of the Nongkulang Hill fauna is separated from that of the Sumeswari fauna by a considerable thickness of strata, we must also conclude that the Nongkulang Hill fauna cannot correspond with that discovered by Mr. Pinfold, and is probably older than the Gáj. The small collection of fossils obtained by Godwin-Austen from the Nongkulang Hill Series has lately been studied by Dr. E. Spengler. The full description has not yet been published, but, in a short preliminary note (*Centralblatt f. M., G., u. P.*, 1915, p. 623), Dr. Spengler mentions the occurrence of a new species of *Clypeaster* and of a *Euspatangus* related to *Euspatangus rostratus* d'Arch. The latter is a characteristic zone-fossil of the Nari of western India, and the comparison made by Dr. Spengler leads us therefore to believe that the Nongkulang Hill Series may be related to the Nari of western India, and that its age, therefore, may be oligocene. Still, the possibility is not yet excluded that it may be, after all, of upper eocene age, and, by a curious coincidence of terms, contemporaneous with the Nanggulan Series of Java.

Fossil palm-wood and dicotyledonous leaves are the only distinct organic remains so far recorded from the "teelah" ridges about Cachar. Between Cachar and the Bay of Bengal, the ranges in Hill-Tipperah and Chittagong include considerable thicknesses of strata regarded as upper tertiary in age. Fragmentary marine fossils have been obtained by Mr. P. N. Bose and other explorers. They are not specifically determinable, but include small clathrate valves of *Venus*, analogous to *V. bataviana* Martin, such as occur abundantly in the upper Tertiary of Java and in the Kama beds of Burma. The existence, in Hill-Tipperah and Chittagong, of equivalents of the Kama and Pyalo stages is probable.

In the North Cachar Hills, the strata, considerably disturbed, which apparently form the continuation of the Newer Tertiaries of the Jaintia hills, include two subdivisions, of which the lower one, with a maximum exposed thickness of 2,000 feet, is mainly shaly, while the upper one, with a maximum thickness of 3,000 feet, consists principally of sandstones.

The north-eastern extension of the Newer Tertiaries of Hill-Tipperah, of Cachar, and of the Jaintia hills, is to be sought in the Mikir hills, where the Mikir Shale Series (F. H. Smith, *Mem. Geol. Surv. Ind.*, Vol. XXVII, p. 84), estimated at 800 feet in thickness, appears to be undoubtedly the continuation of the lower shaly beds of the North Cachar Hills. They contain oysters and other marine shells (Smith, *loc. cit.*, pp. 86, 87) which have not been identified.

They rest on eocene beds, and are overlaid by sandstones, apparently continuous with the upper arenaceous division of the North Cachar hills and containing fossil-wood.

The north-eastern continuation of the Tertiary zone of the Mikir Hills is in the Naga Hills. where Mallet recognised four principal stratigraphical divisions: the Disang series, mostly shaly, with an uppermost arenaceous subdivision, the Naogaon sandstone; overlaid by the coal-measures, principally shaly; the Tipám sandstones with fossil wood; and the locally developed Dihing conglomerates overlying the Tipám beds.

The structure, in the Naga hills, is complicated by faulting and overfolding, which increases the difficulties of classification. The Disang series appears to be partly cretaceous and may be heterogeneous. There is reason to believe that the coal-measures correspond, partly at least, with the coal-bearing Shwezetaw stage of Burma of lower oligocene age. They have not yielded any distinct fossils. The Mikir Shale Series was regarded by Smith as approximately equivalent to the coal-measures. Fossil shells have been observed in the Tipám beds along the high road in the Diphupani gorge near Samaguting by R. D. Oldham who expressly states their identity with some of the Veneridæ from the strata near Prome (*Mem. Geol. Surv. Ind.*, Vol. XIX, p. 228), and, in the valley of the Dayang river, by Hayden (*Rec. Geol. Surv. Ind.*, Vol. XL, p. 291).

The evidence above reviewed reduces itself to this: fossils of the age of the Upper Gáj or Pyalo beds occur at the upper limit of the newer tertiary beds in the Garo hills; while the lower limit of these beds may safely be interpreted as post-eocene, since the Nongkulang Hill Series, whatever its exact age may be, intervenes between these Newer Tertiaries and the middle eocene. The Tipám sandstone is partly equivalent to the Pyalo stage, but we cannot state anything definite regarding its inferior limit. The next older rocks, the coal-measures, are probably, in part at least, of lower oligocene age, while the Sitsayan, Singu, or even Kama horizons, may be represented either by the lower portion of the Tipám beds, or, more probably perhaps, by the upper portion of the coal-measures. The upper limit of the Tipám beds is also indefinite.

With these important, but, at the same time, meagre data, the equivalence of the upper Tertiary beds throughout the vast territories of north-eastern India remains almost entirely conjectural as will be seen from the following tabular statement:—

	GARO, KHASIA, JAINTIA HILLS.	NORTH CACHAR, MIKIR.	UPPER ASSAM.	
UPPER SIWALIK, GWÁDAR.				UPPER IRRAWADI.
MIDDLE SIWALIK, TALAR.	Conglomeratic beds of the Jaintia hills.	....	Dihing beds	LOWER IRRAWADI AKAUKTAUNG.
NAHAN . .				? AKAUKTAUNG in part.
	Fossil zone of Dalu, Bagmara and Karaibari.	(?) Sandstones of the North Cachar and Mikir Hills.		
UPPER GÁJ, BUGTI	Sandstones and shales of the Garo, Khasia and Jaintia Hills.		Tipám sandstones . .	PYALO.
LOWER GÁJ .				KAMA.
UPPER NARI .		Shales of the North Cachar and Mikir Shale Series.		SINGU.
LOWER NARI .	Nongkulang Hill Series .		Coal-measures . .	SITSAYAN.
MULA LIMESTONES.				SHWEZETAW.
				YAW.

From the table it may be noticed that, even by partly referring the coal measures of Assam to as late an age as the oligocene, and even if we bring down the uppermost Jaintia conglomerates to an age as old as that of the Nahan, thereby compressing the sequence within the smallest probable range, yet the number of subdivisions established in Assam or in the neighbouring regions remains much smaller than those already defined, within the same range of time, in Burma, or in north-western India, or in Java; and, consequently, great difficulty is experienced in attempting to apportion the Assam strata to their respective equivalents in other regions. In consequence of the inaccessibility and unhealthiness of the north-eastern districts of India and also the scarcity of rock exposures in a forest-clad country, geological information regarding those regions is in a backward condition, and, until Mr. Pinfold's discovery, not a single horizon had been accurately fixed above the middle eocene. We must congratulate Mr. Pinfold on having for the first time established a definite stratigraphical zone, which will afford a most valuable fixed horizon in further unravelling the geology of this difficult region.

LIST OF ILLUSTRATIONS.

PLATE VIII.

FIG. 1.—Surcula Promensis. Myaukmigon, Burma; *a*, *b*, ventral aspect, natural size and enlarged 2/1; *c*, *d*, dorsal aspect, natural size and enlarged 2/1.

FIGS. 2, 3.—Surcula Promensis. Kyaungon, Burma; *a*, *b*, dorsal aspect, natural size and enlarged 2/1.

FIG. 4.—Surcula Promensis var. Silistrensis. Bagmara, Garo Hills; presented by the British Burma Petroleum Company; *a*, *b*, ventral aspect, natural size and enlarged 2/1.

FIG. 5.—Calliostoma Promense. Kyudawon, Burma; presented by the Burma Oil Company; *a*, lateral view, natural size; *b*, *c*, base, natural size and enlarged 2/1.

PLATE IX.

FIG. 6.—Siphonalia subspadicea. Dalu, Garo Hills; presented by the British Burma Petroleum Company; *a*, *b*, ventral view, natural size and enlarged 2/1; *c*, *d*, dorsal view, natural size and enlarged 2/1; *e*, *f*, side view, natural size and enlarged 2/1.

FIG. 7.—Calliostoma Promense. Myauktin, Burma; *a*, ventral aspect, natural size; *b*, *c*, dorsal aspect, natural size and enlarged 2/1; *d*, *e*, base, natural size and enlarged 2/1.

FIG. 8.—Calliostoma Promense. Myauktin, Burma; *a, b*, ventral aspect, natural size and enlarged 3/1.

FIG. 9.—Turritella Pinfoldi. Bagmara, Garo Hills; presented by the British Burma Petroleum Company; natural size.

FIGS. 10, 11.—Turritella Pinfoldi Myaungu, Burma; presented by the Burma Oil Company; 10, 11*b*, natural size; 11*a*, enlarged 2/1.

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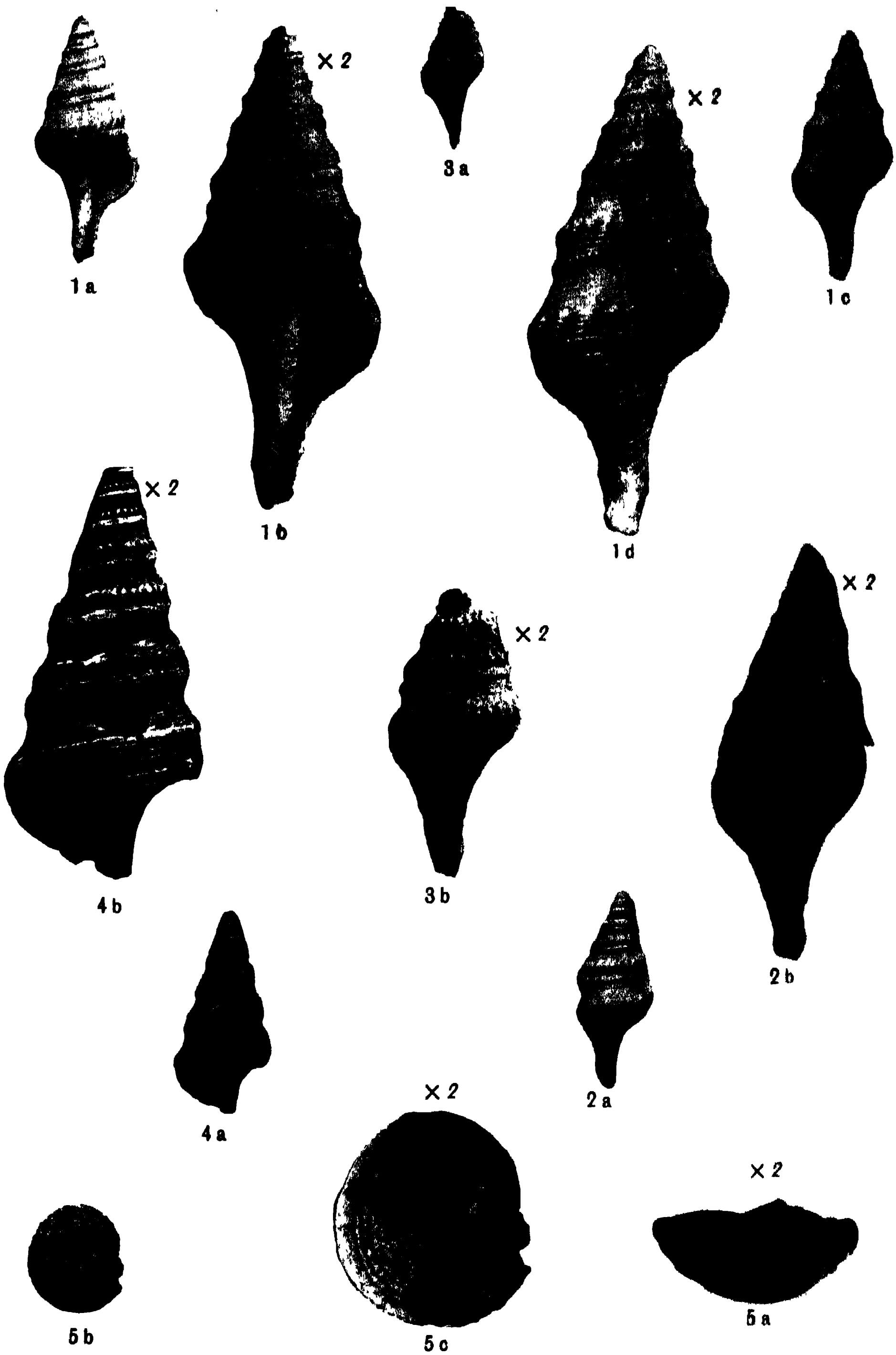

