No. XIX.

JOURNAL

OF THE

BOMBAY BRANCH

OF THE

ROYAL ASIATIC SOCIETY.

JANUARY, 1854.

ART. I.—*Sahyádri Inscriptions.* By the Rev. J. STEVENSON, D.D., President.

Presented 20th October 1853.

IN presenting transcripts and translations of the more perfect inscriptions found at Kárlen and Junir, on the Ghauts, and Kuden in the Concan, I shall reserve any general remarks, additional to those I have already made under the heads of the Káṇheri and Násik Inscriptions, to the conclusion of this paper. I may observe, however, that several of these inscriptions have been before translated by Mr. Prinsep from copies furnished him by Colonel Sykes; and that in reviewing these, along with the rest, if I differ somewhat occasionally from my master in Indian Palæography, it must be remembered that Prinsep had but a small portion of the inscriptions before him, and, therefore, had not the advantage of comparing them one with another; nor had he an opportunity of correcting his first impressions, as I have been enabled to do, by subsequent researches.

1st.—TRANSCRIPTS IN DEVANAGARI, AND TRANSLATIONS OF KARLEN INSCRIPTIONS.

No. I.

This inscription is engraved on a pillar outside the Great Temple-Cave.

सिद्धं महाराविस भोतिपवस अगिमित्त नाकस सिह थभो दानं सिद्धं

Translation.

Peace. The gift a of lion-crowned pillar, by the Chief Agni-Mitra, son of the Emperor Bhúti. Peace.

Notes.

I have already made remarks on this important inscription in p. 3 of my observations on the Káṇheri Caves, and shown that this Mahárája Bhúti was the last of the Sunga dynasty. राव is a common Maráthi corruption of राजा as well as राई. By some oversight, or defect in the ink of the transcript, Mr. Prinsep read the first letter स, instead of म. This is corrected in Dr. Bird's work on the caves. I follow Prinsep, however, in making the sixth syllable भो instead of मो. In Colonel Sykes' transcript used by him, the former is undoubtedly the reading, though in Mr. Brett's fac-simile it is doubtful which of the two it should be made. In a very good copy of this inscription, published in the Asiatic Researches, vol. v. p. 141, and furnished by Sir Charles Ware Mallet, we have very plainly भो, which is also the reading of Captain Jacob. (Jl. Bengal As. Soc. vols. vi. p. 468, and iii. p. 498.) This, too, on examination, was my own impression of the character in question. The only syllable with which सि might be confounded is सि; but by comparing Nos. I., II., and III., and No. I. of Bhájá, a marked difference will be found in the length of the ascending line before it becomes circular: but in this reading all are agreed. नाक is the vulgar Maráthi of नायक. If instead of ना we should read न, the meaning will still be the same; the palatine being substituted for the dental, as usual, and the syllable shortened.

No. II.

This inscription is engraved on a recess on the right side of the porch.

ओं सिद्धं सितासेविना भूतपालेन सेलघर परिनिठपितं जबुदीपम्हि दान मग्गे.

Translation.

To the Triad. By the victorious, fearless, world-protecting, Bhúti, this mountain abode was established in Jambudvípa, in honour of the hero who subdued the passions.

Notes.

I suppose the character at the commencement to be *Om*, though I am not entirely satisfied that it is so. The ही after Jambudvípa is the sign of the locative case in Páli. The next word is the Prácrit for दानम्, and the last word I conceive to be for मनवे, the dative of मनु, taken in the sense of a patriarch or distinguished man, and applied to Buddha. The mention of this cave, as if it were the only one in Jambudvípa dedicated to Buddha, seems to intimate that it was the first excavation of the kind in India; a supposition which, from the simplicity and elegance of its parts, is otherwise probable. निवास is विचास. From the position, I suppose that this inscription was added by some local Buddhist after the excavation of the cave.

No. III.

[1] ओं राञो वासिठि पुतस सिरिसर [पुदुमावस] समचरे सतमे ७ पखे पचमे ५.

[2] दिवसे पथमे १ रतोय पूवाय देखट कियान मञारठस कोसिक पुतस मतदेवस पुतेन.

[3] [चम] चारथिना वासिठि पुतेन सोमदेवेन गामो दतो च लेण सघस च पुरकखननस कद करोस देय [घ] मो यो.

Translation.

To the Triad. In the seventh year (7) of the fifth demi-lunation (5), the first day (1) of the fortunate Emperor [Padma], son of King Vásivi, a village was given to those distinguished for their former meritorious acts, by Matadeva, son of Kosika, distinguished among the commanders of war chariots, and by Somadeva, the son of the famous charioteer Vásivi. A cave also was given as a religious assignation to the priesthood, and to those performers of religious acts who are full of knowledge and wisdom.

Notes.

This is one of those interesting dated inscriptions, on which, under the head of Násik inscriptions, I have already remarked, and on which I may still have some more observations to make at the end of these translations. In the second line we have मञारठ, and in the third line मञारथि. In the transcript by the Rev. Mr. Mitchell, contained

in Dr. Bird's work, these are nearly reversed, and we have सघारचि for the first, and सघारडि for the second. I am warranted, then, I think, in considering them the same. On the descriptive terms applied to the Buddhist priesthood both above and below I need make no remarks, though, except संघ, they are all peculiar, as the sense in which I understand them will readily appear from the translation, except, perhaps, कलमन, which I suppose to stand for कलाग्रान.

No. V.

Notes.

Passing over No. IV. at present, I remark that No. V. has reference to the abovementioned village, bestowed as a free gift upon the monks of the temple. The name Karanjaka at the commencement is plainly legible (गामस करजक); and at the beginning of the second line in Dr. Bird's work the word भिखुस is also easily legible, thus pointing out for whom the village was intended. There are, however, so many blanks and broken letters in the inscription, that I have not attempted to translate it. In what remains, the names of the donors do not appear. Of this inscription a fac-simile, with the image of Buddha, after a drawing by Colonel Sykes, above which it is, will be found in the Jl. As. Soc. Bengal, vol. vi. pl. viii. It follows immediately No. VII. given below.

No. VI.

Notes.

The same remarks apply to this inscription. At the end of the first line is the name of the village Karanjaka, and the rest appears to be either a description of the village, or of those for whom it was intended.

No. VII.

[1] ..... तमा मोख अमच परामत खमे सवच खचु सवा पेरक सवाचवान

[2] पवजिताने भिखुना निकाय सखुख सचाय नयपतोचचख सामा लोचारेउतर मग गाम करजको

[3] भिखु चरे दुदम रतचच गाम करजको भिखु चखे देय पपोचि रतस चस.

Translation.

The village Karanjaka, which lies to the north of the road of the householder Mámá the blacksmith, has been given to the collective body of the priesthood of initiated monks, who are..... free from passion, and have overcome disease; are characterised by universal compassion, command all things, and possess every object of desire.

We grant the village Karanjaka to be taken possession of by the

monks, and as a gift to be cultivated by the monks, along with the water tank in the same district.

Notes.

This inscription, it will be seen, has still respect to the same subject. It is in a very conspicuous position, on the left of the doorway of the temple. It is mutilated at the top, but most of it remains. The last line, which is a kind of repetition of the former part, is interrupted by small pilasters, which makes it appear as if there were blanks it, which, however, is not the case. A village of this name, or rather in the shortened form of Karanja, still exists among the Ghauts, a few miles from Kárle*n*, and is now held in *inam* by the Kárve*n* family, descendants of the Guru of the late Peshwa,—rather a curious coincidence.

Though I have found considerable difficulty in dividing the letters into words, and translating this inscription, I need hardly point out to the Sanscrit scholar the proper substitutes for the Prácrit words. I may notice, however, that पपोचि is a union of the Sanscrit प्रपा and the Maráthi पोचि, and that ख in the last word is considered to be an abridgement of खेत, the Prácrit of क्षेत्र. Also, it is to be kept in mind, that प्रवजित means initiated. (See Káṇheri Inscriptions, p. 31.) I had almost forgotten to notice, that I consider the formation of the image on the wall outside the temple, over which this inscription is placed, together with the gift of the village referred to, to be long posterior to the excavation of the temple itself, for which the reason will appear in my former paper.

Nos. VIII. and IX.

भद्दसमस भिखुस देयधम मिथुन.

Translation.

The religious assignation of a pair (of images) by Bhadrasama the monk.

Note.

These two inscriptions are the same, only that one or two of the letters in the first are a little imperfect.

No. X.

धनुकाकटा (स्स) भाविकस सदंतस दान घर मघ.

Translation.

The gift of a pleasant abode by Dhenukákaṭa to the devoted men of patient and subdued minds.

Notes.

This inscription, I believe, is connected with one of the small caves. The last word is puzzling. मद means pleasure, but perhaps it may here be a corruption of मङ्ख, a kind of mendicant, and the meaning be a house suited to such persons. The type of the letters in this inscription is very ancient and beautiful, as it is in the others also of this class.

No. XI.

धेनुकाकटा उसभदत्त पुतस मितदेवणकस थम दानं.

Translation.

The gift of a pillar by the Chief Mitradeva, son of Dhenukákaṭa, (surnamed) Rishabhadatta.

Note.

I suppose Dhenukákaṭa to be a Greek, and that he had also a Hindu name, as in the text, probably assumed when he embraced Buddhism, or on adoption into some Hindu family, when names also are changed. णक or नाक we have met with already, in No. I.

No. XII.

वोमचतस मचादेव णकस मातताथि लेण दान.

Translation.

The gift of an abode, for the benefit of his parents, by the formidable Chief Mahadeva.

Note.

The first word I understand to be equivalent to औपयुत्.

No. XIII.

नमो सिध. Peace. To the Perfect One.

Note.

Buddha is here no doubt meant. There should probably be a point over ध.

No. XIV.

In this number, we have the last of the inscriptions that mention Dhenukákaṭa.

धनुका कथ यवनस सिध धचानं थम दानं.

Translation.

A gift of lion-supporting pillar, by the Greek Xenocrates (Dhenukákaṭa).

Notes.

We have thus no less than three inscriptions at Kárle*n*, and one at Káṇheri, in which this personage is mentioned. His name is, indeed, spelled differently every time, but this is nothing more than what is usual in India. I took up lately a Maráthi newspaper, and found a particular word, that occurred four times, spelled exactly four different ways on the same page. The orthography Dhenukákaṭa I suppose to be the most correct, as it is capable of being divided into two Indian words, the first of them the name of a Rákshasa, mentioned in the Puráns, and the second meaning an agent, and, perhaps, an artist. It is the custom everywhere, in adopting foreign words, to make them, if possible, significant in our own language; and the nearest Greek name seems to me to be Xenocrates. If the accent be put on the anti-penultimate syllable, as is usually done, that will seem to double the letter *c*, the Greek *κ*. By a similar process, the English word Collector is in Bombay transformed into Cálakaṭṭar. Besides, in Prácrit the *r* is usually omitted, and the next *t* made a palatine letter. By this process, and the substitution of *Dh* for *X*, which does not exist in Prácrit, and the change of the termination to an Indian one, the transformation is completed. I think this Greek name more probably the one meant than Theonikos, suggested by Dr. Wilson. Of this Xenocrates, then, it is said he was a Yavan, which all agree must, in ancient Indian documents, mean a Greek. It is the Hebrew Javan, as we write it, but which should be pronounced as the Jews still do, agreeing with the Indians, Yavan, which has evidently the same radical letters as the Greek Ιων. He had an Indian name, Rishabhadatta, and a son, who is mentioned in No. XI. He was an artist, as is recorded in the Káṇheri inscription No. X., where he is called कलपकसनक. He was a convert to Buddhism, as in the same inscription he is called an Upásaka. The presence of such a Greek at these excavations could only have one object, that of superintending and directing the workmen. Besides, he must have been a man of influence to obtain permission to inscribe his own name on these rocks, and of property to enable him to execute the works he is said to have done at his own expense.

No. XV.

On the fourth pillar from the door, on the left of the temple.

1 3

सपारखामयंताम चमुतरीया लेणम
कस खाति सितस
वसरीवखम दानं.

Translation.

The gift of an image-sustaining pillar, by the exalted Chief S'ánti Mitra, who is clothed with religion, to those who save us from the fear of corporeal attachments.

Notes.

The two last lines of this inscription are shortened by being confined to one face of the pillar, which the first is not. The first word I suppose to be derived from संपक; after धर्मै I read उत्तरीय, "covering, clothing," taken in a figurative sense. The Sanscrit equivalents for the rest are apparent.

I formerly read the name of the Chief here mentioned Jagamitra, but, on looking at it more carefully, I believe it to be as I now give it.

Nos. XVI. AND XVII.

These two Nos. are too much broken to permit me to make anything of them. The second begins with *Nukákata ;* probably *Dhe* is to be prefixed, and then it will belong to the same series as X., XI., and XIV.

No. XVIII.

This inscription is engraved on an excavation adjoining to the Temple-Cave, intended, as appears from its tenor, for a lodging-house and refectory for monks and pilgrims. It is one of those on the date of which we before made remarks.

सिध. राज्ञवासवी पुनस्य सरपुद्रुमावस्य सवहर चतुवीसे २४ हेमतन पंखे तसीय ३ दिवसि वति ३२ उपासकस चरफरनस सतुपरण पुत्रस्य सेवसकस अनु लोमय वथवस्य रम देयधम मटप उधगत विप्र सघियन प(भि?) खुनसस वि चतुसदिय मातपितन पुजा सवसताव चित आयद् चतुय २४ वीसेसि वहरे निखितो सह तच मे प्रस बुधरखितेन तत रचत्य उपसकय बुधरखियु मात दाय धम पाठो अपि.

Translation.