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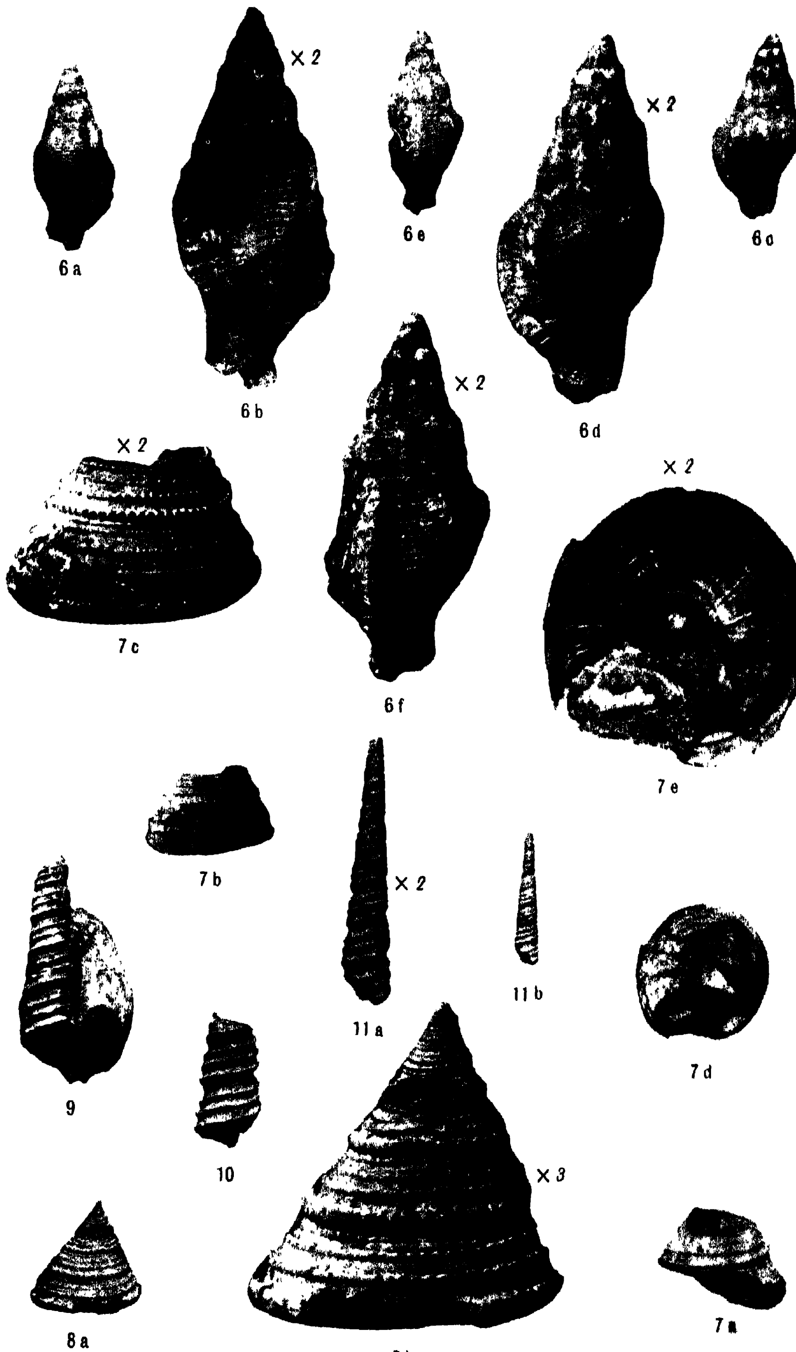
TERTIARY MOLLUSCA FROM THE GARO HILLS.



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TERTIARY MOLLUSCA FROM THE GARO HILLS.

RECORDS

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ILLUSTRATED COMPARATIVE DIAGNOSES OF FOSSIL TEREBRIDÆ FROM BURMA. BY E. VREDENBURG, *Superintendent, Geological Survey of India.* (With Plate 10.)

THE progress of geological research in Burma has revealed the existence of a Tertiary molluscan fauna of a variety and richness that could not have been anticipated from the somewhat meagre collections hitherto described in Noetling's monographs (1895, *Mem. Geol. Surv. Ind.*, Vol. XXVII, part 1; 1901, *Pal. Ind.*, new ser., Vol. I, part 3).

The study of this rich material is already far advanced and has an important bearing on the interpretation of the contemporaneous tertiary faunas of other parts of the East-Indies, principally those from North-Western India.

It is my intention to publish a systematic work on the whole of the Tertiary molluscan fauna of India, so far as its study has been as yet completed. I have written full descriptions of most of the Siphonostomata, amounting to several hundred species, of which a considerable proportion consists of forms hitherto unknown. The preparation of the complete illustrations for so extensive a work will need several years, and I have thought that a useful purpose may be fulfilled, in anticipation of this publication, by issuing preliminary illustrations exclusively representing those forms regarded as previously undescribed, together with short comparative diagnoses. The complete descriptions, all of which already exist in manuscript, will eventually be published in the fully illustrated monographs.

The following pages contain preliminary comparative diagnoses of a number of Terebridæ from Burma, regarded as representing hitherto unknown species or varieties. Two species, designated hereafter as *Terebra Mayoi* and *T. iravadica*, cannot be treated in this brief manner, as they are not sufficiently closely related to any forms previously described to enable us to frame useful comparative diagnoses. In both instances, therefore, the full descriptions have necessarily been published.

In addition to some specimens generously presented by the Burmah Oil Company and British Burma Petroleum Company, most of the fossil shells dealt with in the present notice were obtained by Mr. Sethu Rama Rau. They are from the following localities :

—	Latitude N.			Longitude E.		
	°	′	″	°	′	″
1. Dalabe	19	37	15	95	17	50
2. Kama	19	1	0	95	9	0
3. Kyaungon	19	30	0	95	23	0
4. Kyudawon (a hamlet near Tittabwe)						
5. Leptanzeik	19	24	0	95	14	0
6. Minbu ("zone of *Cancellaria Martiniana*")	20	10	0	94	55	0
7. Mindegyi	19	48	0	94	53	30
8. Myaukmigon	19	31	30	95	24	30
9. Myauktin	19	28	20	95	22	0
10. Myaungu (from two widely different horizons)	20	29	40	94	20	40
11. Myangabaing	19	5	20	95	15	30
12. Singu	20	56	35	94	51	30
13. Thanga	19	32	30	95	23	0
14. Tittabwe	19	31	0	95	28	0
15. Yenangyat ("zone of *Paracyathus cæruleus*")	21	6	0	94	48	10

To these may be added the following occurence from the Garo hills :—

16. Bagmara	25	11	50	90	40	19

All the fossil Terebridæ so far met with in Burma are post-eocene. Amongst the localities enumerated above, the following may be referred to the horizon of the Sitsayan Stage, approximately Stampian:

6 Minbu: 7 Mindegyi; 10 Myaungu (lower horizon); 15 Yenangyat.

The fossils from Singu and Leptanzeik, and perhaps some of those from the higher horizons of No. 7, Mindegyi, belong to the Singu Stage, approximately Chattian.

The Kama Stage, approximately Aquitanian, is represented by the following localities;

1 Dalabe; 2 Kama; 3 Kyaungon; 4 Kyudawon; 8 Myaukmigon; 9 Myauktin; 11 Myingabaing; 13 Thanga; 14 Tittabwe;

To the Pyalo Stage, approximately Burdigalian, belong the following occurrences;

10 Myaungu, upper horizon; 16 Bagmara.

All the fossil Terebridæ so far known in India belong to the genus *Terebra.*

Genus TEREBRA Adanson 1757.

The separate grouping of the species of *Terebra* presents great difficulties on account of the homogeneity of the genus. In addition to the sections *Myurella* and *Noditerebra*, Cossmann, in 1896, (Essais de Paléoconchologie comparée, Fasc. II, p. 47) accepted, as subgenera, *Subula* and *Hastula*, the transition of which to other forms of *Terebra* is so gradual that they scarcely rank, perhaps, above the value of sections, though they constitute very useful subdivisions for the grouping of species. To the divisions admitted by Cossmann, I have ventured to add *Duplicaria* Dall, as a section. In 1908, Dall published in the "Nautilus" (Vol. XXI, p. 124), a short note entitled "Subdivisions of the Terebridæ," in which most of the groups coincide with those of Cossmann's classification of 1896, of the existence of which the author was unaware, since some of the designations used by Cossmann are ignored, and other designations are proposed for the same types. Dall's note only contains an enumeration of the proposed subdivisions, the diagnoses of which were to have appeared in another communication, the publication of which I have been unable to trace. Under the circumstances, we cannot ascertain on what grounds is founded the genus *Duplicaria*, with *Terebra duplicata* as type, with no other diagnosis but the brief remark "sculpture persistent, suture channelled, shell axially ribbed, sulcate." These minor details of ornamentation do not constitute characters of generic importance. Nevertheless, *Terebra duplicata* and the related species, which are particularly well represented amongst the Tertiary fossils of India, may be provisionally classified under the name *Duplicaria*, as a section including such forms as differ from *Terebra s. str.* by the persistence, at all stages of growth, of their ribbed ornamentation and posterior furrow, from *Myurella* by the absence of spiral threads, from *Hastula* by their relatively short base.

The fossil forms so far examined in India may be provisionally grouped in the following sections:—

(*a*) *Terebra s. str.*, large, with fairly short base, ornamentation becoming indistinct on the later spire-whorls and body-whorl.

(*b*) *Duplicaria*, size variable, axial ornamentation consisting of ribs, spiral ornamentation consisting of wide-spaced furrows, one or two in number, base moderately elongate.

(*c*) *Subula*, large or medium, ornamentation usually dwindling at later stages of growth, whorls strongly overlapping, base moderately elongate.

(*d*) *Myurella*, size variable, spiral ornaments always present, axial ornaments interrupted by some at least of the spiral ornaments, base moderately elongate to very short.

(*e*) *Noditerebra*, small, ornamentation nodular, base moderate to very short.

(*f*) *Hastula*, small or medium, spiral ornaments, when present, interrupted by the axial ornaments, base elongate.

It is necessary to say a word concerning the internal plications of the columella generally observed in *Terebra*. In many species of *Terebra*, the twisted zone constituted by the accretions to the terminal notch forms a more or less bulging main band bordered by two rims which are frequently rather prominent, one on the posterior margin, separating the main zone from the adjacent anterior concavity of the base, one along the anterior margin coinciding with the terminal twisted edge of the columella. In certain species, the columellar lip may spread over these two bounding ridges without obliterating them, and it seems as though the two spiral folds frequently observed along the inward extension of the columella are nothing else but these external features, coated by the glazed substance of the internal shell-wall concurrently with the growth of the shell. From a perusal of works dealing with the shells of this family, it appears that this is the generally accepted explanation of the presence of spiral folds upon the columella of *Terebra.* Yet, in a great many instances, these folds are not visible along the columella in the apertural part of the shell, the corresponding external ornaments having been entirely reabsorbed along the edge of the aperture during the formation of the columellar lip. In such cases, the frequently well developed internal folds cannot possibly represent the same structures as those accompanying the external zone of accretions, and must be regarded as true columellar structures developed from the interior of the shell *pari passu* with the reabsorption of the external ridges. Moreover, a careful examination of many shells reveals the fact that, very frequently, their position corresponds only approximately with that of the external ledges and that they are not at all proportionate to their relative degree of prominence : for instance, a shell with a very feeble posterior boundary ledge may internally exhibit a very prominent posterior columellar fold, or else a very prominent anterior columellar fold may be observed in a shell in which the external anterior twisted edge of the columella is perfectly even and the terminal zone of accretions totally devoid of any anterior rim. It seems evident, therefore, that the columella of *Terebra*, whenever it bears spiral folds, must be regarded as truly plicate and that the observed structure is not a mere illusory appearance.

The genus *Terebra* is abundantly represented in the Tertiary formations of India. The forms at present known are the following :—

Group of *Terebra crenulata* [Linn.]

1. *Terebra narica* Vred. Nari of Baluchistán.
2. *Terebra dalabeensis* n. sp.

Group of *Terebra duplicata* [Linn.]

3. *T.* (*Duplicaria*) *subtessellata* d'Orbigny, var. *oligocenica* Vred. Nari of Sind.
4. *T.* (*Duplicaria*) *mekranica* Vred. Mekran beds.
5. *T.* (*Duplicaria*) *gedrosiana* Vred. Mekran beds.
6. *T.* (*Duplicaria*) *Theobaldi* n. sp.

7. *T.* (*Duplicaria*) *protoduplicata* Noetling. Kama, Kyaungon, Myaukmigon, Tittabwe.

8. *T.* (*Duplicaria*) *Smithi* Martin. Myaukmigon.

9. *T.* (*Duplicaria*) *Cotteri* n. sp.

Group of *Terebra longiscata* Desh.

10. *T.* (*Duplicaria*) *Woodwardiana* Martin, var. *mindegyiensis.*

11. *T.* (*Duplicaria*) *myaunguēnsis* n. sp.

Group of *Terebra anomala* Gray.

12. *T.* (*Duplicaria*) cf. *anomala* Gray (Cossmann, Journ. Conch, 1900, Vol. XLVIII, p. 23, Pl. II, figs. 15, 17). Upper Tertiary of Karikal.

Group of *Terebra maculata* [Linn.]

13. *T.* (*Subula*) *Noetlingi* (*T. Smithi Mart. sec.* Noetling, *Pal. Ind.*, new ser., Vol. I, part 3, p. 339, Pl. XXII, fig. 18; *Subula* sp., *loc.*, *cit.*, p. 341, Pl. XXII, fig. 20). Minbu.

14. *T.* (*Subula*) *fuscata* [Brocchi]. Myaukmigon, Tittabwe; also in the miocene and pliocene of Europe.

15. *T.* (*Subula*) *Cossmanni* n. sp.

Group of *Terebra tessellata* Gray.

16. *T.* (*Noditerebra*) *samarangana* Martin. Dalabe, Kama, Kyaungon, Myaukmigon, Thanga, Tittabwe.

Group of *Terebra dislocata* Say.

17. *T.* (*Myurella*) *Mariesi* Smith (Cossmann, Journ. Conch., 1900, Vol. XLVIII, p. 22, Pl. II, fig. 5). Upper Tertiary of Karikal.

Group of *Terebra variegata* Gray.

18. *T.* (*Myurella*) *aspera* Hinds. Mekran beds.

Group of *Terebra pretiosa* Reeve.

19. *T.* (*Myurella*) *promensis* n. sp.

Group of *Terebra Cumingi* Deshayes.

20. *T.* (*Myurella*) *birmanica* n. sp.

Group of *Terebra triseriata* Gray.

21. *T.* (*Myurella*) *kyudawonensis* n. sp.

Group of *Terebra reticulata* Sowerby.

22. *T.* (*Myurella*) *reticulata* J. de C. Sowerby. Gáj of Kachh.
23. *T.* (*Myurella*) *kachhensis* Vred. Gáj of Kachh.
24. *T.* (*Myurella*) *Martini* n. sp.
25. *T.* (*Myurella*) *karikalensis* nom. nov. (Cossmann, Journ. Conch., 1900, Vol. XLVIII, Pl. II, fig. 14). Upper Tertiary of Karikal.
26. *T.* (*Myurella*) *Hornelli* n. sp.
27. *T.* (*Myurella*) *euglyptica* n. sp.
28. *T.* (*Myurella*) *protomyuros* Noetling. Bagmara (Garo hills), Dalabe, Kama, Kyaungon, Myaukmigon, Tittabwe.
29. *T.* (*Myurella*) *quettensis* Vred. Leptanzeik, Myaungu (low horizon), (?) Yenengyat, Singu; also in the Nari of Baluchistan.
30. *T.* (*Myurella*) *trizonata* Vred. Mekran beds.
31. *T.* (*Myurella*) *Tipperi* n. sp.

Group of *Terebra myuros* Lamarck.

32. *T.* (*Myurella*) *myuros* Lam., var. *obeliscus* n. var.
33. *T.* (*Myurella*) *butaciana* Martin. Dalabe, Myaukmigon.
34. *T.* (*Myurella*) *cingulifera* Lamarck (Cossmann, Journ. Conch., 1900, Vol. XLVIII, p. 28). Upper Tertiary of Karikal.

Group of *Terebra Stearnsii* Pilsbry.

35. *T.* (*Myurella*) *Oldhami* n. sp.

Group of *Terebra cancellata* Gray.

36. *T.* (*Myurella*) *intermedia* n. sp.

Group of *Terebra caliginosa* Deshayes.

37. *T.* (*Hastula*) *Hirasei* n. sp.
38. *T.* (*Hastula*) *Lepperi* n. sp.
39. *T.* (*Hastula*) *Sethuramæ* n. sp.

Group of *Terebra strigilata* [Linn.]

40. *T.* (*Hastula*) *calamaria* n. sp.

Group of *Terebra cinerea* Born.

41. *T.* (*Hastula*) *pectinata* n. sp.
42. *T.* (*Hastula*) *pagoda* n. sp.

Group of *Terebra Mayoi.*

43. *T.* (*Hastula*) *Mayoi* n. sp.
44. *T.* (*Hastula*) *tittabweensis* n. sp.

Group of *Terebra iravadica.*

45. *T.* (*Hastula*) *iravadica* n. sp.
46. *T.* (*Hastula*) *Stuarti* n. sp.
47. *T.* (*Hastula*) *continuicosta* Cossmann (Journ. Conch., 1900, Vol. XLVIII, p. 24, Pl. II, figs. 9, 10). Upper Tertiary of Karikal.

Species of uncertain affinities.

48. *T.* (*Hastula*) *Herklotsi* Martin, var. *arundinea.*

The forms occurring in the Nari, Gaj and Mekran beds of North-Western India are fully described in a volume of the Memoirs of the Geological Survey of India, at present in course of publication. The diagnoses of hitherto undescribed forms from the Tertiary of Burma are contained in the following pages.

TEREBRA DALABEENSIS n. sp.

Pl. X, fig. 1.

Except for its much smaller dimensions, this shell corresponds exactly with *Terebra Junghuhni* Martin, from the Tertiary formation of Java. Unless all the specimens be immature fragments, they must represent a different form, perhaps a premutation, which may provisionally be regarded as specifically distinct. The Burmese fossil is evidently an ancestral form of *Terebra dimidiata* [Linn.] with the earlier whorls of which it entirely agrees.

Occurrence.—Dalabe, Kyaungon.

TEREBRA (DUPLICARIA) THEOBALDI n. sp.

Pl. X, fig. 2.

This shell is closely related to *Terebra gedrosiana* Vred., from the Mekran beds of Baluchistàn, from which it is distinguished principally by its wider-spaced ribs. The vertical disposition of the ribs distinguishes it from *Terebra myaunguënsis* in which they are strongly oblique, and from *Terebra protoduplicata* in which, moreover, they become more crowded on the body-whorl upon which their spacing remains unaltered in the case of *Terebra Theobaldi*. The angular intervals between the ribs of *Terebra Theobaldi* distinguish it from *Terebra Smithi* Martin, in which these intervals are flat. Amongst living species, *Terebra Dussumieri* Kiener is very closely related, but grows to much larger dimensions.

Occurrence.—Kyudawon.

TEREBRA (DUPLICARIA) COTTERI n. sp.

Pl. X, fig. 3.

In shape, this shell comes very close to the living *Terebra duplicata* [Linn.], while the ornamentation of the circumsutural band closely recalls that observed in the living *Terebra Dussumieri* Kiener, the whorls of which are taller; both living species, moreover, growing to a larger size. The shell is perhaps to be regarded as a fossil precursor of *Terebra Dussumieri*.

Occurrence.—Mindegyi.

TEREBRA (DUPLICARIA) WOODWARDIANA Martin, var. MINDEGYIENSIS n. var.

Pl. X, fig. 4.

The smaller dimensions, on the supposition that the only available specimen is full-grown, constitute the only precise difference between this shell and *Terebra Woodwardiana* Martin, from the Tertiary formation of Java of which it may, provisionally, be considered as constituting a variety. The ribs, in the Burmese shell, are somewhat more numerous.

Compared with *Terebra protoduplicata*, this shell is distinguished by its more convex whorls, its broadly roof-shaped ribs, its narrower circumsutural band, and the delicate web of spiral markings.

Martin has compared *Terebra Woodwardiana* with the living *Terebra longiscata* Deshayes, the distinction from which, so far as can be made out from available figures and descriptions, somewhat lacks precision.

Occurrence.—Mindegyi.

TEREBRA (DUPLICARIA) MYAUNGUENSIS n. sp.

Pl. X, fig. 5.

The resemblance between this shell and *Terebra Woodwardiana* is so close as to justify a great deal of hesitation as to whether it should be specifically separated. The great obliquity of the ribs constitutes the only conspicuous difference which, however, is so evident that it may, provisionally, be regarded as sufficiently precise to constitute a specifically distinguishing character. The ribs are fewer than in the previously noticed variety *mindegyiensis*, in which character the shell approaches more closely to the Javanese type of *Terebra Woodwardiana.*

The obliquity of the ribs distinguishes this fossil from the living *Terebra longiscata* Deshayes, which has been compared by Martin with *Terebra Woodwardiana.*

Occurrence.—Myaungu, high horizon.

TEREBRA (SUBULA) COSSMANNI n. sp.

Pl. X, fig. 10.

This shell exhibits a certain superficial resemblance to *Terebra protoduplicata*, from which it is distinguished by its much more dimorphous and more complex ornamentation, its larger size, its anteriorly less contracted base. Compared with *Terebra Noetlingi*, it is smaller and more elongate.

Amongst living species, the one which it approaches nearest is *Terebra chlorata* Lamarck, which is larger and smoother. *Terebra senegalensis* Lamarck is also very closely related and may have the ribbed ornamentation persistent up to the body-whorl, but it also grows to considerably larger dimensions.

Occurrence.—Kyaungon, Tittabwe.

TEREBRA (MYURELLA) PROMENSIS n. sp.

Pl. X, fig. 6.

The great breadth of the circumsutural band of this shell, measuring half or nearly half the height of the whorls, is equalled only in certain varieties of *Terebra pretiosa* Reeve, which, moreover, closely resemble the Burmese fossil in their general outline, in the shape and proportions of their spire-whorls and body-whorl, and in the characters of their axial ornaments and of the crowded delicate wrinkled spiral lines crossing them, but which are distinguished by their much larger dimensions. The Burmese fossil is probably to be regarded as an ancestral premutation.