To the Perfect One. In the twenty-fourth (24) year of the Fortunate Padma, son of king Vásava, in the third (3) demi-lunation and thirty-second (32) day of winter, this delightful religious assignation was made by the long-haired mendicant Sevásakta, son of the wavy-garland-wearing devotee Satva Sphuran. Come then to this residence, constructed from reverence to my parents, ye company of learned men of elevated mind—to this house for mendicant priests, from the four quarters (of the world). This inscription also was engraved with a chisel in the twenty-fourth (24) year, on my account, by Buddharakshita, in the

month when the threads which insure the protection of Buddha are bound on the arms of devotees.

Notes.

It is not worth while to point out to the Sanscrit scholar the equivalents in this inscription, as they will all readily occur from comparing the transcript with the translation; although in some instances there is room for a difference of opinion, as in मटप, which I interpret मंचपा: The last line is difficult, and I may have missed the sense. I conceive it to mean that the inscription was executed on a lucky day—that on which, according to the custom of all sects of Hindus, charms are bound round their own arms, and the necks of their cattle. This day in our Presidency is different in different districts, but always the same in any given place. Perhaps पाडो, after all, may be our old friend पोढि; and it may be its excavation that is recorded.

No. IV.

Notes.

This inscription belongs to the Satrap series, which is so prominent in the Násik caves. It is in Prácrit, as all at Kárle*n* are, and the form of the letters is evidently of the Gujaráthi type. It is too much broken, however, to admit of a continuous translation.

The first line mentions that the son-in-law of Nahapána, the Satrap of king Kshaharáta, bestowed —— thousand húns at the river Bárṇásoya; and lower down, in the fourth line, a donation to the mendicant priesthood is mentioned.

BHAJA INSCRIPTIONS.

Bhaja is a small village three miles S.E. from Kárle*n*, the Buddhist remains of which are described in the Jl. Bom. As. Soc. vol. i. p. 483, by Mr. Westergaard.

No. I.—Over a small tank.

ओं मघारठिस कोसिकी पुतस
विण्हुदतस देयधम पोढी

Translation.

The religious assignation of a cistern by Vindhyadatta, son of the famed charioteer Kosiki.

Note.

Though the orthography of the last syllable varies, the Kosiki here mentioned is probably the Kosika of No. III. of Kárle*n*. The cast of the letters is exactly the same, and also the form of the initial figure.

No. II.

This inscription is engraved on a small dágoba.

नदस नदनयस
भगवतस भाभेदानं

Translation.

The gift of a sanctuary to the joyful, venerable lord.

Note.

I do not find here the name of the donor, as usual. The inscription, then, was probably engraved by a priest, at some period future to the construction of the dágoba.

N. B.—The two inscriptions at Bedse*n* or Birsa have not been taken by Mr. Brett. Copies of them by Mr. Westergaard will be found lithographed in Dr. Bird's work, and in vol. i. of our Journal, in the plate fronting p. 438. The first, of one line, seems to celebrate the construction of the cave over which it is carved by an inhabitant of Násik. The second, of three lines, mentions the charitable gift of a water cistern, by a person there mentioned, whose name I cannot certainly make out. I fear the lithographer has not done entire justice to Mr. Westergaard's copy of these inscriptions.

JUNIR INSCRIPTIONS.

As Mr. Brett's plan of the locality of these caves sufficiently explains where each inscription is to be found, I need not refer to this point further than to direct the inspector to it. Very correct facsimiles of many of these inscriptions, taken by Colonel Sykes, will be found in the Jl. Royal As. Soc. vol. iv., with an account of the caves. Dr. Bird's work can also be referred to, and the Jl. As. Soc. Bengal, vol. vi. p. 1045.

No. I.

ओं. धन्यीक सेनीय सतभं गोडीच दाय धम तं

Translation.

To the Triad. A chamber for a refectory, and a water cistern, by the military officer Dhanyaka. A religious assignation. Peace.

Notes.

The two words चत्त and मत्त may be translated as if uncompounded, and then the sense will be a sanctuary and refectory ; but the point over the म seems to intimate this is not the case. (See Kánheri Inscriptions, pp. 8, 15, 22.) We have here दाव instead of देव, if there is no mistake in the transcript.

No. II.

सिद्धं कलीअन्यस्य हेरणिक पुतस्य सुलासदातस्य ठकपुरिसस्य चेतिय घरोगियुतो देवघम सिद्धं

Translation.

Peace. The religious assignation of a chaitya temple, constructed at the command of the lord of Thakapura Sulásyadatta, son of Heraṇika (a goldsmith), inhabitant of Kalyaṇa.

Notes.

The Sanscrit टंक, like the Maráthi टोक, means the peak of a mountain ; and since Junir is situated on the high road from Devagiri (Dowlatabád) to Kaliaṇ, on one of the peaks of the Ghauts, and the present name means the old town, I suppose it to be the Thakapura here mentioned. नियुतो, for नियुक्त, here should, I think, be rendered "commanded or ordered," and construed as I have done.

No. III.

ओं. कपिला उपासकस नतु नैतापस उपासकस सिद्धं
ओं. पुतस आनदस देय धंमं चेतियघरो नियुतो सिद्धं

Translation.

The religious assignation of a chaitya temple by order of A'nanda, grandson of the devotee Kapila, and son of the ascetic Naya, also a devotee.

Note.

Here we have ओं at the beginning, and सिद्धं at the end of each line.

No. IV.

सिद्धं कलीअन्यस्य कुटीर पुतस्य सुवंनकारस उपासकस पोढी देय धंम सिद्धं

Translation.

Peace. The religious assignation of a cistern to the priesthood by
13 ★ Suvarṇakára (a goldsmith), son of Kuṭira, a citizen of Kaliaṇ.

No. V.

दृषि मङ्ग सामिणो ऽ भय
म उपासिकय नादक तारिकस
ले [ण] सिनिकय देय धम पोडि

Translation.

The religious assignation of an excavated cave (Leṇa) and cistern to the excellent ascetic, fearless sages, by the devotee Nándaka Tárika.

Notes.

The initial auspicious mark in this inscription is peculiar. I suppose it may be a form of ॥ (Svastika). Perhaps म, the third letter, should be वि, and then विङ्ग, being joined to the next word, will give "the cave ascetic." If म remains, the next letter, ङ्ग, should be doubled, to make मङ्ग. We have here the word सामिण (*Sanscrit* श्रमण) for a Buddhist ascetic. From the Sanscrit comes the Greek Σερμανης, and from the Prácrit Σεμνος, and Σαμαναιος. A few of the letters of the inscription are apparently badly or imperfectly formed. The letter I have made सि in the second line more resembles सि, and दे in the last line is like रे। Perhaps here also we should, instead of अभयम, read भयम in the sense of भद्दंत as noticed below; and for fearless, translate venerable.

No. VI.

सोम उपासकस पुतस ॥
सिवकुतिस देय धम लेणं
कपिचिता संघस नियुतक

Translation.

The religious assignation of a cave by Sivakriti, son of the devotee Soma, destined for the tender-hearted priesthood.

Notes.

Regarding the initiatory symbol, I have no information to give. It is not improbably a form of *Om*, the three superior branches designating trinity, and the inferior circle unity. Among the Jain lucky figures, the कुंभ, or flower-pot, taking merely the general outline, will agree pretty well with the initial symbol here, and, possibly, this may be what is intended. There is also the *Gokhúr*, or cow's hoof, which resembles the upper part of it. Perhaps the word नियुत might imply the performance of some ceremony, similar to the निसर्ग of the Brahmáns, by which the proprietor renounces all property in the temple, &c. dedicated to religious purposes.

No. VII.

वीरसेणकस महपति पमुखस
धमनिमसस देय धम चेतिय धरो
निगुनो सवि लोक हित आणीयं

Translation.

A religious assignation of a chaitya temple, dedicated to the religious men skilled in sacred learning, by Virásenaka, first in rank among the citizens. Bring all people here.

Notes.

The same remarks as were made on the initiatory symbol of the last inscription will apply to this, only that this more resembles the Jain मीन, or fishes, which form one of the eight lucky figures. The word प्रमुख in the end of the first line I conceive to be a corruption of प्रमुख, similar to प्रगट, which the Marathás use for the Sanscrit प्रकट. The mark for ख seems too plainly expressed to be a mistake, and therefore Mr. Prinsep's suggestion from the reading मख is inapplicable. After मह, also, our reading is plainly प, and not ह्न. Probably the person in question, if not head of the police, was the chief of the mercantile caste, and had a certain authority and responsibility on this account. The concluding formula in similar inscriptions at Kánheri and Násik has been "come," &c., and not "bring"; but I fear आणीय cannot be so rendered.

No. VIII.

सुपखरियाणस वगिरिनासस पुतस पनोवघकस गिरिभुतिस भिखुयाकस लेण पोढीच [दे] यधंम एतसच लेणस पोडियाच नकरच गिरिनि उपासयस षमुनरियान अखय निविक.

एतो लेणस चिवरिक काहपकस सिपरिय चीव [र]

Translation.

The religious assignation of a cave and cistern by Suprakhariyána, son of Vagirinása, for the self-denying, strong-as-a-mountain company of monks. There is also connected with this cave and these cisterns the capital stock left by Nakara Giriní, the devotee, for those who are entirely devoted to religion. There is also in this cave an endowment for giving money to mendicants, and supplying them with skins and clothing.

Notes.

There are considerable difficulties in this inscription, especially in

the last line. The meaning of the six last letters, I think, however, must be near what I have given. चीवर means such clothes as mendicants wear, and चिपि "skin or leather." The skin probably was for the purpose of a rug to lie down on, for which purpose dressed deer and tiger skin is still used by ascetics, instead of a mattress.

No. IX.

This inscription is in the same cave as the last, and probably has relation to the same thing, as some of the words agree; but as all the lines are considerably broken at the beginning, I find that I cannot give a satisfactory translation of it.

No. X.

मणा चरियान थेरान भ
यंत सुलासानंते विजा
न अंतेवासिनं थेरानं भ
यंत चेतिय सानंते वी
न नदनन नवकं

Translation.

To the spiritual guides of the company (of priests), the established teachers (Theros), the venerable Sulasa, and Ananta Vijaya; to their disciples, the established teachers, the venerable Chetiyasa, and Anantevi.....

Notes.

This imperfect inscription contains the names of a number of the principal persons once connected with the monastery over which they are inscribed, similar to what we found in No. IV. of the Káṇheri inscriptions (p. 25). That, also, when compared with this, has led me to the right rendering of भयत, which I formerly supposed to be भयच, "delivers from fear," but here it is used for भदंत, and has the anusvára over the य as a substitute for न्. The word भदपति appears in the 7th line, so that the inscription probably recorded some donation from one of the laity to the priesthood.

No. XI.

सनिति भदपति पुतस भदपतिस सिवदासस वितीयो नय च सह पकवा

Notes.

This imperfect inscription records a donation from the householder Sivadása, son of the householder Saviti. It is worthy of observation that

a Sivadas is here found among the worshippers of Buddha. वितीयो मय may mean the second moral duty (दान), charity ; and the last word may have reference to the distribution of cooked provisions, but in the want of the context it would be hazardous to affirm anything certainly on the nature of the donation.

No. XII.

सि भारुकछकानं ईकुटियानं तातूनं
बुधमितस बुधरखितस च वीमम देय धंमं

Translation.

Peace. The charitable assignation of the court of the temple by Buddha Mitra and Buddharakshita, for the homeless fathers from Broach.

Notes.

I suppose Bharukachha is rather Broach (बडोच) than Bhúj, in the province of Cutch, as I conjectured before, p. 50 of Násik inscriptions. The वि initial is very frequently in Maráthi changed to ई, and I suppose that to be the case here. वीमम in the sense here given will be found in the Káṇheri inscriptions (p. 23). Attracted by the holiness of the place, these foreign devotees, having come to Junir, had the verandah of the temple assigned them for a residence, and this inscription engraved as the title deed.

Nos. XIII., XIV., AND XV.

These inscriptions, found on the pillars in the portico of the temple, were probably engraved at a later period than its excavation by visitors. In the 3rd line of No. XIII. we have plainly the name उमज ; regarding others, conjectures might be formed, did the inscription promise to offer anything worth the while of a closer examination. It is possible, also, that it may be of the same nature as No. X., and be the names of the heads of the society.

No. XVI.

मामेविनिचा श्री सुक रजभुति उदेसेण निवतणानि २० वीस। मान प्रप सुभो वतणाने.

Translation.

In the village of Vitihá, through the influence of S'ris'uka, the king's minister, twenty acres of land were (bestowed) : the village and watering place to be a fortunate, firm possession.

Notes.

I am sorry that the state of this important inscription does not permit me to give a more satisfactory transcript and translation. Several of the characters are either incorrectly given, or so peculiar, that they must be guessed at: two letters of the name of the village mentioned fall under this head, and the first letter of the name of the donor. The two last letters of the name, however, are very plain and well-formed, and exactly agree with those of the first monarch of the A'ndhra dynasty, whose name in the Matsya Purán is written S'is'uka. Our first letter cannot be शि, but it may be श्री, and probably this is a more correct reading than the Puránic one. I suppose he was at the time of the grant only prime minister, hence he is here called राजभृत्य, and in No. XVIII. आन्ध्रकभृत्य, which is almost his Puránic epithet. If he had been sovereign, we should have expected also in the second line आदेश्याने, and not उद्देश्याने. The *nivartana* is a piece of land of four thousand square cubits; so that, though I have rendered it by the word acre, it is not equal to an English acre. It will correspond, nearly, to the bighá in use at present in most parts of this Presidency, and is thus about three-fourths of an acre. I have merely guessed at the last line: perhaps the curious character that stands fourth is nothing more than नि; and the sense will then be—"In the village and watering-place are —— acres." In this case the inscription is incomplete. On the whole, it seems evident from it, that land, to the extent mentioned, was given to the monastery, through the first monarch of the A'ndhra dynasty, while yet prime minister.

No. XVII.

From the shortness and broken state of many of the letters of this inscription, I find it difficult to give an intelligible translation of it; and therefore pass it over at present.

No. XVIII.

आधाका भति निवतणाणि .. वाहतेव खेतकस

Translation.

A field for out-door recreation by the A'ndhrabhritya, of —— acres.

Notes.

Mention is made only in a cypher of the number of bighás of land in this donation; and as the cypher occurs nowhere else, that I can

find, I forbear speculating on its value. This inscription is distinct, and Dr. Bird's fac-simile differs from ours but in one letter, so that the interpretation may be received with a good deal of confidence.

No. XIX.

महवाकु गामेजाधभति उदेसेण निवितणानि पचविस खधा चम्म अपराजितो खचतानि सेखस.

Translation.

Through the influence of the A'ndhrabhritya, born in the town of Maháváku, twenty-five acres (were given) as a perpetual portion on this incomparable mountain abode.

Notes.

I do not know if there be any town in Telingána that bears a name in any way resembling the one given in our text; but the letters seem all plain and unambiguous. Is this a contraction of Varankal, the name of the ancient capital? खधा is for खन्धा. The word संस्थान is a favourite among the Maráthas for a place where holy men reside, or for a village given for the support of religion; खचतान I suppose here to be a corruption of it.

No. XX.

This, again, is too much broken, and contains too many anomalous letters for me to attempt to translate.

No. XXI.

कोणाचाके सेणिच
चच खको आहिमिहि
शिको ॥ वाटालिकायक
रजमूल निवतणानि वीस ॥
कूटं पुतिक मड [घ] आलेन
चितस दे [च] चम ॥

Translation.

Twenty acres, according to the royal standard, from the military officer Koṇácháka, producing barley and mountain fennel, and adorned with garden flowers. The religious assignation to those of discriminating knowledge of an ornamented cave, for religious purposes, by the son of Kuṭa.

Notes.

The meaning of the name of this military officer, in Maráthi, is

" One who has the keenness of Mars, (or) is a worshipper of Mars." The names of the vegetables here, except the first, are doubtful, as several of the letters are anomalous.

No. XXII.

Notes.

This inscription contains the record of a religious assignation, by Dhanyapálaka, of a Sanghagriha, or monastery, to the priesthood; but so many of the letters are anomalous, that I cannot venture to translate it, though I think the first line contains the name of a village, and perhaps the word for acres. If so, the letters are a good deal corrupted.

No. XXIII.

Notes.

This inscription contains a record of no less than five different donations, for so often does the term देयधर्म occur: once in the first line, twice in the second, once in the third, and once in the fourth. In the first line the donation is (तेसेा सवज्ञा) three hundred gold mohurs; in the second (निवतणानि पाचस) fifty acres; and in the fourth a certain number of (आधक मूल निवतणानि) "acres, according to the A'ndhra standard." The word गामे, for "in the village," is also twice plainly legible; but amid the number of broken and uncertain letters, to attempt to make out the names of men and villages, as they originally stood, would be labour in vain.

No. XXIV.

गामके सिरि वलवाय खेत वीरठाम चरस प्रवसे निवतणानि अठा ८ काच ४ [अजि] तिय सेनिय .... देयधम.

Translation.

The religious assignation of eight (8) acres and four (4) poles, by the military officer Ajitya, being a field in the village of S'rí Valavá, for the lodgers in the abode of Vírasthána.

Notes.

This is the last of a series inscribed on the walls of the last but one of the three southern groups of caves. They are all more or less imperfect, and, therefore, it is with difficulty that any of them can be translated. Still they are important, as showing the numerous grants of land made by individuals to the support of the monks dwelling in those

caves, and on account of the mention several times made of the A'ndhra-bhrityas, the first sovereign of which dynasty, I conceive, is here specifically named, in reference to a time when he had not yet ascended the throne; leading us back to about the year 20 B. C.

I may notice, that there is a village half way between Kárle*n* and Wa*d*gam at present, called Valva*n*. Whether Víra here means Buddha, or some previous excavator of a cave, is open to conjecture.

No. XXV.

सिवसमपुतस सिवभुतिस देयधम पोडि

Translation.

The religious assignation of a cistern, by S'ivabhúti, the son of S'ivas'ama.

Note.

The names in this inscription point to a votary of S'iva: whether he was a convert to Buddhism, or merely caused the tank referred to to be excavated as a matter of charity, is not said.

No. XXVI.

क खतपस रास नहपानस.....
सवहस गोतस अघमस .....
मच चिमटप च प्रस्र थयवस मणकेतो

Translation.

In the —— year of the Imperial Nahapána this subterranean abode (was excavated) for those acquainted with the sacred triad invocation, and established in wisdom, by ——, of the family of Aghama. (*Quære* Angirasa?)

Notes.

We have here mention made of the Parthian Satrap who figures so prominently in the middle group of the caves at Násik. Some of the letters in the last line are anomalous; and, therefore, much stress must not be laid on the translation of that portion of the inscription.

KUDEN, OR KORAH INSCRIPTIONS.

The locality of this village, on the Rájapuri creek, to the south of Bombay, the extent of the Buddhist remains existing there, and the account of their discovery by Vishnu Shástri, will be found in vol. iii. of our Society's Journal, in Dr. Wilson's very complete and interesting

memoir on the subject of cave-temples and other remains in Western India.

No. I.

अयितिलु उपासकस धंमुत्र सतवाय ⟨ भवि
खया खमनीय चेतिय घरो देयधंम

Translation.

The religious assignation of a chaitya temple for a place of worship, and a delightful secure asylum to the religious, by the devotee Ayitilu.

Notes.

The last syllable of the name of this lay devotee is a common nominal termination in the Telinga language, and the former part of it is probably derived from अर्य, "a man of the mercantile caste." सत्र has been generally found used in the sense of a confectory for the charitable supply of provisions; but I consider this rather inconsistent with the notion of a temple; hence the translation given. आखमनीय I have rendered as if आरमनीय, as the ख and र are sometimes convertible into each other; but it may be for आखम्बनीय.

No. II.

मङ्क खरस वधुकस पुतस म[ङ्क] रस
सिवपिरीतस देयधम खेण.

Translation.

The religious assignation of a cave (Lena) by S'ivaprita, inhabitant of Mangka, son of Vadhuka, inhabitant of Mangka.

Notes.

I cannot at present learn anything of the village here mentioned: the name means "the head of a boat," if the second syllable is correctly given. The name of the donor denotes that he was a convert from S'aivism.

No. III.

मधानोयस षाडकरस सुदसणस
रञ्ञस विजय निकाय देयधम खेन.

Translation.

The charitable assignation of a cave (Lena) to the venerable, victorious body, by Sudar'sana, inhabitant of Salsette (Sashṭi), situated on the ocean (brink).

Notes.

There are some difficulties in this inscription; as, for example, one in the first word, and another in the word रहुनय. Whether this should be derived from अर्हनीय, as I have done above, or from the root रुह, "to advance," I cannot determine. साट, and in the fifth No. साट, I suppose to mean Salsette, called by the Brahmans Sashṭi. The whole of the last six words I suppose united in one compound expression, as far as construction goes. The concluding symbol resembles some of those we met with at Junir, as in Nos. VI. and X., but is more of the form of the Gopadma, or "cow's hoof," a lucky figure among the Bráhmans.

No. IV.

करहाकडक [रस] लोहवणयीयस मोहिकस
देय धम लेण

Translation.

The religious assignation of a cave (Lena), by Mohika Lohavarṇaníya, of the town of Karhákaḍa.

Notes.

There is a town on the Krishná, nearly in a direct line south from Sattara, called Karháḍ; perhaps this may be the town meant. The meaning of the surname is iron-coloured. If I could, I should like to read लोक वर्णनीय "worthy of the people's praise." Perhaps there may be some mistake in the copy of the fac-simile, or in the original; or in some provincial dialect the ह might have been substituted for क.

No. V.

महा भोजीय साट भेरीय विजयय पुत[स] । महभोजस मंडवस खंडपालिन स लखक । सुलासदत्त पुतस उतरदत्त पुतसच । सिवभूतिस सच भयंयनंदय देय धम.

Translation.

A religious assignation to the venerable, joyful (company), by the guardian of the mountain passes, the great proprietor Maṇḍava, son of the great proprietor of the Salsette mountains Vijaya, and by Lakhaka (the painter or writer), son of Sulasyadatta, and also Sivabhúti, son of Uttaradatta.

Notes.

The first word, according to the Bráhmans here, is used synonimously with Maharája, though it is not common. I consider here

खाड equivalent to खाडी. There is some doubt about the arrangement of this inscription. Each line has a break in the middle; and the question is, are we to return from that point, or read on? But it does not seem of much importance which way we do. I have taken खंड, or, as the Maráthas often write it, खिंड, in the Maráthi sense. It differs from a ghaut (घाट) in that there is no ascent of consequence, the mountains opening so as to enable you to pass straight on. It is not, however, unlikely that खंड may be taken in the sense of division or district, and the meaning be that he was one of the provincial governors. I have also taken पालित in the sense of पालयता. In No. IX., where several of these words again occur, a different rendering is given of some of them; to that number the reader is therefore referred.

No. VI.

नमत वेजियस वेजस इसिरखितु पासकस पुतस वेजस सोम देवस देय धंमलं पुतसच सनाअस इसिरखितस सिवघोसस्चै दुहुतायच सदसिपालिताय पुसाय धंमाय सघाय च

Translation.

To the victorious (company) acquainted with the essence of things, the religious assignation of a cave (Lena), by the noble Somadeva, son of the noble devotee Rishirakshita.

Also by the sons of Rishirakshita Sonaga and Sivaghosha, for the benefit of Duhrita, and also Rishipalita, to promote religion and sociality.

Notes.

This inscription is divided into two parts, and in the second part, either the construction is uncommon, or there is something awanting. I have given what I deem the sense of it. The first word I have derived from नमः. The curious word वेज seems to be the Prácrit of वैद्य, in the sense of वाद्य, "of a good family," from वोज. If this be objected to, it must be taken as a contraction of विजय, similar to the modern जो. The word पुसाय is considered to be the dative of a masculine noun, derived from पुष, and to mean the same or something near पुषा, "cherishing."

No. VII.

देय धर्मय दाक्ष भिक्षु
वुद्ध खियस मातापितु
अर्घ्य नाम कला तटाक चषा
दता पुत्यतर्भवभ्य सर्व्व सत्व
नाम अग्रे रजाता वाक्ष ये

Translation.

A religious assignation, for the benefit of the father and mother of the Sákya mendicant Buddha S'ri, of the village of Arva, along with its tanks and public buildings, given to those pure in heart, who are outwardly free from strife, distress, and pain.

Notes.

This inscription approaches very near to the Sanscrit, although it does not seem quite pure; thus कडा, "a boundary wall," should be कड्धा; also ग्राम, ग्राम; and if I mistake not in the next line we should have पूत्यन्तर्भवद्भ्य: The type of the letters in this inscription is more modern than any we have had, especially in the bending down slightly of the *kána*, or mark for the long *a*. The Buddha S'ri of this inscription is more probably some devotee of that name, than Buddha himself. I cannot learn that there is now any village of the name here given.

No. VIII.

सिद्ध. थेराण भदत पा[लि] नमितान भदत
अमिमितन च भामिणेयिय पाव
यिनिकाय पदमनिकाय देय धम
लेण पोढिच सघ अनेवासिनिच बेधिय
सघच अतिवासिनिय असल्हमित्राय

Translation.

To the Perfect One. The religious assignation of a cave (Lena), and a cistern to the Theros, viz. the venerable Pálita-mitra, the venerable Agni-mitra, and his sister's son, the purified Duhrita the astrologer, and the purified Padmanika; along with the disciple Bedhya, and along with the disciple Asalha-mitra.

Note.

This inscription is so plain, that no remark seems necessary, except to notice, that in reference to the two highest dignitaries the plural is used for the singular number.

No. IX.

मदा भेजिच षाड मेरिय विजयाय पुतस मदा भेज सामंदसस खंडपालितस
उपजोविमं सुलासदतस उतरदतायच पुतानं भातूनं लेखका शिवभूति मुकमेड
ष शिवमस देय धंमं लेमं सघ मयाय विजयाय पुचार्मच ससुलासदतम शिवपालि
तस शिवदतस शपिलासच शेलदपकस दुदुतुन ससपाय शिवपालिताय शिव
दताय सुलासदतायच धंमो

1 4

Translation.

The religious assignation of a cave (Lena) by the Secretary S'ivabhúti, intent on emancipation, and most blessed, for the dependents of the strong-armed prince Khandapálita, son of the strong-armed Vijaya, of the Salsette hills, and the sons and brothers of Sulásadatta and Uttaradatta.

Also a pillar has been erected to the sons of the venerable Vijaya, along with Sulásadatta, S'ivapálita, S'ivadatta, Sapila, and also Sailyarupakama, and Duhrita, and for the associates of S'ivapálita, S'ivadatta, and Sulásadatta.

Notes.

I have here translated Sámandava as if it were Sámanta, and made Khandapálita a proper name. In No. V. I made the former the proper name, and translated the latter, but I think now that this is the better way; yet it is not a matter of much importance. This person was probably a ruler over the Concan, either in the latter times of the A'ndhra dynasty, or after its extinction. The style of the letters point to that period, as well as the political state of the country.