Occurrence.—Kyudawon; Myaungu, high horizon.

TEREBRA (MYURELLA) BIRMANICA n. sp.

Pl. X, fig 8.

Amongst hitherto described species of *Terebra*, there do not appear to be any, which combine the shape of this shell with a decoration so evenly and delicately trellised. This elegant shell seems related to *Terebra Cumingi*, with which it shares, to some extent, the glossy appearance of the surface, as though it had been dipped in gum or coated with a porcelain glaze.

Occurrence.—Dalabe.

TEREBRA (MYURELLA) KYUDAWONENSIS n. sp.

Pl. X, fig. 7.

Compared with *Terebra Martini* which it resembles, this species is smaller, more elongate, with much more prominent posterior bands, with more regularly distributed spiral ornaments on the anterior part of the whorls. Except for its small dimensions, it bears the closest resemblance to *Terebra triseriata* Gray, from the eastern seas, of which it may represent a premutation.

Occurrence.—Kyudawon.

TEREBRA (MYURELLA) MARTINI n. sp.

1879. *Terebra bicincta* Martin. Tertiärschichten auf Java, p. 33, pl. VI., fig. 13.
1900. *Terebra (Myurella) Cumingi* Desh. *sec.* Cossmann, Journ. Conch., Vol. XLVIII, p. 27, pl. II, fig. 18 (*non* fig. 14).
non Terebra bicincta Hinds, *Proc. Zool. Soc.*, 1843, p. 150.
non Strioterebrum bicinctum Mart. *sec.* Noetling, *Pal. Ind.*, new ser., 1901, Vol. I, part 3, p. 337, pl. XXII, fig. 15.

Compared with *Terebra bicincta* Martin (*non* Hinds) from the miocene formation of Java, the Burmese specimens usually exhibit, on the anterior portion of the whorls, somewhat more prominent axial folds than the Javanese type. The posterior band is usually somewhat less prominent in the Burmese shells, and the general shape is usually not so slender. Taking into consideration the degree of variability indicated by the numerous available specimens of the Burmese fossil, the differences seem insufficient for distinguishing them as a separate species. The specimens from Kyaungon agree especially closely with the Javanese type.

One of the specimens from the Tertiary formation of Karikal figured by Cossmann (fig. 18, *loc. cit.*) and referred to *Terebra Cumingi* Desh, also appears to be identical with the Burmese fossil under consideration. Anteriorly to the double circumsutural band, the above-mentioned Karikal specimen exhibits clearly only four spiral threads, while in the majority of the Burmese specimens, five are visible, and in some varieties, more. There are nevertheless also specimens from Burma in which only four spiral threads are clearly visible, and these entirely agree with the above-mentioned specimen from Karikal. The second specimen figured from Karikal (fig. 14, *loc. cit.*) represents a coarser-ornamented form, probably belonging to another species. These Karikal specimens lack the raised spiral lines of the circumsutural band, which form one of the most characteristic features of *Terebra Cumingi* and do not seem, therefore, to be referable to that species.

Amongst living forms, *Terebra Loebeckeana* Dunker, from Japan, seems related, but is distinguished by the presence, on the circumsutural band, of spiral striations which are not distinctly developed in the Burmese shell.

Occurrence.—Dalabe, Kyaungon, Myaukmigon, Tittabwe.

TEREBRA (MYURELLA) HORNELLI n. sp.

Pl. X, fig. 9.

Compared with *Terebra Martini*, this species, although of exactly the same length, is relatively somewhat narrower. It is distinguished by the structure of its circumsutural rim consisting of two equal main divisions, while in *Terebra Martini*, the posterior division greatly exceeds the anterior one in width. The spiral threads of the anterior portion of the spire-whorls are of much more uniform thickness in *Terebra Martini* than in *Terebra Hornelli*. On the anterior part of the spire-whorls, the axial ribs of *Terebra Hornelli* are more prominent and straighter than those of *Terebra Martini*. The nodes of the circumsutural rim do not tend to become effaced with increasing growth in *Terebra Hornelli* in the manner usually observed in *Terebra Martini*. Lastly, the base of *Terebra Hornell* does not exhibit the more or less abrupt effacement of the ornamentation observed in *Terebra Martini.*

Terebra pamotanensis Martin (*Samml. des. geol. Reichs.-Mus. in Leiden*, 1906, new series, Vol. I, p. 284, Pl. XLII, fig. 681) from the miocene beds of the neighbourhood of Gunung Butak in Java, is closely related to the Burmese fossil, but is distinguished by the more even size and more even distribution of the main spiral threads of the anterior part of the spire-whorls. It also lacks the subsidiary parting of the circumsutural rim. The living *Terebra torquata* Ads. and Reeve, as illustrated in Hirase's monograph (1917, Terebridæ of the Japanese Empire, p. 11, P. III, figs. 30-32) also closely resembles the Burmese fossil, but, like *Terebra pamotanensis*, is distinguished by its more regularly disposed ornamentation, while its spire also appears somewhat more broadly conical.

Occurrence.—Dalabe, Kyaungon, Myaukmigon, Thanga, Tittabwe.

TEREBRA (MYURELLA) EUGLYPTICA n. sp.

Pl. X, fig. 11.

In the absence of any distinct passage forms, this shell may provisionally be regarded as specifically distinct from *Terebra Hornelli*, compared with which it is distinguished by its smaller dimensions, its decidedly more crowded whorls, the broader more prominent posterior swollen band of which the anterior subdivision tends to split up posteriorly at a relatively early stage of growth, the shorter body-whorl, and, lastly, the more sharply defined ornamentation.

Occurrence.—Thanga, Tittabwe.

TEREBRA (MYURELLA) TIPPERI n. sp.

Pl. X, fig. 12.

Compared with *Terebra protomyuros*, this species is distinguished by the different proportion of its whorls, which are lower relatively to their width, by the more crowded axial ribs, the more regularly disposed spiral threads, and by the greater breadth and absence of prominence of the posterior differentiated band. It resembles *Terebra pamotanensis* Martin from the miocene of Java, but it has broader spiral threads relatively to the intervening spaces, more crowded axial ornaments, and is further distinguished by the three-fold division of its circumsutural rim, of which there is no indication in the Javanese shell.

Occurrence.—Myaukmigon.

TEREBRA (MYURELLA) MYUROS Lamarck, var. OBELISCUS n. var.

Pl. X, fig. 13.

In the recent examples of *Terebra myuros*, the posterior sub-zone of the circumsutural band still shows a slight tendency to form a circumsutural swelling, while both this zone and the second band anteriorly to the bounding furrow of the circumsutural band show a slight tendency to develope nodules in a manner which is not observed in any of the fossil specimens. In no instance does the circumsutural band, in the living form, become converted into a slope contracting towards the suture as in the fossil examples. These differences in structure of the circumsutural portion of the whorls, which are more pronounced in some specimens than in others are not sufficiently precise to constitute a specific distinction. On the body-whorl, the transition from the cylindrical outline of the portion corresponding with the spire to the convexity of the base is perhaps slightly less gradual in the living than in the fossil examples. The fossil may be regarded as a variety, or perhaps rather only as an extinct race of the living species.

Occurrence.—Kyaungon.

TEREBRA (MYURELLA) OLDHAMI n. sp.

Pl. X, fig. 14.

This beautiful shell is, perhaps, to be regarded as an ancestral form of the large *Terebra Stearnsii* Pilsbry, from Japan, the whorls of which are shaped and decorated in very much the same manner as in the Burmese fossil.

Occurrence.—Kyudawon.

TEREBRA (MYURELLA) INTERMEDIA n. sp.

Pl. X, fig. 16.

?1900. *Terebra* (*Myurella*) *cancellata* Quoy *sec.* Cossmann. Journ. Conch., Vol. XLVIII, p. 26, Pl. II, figs. 6-8.

Much hesitation is felt in attempting to classify this shell. It combines the spiral ornamentation of *Myurella* with the feeble terminal notch and non-bulging terminal zone of *Hastula.* It possesses a circumsutural band like *Myurella,* but the furrow limiting this band is completely bridged over by the axial ribs. Moreover, although this posterior furrow is supposed to be characteristically absent in *Hastula,* a careful inspection will soon show that its absence is neither complete nor invariable amongst species which are undoubtedly referable to that sub-genus. The specific name has been suggested by these characters which appear to be quite intermediate between those of *Hastula* and those of the *Myurella* section of *Terebra.*

This shell does not seem specifically distinguishable from a Karikal fossil which Cossmann (*loc. cit*) has referred to the living *Terebra cancellata* Quoy and Gaimard. In the Karikal shell, the spiral ornaments, instead of becoming more crowded towards the anterior margin of the spire-whorls as in the Burmese specimens, either remain even-spaced, or the spacing may expand. The circumsutural ridge is a little broader in the Karikal shell than in the Burmese specimens, usually more distinctly striated, and the bounding furrow is somewhat more continuous though still bridged over by the ribs. All the other characters of shape, size and ornamentation are identical, and the differences above-mentioned seem insufficient for establishing any specific distinction. All these fossils, whether from Karikal or from Burma, scarcely attain half the dimensions of the living *Terebra cancellata,* and, unless all the specimens be regarded as immature, their specific identity with the living form seems improbable. The same difference in size distinguishes the Burmese shell from the living *Terebra Fortunei.* Desh., which it otherwise resembles.

Occurrence.—Dalabe, Myaukmigon.

TEREBRA (HASTULA) HIRASEI n. sp.

Pl. X, fig. 18.

Except for its much smaller dimensions, this shell entirely agrees with an unnamed species from Japan published in 1917 by Hirase (Terebridæ of the Japanese Empire, p. 15, Pl. VII, figs. 111, 112). The Burmese shell is evidently a precursor of the recent species. Another closely related species is *Terebra caliginosa* Deshayes, from the eastern seas, which, apparently, lacks the spiral ornaments.

Occurrence.—Dalabe, Thanga, Tittabwa.

TEREBRA (HASTULA) LEPPERI n. sp.

Pl. X. fig. 15.

This shell exhibits the closest resemblance to *Terebra Hirasei*, of which it should, perhaps, be regarded as a variety, but from which it is distinguished by its smaller dimensions, its rather more abruptly contracted base accounting for the relatively smaller size of the aperture, the somewhat different shape of the whorls the greatest thickness of which is nearer to the posterior than to the anterior margin, while, in *Terebra Hirasei*, the convexity of the whorls is more even and their greatest thickness is situated at half their height or nearer to the anterior margin. The spiral ornaments are more crowded in *Terebra Lepperi* than in *Terebra Hirasei*, the raised ornaments exhibiting more of the ordinary appearance of spiral threads instead of forming flattened ribbon-like bands as in *Terebra Hirasei*. The circumsutural band is much more distinctly marked off in *Terebra Hirasei*, in which its distinctness increases with growth, than in *Terebra Lepperi*, in which, on the contrary, it becomes more indistinct on the later whorls.

Occurrence.—Dalabe, Kyaungon, Myaukmigon, Thanga.

TEREBRA (HASTULA) SETHURAMÆ n. sp.

Pl. X, fig. 17.

This shell closely resembles *Terebra Hirasei*, from which it is distinguished by its smaller dimensions, its relatively shorter whorls and shorter base, and its much more pronounced posterior furrow. *Terebra Woodwardiana* Martin from Java (*Samml. des geol. R.-Mus. in Leiden*, Ser. 1, Vol. III, p. 73, Pl. V, fig. 76) exhibits some superficial resemblance, but carries, on the circumsutural band, spiral striations, of which there is no indication in the Burmese shell.