N. B.—There still remain several important Sahyádri inscriptions, of which fac-similes have not been executed by Mr. Brett. Of these the most important is that which exists in a cave at the head of the Náná Ghát. A fac-simile, however, of this, was taken by Colonel Sykes, a copy of which will be found in the Jl. Royal As. Soc. of Great Britain and Ireland, vol. iv. p. 288. The initial invocation to Buddha is obliterated; that to Dharma remains; then follow invocations to Indra and other Hindu gods, as before noticed (p. 7). Near the end of the first line we have the word Kahápaṇa, so often used in these inscriptions for the piece of money given in charity to mendicant priests. It occurs again at the end of the ninth line, and also near its beginning, according to a copy I myself took some years ago. In the second line the word Dakhan, "South," occurs; and in the third Ságara-giri, "Ocean-hills," intended probably as a name for the whole chain; also a certain Maráthi "great warrior," who probably had the charge of the construction of the cave and the keeping the ghát in repair, is named.

In the fourth line, or third line of No. V. of Colonel Sykes' fac-similes, we have a great many high-sounding titles, which belong, I conclude, to the sovereign by whom this alms-house was constructed. This line in Devanágari is as follows:—

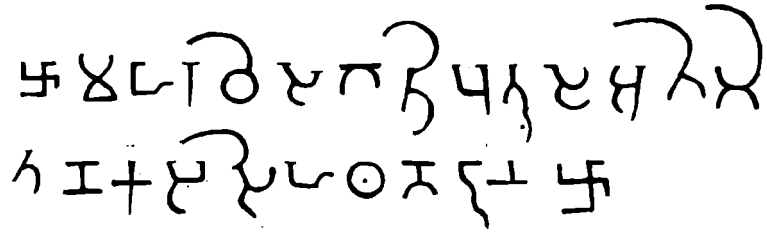
INSCRIPTIONS

FROM THE CAVES AT KARLÉ. N.

REDUCED FROM IMPRESSIONS TAKEN BY

LIEUTENANT F. P. F. BRETT.

I.

1 

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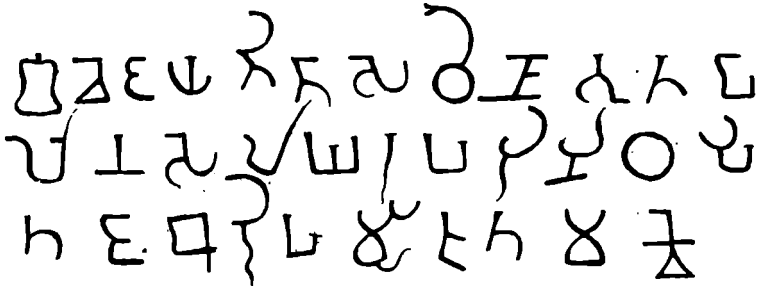
1 

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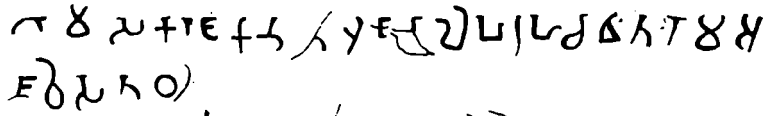
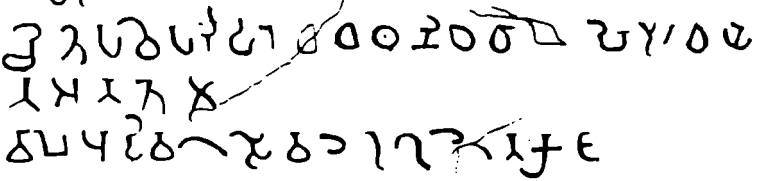
1 

2 

1.

2.

KARLE.N.

KARLE.N

VI.

VII.

KARLE.N.

VIII.

IX.

X.

XI.

XII.

XIII.

XIV.

XV.

XVI.

XVII.

XVIII.

INSCRIPTIONS
FROM THE CAVES AT RORAH SOUTH CONCAN
REDUCED FROM IMPRESSIONS TAKEN BY
LIEUT. F. P. F. BRETT.

I.

II.

III.

IV.

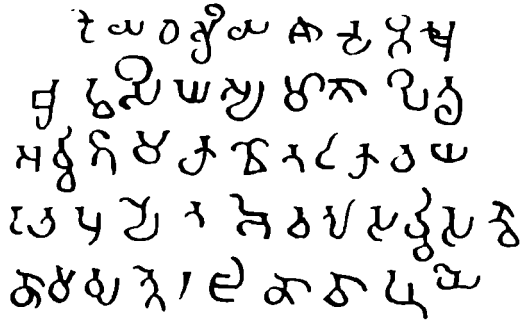
V.

VI.

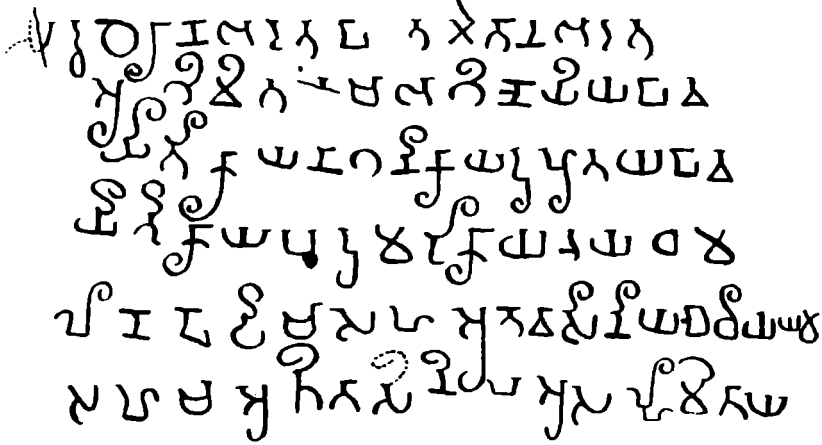
RORAM

VII.

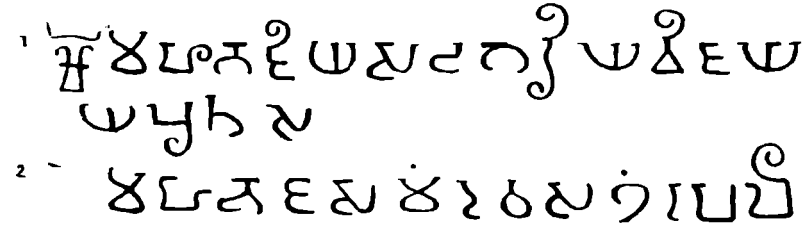
Under an Image of Buddah.



VIII.



IX.



ROMAN

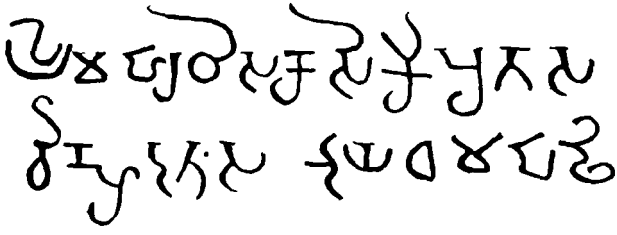
INSCRIPTIONS

FROM THE CAVES AT BAJA

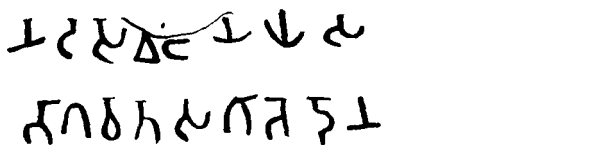
REDUCED FROM IMPRESSIONS TAKEN BY

LIEUT. F.P.F. BRETT.

I.



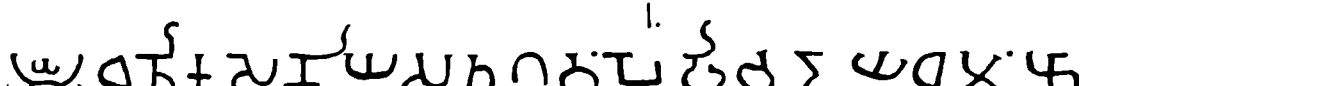
II.



INSCRIPTIONS

FROM THE CAVES AT JUNIŔ, REDUCED FROM IMPRESSIONS TAKEN BY LIEUTENANT F.P.F. BRETT.

I.



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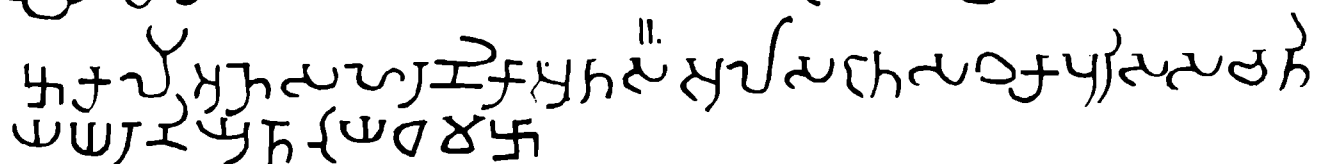

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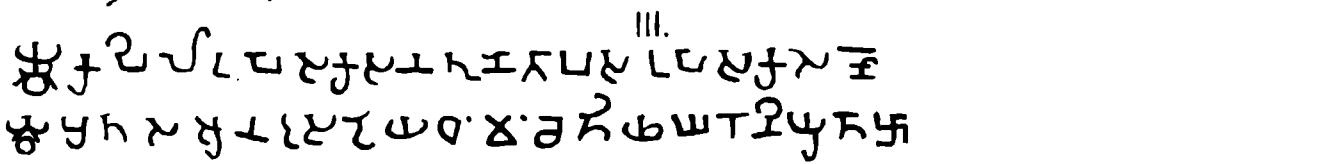


JUNIŔ

IV.

V.

VI.

VII.

VIII.

JUNÍR.

JUNIR

XII.

XIII.

XIV.

XV.

XVI.

XVII.

XVIII.

XIX.

XX.

XXI.

JUNÍR.

XXII.

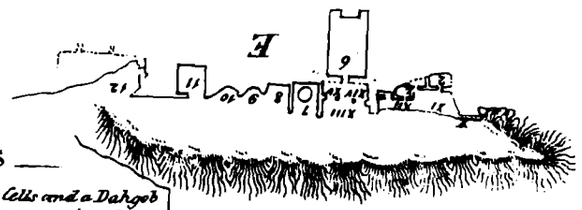
XXIII.

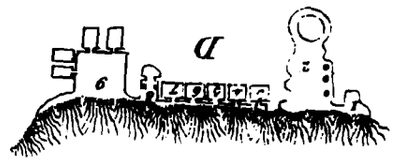
XXIV.

XXV.

XXVI.

PLANS of the SOUTHERN CAVES





INDEX to the PLANS

NORTHERN RANGE.
A

These caves are situated to the north of the Town of Junir in the Solimany hills and consist of 7 Cells with Couches, 12 feet above No 8

c Hall nearly 30 feet Square with 7 Cells.
Inscription No I is in the verandah of this cave the pillars of which are destroyed

g Water Tank

10 Chaitya with the roof arched and ribbed with stone supported by 16 Pillars, 6 of which are plain the others have Groups of Animals sculptured on their Capitals.

Inscription No II is in the verandah of this cave.

11 Large Vihar, 23 feet above level of the Chaitya, reached by a flight of Steps.

12.13.14 Three rooms of various sizes between which and 15 there are somother Cells near by inaccessible.

15 Oblong Chaitya with a Pahgob.
Inscription No III is in Verandah of this Cave.
Beyond this there are some water tanks over two of which Inscriptions No IV and V are found besides Cells with an Inscription No VI. engraved on the front of one of them, the means of getting to these is too difficult to admit of their being Surveyed with Satisfaction.

CAVES in the HILL-FORT
B.

These are situated in the Scarp of the Hill Fort and consist of one principal series B. besides several detached cells in various parts of the Hill none of the latter contain any inscriptions.

No 1. Over this tank there is an Inscription but too much effaced to be worth Copying.

No 2.3.4 2 Small Cells 3. a Caves unfinished

5 Chaitya with a flat Ceiling which at pears to have been painted Inscription VII. is in the front of this temple.

6 Cave with 5 Cells and a Dahgob in relief between those facing the entrance

7.8.9. Cells.

10 Cave with 12 Cells between this Cave & Hand over the water tanks there is a Sq^re room

11.12.13 Cells, the last has a Dagob in relief on its left & Inscriptions VIII & IX on its front, a few of the letters of No IX have been defaced.

16 Cave

16 Cave

WESTERN RANGE
C.

No 1 Square Temple with one small cell to its left.

2 Cell turned into a Temple devoted to the Goddess Kalee.

3 Circular Chaitya with a dome supported by 10 Octagonal Pillars.

4-5 4 Caves with 4 Cells 5 Cells.
This Series contains no inscriptions. The face of the Hill in which they have been excavated has been worn away by the action of falling water leaving in many places only the inner half of the Cave remaining. On account of their containing a favorite Shrine a Tank has been built for the use of pilgrims below the Caves.

SOUTHERN RANGE
D

1. 2 1 Small Cell 2 Unfinished Chaitya.

3.4.5.6.7.8 3. 4. 5. 6 Cells above the level of the Chaitya under which there are a number of cells filled with earth. 8 Cells.

9 Cave with 4 Cells above which there are several Cells.
There are no Inscriptions in these Caves.

E

No 1 Cave filled with earth. Inscription I is on the right of this Cave.