Occurrence.—Thanga, Tittabwe.

TEREBRA (HASTULA) CALAMARIA n. sp.

Pl. X, fig. 19.

This shell is closely related to *Terebra strigillata* [Linn.] which is relatively broader. *Terebra nitida* Desh. is also related, but carries thicker ribs. The ribs, on the contrary, appear to be more delicate in *Terebra cuspidata* Hinds and *T. Trailli* Desh., which are further distinguished by their somewhat smaller dimensions.

Occurrence.—Dalabe.

TEREBRA (HASTULA) PECTINATA n. sp.

Pl. X, fig. 20.

The ornamentation of this shell, recalling the appearance of a combed fleece or mass of hair is characteristic. The shell bears the closest resemblance to the living *Terebra acuminata* Gray, the *habitat* of which is unknown. In *Terebra acuminata*, the ribbed decoration is restricted to the posterior border of the whorls, the anterior portion of which is smooth. According to Tryon, *Terebra acuminata* together with a host of other forms, should be regarded as specifically identical with the much larger *Terebra cinerea*, in which the base is much shorter and much more abruptly contracted than in *Terebra acuminata* and in the Burmese shell, while the ornamentation extends throughout the entire height of the whorls and is identical with that of the Burmese fossil. If the view of the specific identity of *Terebra acuminata* and *Terebra cinerea* be accepted, the fossil equally cannot be considered to be specifically distinct, and must be regarded as a variety of *Terebra cinerea* combining the ornamentation of that large form with the shape and smaller dimensions of *Terebra acuminata.*

Occurrence.—Myingabaing.

TEREBRA (HASTULA) PAGODA n. sp.

Pl. X, fig. 21.

No other species appears to have been described in which the same ribbed decoration is combined with such tall, narrow whorls, with so straight an outline. Amongst living species, somewhat recalling this shell by their tall spire-whorls, are *Terebra bacillus* Deshayes, from the Hawaiian Islands, *T. apicina* Deshayes, from Singapore, *T. cuspidata* Hinds, from South Africa. In all these species, however, the whorls are more distinctly convex, and the ribbing is restricted to the posterior margin.

Occurrence.—Kyaungon, Tittabwe.

TEREBRA (HASTULA) MAYOI n. sp.

Pl. X, fig. 22.

Small-medium, slender, with elongate conical spire measuring three-fourths of the total height.

The apex is missing. The number of whorls following the protoconch is probably about thirteen. Their height is equal to two-thirds of their width. The whorls exhibit an extremely shallow posterior concavity and anterior convexity, scarcely perceptible, so feeble that they practically do not interfere with the steeply conical shape of the whorls, the posterior margin of which fits so tightly round the preceding whorl that the surface is not stepped at the sutures, and the conical outline of the spire is remarkably even. The linear sutures are slightly incised. A discontinuous, rather inconspicuous and rather shallow furrow determines the formation of a posterior zone measuring somewhat more than one-third of the height of the whorls. The whole surface is divided into flat spiral bands by spiral incisions. On the circumsutural zone, throughout the greater portion of the spire, there are four equidistant spiral incisions dividing the surface into five bands, of which the one nearest the suture is very narrow, while the remainder are broader and all equal. Anteriorly to the main furrow, the spiral incisions are so disposed that, at intermediate stages of growth, there are, about the middle of the whorls, four relatively broad bands, broader than those of the circumsutural zone, while, along the zone bordering the anterior margin, there are four more bands narrower than those of the posterior circumsutural zone. These four anterior narrow bands result from the breaking up of two bands of relatively double their width occupying the same position on the earlier whorls. Towards the end of the last spire-whorl, the broad bands of the middle portion of the whorls and the two anterior bands of the circumsutural zone, also tend to become each subdivided by a median furrow. All the spiral features, whether raised or sunken, are interrupted by very narrow, wide-spaced axial ridges stretching from suture to suture, and very slightly thicker along the posterior circumsutural zone than in the other parts of their course. Their general direction is vertical, and they exhibit a very stiff sigmoidal curvature of which the point of inflection is at the level of the boundary furrow of the posterior circumsutural zone, the forward-facing convexity of the ridges corresponding with the portion situated on that circumsutural zone, the remaining portion exhibiting a forward-facing concavity; the curves being so disposed that the posterior termination of the ridges is normal to the posterior suture, their anterior termination very steeply antecurrent to the anterior suture. The intervals between the ribs are occupied by extremely crowded fine lines of growth, especially visible where they cross the spiral furrows.

The body-whorl measures two-sevenths of the total height. Anteriorly to the level of the suture it contracts with a somewhat ovoidal convexity, inflected anteriorly into a concavity which carries the outline into a vertical direction at its junction with the non-projecting, feebly differentiated zone of accretions to the shallow terminal notch which is bounded posteriorly by a feebly prominent, rather ill-defined, slightly angulated bulge. The ornamentation of the last spire-whorl is continued on the corresponding part of the body-whorl with an accentuation of the above-described bifurcation of some of the broader bands, the subdivisions of which now become practically independent, so that, with the exception of the portion nearest the suture, the greater part of the body-whorl appears to be ornamented with very narrow spiral bands separated by incised lines, the same spiral decoration being continued, anteriorly to the level of the suture, all over the base as far as the boundary of the terminal zone, with only occasionally a band a little broader than the remainder. The furrow bounding the circumsutural band becomes practically undistinguishable from the other spiral incisions on the body-whorl. The axial ribs disappear almost immediately beyond the level of the suture, the base, up to the border of the terminal zone, bearing in addition to the already described spiral ornaments, only some obscure lines of growth, recurved, and gradually receding anteriorly. The terminal zone carries a few fine, raised spiral lines, much narrower than the intervening spaces, crossed by crowded lines of growth, concave towards the extremity of the shell.

The aperture is posteriorly angulated. The columella is connected at an angle of 135° with the base of the penultimate whorl, anteriorly to which, for a considerable portion of its course, it is vertical, and afterwards bends into a somewhat convex extension, steeply oblique, towards the left of the shell, corresponding with the steeply and moderately twisted, rather blunt terminal edge. Internally the inward extension of the columella carries a very thin, but at the same time very sharply defined spiral ledge, close to the inward continuation of the anterior twist, which does not correspond with any external feature. The columellar lip is fairly thick, with a well defined edge, slightly expanded posteriorly over the base. The outer lip is normal to the suture and nearly vertical.

Dimensions,

	mm.
Height	36
Thickness	6
Height of spire	28
Height of body-whorl	11

Occurrence.—Tittahwe.

REMARKS.—It has been necessary to give the foregoing description in full, because, amongst hitherto described species, there do not appear to be any that combine the various characters of this shell, which I have much pleasure in dedicating to the Burmah Oil Company's geologist Mr. H. Mayo.

TEREBRA (HASTULA) TITTABWEENSIS n. sp.

Pl. X, fig. 23.

This shell is very closely related to the above-described *Terebra Mayoi*, though, in the absence of any connecting links, it must be provisionally regarded as a separate species distinguished by its more sharply defined posterior furrow, its wider-spaced ribs, its crowded spiral striations, even at early stages of growth. Externally it bears some resemblance to *Terebra Lepperi*, from which it is distinguished by its feebly uniplicate columella, that of *Terebra Lepperi* being strongly biplicate.

Occurrence.—Tittabwe.

TEREBRA (HASTULA) IRAVADICA n. sp.

Pl. X, fig. 24.

Small, elongate, with slender conical spire measuring four-fifths of the total height.

The apex is missing. The number of spire-whorls following the protoconch is probably about twelve. Their height is equal to two-thirds of their width, They are slightly convex, separated by linear sutures. A well marked though somewhat interrupted furrow demarcates a posterior circumsutural band measuring one-third of the height of the whorls. Anteriorly to the circumsutural band, the surface carries seven spiral threads, somewhat broader than the intervening spaces, either evenly distributed, or else gradually wider-spaced towards the anterior margin. Four more, rather narrower and rather less distinct threads decorate the circumsutural band, two corresponding respectively with its anterior and posterior margins, and two intermediate ones. With the exception of the boundary furrow of the circumsutural band, all the other spiral features, whether raised or sunken, are interrupted by a set of prominent, ridge-like, narrow, rather wide-spaced axial ribs, which, although they bridge across the posterior main furrow, are nevertheless depressed at its intersection. They are slightly thicker on the posterior band than on the remainder of the surface. They are slightly oblique on the circumsutural band, steeply antecurrent to the suture. On the anterior surface they exhibit a very shallow curvature with forward directed concavity, practically continuous at first, across the main furrow, with the oblique direction, which the ribs follow on the circumsutural band, while anteriorly, the slight curvature carries them first into a vertical trend and finally into a slight obliquity in the opposite direction, so that they finally reach the anterior margin with a steeply antecurrent obliquity. The ribs exhibit a slight tendency to become crowded towards the termination of the spire.

The body-whorl measures one-third of the total height. Anteriorly to the level of the suture, it contracts with an ovoid convexity, the curvature of which stiffens anteriorly, and may reach the feebly differentiated zone of accretions of the terminal notch either with a still contracting oblique trend, or else with a slight concave inflection, by means of which it may just reach verticality. A feebly raised rim posteriorly bounds the rather steeply winding, scarcely projecting terminal zone. The decoration of the last spire-whorl is continued on to the corresponding portion of the body-whorl. Just beyond the level of the suture the ribs vanish, so that almost the entire base up to the terminal zone is perfectly smooth.

The aperture is narrowly angulated, slightly channelled posteriorly. The columella, straight and practically vertical until it bends into the terminal twist close to its termination, forms an angle of 130° with the base of the penultimate whorl. Its inward extension exhibits one thin. feeble spiral fold close to the anterior twist. The columellar lip is slightly thickened, slightly expanded posteriorly over the base. The outer lip is steeply antecurrent to the suture, anteriorly to which it recedes with a steep obliquity.

Dimensions.

	mm.
Height	26
Thickness	5
Height of spire	20
Height of body-whorl	8

Occurrence.—Kyaungon, Tittabwe.

Comparison with other species.—There do not appear to be any forms closely related to this shell amongst hitherto described species of the sub-genus *Hastula*. *Terebra textilis* Hinds bears a somewhat similar decoration, but it has a shorter base and belongs to a different group.

TEREBRA (HASTULA) STUARTI n. sp.

Pl. X, fig. 25.

This shell is related to *Terebra iravadica*, but it is larger, somewhat more slender, and with a different character of the ornamentation, especially as regards the spiral decoration consisting of mere incisions, few in number, separating broad flat bands, instead of the well-defined, crowded spiral threads of *Terebra iravadica*. *Terebra continuicosta* Cossmann, from the Tertiary beds of Karikal, is not unlike *Terebra Stuarti*, but it has a broader circumsutural band and wider-spaced ribs.

Occurrence.—Kyudawon.

TEREBRA (HASTULA) HERKLOTSI Martin, var. ARUNDINEA n. var.

Pl. X, fig. 26.

1879. *Terebra Herklotsi* Martin.—Tertiärschichten auf Java, p. 34, pl VI., fig. 14.

On the supposition that this shell may have been nearly full-grown, the Burmese form would be distinguished from the Javanese type of *Terebra Herklotsi* by its much smaller dimensions, on which account it may provisionally be regarded as a distinct variety. In every other character but that of size, it agrees with the description and figure published by Prof. Martin.

Occurrence.—Dalabe.

The admirable photographs illustrating these notes have been prepared in the office of the Zoological Survey of India by S. C. Mondul with the kind permission of Dr. N. Annandale to whom I wish to express my heartiest gratitude. The original photographs as well as the beautiful photogravure reproduction prepared by the Survey of India are entirely free from retouch.

EXPLANATION OF PLATE X.

FIG. 1.—Terebra dalabeensis n. sp. Dalabe. $\frac{2}{1}$.

FIG. 2.—Terebra (Duplicaria) Theobaldi n. sp. Kyudawon. $\frac{2}{1}$.

FIG. 3.—Terebra (Duplicaria) Cotteri n. sp. Mindegyi about 1,000 feet above base of exposed section. $\frac{1}{1}$.

FIG. 4.—Terebra (Duplicaria) Woodwardiana n. sp. Martin, var. mindegyiensis. Mindegyi, about 2,800 feet above base of exposed section. $\frac{2}{1}$.

FIG. 5.—Terebra (Duplicaria) myaunguensis n. sp. Myaungu, high horizon.

FIG. 6.—Terebra (Myurella) promensis n. sp. Kyudawon. $\frac{2}{1}$.

FIG. 7.—Terebra (Myurella) kyudawonensis n. sp. Kyudawon. $\frac{3}{1}$.

FIG. 8.—Terebra (Myurella) birmanica n. sp. Dalabe. $\frac{2}{1}$.

FIG. 9.—Terebra (Myurella) Hornelli n. sp. Thanga. $\frac{2}{1}$.

FIG. 10.—Terebra (Subula) Cossmanni n. sp. Kyaungon. $\frac{2}{1}$.

FIG. 11.—Terebra (Myurella) cuglyptica n. sp. Thanga. $\frac{2}{1}$.

FIG. 12.—Terebra (Myurella) Tipperi n. sp. Myaukmigon. $\frac{2}{1}$.

FIG. 13.—Terebra (Myurella) myuros Lamarck, var, obeliscus. Kyaungon. $\frac{1}{1}$.

FIG. 14.—Terebra (Myurella) Oldhami n. sp. Kyudawon. $\frac{2}{1}$.

FIG. 15.—Terebra (Hastula) Lepperi n. sp. Thanga. $\frac{2}{1}$.

FIG. 16.—Terebra (Myurella) intermedia n. sp. Myaukmigon. $\frac{2}{1}$.

FIG. 17.—Terebra (Hastula) Sethuramæ n. sp. Tittabwe. $\frac{2}{1}$.

FIG. 18.—Terebra (Hastula) Hirasei n. sp. Tittabwe. $\frac{2}{1}$.

FIG. 19.—Terebra (Hastula) calamaria n. sp. Dalabe. $\frac{2}{1}$.

FIG. 20.—Terebra (Hastula) pectinata n. sp. Myingabaing. $\frac{2}{1}$.

FIG. 21.—Terebra (Hastula) pagoda n. sp. Tittabwe. $\frac{2}{1}$.

FIG. 22.—Terebra (Hastula) Mayoi n. sp. Tittabwe. $\frac{2}{1}$.

FIG. 23.—Terebra (Hastula) tittabweensis n. sp. Tittabwe. $\frac{2}{1}$.

FIG. 24.—Terebra (Hastula) iravadica n. sp. Tittabwe. $\frac{2}{1}$.

FIG. 25.—Terebra (Hastula) Stuarti n. sp. Kyudawon. $\frac{2}{1}$.

FIG. 26.—Terebra (Hastula) Herklotsi n. sp. Martin, var. arundinea. Dalabe. $\frac{2}{1}$.

INDIAN FOSSIL VIVIPARAE. BY N. ANNANDALE, D.SC., F.A.S.B. *Zoological Survey of India.* (With Plate 11).

IN a recent paper[1] I discussed the fossil Viviparidæ of Upper Burma and compared them with their living representatives from the same country and with similar forms from other regions and epochs. I had not seen Mons. H. Mansuy's[2] interesting account of fossil species of the family from a lacustrine basin in Yunnan, but Mr. Vredenburg has now been kind enough to call my attention to it and I am glad to find that the French author and I, working independently, have come to very similar conclusions as to the evolution of highly sculptured shells in such genera as *Taia* and *Margarya*. There is, however, one point in my own paper on which additional information, only quite recently available, leads me to think that I expressed too confident an opinion, namely that the nodulose, squamose or even spinose sculpture in the shells of such species was derived from smooth spiral ridges. I was led to this view by the fact that in *Taia theobaldi*, which is in some respects the most primitive form in its genus, the spiral ridges on the shell are nearly smooth; but even in this species they are not absolutely so, and it inhabits an environment (running water in small streams) in which entirely primitive types rarely occur. Moreover, the smooth, hollow ridges on such a shell as that of *Vivipara oxytropis* (Benson) are associated, as I hope to show shortly in a more appropriate place, with an entirely different type of mantle-structure from that correlated with the shell-sculpture of *Taia* and *Margarya*. Indeed, in the Viviparidæ with highly sculptured shells we find three types of sculpture, the nodular, the solid linear, and the hollow linear and they are not homologous, probably not even analogous.

The fossil shells of *Vivipara* from Peninsular India and Baluchistan in the collection of the Geological Survey of India are of late cretaceous, tertiary and quarternary age, but the specimens are few. They have not the superficial interest of the peculiar Burmese forms, but are probably of no less importance, in proving that the

[1] Annandale, *Rec. Geol. Surv. Ind. L*, p. 209 (1919).
[2] Mansuy, *Bull, Serv. Geol. de l'Indo-China V*, fasc. 3 (1918).

Indian Viviparidæ have undergone very little outward modification since late cretaceous times and that, so far as the evidence at present available goes, have never developed shells with prominent sculpture.

In describing and discussing these species a question of some little difficulty has first to be answered : Which of the Intertrappean species assigned by Sowerby[1] and Hislop[2] to the genus *Paludina* really belong to the Viviparidæ ? In the collection before me I can find only one that I believe to do so, namely *Vivipara normalis* (Hislop). A few others (*e.g.*, Hislop's *Paludina rawlesi*) may possibly do so, or may even represent connecting links between the Viviparidæ and the Hydrobiidæ ; but such questions I must leave to Colonel Godwin-Austen, who tells me that he proposes to re-describe Hislop's species and other molluscs from the Intertrappean beds. If I am right as to the position of *V. normalis*, I have seen only four fossil species from any part of the Indian Empire that can be referred to *Vivipara.* They are :—

Vivipara normalis (Hislop).	Intertrappean (late cretaceous) beds of the Central Provinces of India.
Vivipara bugtica (Blanford).	Oligocene or miocene beds of the Gaj stage in the Bugti Hills, Baluchistan.
Vivipara atavia sp. nov.	Same beds in the Bugti Hills.
Vivipara bengalensis (Lamarck).	Alluvium of the Narbada and the Ganges ; recent all over India east of the Indus.

The most interesting of these species is perhaps *V. atavia* as it appears to have given rise with very little modification to a species still living in the inland delta of the Helmand.

VIVIPARA NORMALIS (Hislop).

1860. *Paludina normalis*, Hislop, *Quart. Journ. Geol. Soc., London*, XVI, p. 166, pl. v, figs. 2a, 2b.

I have examined a large number of specimens, including several presented by Hislop himself, but unfortunately they are all casts and none show the true structure of the mouth. So far as can be seen, the shell differed little from species still common in the

[1] Sowerby, *Trans. Geol. Soc. London*, 2nd Ser., V, pl. xlvii (1840).
[2] Hislop, *Quart. Journ. Geol. Soc. London*, XVI, p. 166 (1860).

same districts and belonging to the group of *Vivipara dissimilis* (Müller).

According to Hislop the fossil is found rarely at Karwad and more abundantly at Takli and Phizdura.

VIVIPARA BUGTICA (BLANFORD).

1883. *Paludina bugtica*, Blanford, *Mem. Geol. Surv. Ind.* XX, p. 131, pl. i, figs. 6, 7.

In addition to two cleaned specimens labelled "type" and evidently those figured by Blanford, there is a large series in the Geological Survey, all collected by the author of the species at Gandoi in the Bugti Hills and some of them still in the original matrix. Blanford believed them to be lower miocene, and Pilgrim[1] has shown that they belong to a fluviatile facies of the Gaj stage, which in the same locality has yielded numerous vertebrate fossils.

The species seems to belong to the same group as *V. normalis*, but the shell is narrower and less acuminate. I have nothing to add to the original description.

VIVIPARA ATAVIA sp. nov.

Pl. XI, figs. 1, 2.

A species closely allied to the living *V. helmandica*, Annandale[2] from Seistan, Eastern Persia.

The shell is short and broad, about 20-25 mm. high and 1¼ times as high as the maximum diameter, acuminate, with 4½ or 5 whorls. The whorls of the spire increase in size gradually and evenly; the body-whorl is a little higher than the spire. None of the whorls are swollen or oblique, but the suture, though linear, is impressed and the surface convexly and narrowly flattened outside it. The aperture seems to have been broadly oval and very little or not at all pointed above, but is incomplete in the specimens examined. The umbilicus was probably closed or rimate. The ventral surface of the body-whorl is more convex than the dorsal and evidently receded abruptly below the umbilicus. There is no trace of angulation or carination on this whorl. The external sculpture has entirely disappeared.

Type-specimen.—K 11—812 *G. S. I.*

[1] Pilgrim, *Rec. Geol. Surv. Ind.* XXXVII, p. 142 (1908).
[2] Annandale, *Rec. Ind. Mus.* XIX, p. 114 (192

Material.—The species is described from two specimens, both incomplete, collected by Dr. Guy Pilgrim at Kumbhi in the Bugti Hills, Baluchistan. They occurred in the freshwater beds of the Gaj stage, which Pilgrim[1] from determination of their contained vertebrates correlates with the upper Aquitanian stage of the European oligocene.

The two shells, though broken, are well preserved as to the greater part of their structure. The original shell-substance has been replaced by a hard crystalline stone of a creamy tint. In the aperture of one of them there is a plate that at first sight seems to represent a testaceous operculum, but it has no visible structure. In recent shells of *V. helmandica* dug from mud impregnated with salts in the Seistan desert I have observed a hard deposit on the outer surface of the true horny operculum, which is unusually thin, and I have little doubt that the plate in the fossil specimen had a similar origin.

Affinities of the species.—Had the two fossil shells been recent, I would have had no hesitation in referring them to *V. helmandica*, but as there are certain small differential characters it seems best not to assume a specific identity without further evidence. These characters are the less swollen whorls and the smaller relative size of the penultimate whorl. They are to some extent variable in the living species, but in a large series of shells from Seistan I can find none that agree precisely with the fossils. *V. atavia* has been confused in the collection of the Geological Survey of India with *V. bugtica* (Blanford); but the shell is very different in shape, being much broader and in many respects more like the species that are now found living in the extreme north-west of India and in Eastern Persia.

VIVIPARA BENGALENSIS (Lamarck).

Pl. XI, figs. 5-7.

1822. *Paludina bengalensis*, Lamarck, *Anim. sans Vertèbres* VI, (2), p. 174.
1860. *Paludina bengalensis*, Theobald, *Mem. Geol. Surv. Ind.* II, p. 284.
1920. *Vivipara bengalensis*, Annandale, *Rec. Ind. Mus.* XIX, p. 112.

This is at present the dominant species in the Ganges valley and has many races and phases in different parts of the plains of the Indian Empire west of the Indus. It belongs to a different group from the other Indian recent and fossil forms and is more closely

[1] Pilgrim, *Rec. Geol. Surv. Ind.* XXXVII, p. 142 (1908) and XLIII, p. 264 (1913).

allied to those found in the Palæarctic Region. Possibly the group has reached India only since the present formation of the country was assumed, and no shells belonging to it have been found except in recent or subrecent deposits.