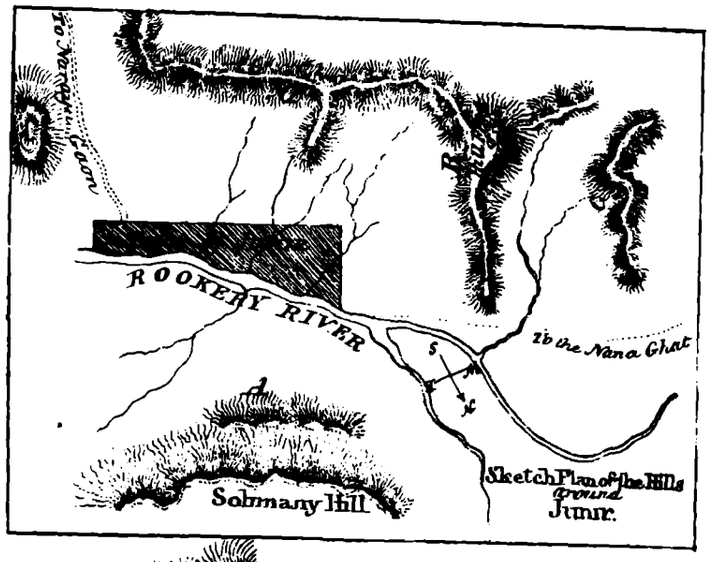
2.3.4.5 Cells also filled with earth. Inscription II. is between the doors of Cells 2 & 3 and XII between 4 & 5.

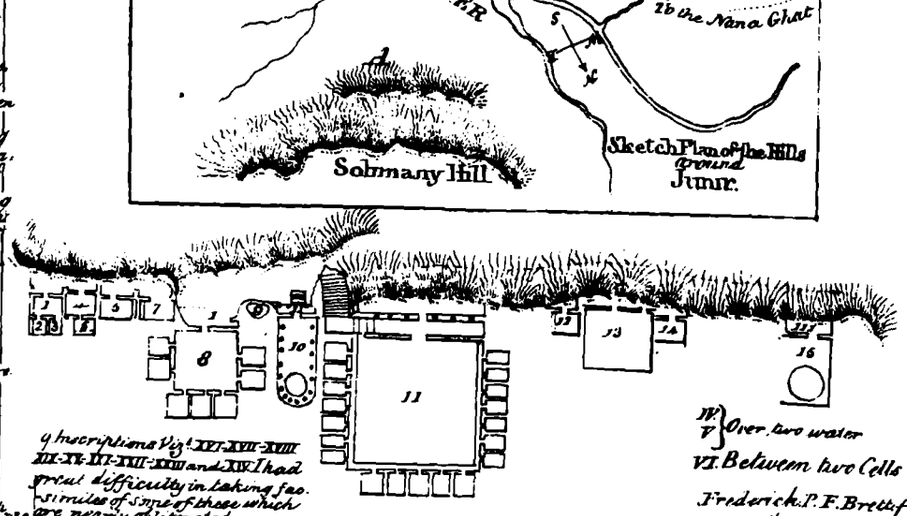
6 Unfinished Chaitya with the Dahgob having its Varandah Supported by 4 pillars the left centre one of which contain Inscription VIII. IX. and the other Inscription IV over the entrance of which I have given an elevation. There are 4 Inscriptions Viz^t XVI-XVII-XVIII XIX-XX-XXI-XXII-XXIII and XIV I had great difficulty in taking [illegible] Situation of some of these which are nearly obliterated.

7 Cave with small circular daghobs 8.9.10.11. Cells over which there are others. 12 Caves filled with earth

F

There is another set of Caves round the Hills to the SE consisting of a Chaitya, 2 of moderate size & several small cells in 2 of which Inscriptions XIV and XVI are found as they all are very difficult of access I found it impossible to take a plan of them.



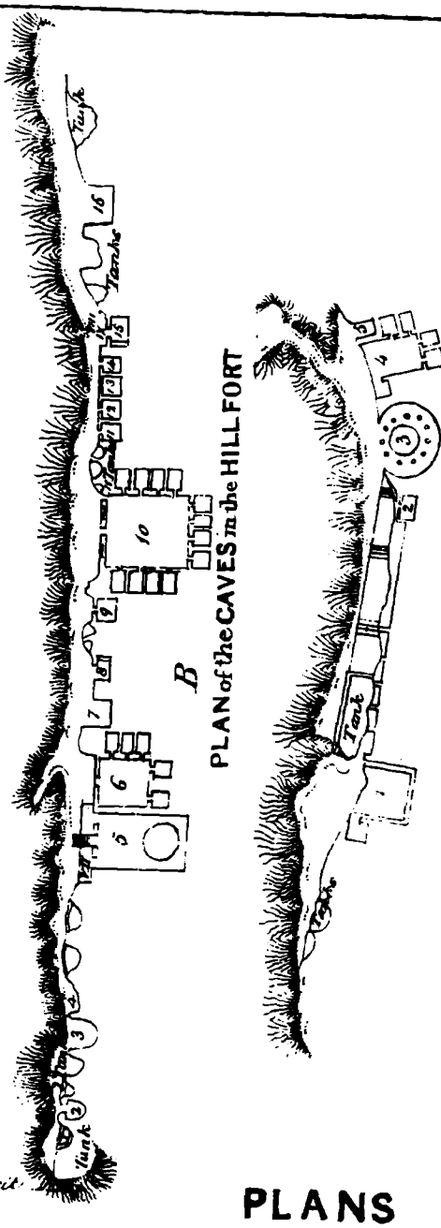


PLAN of the NORTHEN CAVES.
A

The Sketch plan is intended to shew the situation of the different Range of Caves

IV } Over two water
V }
VI. Between two Cells

Frederick P. F. Brett fecit
1st Dec. 1852.



PLAN of the CAVES in the HILL FORT
B

PLAN of the WESTERN CAVES.
C

PLANS of the CAVE-TEMPLES of JUNIR

वारिसावरिय देवस पुत दसवर दसकाम दसधन दसंवेदी सिरिमत सालि सो सिरिमत सावमंत. सोम.

Colonel Sykes' copy differs from mine in not having the first syllable, and in having in the fourth म for व. The word दसधन, also, differs slightly. Then, again, mine wants the last word, which I have supplied from his. After this there is a large blank, where the letters are wholly obliterated. The type of these letters is so entirely the same as that of the Láth inscriptions, that they must belong to the same era. On this account I am tempted to conjecture that the name Várisávariya is the Vindusára of the Puráns, and the Bindusáro of the Buddhists, whose name Várisára in the Bhágavat is essentially the same as ours. This, then, is the father's name; the word S'ántin is probably an epithet, though S'ánti is the Jain name for one of the Magadh emperors. The word सावमंत is probably सामन्त or सवाङ्. The obliterated letter may be अ; and the last म, as the letters are there indistinct, may be a mistake for क; thus giving us A'soka. I would then translate "The son of the divine Vindusára, possessed of tenfold endowments, tenfold loveliness, tenfold wealth, and tenfold knowledge, the fortunate auspicious, the fortunate imperial A'soka." It is very provoking, however, that the inscription should fail us in the very place where it becomes most interesting. It would certainly be gratifying if we could certainly identify this as one of A'soka's numerous monuments; still I conceive, all things considered, we are warranted to draw this conclusion.

There are also two inscriptions known to exist near Mahad (Mahar), in the Concan, and given in Dr. Bird's work, of which we have not got fac-similes. They evidently belong to the Kuḍen (Korah) series. There are also inscriptions at Adjanta, in a much more modern character, accurate copies of which are still a desideratum.

Chronological Summary.

I shall now conclude this paper with a short summary of the chief events mentioned in the Sahyádri inscriptions, in chronological order. It will be sufficient reference merely to note the page of this, and of my former paper, on which the statement made is founded. The dates which have not been ascertained from inscriptions, but merely made out by calculation, are marked with an interrogation.

B. C.		Page of former Paper.	Page of present Paper.
200?	A cave was excavated, and an alms-house established in it, on the top of the Náná Ghát, by an Emperor of India, probably A'soka, the first Buddhist Emperor		174-5

B. C.		Page of former Paper.	Page of present Paper.
70?	The Great Cave Temple at Kárlen was formed by the Emperor Devabhúti, under the superintendence of Xenocrates, a Greek	4, 11	152-3
65?	A small cave was excavated at Káṇheri by the same Xenocrates, in which a supposed tooth of Buddha was deposited, till it was removed to an adjoining tope, as mentioned below.	20	
23?	The expedition of the constructor of the cave mentioned below into Malabar, to quell an insurrection there, took place	40, 49	
22?	The central or Satrap cave at Násik was excavated by Ushavadatta, son-in-law of the Satrap Nahapána, of the Parthian monarch Kshaharáta (Phrahates?)	40, 49—53	
20?	Lands were given to the monks at Junir, who dwelt in the third series of southern caves, by several individuals, and especially by S'iṣuka, called there S'risuka, the first A'ndhrabhritya sovereign, while he was yet only prime minister		165-7
15?	The Great Temple Cave at Káṇheri was probably excavated by the same monarch, after he ascended the throne. The name given him above is that of the Matsya Purán; here he receives the name of Balin, that given in the Bhágavat..	27-8	
A. D.			
189	A tope or mound was constructed at Káṇheri to contain the tooth of Buddha, mentioned above, and also in honour of a celebrated Buddhist devotee, by Pushyavarman, who was connected with the A'ndhra royal family	13, 33	
	N. B.—This is the tope opened by Dr. Bird in 1839, and which contained a plate with the date on it.		
326	The village of Karanja, on the Ghats, was made over to the monks at Kárlen, by two great military commanders, who in the struggles between the regal Satraps and Magadh Emperors had most likely wrested the adjacent territory from the former, and afterwards resigned it to the latter. About the same time, also, the image of Buddha, on the left of the entrance, where these inscriptions are found, was probably executed		153—155
337	The large cave most to the left of those that contain inscriptions at Násik was excavated at the command of the queen of Gautami-putra, described as lord paramount of India and Ceylon, and who had established in his capital a college for Brahmánical, and another for Buddhist science, an institution for teaching archery, and a hospital	36, 42	
	N. B.—Reasons have been adduced to show that the era mentioned in this inscription is the Balabhi, and that it was established in commemoration of the overthrow of the Greco-Parthian empire in Western India, by		

		Page of former Paper.	Page of present Paper.
	the united forces of the Magadh Emperor and the Balabhi Commander-in-chief, who rebelled against his sovereign, the reigning royal Satrap, and rendered himself independent. These Satraps had, in all probability, reigned for a long time in their own right, and had prefixed the title regal to their former appellation, to point this out. The latest date on any of their coins is Samvat 390, or A. D. 333; for I think, from the form of the letters, that the era must be the common Samvat. We have, then, only to suppose, that on the Indus their government subsisted fourteen years after it was overthrown in Gujarát, as the Balabhi era commences with A. D. 319. In accordance with this supposition, none of the 400 regal Satrap coins that were found at Junir in 1846 belong to the two last Satraps. The vaunting, too, of Rudra Dáma, the last of them but one, on the Girnár inscription, over the S'atkarṇi ruler of the Dakhan, our A'ndhra monarch, could refer only to some partial success preceding the final catastrophe, as we usually find people boast most when hardest pressed. From our inscriptions it is evident that the hills in which the caves are excavated were sometimes in possession of the one, and sometimes of the other party.		
A. D.			
342	The monastery cave at Kárlen was executed by a mendicant devotee	36	158
410?	Buddhaghosha, the author of the Páli work called in Ceylon the Atthakatha, and the Buddhist apostle of the Burman peninsula, set up a middle sized image of Buddha on the right porch of the great Temple Cave at Káṇheri ..	13, 14	
428?	During the reign of the A'ndhra monarch Yadnya S'ri Sát Karṇi, who is mentioned in the annals of China as having sent ambassadors there, a nephew and other relations of his set up the two colossal images on each side of the porch of the same great cave; and at the same time a village was given to the monks	26	
430?	Other relations of the same emperor established an almshouse in connection with a cave at Káṇheri.....	24	
431?	Others of the royal family established a refectory in connection with another cave there	22	
433?	A monastery-cave was excavated at Násik by command of the wife of the commander in chief of the same Emperor ..	13, 56	
460?	A temple cave at Kuḍen (Korah), in the Concan, was excavated by the Secretary of the Chief of Salsette, who seems to have exercised authority over a considerable adjoining district of country		171, 174

N. B.—The above mentioned works are all that appear to me to derive from the inscriptions probable indications of the period about which they were executed, whether by means of the dates, or the names they contain. The time when the others were engraved can only yet be guessed at from the style of the letters, but none seem to me to have been inscribed on the Sahyádri rocks at a later period than that last mentioned, and certainly none earlier than the first date here given, bringing them all within the two centuries preceding, and the five succeeding the Christian era, during which time Buddhism flourished in Western India, while the modern Hindú system was silently moulding itself into its present form, and preparing to take the place, at a somewhat later period, of the religion of Buddha, and to exhibit that compound of Vedic pantheism, Buddhistical tenderness for animal life, and indigenal superstition, that is now current in India. During, however, the whole period of the Buddhist ascendancy, Brahmáns existed, studied their literature, had their holy places, and performed those of their rites that could be performed in private. The common people also worshipped Krishna, Bhaváni, and S'iva, as local gods, in particular districts.

The travels of the Chinese Fa Hian show, that at the beginning of the Fifth Century Buddhism prevailed throughout India; and those of Whang Thsang show that this was still the case in the beginning of the Seventh Century. An inscription, of date A. D. 657, originally affixed to a Buddhist temple near Nagpore, shows that it still prevailed in the East at that period. (Jl. Bom. Royal As. Soc. vol. i. p. 150.) It is to be noticed here, also, that there is a discrepancy of 42 years between the date A. D. 342 and A. D. 428.

Errata.