There are, however, three sets of specimens in the collection of the Geological Survey that have been referred, I think rightly, to *V. bengalensis*. The particulars are as follows:—

The oldest in appearance consists of a single imperfect shell labelled "Kolar Range; recent alluvium. Rev. S. Hislop." The greater part of the shell-substance has been almost entirely replaced by a hard crystalline deposit, but some of the former apparently persists in the columellar region, which is very imperfect. There are 5½ whorls and the outline, so far as it can be seen, seems to be rather more cylindrical than it is in most living forms of the species. The penultimate whorl is large and swollen as in Kobelt's var. *nepalensis* from the Eastern Himalayas.

The second series includes five shells in excellent preservation and is labelled "Pleistocene. Narbudda. Hacket." Theobald has recorded the existence of two forms of the species in alluvial deposits on the Narbada and it is probable that these shells belong to the larger form to which he refers. The specimens differ considerably from most recent shells in their thickness, strong vertical sculpture, elongate shape and wide umbilicus. They agree, however, very closely in these and other respects with two shells I once found on the sea-shore at Puri. The latter were evidently from a series of pools in the bed of a small stream of fresh water the mouth of which was temporarily blocked by sand. Their surface was fairly fresh and there was no reason to regard them as anything but quite recent. Had these two shells and those from the Narbada deposits stood alone, I would have been prepared to regard them as representing a species distinct from *V. bengalensis*, but there are in the Indian Museum two large series of recent shells from widely separated parts of Peninsular India that render this course impossible. All these specimens agree with those from Puri in the thickness of the shell, but they vary widely both in general outlines and in the form of the umbilicus, providing a complete transition to the typical *bengalensis* in every character except that of thickness of shell. These specimens are from Poona and from the Karnul district of Madras.

I propose for the large elongate phase from Puri and the Narbada the new name "phase *pachydolicha.*"

The third series of shells of *V. bengalensis* in the collection of the Geological Survey was dug up under Clive Street in Calcutta and is probably not at all ancient. The shells are thin and small and represent a type by no means uncommon in ponds of very slightly brackish water in the delta of the Ganges. These specimens are certainly recent. They are from the deposit in which the large oyster called *Ostræa gryphoides* by Newton and Smith[1] also occurred.

[1] Newton & Smith, *Rec. Geol. Surv. Ind.* XLII, p. 1 (1912). See also Vredenburg, *ibid.*, Vol. XXXI, p. 174 (1904) and Annandale, Vol. XXXVII, p. 221 (1908).

EXPLANATION OF PLATE XI.

(All the figures are from direct photographs of natural size.)

Vivipara atavia sp. nov.

FIG. 1.—Type specimen from the miocene beds of the Bugti Hills, Baluchistan.

FIG. 2.—Another specimen from the same locality and horizon, showing the apparent presence of a testaceous operculum.

Vivipara helmandica Annandale.

FIG. 3.—Small shell from the recent alluvium of the Helmand, Seistan, Eastern Persia, showing the thin horny operculum covered with a deposit of caked mud and salt.

FIG. 4.—Larger shell (co-type) from the same locality.

Vivipara bengalensis phase *pachydolicha*, nov.

FIGS. 5, 6.—Shells from the alluvium of the Narbada.

FIG. 7.—Fresh shell from Puri, Orissa.

ON A NEW FOSSIL UNIONID FROM THE INTERTRAPPEAN BEDS OF PENINSULAR INDIA. BY B. PRASHAD, D.Sc., *Zoological Survey of India, Calcutta.* (With Plate 12, figs. 1, 2.)

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WHILE examining the fossil Indian Unionidæ in the collection of the Geological Survey of India I found a well preserved specimen labelled "*Pisidium medlicottianum*, Hislop" and collected at Goraha, Narbada from the Intertrappean beds of Peninsular India. This specimen does not belong to the genus *Pisidium* and has no relationship with *P. medlicottianum*, Hislop,[1] but is a true Unionid and should be assigned to the genus *Lamellidens*, Simpson. The shell is probably a young one, but is of particular interest in that it is the first fossil representative of the genus *Lamellidens* hitherto recorded. The fossil belongs to a new species, and I have great pleasure in associating it with the name of Mr. E. W. Vredenburg of the Geological Survey of India who has given me all facilities for going through the fossil Unionidæ under his care, and in recognition of the help he has given me in looking up the geological literature on the subject.

The genus *Lamellidens* is represented by a large number of species in South East Asia and is one of the dominant genera of Unionidæ in India. The find of a fossil specimen from the Intertrappean horizon is specially interesting in that it throws some light as to the probable time when the genus *Lamellidens* was evolved from the genus *Unio* (*sensu lato*). It also shows the direct relationship of the freshwater fauna of the late cretaceous times in Peninsular India and that which still occupies the same territory. *L. vredenburgi* from its very primitive characters appears to come near the ancestral species from which the other more highly specialized present day forms have been evolved.

LAMELLIDENS VREDENBURGI sp. nov.

Pl. XII, figs. 1, 2.

Shell elongate, subrhomboidal, fairly thick, somewhat convex, subequilateral with an extremely narrow posterior wing, greatly

[1] Hislop, *Quart. Journ. Geol. Soc., London*, XVI, p. 181, pl. x, figs. 65 a-c (1860).

depressed below, umbones rather imperfectly preserved, but distinctly showing their somewhat elevated character, eroded; surface with fine concentric ridges all over the surface; posterior ridge nearly straight, high, broadly rounded to the more or less regular curve of the posterior margin; anterior side somewhat angulate above, rapidly curving in after a short straight course to the ventral surface which is slightly curved; upper surface curved but having a distinct angle of 130° about the middle in the umbonal region. Hinge unknown.

The unique type-shell measures 25·1 mm. in length by 15 mm. in height and 7·3 mm. in maximum thickness.

The above description is drawn from the single nearly perfect shell consisting of both the valves united, and numbered K1-464 in the registers of the Geological Survey of India from Goraha, Narbada.

Remarks.—The species, though nearly related to the living forms *L. marginalis* (Lam.) and *L. corrianus* (Lea)[1], differs from either in shape, in the umbones being more prominent and the upper surface being more angulate. As already remarked it seems to come very near the ancestral form of the living species.

[1] See Simpson, *Descriptive Catalogue of the Naiades*, Detroit, Michigan, pp. 1160, 1175 (1914), and Annandale and Prashad *Rec. Ind. Mus.* XVIII, p. 59, pl. iii, fig. 11.

EXPLANATION OF PLATE XII.

FOSSIL UNIONIDÆ FROM INDIA AND BURMA.

Lamellidens vredenburgi Prashad.

FIG. 1.—Dorsal view of the type-specimen. × 1½

FIG. 2.—Ventral view of the same. × 1½

Indonaia glyptica Vredenburg and Prashad.

FIG. 3.—Left valve of the type-specimen.

FIG. 4.—Left valve of a young specimen.

FIG. 5.—Left valve of a young specimen (× 2), showing the umbonal sculpture.

FIG. 6.—Photograph of a young specimen from above, showing the umbones and the ligament.

FIG. 7.—Fragment of a right valve, showing the cardinal and a portion of the lateral teeth.

FIG. 8.—Fragment of a left valve, showing the hinge.

FIG. 9.—An incomplete left valve, showing the lateral tooth.

Parreyssia latouchei Vredenburg and Prashad.

FIG. 10.—Left valve of the type-specimen.

FIG. 11.—Left valve of a large specimen, showing the remains of sculpture.

FIG. 12.—Left valve of a rather incomplete young specimen (× 2), showing the sculpture on the surface.

FIG. 13.—Photograph of the type-specimen from above, showing the umbones and the ligament.

UNIONIDÆ FROM THE MIOCENE OF BURMA. BY E. VREDENBURG, *Geological Survey of India* AND B. PRASHAD, D.SC., *Zoological Survey of India.* (With Plate 12, figs. 3—13).

IN the present communication, we deal with certain freshwater fossil Unionidæ from Burma, specimens of which were some years ago for the first time forwarded for identification, to the Geological Survey of India by Mr. Macrorie. They were obtained from the Irrawadi Series amongst strata which are probably of uppermost miocene (pontian) age at Chaunggyauk (19° 42′, 95° 24′). Latterly the locality was visited by Rao Bahadur Sethu Rama Rau, of the Geological Survey of India, who observed the same fossils both at this place and at Didokpin, about six miles north-west of Chaunggyauk, where the same fossiliferous bed reappears.

At Chaunggyauk, the fossiliferous bed also contains in great abundance a large Melaniid which Dr. Annandale regards as a variety of the living *Acrostoma variabile* (Benson), one of the commonest and most characteristic species amongst the freshwater gastropods of Burma.

As the Chaunggyauk specimens include the first fossil Unionidæ that have as yet been recorded from Burma, we have thought it desirable to describe them in order to facilitate future work on this interesting group of Indian Mollusca. We have further been led to this decision by the excellent condition of preservation of the fossils and of their sculpture, as also of the hinge-teeth of one of the forms.

Apart from some imperfectly known occurrences in the sub-Himalayan Siwaliks recorded by Forbes (in Falconer's Palæontological Memoirs, Vol. I, p. 389), the only pre-quaternary geological formations that have so far yielded specimens of Unionidæ in India, are the Intertrappeans, of uppermost cretaceous age, in the Peninsula[1] and the lower miocene Bugti-beds of Baluchistan.[2] In neither case do the fossils resemble the Burmese specimens, but the exact

[1] See Hislop, *Quart. Journ. Geol. Soc., London*, XVI, pp. 174—176, pl. VI, figs. 24 a-c and Pl. VII, figs. 26, 27 a-c; 28, and the references cited therein (1860).

[2] Blanford, *Mem. Geol. Surv. Ind.*, XX, pp. 132-136, Pl. I, figs. 8, 9, 10—13, Pl. II, figs. 1—3, Pl. III, figs. 1—4 (1883).

generic position of the Peninsular and Baluchistan fossils needs revision in the light of the extensive work of Simpson[1] and others on the living Indian Unionidæ.

The Burmese fossils are referable to two species of the genera *Indonaia* Prashad[2] and *Parreyssia* Conrad[3]. Both these genera are represented in India and Burma by a fair number of living species. The two fossil species, although allied to some of the living forms, appear to be new, and are here described as *Indonaia glyptica* and *Parreyssia latouchei.* Their exact relationships are discussed in the remarks at the end of the descriptions of the species.

INDONAIA GLYPTICA sp. nov.

Pl. XII, figs. 3—9.

Description.—Shell of small dimensions, thick, inflated, very inequilateral, posteriorly elongate and with a very narrow posterior wing. Umbonal region very anteriorly situated, high, somewhat compressed. In addition to numerous concentric ridges or folds, which alone remain visible when the outer surface is somewhat weathered, the valves of well preserved specimens are almost entirely covered with two interfering sets of steeply oblique crowded narrow ribs, producing a characteristic criss-cross pattern, such as is often observed in the Unionidæ. The posterior wing carries a third set of oblique markings disposed differently from the two other sets. Anterior end narrowed and rounded. Base line nearly straight, curving up sharply posteriorly somewhat behind the middle to form the nearly pointed posterior end. The hinge is preserved in some otherwise incomplete fragments and the following description is drawn from these specimens: in the right valve the pseudocardinal is single, thick, roughly triangular, with a distinctly rugose appearance; the lateral appears as a slightly arched lamellar ridge. In the left valve, the pseudocardinal is more massive and distinctly divided into two parts, an anterior, nearly smooth, thin one, and a posterior, rather deeply ridged, more massive posterior tooth; the lateral, in this valve, also appears to be single. The muscle-scars are circular to ovoid and deeply impressed.

[1] Simpson, Descriptive Catalogue Naiades, Detroit, Michigan (1914).

[2] Prashad, *Rec. Ind. Mus.*, XV, pp. 146—148, fig. 2 (1918).

[3] Conrad, *Proc Acad. Nat. Sci.* Philadelphia, VI, p. 267 (1853) and Preston, *Faun. Brit. Ind. Freshw. Moll.* p. 154 (1915).

Dimensions.—Amongst the specimens at present available, the largest dimensions are those of a single left valve which measures 46×28 mm. This size is quite exceptional, none of the other specimens exceeding 39 mm. in length. Amongst the specimens with united valves exhibiting the shape of the shell in a good state of preservation, the largest shell gave the following measurements: length 39 mm. height 24 mm. thickness 17 mm. The dimensions of the specimen shown in fig. 4 are: length 31 mm. height 18 mm. thickness 12 mm. The separate valve represented in fig. 9, whose shape is somewhat more elongate, measures 35 mm. in length and 19 mm. in height.

Remarks.—The above-described species is closely related to *Indonaia crispata* (Gould), which has a wide range in Burma, Siam and Cambodia. The sculpture of the fossil is, however, much finer, and the shape of the shell different. Moreover, the shell is much thicker in the fossil species than in *Indonaia crispata.*

PARREYSSIA LATOUCHEI sp. nov.

Pl. XII, figs. 10—13.

Description.—Shell of medium size, moderately elongate, rather inflated, approximately triangular in lateral outline, with a very pronounced ridge separating off a narrow posterior wing. This ridge extends from the anteriorly situated umbo to the pronounced posterior lower angle, above which the marginal outline exhibits two more very obtuse angular bends corresponding with the terminations of two very obscure keels or swellings that occupy the narrow surface of the posterior wing. From the anterior part of the hinge to the posterior angle, the anterior and inferior margin of the valves forms a continuously convex curve, except for an exceedingly shallow sinus just in front of the posterior angle. An extremely shallow depression of the surface of the valves borders the posterior ridge from this sinus to the umbo. Posteriorly to the umbo, the external ligament occupies a narrow, elongate, deeply sunken escutcheon, the surface of attachment being bordered internally by a narrow prominent ridge.

The valves bear concentric ridges or furrows at irregular intervals, representing successive periods of growth, and are otherwise unornamented, except in the umbonal region, which faintly exhibits the characteristic corrugated lattice frequently seen in the Unionidæ;

this feature being especially distinct in well-preserved juvenile specimens.

Dimensions.—The following are the measurements of the figured specimen which appears to be full-grown and which has the valves united :

	mm.
Length	44
Height	32
Thickness	22

Comparison with other species.—The nearest allies to this fossil appear to be certain recent species from the Indian and Indo-Malay regions, such as the common species of Bengal, *Parreyssia favidens* (Benson),[1] and *Parreyssia tavoyensis* (Gould),[2] from Tenasserim and Burma. The similarity in shape between P. *latouchei* and *P. favidens* is very close, but the fossil species has the anterior region still shorter than the recent one. *P. tavoyensis* is practically identical in shape, but has the posterior wing less distinctly marked off and the umbonal region and some part of the valves decorated with very definite criss-cross ridges, which are only feebly developed in the fossil specimens. The two species are probably very closely related.

The explanation of Plate XII will be found on page 369.

[1] Preston, *op. cit.*, p. 158, and Simpson, *op. cit.*, pp. 1109, 1110.
[2] Preston, *op. cit.*, p. 166, and Simpson, *op. cit.*, p. 1114.

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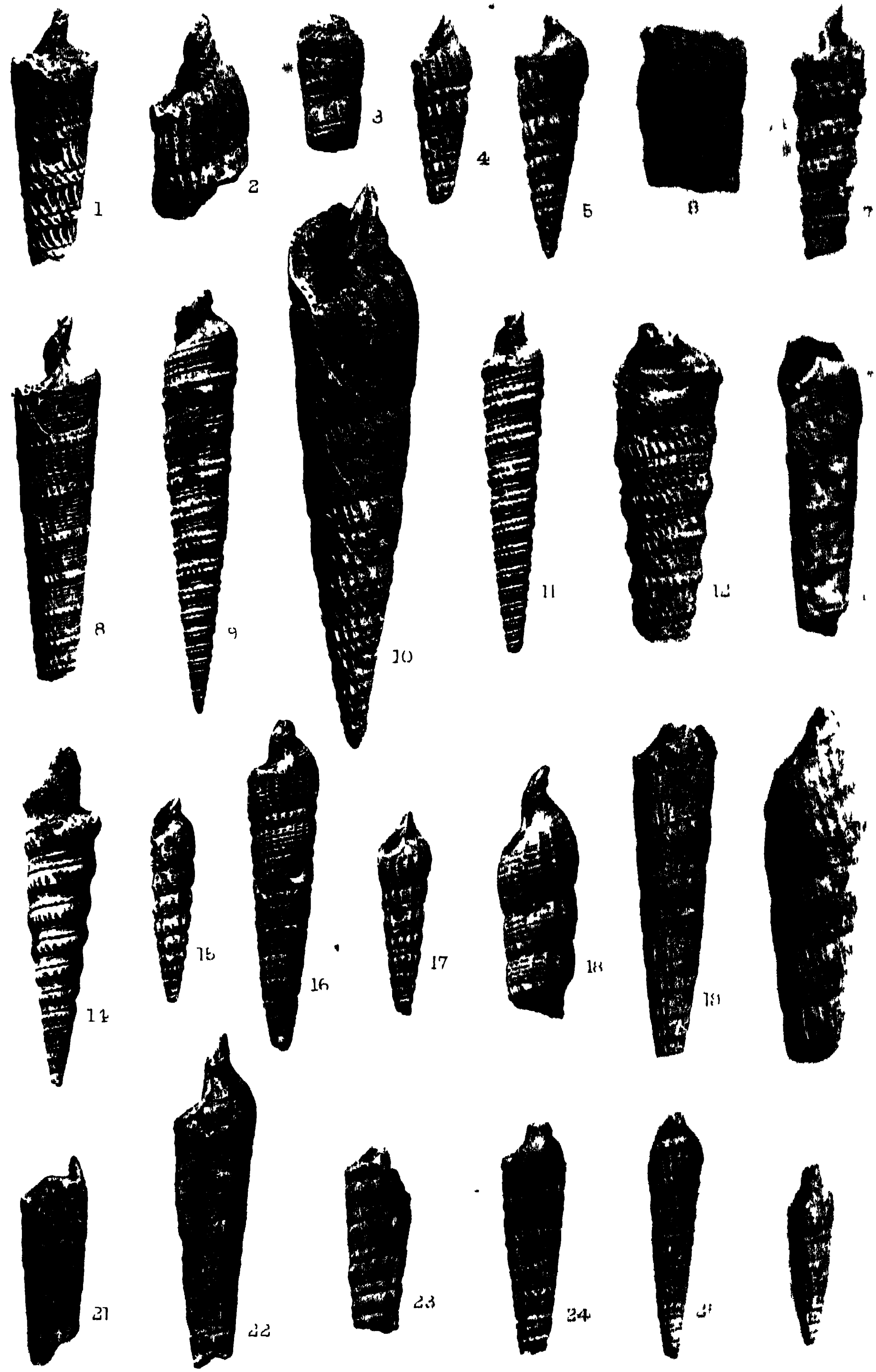

FOSSIL TEREBRIDAE FROM BURMA

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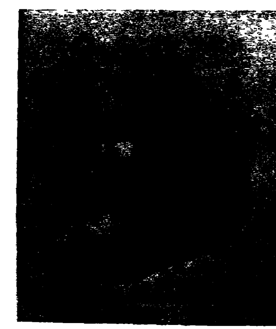

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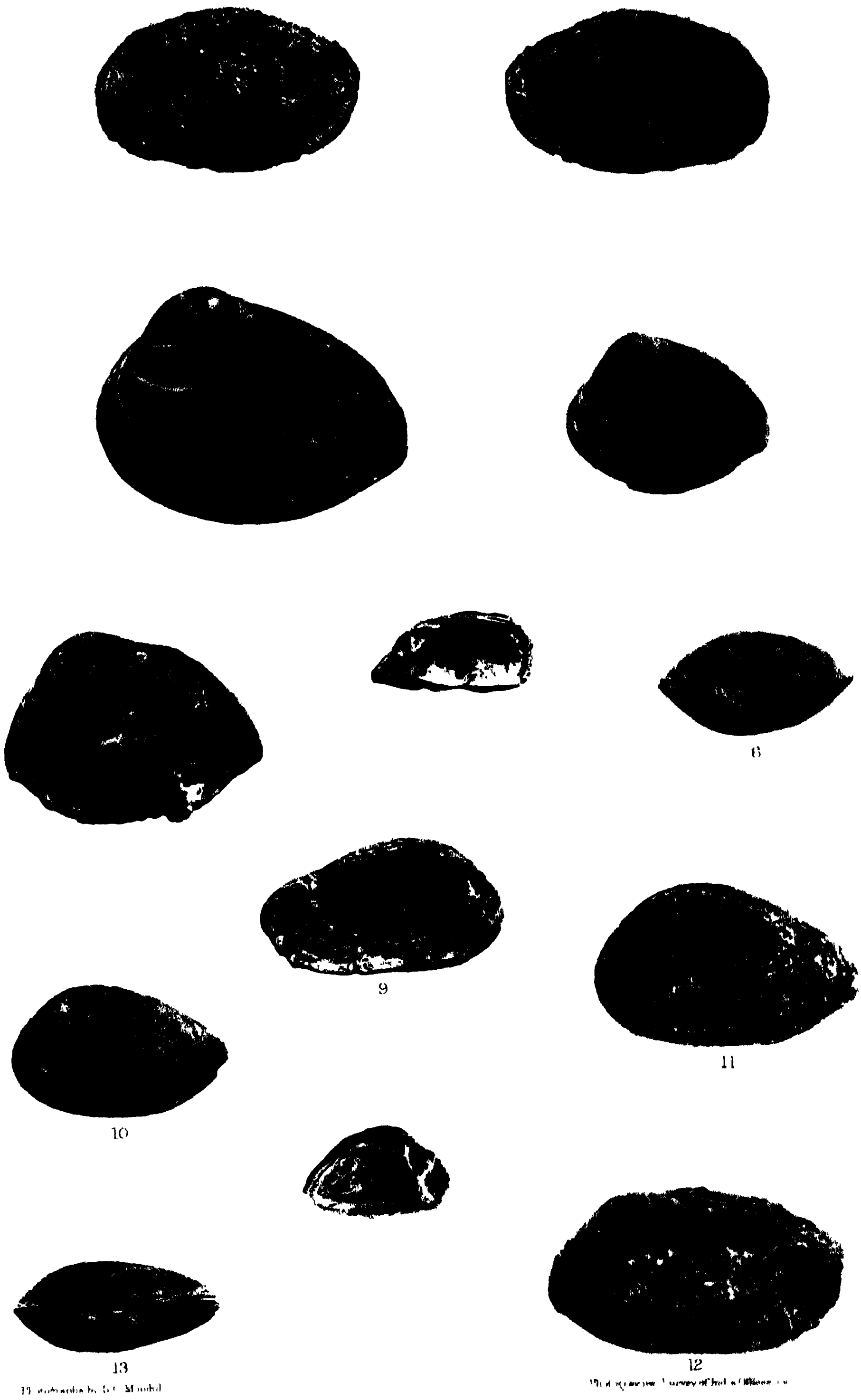
G. S. I. Calcutta

INDIAN FOSSIL AND RECENT VIVIPARÆ.



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INDIAN FOSSIL