Without noticing mere obvious typographical errors, the reader is requested to correct the following mistakes in this and the preceding paper:—

Page 3, line 3 from bottom, *for* "erected" *read* "bestowed as a gift"
„ 4, „ 12 „ „ *before* "Commander" *insert* "wife of the"
„ 7, „ 11 from top, *for* "Apsaras)," *read* "serpents),"
„ 32, „ 9 from bottom, *before* "p. 97;" *insert* "vol. x."
„ 33, „ 14 „ „ "श्रावक" is translated "lay disciple," which is the Jain sense; but in Buddhist literature it means an order of the priesthood; the preceding word, "Agrya," also, may be a proper name.
„ 52, „ 8 from top, *for* "a thousand milions:" *read* "a thousand and a million:"
„ 153, „ 2 The word "Bhúti," should be in brackets, as it is supplied. In the Prácrit inscriptions ভ is sometimes changed to ম্ভ, and sometimes to ম্ব, according as the word in its Sanscrit form requires; but neither of these syllables occurs, except in the Sanscrit inscriptions: where either of them is found in the Prácrit, the original is ভ.

ART. II.—*Summary of the Geology of India, between the Ganges, the Indus, and Cape Comorin.* By H. J. CARTER, Esq., Assistant Surgeon, Bombay Establishment. [With Map and Diagram.]

Presented August 1853.

IT is but a few years since that the late Captain Newbold, of the Madras Army, wrote his "Summary of the Geology of Southern India," which was published in vols. viii. xi. and xii. of the Jl. of the Royal As. Soc.; and certainly no one has ever preceded or followed him in India whose opinions are entitled to so much respect, from his general geographical and geological knowledge, his active powers of observation, and his great personal experience of the country about which he has written. It is to be regretted, however, that he did not include that part of India between the Ganges and the Indus; because, with his actual acquaintance with the former, and the published observations on the latter, he might have drawn much more faithful and useful comparisons between the two than one behoving almost entirely to the observations of others for a summary of both.

As it is, there is nothing left but a careful perusal of all that has been written, directly and indirectly, on the subject, for at least the last twenty years, with frequent reference to a museum of authenticated specimens, before the student can feel himself master of what has already been done, and enabled to proceed with confidence to further investigation.

Very few, however, possess such opportunities, although there are hundreds so situated in India, who, if they could be conveyed to them, would not only be able to examine their respective localities efficiently, but be most grateful for the means thus afforded of additional occupation.

Feeling sensible of this, at the same time that it is impossible to transfer such advantages in bulk, I have endeavoured to supply their place, by giving a short summary of all the principal facts and

conclusions to which an attentive study of the observations of others and my own limited experience on the subject have enabled me to arrive, wishing that this long desired compilation had been undertaken by a more competent person.

The part of India I propose for our consideration is comprised within the Ganges and Jumna on the NE., the Indus and Sutlej on the NW., the Bay of Bengal and Arabian Sea respectively on the E. and W., and Cape Comorin on the S.; cutting off, however, that angular portion which is NE. of a line extending from Delhi to Ferozepore, as this would entail a description of the geology of the sub-Himalayan range, which, besides rendering the subject much more complicated, and being almost entirely without the natural boundaries of the tract mentioned, I am not prepared to enter upon.

With the general geographical features of this tract I must presume that the reader is already acquainted, and, therefore, shall only add a small map, to facilitate his finding out the places and localities to which I may have occasion to direct his attention.

Numerous as the geological observations on the portion of India before us appear to be, there are still so few, comparatively speaking, of general bearing, and these on localities so widely separated, that, after having perused many hundreds of pages, the student finds himself barely on the threshold of his subject, and with but a faint sketch even of the most prominent geological features of the country he at first thought so well known. Such, however, must always be the case in an attempt to generalize from unconnected facts and data indefinitely described, which most of these are. Yet India has not been without her able, faithful, and devoted geologists; but the treachery of her climate, her uninhabited wastes, where her rocks are best seen, her extensive and impenetrable tracts of vegetation, and her stratified formations metamorphosed and unfossilized by the intense heat of repeated intrusions of igneous matter, have, all combined, opposed the development of her geological history, and the former sent many an efficient enthusiast to an early grave, ere his task of practical examination had hardly been commenced.

The progress of Indian geology is, therefore, necessarily slow, and its advancement now almost impossible, without a previous knowledge of what has already been done; which, however much more advantageously obtained by personal observation in a temperate climate, with an abundant and highly civilized population, will not admit of a similar exchange in India, where the uninhabited and unhealthiest parts are

generally the most instructive, and can hardly be expected to be visited more than once by the same individual.

Limited, however, as our actual acquaintance with the geology of India may be, there is still enough to shadow forth a systematic outline of what really exists, and which, if learnt, may materially facilitate the further development of her mineral and geological resources.

It will hereafter be seen, that in the tract mentioned we have, at least, representatives of all the geological series of Europe, from the Oolitic period down to the present time, with metamorphic strata, and plutonic and volcanic rocks in abundance, such as are to be found in other parts of the world. So far, the Oolitic deposits appear to be the most interesting, both in an economical and in a geological point of view; for they not only contain the coal beds of India, iron-ore, and a very fair lithographic limestone; but in their metamorphic state appear to afford the white marble of India, which, together with the red coloured sandstone, another part of this series, form the chief materials of the Taj Mahal at Agra, and the latter that of all the principal buildings of the towns on the Jumna from Mirzapore to Delhi. At Ajmeer and elsewhere the same sandstone, apparently metamorphosed, yields lead; copper is found in the shales of this series; serpentine in Bahar; steatite (pot-stone) in many places; magnesite near Jubbulpore, &c.; and the researches of Captain Franklin and Jacquemont in Bundelkhund, and Voysey in Southern India, would seem to show that the original conglomerate, if not the real bed of the diamond and a part of, at least almost invariably accompanies, this series. While the late discoveries of the Rev. Messrs. Hislop and Hunter in the neighbourhood of Nagpore have shown that the Oolitic deposits abound in by far the most interesting fossils that the interior of India has yet afforded.

The so-called cornelian mines, again, at Rattanpore, about 42 miles inland from the mouth of the Nerbudda, would appear to be in an old beach, chiefly formed of rounded flints from the amygdaloidal rocks. But these and other conclusions had better be given in connection with the facts from which they have been derived, lest the mind of the reader be biassed in anticipating that which, after all, may prove to be fallacious; the object of this summary being, not so much to insist on the correctness of the views it may contain, as, in the absence of more extended data, to place something before the reader which may draw his attention to the subject.

With this short introduction, let us proceed at once to the description of the different formations, commencing with the oldest, and ending with the most recent. These will be separated into Groups, headed respectively with a tabular view of their contents.

For authority, the author's name alone will be given, the titles of his publications being inserted at the end of the article; and, when reference is made to a specimen in the Society's Museum, the letters Mm. will precede the contributor's name, likewise P.MS. for private manuscript.

In the spelling of the names of places I am compelled to follow that of the Maps as much as possible.

GROUPS.

I.

PRIMITIVE PLUTONIC ROCKS.

This group is intended for the primitive granitic rocks of India, when such shall have been determined. So far, the observations which have been communicated on the plutonic rocks are, comparatively, so scanty and so unconnected, and in every instance these rocks themselves so intimately mixed up with metamorphic strata, that primitive granite has not been satisfactorily demonstrated, and until this is done we must commence with the oldest *stratified* formations.

II.

OLDER METAMORPHIC STRATA.

Gneiss.	*Quartz Rock.*
Mica Schiste.	*Micaceous Slate.*
Chlorite Schiste.	*Talcose Slate.*
Hornblende Schiste.	*Clay Slate.*

Granular Limestone.

I have called these "Older," in contradistinction to newer metamorphic strata, which also exist in India. They may be generally known by their composition, and by their being frequently veined with rocks of the secondary granitic series.

Gneiss.—This rock appears to be by far the most general and abundant of all the metamophic strata. It occurs at Oodeypore (Dangerfield), near Baroda (Mm. Fulljames), Zillah Bahar (Sherwill), Rajmahal hills (M'Clelland), Phoonda Ghaut (Mm. DelHoste), Northern Circars (Benza), more or less throughout the peninsula to the Palghaut (Newbold), and probably to the extremity of India. It forms,

with the other hypogene schistes, the scarp at the falls of Gairsuppa, which is 888 feet, to the water below, and the latter is 300 feet deep (id.). Christie considered this to be primitive gneiss: it is veined by granite (Newbold), which Christie also considered not the oldest. It is also veined by granite at Wallavapore, in the bed of the Toombudra, 35 miles WSW. of Bijanuggur (Newbold), Chittoor, on the Eastern Ghauts, top of the Bisly pass above Mangalore, the Palghaut, Sunkerrydroog, and Bangalore (id.).

It contains specular iron ore (Siderocriste) in most places: western extremity of the Vindhya range (Fulljames), Rajmahal (M'Clelland), in large beds at Malwan, on the Malabar Coast (Malcolmson), and at Hazareebagh is a bed of flinty brown iron ore of a pitchy lustre, and splintery fracture, 20 feet in thickness (Williams *apud* M'Clelland). Graphite replaces the mica at Banuswar near Bangalore (Newbold), Tinevelly, and Travancore (Major General Cullen). Tin is found in it on the banks of the Barakur, within a few miles of the town of Palmow (M'Clelland). Beds of garnets are common in it everywhere, corundum in Southern India (Christie), and beryl in the Mysore (Newbold).

It varies in composition, texture, and colour, containing more or less mica, being more or less compact, massive or schistose, and varying in colour from speckled, black, brown, reddish, to grey and white. It is also tinted green sometimes, when chlorite replaces the mica. When very fine-grained, and decomposing, it bears a close resemblance to fine-grained sandstone.

Mica Schiste.—This rock, though not so often mentioned as hornblende schiste or gneiss, is probably always more or less present in parts of the latter. Like it, also, it contains garnets in the Southern Mahratta Country (Malcolmson), western extremity of Vindhya range (Mm. Fulljames), &c. It seems to pass into micaceous slate at the Phoonda Ghaut. Newbold states, that although generally veined with quartz, he never saw a vein of granite passing into it. Being associated with gneiss and hornblende schistes, they of course pass into each other.

Chlorite Schiste.—This, like mica schiste, contains garnets in the Southern Mahratta Country, and passes into mica schiste and gneiss, to which it is subordinate: also into steaschiste (pot-stone), massive and laminar, and into chlorite slate, and clay slate. *Talc Schiste* is almost synonymous with *Chlorite Schiste* in geology, though talc and chlorite differ in mineralogical composition. Talc is frequently much more difficult to distinguish from chlorite than the latter from mica, by any empirical character.

Hornblende Schiste.—This rock, though not so abundant as gneiss, is just as frequently mentioned. It forms the eastern and western sides of the Neilgherries, where it is from 5 to 7 miles in breadth, and slopes pentlike on either side on the granitic rocks which form the central axis of these mountains (Benza). Like gneiss, garnets are common in it at the Neilgherries (id.), Southern Mahratta Country (Mm. Aytoun), and corundum in Southern India (Newbold), &c. It contains magnesite, and chromate of iron in veins, at Karpur, 4 miles north-west of Salem, and green garnets in quartz veins at Sunkerrydroog, about 20 miles SW. of Salem (id.). Actinolitic forms of this schiste are frequently mentioned by Newbold. It is also found with mica schiste on the Malabar Coast, which often passes into it (Malcolmson, and Mm. Aytoun).

Quartz Rock.—Commencing in the north, Jacquemont states, in his journey from Delhi to Bombay, that all the hills are composed of quartz from Delhi to Alwar, as well as between Ajmeer and Oodeypore. The quartz of the mountains at Ajmeer is compact and granular, with disseminated mica, and of a violet, grey, brown, or red colour. Tod mentions the summits of the diverging ridges from Ajmeer as being "quite dazzling," from their "enormous masses of vitreous rose-coloured quartz." On the great tract of slates forming the Suloombur range, about half a mile north of Maunpore, a little village situated on its ordinary summit, are two hills from 150 to 200 feet high, composed entirely of compact white semi-transparent quartz, in parts tinged with red, which, from its brilliant white colour, contrasted with the sombre hue of the slates, makes these hills at a distance resemble "snowy peaks" (Dangerfield).

Immense beds of quartz abound, not only in the neighbouring hills, but in all the plains of Suloombur, and towards Oodeypore. From the summit of the mountains round the Deybur lake or Beerpore, rises "an almost perpendicular wall of a large conglomerate or compound rock, consisting of immense reniform, or compressed globular masses of hornstone or quartz, imbedded in paste of the same, but having interposed a large quantity of golden mica in brilliant small plates; thin beds of mica slate occur near the centre of the mountain, with small seams of felspar, and large imbedded masses of Lucullite" (Dangerfield). The brilliant whiteness of the quartz in the Southern Mahratta Country is also spoken of as being very striking, and Christie mentions ranges of hills there which are crested with limpid quartz, from the granite in which it is imbedded decaying on either side. Returning to the north, again, Jacquemont states that he saw a mountain at Alwar composed

of nearly vertical strata of quartz, alternating with thin beds of black amphibolic, or argillaceous, or ferruginous limestone. Around Jaipore and Ajmeer loose micaceous sand prevails, with projecting rocks of white quartz, amphibole, mica schiste, and dykes of syenite; and 4 miles from Chittore a ridge of nearly vertical strata of quartz, resting against granite on one side, and alternating on the other in argillaceous schiste, on which again rests compact limestone. (See Jacquemont's section.) Quartz rock is found at the western extremity of the Vindhya range, associated with mica slate (Hardie and Mm. Fulljames); and at its eastern extremity "in subordinate beds" in "old blue slate," but "mostly occupying a position between the older and newer varieties of slates, stratified," and "reposing on the back of old blue slate mountains in tabular masses, thus forming mountain declivities uncovered by other rocks. A columnar fibro-slaty variety is found between the newer and older clay slate in nearly erect strata, passing on the one side into blue resinous conchoidal quartz, and on the other into the newer clay slate" (M'Clelland). Other hills of slaty quartz and of hornstone in the same vicinity may be referred to the same formation (id.).

Veins and large beds of quartz, more or less amethystine, are present in the granite plains of Hydrabad (Voysey). They occur also more or less throughout the peninsula; but the existence of quartz rock is not so often mentioned in the southern as in the northern part of India: indeed, after crossing the Toombudra, this rock on the western side of the peninsula appears to be subordinate in development all the way to the extremity of India, and micaceous and clay slate never to my knowledge mentioned.

It contains lead at Ajmeer (Jacquemont and Dixon), where both are in a granular form, and iron and copper in the Southern Mahratta Country (Mm. Aytoun). Mica is frequently found in large masses, and disseminated throughout the rock; talc also, and chlorite, occasionally; and there is an extremely beautifully green specimen from the Southern Mahratta Country, coloured apparently with the latter (Mm. Aytoun).

Micaceous Slate and Chlorite Slate.—These are but more or less laminar aggregates of fine clay and mica, or fine clay and chlorite, the former rendering the mass more or less sparkling in appearance, the latter more or less satiny and greasy to the touch. They both occur at the Phoonda Ghaut (Mm. DelHoste), and the latter in the Southern Mahratta Country. Micaceous slate also occurs in the Suloombur range (Dangerfield). Both pass into clay slate, when the brilliancy of the one and the greasiness of the other completely disappear. Copper

occurs in a talcose form in the Southern Mahratta Country (Mm. Aytoun), but I am unable to state if it belongs to the old or to the new metamorphic rocks: my opinion inclines to the latter.

Clay Slate.—This formation appears to be of great thickness. It is both massive and laminar, and of a variety of colours. Tod states that "the Aravulli range is chiefly characterized by granite reposing on massive, compact, dark blue slate." In passing from the north-western part of Malwa to Oodeypore, across the Duryawud valley, and the Suloombur range, towards the Deybur lake, clay and chlorite slates are almost the only rocks met with for five or six miles. The Suloombur range is found to be almost entirely composed of clay and chlorite slates, in vertical or highly inclined layers, with subordinate beds of greenstone, greenstone slate, and a fine crystalline limestone (Dangerfield); and the great mountain chain which runs nearly in a direction north and south, past the westward of Oodeypore, dividing Guzerat from Malwa, Rath, and Bagur, is, as far as it is known, principally composed of slates and primitive limestone (id.). In the Curruckpore hills, where micaceous slate passes into clay slate, the latter occupies a belt of country 20 miles in breadth, extending across the direction of the strata (M'Clelland). The Nerbudda passes through mica talcose and chlorite schiste, and gneiss, superposed with dolomite between Lamaita and Beragarh, close to Jubbulpore (Franklin); and again, on the south side of the Nerbudda, between Mandela and Amerkuntak, Dr. Spilsbury states that the schistes are like the scales on a Manis' back. Micaceous slate passing into clay slate occurs in the Phoonda Ghaut (Mm. DelHoste), also in the Saltoor pass, in the Southern Mahratta Country (Aytoun). Voysey, in his last journey from the vicinity of Nagpore to Calcutta, *viâ* Sumbulpore, mentions "clay stone [clay slate?] in gneiss, in the bed of a watercourse between Kishenpore and Surekeela, just after having passed gneiss, hornblende schiste, and quartz rock, repeatedly alternating," and in alluding to its metaliferous character he adds: "At Calastry it contains led ore mixed with silver; at Nellore copper; at Nagpore manganese and lead ore, and copper; micaceous iron ore is a very common product of this rock." Old clay slate with flinty slate and limestone was seen by Dr. H. [Dr. Heyne?] about the Kistnah (Extracts from Dr. H.'s MS. *ap.* Voysey).

Micaceous and magnetic iron ore occur in clay slate in the Southern Mahratta Country (Mm. Aytoun), manganese in the Kupputgode range, in the same neighbourhood (Aytoun and Newbold), lead in the Eastern Ghauts at Jungamanipenta (Newbold), plumbago in

the branch of the Pulicat hills running south from Cuddapah (Dr. H. *ap.* Voysey). Tod mentions garnets in a hill of blue slate one mile east of Poorna, a little north of Oodeypore; also on the frontier of Kishengurh and Ajmeer; and mines of tin? and copper at Dureeba, close by. Aytoun's ENE. and WSW. section of the Kupputgode hills shows a vast quantity of iron schiste interstratified with chlorite "and micaceous schistes; with talcose quartz, hornblende gneiss, mica slate, and hornblende schiste" on the ENE. side: one stratum of iron ore is 60 feet in thickness. Gold is found in the iron sand of the watercourses running from these mountains, and also from the Saltoor range adjoining, while in the centre of the Kupputgode range are two hills called the "great" and "little" gold mountains.

Granular Limestone.—Connected with the old metamorphic strata, appears to be a limestone, though the fact is by no means substantiated, on account of the metamorphosed state of much of the Oolitic limestone of India. Captain Dangerfield mentions subordinate beds of a "finely granular crystalline limestone, of a light grey colour, occurring with greenstone slates in the clay and chlorite slates of the Suloombur range, at Maunpore, between Malwa and Oodeypore"; also "imbedded masses of Lucullite of a black colour, and dull conchoidal fracture," with thin beds of mica slate and small seams of felspar, in mountains of gneiss round the Deybur lake, of the same neighbourhood. Jacquemont saw a mountain of quartz at Alwar, interstratified with thin beds of amphibolic, argillaceous, or ferruginous limestone, in vertical strata. There is a compact finely granular limestone, of a dark bluish-grey colour, associated with mica slate, in the Phoonda Ghaut (Mm. Del Hoste). It has all the appearance of mountain limestone; while a still more compact variety of a lighter colour exists on several parts of the Malabar Coast in the neighbourhood: near the entrance of the Goa river, in very subordinate beds, associated with the chert and slate of that locality (Mm. Dalzell), this would be worth examining more minutely, as it evidently contains the remains of shells. Limestone is found in hornstone slate in the Nulla Mulla mountains; and the lead mines of Jungamanipenta, in the Eastern Ghauts, are in limestone associated with argillaceous and arenaceous slates and shales, "resting conformably on the hypogene schistes," whose age Newbold states is undecided. He also mentions a layer of fine crystalline limestone, apparently magnesian, in gneiss broken up by granite, at Sunkerrydroog, with innumerable garnets in the limestone where it is in contact with the granite. Fine white highly crystalline limestone, with graphite, in grains, disseminated in it, or with masses of green and clove-brown? hornblende, in laminar or

granular crystallization, occur in the district of Tinevelly (Mm. Major General Cullen).

Obs.—As with the *Quartz Rock*, so with the *Clay Slate*, and *Granular Limestone*, there is in many instances no possibility of determining which belongs to the older, and which to the newer metamorphic rocks, from the present observations; and they never will be satisfactorily described and distinguished throughout India, until they are examined by a practical geologist, on the spot, well acquainted with Indian geology. There are evidently two metamorphic series, at least; and until their respective minerals and characters are determined, they will be perpetually confounded. I think it extremely probable that I have unavoidably done this, but I must be content to leave future investigation to point out my mistakes; let us now direct our attention to the rocks by which these strata were first penetrated.

III.

SECONDARY PLUTONIC ROCKS.

Granitic or Felspathic.	*Granite.* *Protogine.* *Syenite.* *Pegmatite.* *Leptynite.* *Eurite.*	Diallagic	*Euphotide.* *Eclogite.*
		Amphibolic or Hornblendic.	*Amphibolite.* *Hemithrene.* *Diorite.*

Granitic or Felspathic Rocks.

Granite.—Huge masses of a compressed round or cuboidal figure, heaped upon each other irregularly or in columnar piles and erratic blocks, compact, or undergoing concentric laminar decomposition *in situ*, or in detached portions, form the grand characteristic features of this formation in India as well as elsewhere; and as it appears to exist more continuously, and to a greater extent, in the neighbourhood of Hydrabad than in any other district, so its features are, perhaps, more strikingly developed in this than in any other part of India. Voysey states, that on quitting the banks of the Kistnah, granite alone, chiefly of a red colour, is the basis of the country to the Godavery. Red felspar seems to be the predominant ingredient in the secondary plutonic rocks throughout India. The granite, which veins the metamorphic strata, appears to be principally red, though not always, for at the falls of Gairsuppa it is grey, and sometimes it is red in one part of the vein, and grey in another (Voysey); while at Goontacul, near Gooty, a still younger red granite is seen to vein the older secondary one (Newbold). Captain Jenkins mentions a grey granite at

Ramteek, in the hills NE. of Nagpore, composed chiefly of whitish felspar in very large crystals, which is traversed "three or four times" by granitic veins, the granite becoming finer in structure, and redder, as it is more recent. Red granite, however, is far from being exclusively the colour of the secondary granites, though it seems to be the most prevailing one.

Protogine, Syenite, Pegmatite.—The granitic rocks vary in structure and in mineral composition as they do in colour—hence these appellations: at one place they are syenitic, at another protoginic, and at a third pegmatitic, while a very common form is the quaternary compound called *Syenitic Granite*, from its containing hornblende as well as mica. This is the prevailing felspathic rock of the Neilgherries (Benza). Christie was of opinion that white and red syenites were the most prevalent rocks of the peninsula; and that, from being associated with granite, they were the same as those of Egypt. All who have observed the felspathic rocks of India have been struck with the large size and beautiful flesh-colour of the crystals of felspar, and of its frequent prevalence in place of the other ingredients. At Severndroog some of the reddish-coloured crystals are nearly two inches long, and imbedded in a small-grained reddish granite. Some of the dark-red crystals at Roan, in the district of Dharwar, contain minute veins of quartz, and cavities filled with crystals of chlorite (Christie); and occasionally in the Southern Mahratta Country the whole mass consists of red crystalline felspar, granular or in large crystals (Malcolmson, and Mm. Aytoun). Mica appears to be very sparingly disseminated in the large-grained red felspathic rocks, and is frequently replaced by green chlorite, rendering the rock protoginic. Sometimes it is replaced by actinolite (Newbold), and occasionally by epidote. The latter, with red felspar, forms a beautiful rock, in the western extremity of the Vindhya range (Mm. Fulljames); but I am ignorant of its extent. In the Southern Mahratta Country the red felspar is sometimes accompanied by quartz only, which, being transparent and colourless, forms, when coarse-grained, a beautiful pegmatite (Mm. Aytoun). A grey granite prevails at Vencatagherry, which, at Naikenery, at the top of the Moglee pass, contains nests of mica as large as a man's head (Newbold). Sometimes all kinds of granite and granitic rocks may be found in different parts of the same mountain, as in that at Bellary (id.). At Bijanuggur the granite is generally red; at Vingorla, on the Malabar Coast, it is grey.

Tracing these rocks through the tract mentioned, and beginning in
16★ the north, we find none in Cutch (Grant); but at Nuggur in Parkur

there is a hill of red and white syenite (id.), which can be traced on in masses just projecting above the sand to Balmeer, and its immediate neighbourhood, where the granitic mountains are 1,200 to 1,500 feet high, and the felspar of an opaque reddish yellow, or flesh-colour, imbedded in a fine-grained syenite (Mm. Forbes). At Jessai, which is a village among this group, the granitic mountains have been deeply fissured by subterranean violence (id.). At Mount Aboo there is granite again (Mm. Waddington); and the Aravulli range consists chiefly of it "reposing on slate," as has before been mentioned (Tod). At Ajmeer and around Jaipore red granite and syenite are seen in veins and dykes traversing the hills and mountains of quartz, which project above the sand in these parts (Jacquemont). Between Oodeypore and Malwa are all the varieties of granite above mentioned, the red and largely crystallized always predominant (Dangerfield). They extend more or less southward to Chota Oodeypore, near the Nerbudda (Hardy and Dangerfield), and form part of the western extremity of the Vindhya range near Baroda (Mm. Fulljames). The Girnar mountains in Kattyawar consist of a grey syenitic granite (Mm. Aston), and granite mounds are seen projecting above the surface on the site of the ancient Valabipura, a few miles NW. of Gogah, in the same peninsula (Nicholson). Passing to the neighbourhood of the eastern extremity of the Vindhya range, we find the fort of Kallingur, about 110 miles W. of Mirzapore, situated on a hill formed of red syenite capped with sandstone (Jacquemont), and several syenitic mounds in the vicinity. Enormously coarse-grained granite is met with in the Zillah Bahar, as well as fine-grained passing into eurite (Jacquemont and Sherwill); and red syenite near Curruckpore; also in the Bhagulpore and Monghyr districts, on both sides the Ganges, and veining gneiss with trap two miles from Luchmipore (M'Clelland). Returning to about midway between this and the mouth of the Nerbudda, we have granite on the south side of the latter, between Mandela and Amerkuntak (Spilsbury); also syenitic granite with flesh-coloured felspar at Jubbulpore, 30 miles in extent (Franklin); at Baitool, close to the northern border of the great trap district (Finnis); veining limestone, and bursting through the sandstone overlying it at Nagpore (Malcolmson); in Cuttack (Stirling), Orissa, and the Northern Circars, which, with the province of Bahar, are almost unexplored districts, as far as their geology and mineral resources are concerned. Its great extent in the district of Hydrabad has been mentioned. At Vingorla, on the Malabar Coast, it limits the great trappean effusions of Western India; and thence southward, with the other felspathic rocks, forms the grand plutonic

net-work of the peninsula. There is a granitic ridge a mile long and 120 feet high at the Seven Pagodas, between Madras and Pondicherry, close to the sea (Newbold); and at the Amboli pass, about 20 miles from Cape Comorin, the mountainous tract of Southern India ends in a bluff peak of granite, probably about 2,000 feet high, from the base of which a low range of similar rocks extends southward to the sea (Calder). Everywhere the red felspathic granitic rocks are mentioned more than the grey or white felspathic variety; everywhere, almost, the former appear to vein the metamorphic strata, where they exist; and almost everywhere both secondary granitic and metamorphic rocks appear to be again veined or dyked by greenstone (diorite) and the trappean rocks.

Leptynite, Eurite, and Porphyry.—The first is occasionally mentioned by Newbold, and *Eurite* not unfrequently; but *Porphyry* very seldom. With the exception of a dyke passing through gneiss at the northern sally-port of the fort of Seringapatam, near to which Tippoo was killed, I know of no other to which prominence is given. This, which has been described by both Benza and Newbold, is said by the former to consist of "well-defined crystals of red felspar, which is occasionally white, imbedded in a paste of compact felspar of the same colour." It also contains "tourmaline in numerous needle-shaped crystals."

Diallagic Rocks.

Abundant as these rocks are on the South-east Coast of Arabia, where, with serpentine and diorite, they in extent almost represent the trap of India, there is only one place in India where euphotide is clearly mentioned, and that is at Banuswar, in the Mysore, a little west of Bangalore. Newbold, who has described it, states that it differs from the euphotide of other parts, in being a compound of felspar and quartz, with the latter predominating, the diallage varying in colour from olive grey to smaragdite green.

Hornblendic Rocks.

Diorite or Greenstone.—This rock differs from the fine-grained diorites of the trappean effusions, to which we shall come by-and-bye, in being of a coarser structure and entirely crystalline, and not containing the small portion of amorphous or uncrystalline earth, which the latter do, in presenting no vesicular cavities, and no zeolitic minerals, but imbedding, if anything, chiefly talc, mica, or garnets. Besides these differences, it seldom overlies the other rocks to any extent, occurring

chiefly in veins, intercallations, dykes, or mural ridges, the latter sometimes, with granite on each side (Malcolmson).

Its structure, composition, and colour vary: for the most part, perhaps, it is largely granular, crystalline, and of a dark or black green colour, when it is almost wholly composed of hornblende, and therefore closely approaches Brongniart's amphibolite; or of a granitoidal aspect and structure, when it consists of equal quantities of felspar and hornblende; or porphyritic, when it is fine-grained, with one or the other of its ingredients in large crystals.

An "old trap" is said to exist in "the big" and "little Mounts" at Madras, and on the granite of the Seven Pagodas, which is compounded of "felspar, hornblende, and quartz, with a small proportion of mica, pyrope and epidote, which enter it as foreign minerals" (Dr. H. *ap.* Voysey). Newbold also describes a similar rock at Chingleput, 36 miles SSW. of Madras, which is garnitiferous. Amphibolites also exist in the Southern Mahratta Country, which are respectively micaceous and garnitiferous (Mm. Aytoun); and a beautiful diorite, compounded of equal parts of translucent, colourless felspar and dark green, granular hornblende, with chlorite disseminated in the latter. A compact greenstone, foliated, and ringing when struck, is often used for lingums (Dr. H. *ap.* Voysey). Common hornblende of an olive green is found in the Bura-maul, in Noorcull, in primitive trap, with garnets (id.). A porphyritic greenstone is found in conjunction with syenite in a considerable tract between the villages of Curhurbalee and Palmow, in the zillah of Huzareebagh. The porphyritic structure is produced by small pieces of talc, of uniform size, disseminated throughout the mass of hornblende (M'Clelland).

Going to the southern part of the peninsula, Benza describes a tract of 15 miles in extent, 5 miles NW. of Salem, which is composed of diorite veined with magnesite. The structure and composition of the rock is only seen from the surface, as there are no hills, only mounds, which are all interlaced with a net-work of magnesite veins from 0—3 inches in thickness, massive, or in cauliflower crystallization. Stromeyer found this magnesite to be composed of magnesia 47·89, carbonic acid 51·83, and lime 0·28. It is nearly anhydrous, heavy, and so hard and compact as to strike fire with a hammer, breaks with a conchoidal fracture, and has a waxy structure; also effervesces slightly with acids. Asbestus, talc slate, and nephrite occur here and there, and where the magnesite is in contact with the main rock the latter is ophitic. Another part of this diorite probably is alluded to by Newbold, who states that at Karpur, 4 miles NW. of Salem, is a

hornblende schiste, alternating with talcose massive schiste, netted with magnesite veins, along which, also, chromate of iron runs, and layers of magnesian rock like serpentine, the whole of which is dyked with basalt. Chromate of iron is also stated to exist near Trichinopoly, also with magnesite at Hansoor in Mysore (Gilchrist); and the latter in the Nellore district. Serpentine is often mentioned in subordinate beds in mountains or hills, among the hornblende schistes, but never serpentine rock, occurring with diorite and euphotide, as in Arabia. It is, perhaps, worth remembering, that the only part of India where hornblendic rocks, approaching to those of the South-east Coast of Arabia, have been noticed, is in the neighbourhood of calcareous beds belonging to the lower Cretaceous and upper Oolitic systems; and these, again, have only been noticed in the southern part of the peninsula, between Pondicherry and Trichinopoly. May we infer from this, that the latter exist on the coast of Arabia, and that they never have existed in the greater part of India?

Like the granitic, the greenstone rocks vein and dyke the metamorphic strata almost everywhere, and, coming after the former, vein them also, while they are in their turn cut through by the trappean rocks.

As before stated, their greatest continuity is seen in mural ridges, and not as overlying rocks. They occur extensively both in the granitic district of Hydrabad, and throughout the peninsula (Malcolmson and Newbold). Some dykes have been traced for 20 miles continuously (Newbold). About Hybrabad they are from 100 to 300 feet broad, and may be traced from 15 to 20 miles, occasionally spreading out a little (Voysey). About 4 miles south of Dhonee, between Gooty and Kurnool, there is a basaltic greenstone dyke, 150 feet high and 200 feet broad, running through a range of sandstone and limestone mountains (Newbold), and near the village of Bunkapilly, within 4 miles of the Munjira, as well as on the banks of the Munjira itself, Voysey saw a "greenstone or syenitic greenstone" veined with granite, the granitic veins being in some parts red, in others white, and projecting 2 feet beyond the weathered surface of the greenstone. This must not be set down, however, as an instance of granite veining greenstone, for the genuineness of the latter is by no means apparent, from his calling it "greenstone or syenitic greenstone."

The other two rocks mentioned in the table, viz. *Eclogite* and *Hemithrene*, though probably existing, have not yet been mentioned in India. For their characters, as well as for those of the other rocks in

this group, I must refer the reader to the Article "Roches," by Alexandre Brongniart, in the "Dictionnaire des Sciences Naturelles."

IV.

"CAMBRIAN AND SILURIAN ROCKS" (M'Clelland).

Newer Clay Slate, with beds of Quartzoze Breccia.	*Syenite.*
Transition or Cambrian Gneiss.	*Porphyritic Greenstone.*
	Hornblende Slate.
	Slaty Quartz.

We have now come to a period which followed the eruption of some of the red felspathic rocks, at least, in which it seems desirable to bear in mind that chlorite frequently replaced the mica, rendering the rock protoginic, and that the crystals of felspar themselves sometimes contained chlorite. Voysey mentions the passage of granite about Hydrabad "from greenstone to pot-stone." Stirling mentions that the granite about Ganjam, in Cuttack, is chiefly red, and abounds in garnets, and veins of steatite. Chlorite slate, steatite, and hornblende, with mica, and abundance of garnets, all form parts of the metamorphic rocks, and we therefore must be prepared to meet their *debris*, together with those of the red felspathic ones which broke through them, in the sedimentary strata which immediately followed the eruption of the latter.

Such a system of stratified deposits appears to exist in the Curruckpore and Rajmahal hills, in the Bhagulpore district, where they have been studied by Dr. M'Clelland, who describes them provisionally, as they have as yet yielded no fossils, under the head of "Cambrian and Silurian Rocks," as follows:—

"*Newer Clay Slate and Quartzoze Breccia.*"

"The old or primitive variety is succeeded by the newer green or Cambrian variety of slate: the greenish or newer clay slate, referred by authors to the transition or greywacke series, extends from Bhem Bhan to midway between Goordhee and Murgrah, being a distance of 6 to 8 miles in a SW. direction, across the traverse of the strata, which run SE., and dip SW.

"The continuity of the old blue and newer green slates is interrupted by intermediate beds of quartz and talcose slates, which interpose between them.

"*Beds subordinate to the Newer Clay Slate.—(a)* Blue compact quartzoze breccia, veined, like marble, with white streaks, resembling

transition limestone, occurs in beds of 5 to 50 yards in breadth, alternating with the newer clay slate, between Bhem Bhan and Goordhee.

"(*b*) Greywacke, or Steatitic Sandstone.—This greywacke or steatitic sandstone forms the abrupt and precipitous ridge of outer ghats at Guidore, where it is used as a building stone in the construction of the old fort at that place. It is a quartzoze sandstone, containing steatite and diallage which give the fresh rock a peculiar greenish yellow colour, and resinous lustre, with a compact splintery fracture; all which characters it loses on long exposure, becoming an ordinary fine-grained, yellow earthy sandstone.

"It terminates at the north side of the pass by which the Kewlee river enters the plains at Guidore, where it forms a bold precipitous escarpment, resting on mica slate.

"I have been long familiar with the characters of this rock in Kemaon, and although I never saw it covered by any other, yet I believe its proper place to be with those great quartzoze beds which are connected with the newer clay slate, but never on any subsequent formation,—an important practical point to understand, as it places this rock considerably anterior to the sandstone of coal measures, for which it might otherwise be mistaken.

"*Transition or Cambrian Gneiss.*"

"This rock is of great extent in the Bhagulpore district, composing two-thirds of the intermediate country from the Curruckpore to the Rajmahal hills, together with the greater portion of the southern ridges of the Rajmahal group. It consists of quartz, more or less hornblende, lenticular nodules of felspar, more or less compressed and flattened, coarse garnet pebbles, and mica, all embedded in a matrix of earthy, half crystalline felspar. When the hornblende predominates, the rock assumes the form of a soft, pliable hornblende slate.

"These beds sometimes suddenly change into a fine granular structure, retaining all the ingredients of the coarser variety, but assuming the appearance of sandstone flags, (between Mungra and Belharh).

"From the partial or complete decomposition of the hornblende and felspar, the rock often appears as a coarse pseudo-crystalline conglomerate, containing nodules of felspar. (Bed of the Bundooah river.)

"In other situations the formation assumes the form of slaty quartz, or a somewhat compact, but close granular structure, containing more or less mica and hornblende, chiefly the latter. Beds of this

quartzoze variety alternate sometimes with the coarse-grained rock. (Suyapatam.)

"In some situations the formation passes into, and alternates with, beds of micaceous and hornblendic schistose form, and even contains small beds of calcareous breccia; all which varieties are met with in the ascent from the ghat below Suyapatam, where the formation is much disturbed by outbursts of trap and quartz dykes.

"Thus the line of section from midway between Goordhee and Mungra to Suyapatam, a distance of 12 miles, at right angles to the direction of highly inclined strata, extends exclusively over this formation, the strata running during the first part of the section, with slight deviations in the direction of NW., dip 45° to 60° SW.

"From Nungajoor to Luchmipore, the first part of the country along the same line of section is much disturbed and broken up by quartz dykes and rounded hills of trap. Amidst these disruptions, beds of the same coarse-grained slaty rock reappear at intervals, composing the country as before.

"After passing Luchmipore about a mile, in continuation of the same line of section, the rock is seen passing in places into syenite, with outbursts of which it alternates, more or less, all the way to Noonyhath.

"From this last mentioned place to Kottycoon, a distance of 24 miles along the same line of section, (still crossing the direction of the strata), the rock resumes its characteristic coarse crystalline slaty structure, much resembling gneiss, but distinguished from that rock by the addition of hornblende, which is always present in this, while it is of rare occurrence in primitive gneiss.

"It also differs from the primitive rock in the manner in which it occurs, filling up valleys, and forming low undulating plains between primitive mountains of clay slate and gneiss, as in the intermediate low country between the Curruckpore and the Bhagulpore hills; again (though broken up by eruptions of syenite), between Nangajoor and Noonyhath; and lastly, as it occurs in the somewhat elevated valleys composing the north-western declivities of the Rajmahal hills, extending from Noonyhath to Kottycoon, encircling the base, but never ascending higher on the acclivities of mountains.

"At Kottycoon it is succeeded by beds of granular slaty quartz and trap as before, and finally disappears beneath the conglomerate underlying the coal measures.

"*Mineral Contents of Transition Gneiss.*—Garnets abound in this rock, more particularly in the vicinity of quartz dykes, where they

form a large proportion of its substance, imbedded in earthy felspar and hornblende, from which they are dislodged by the decomposition of the matrix, and thus form a gravelly deposit on the surface of the soil. (Suyapatam.)

"The garnets here are of uniform size, and spheroidal shape, somewhat larger than a musket ball, and when sharply struck with a hammer, each nodule separates into two equal parts, without exhibiting a fractured surface. I observed the same phenomenon many years ago in quartzoze vein-stones, from veins of clay slate in Kemaon. It contains no valuable minerals.

"*Syenite.*"

"This consists of unstratified, erupted masses, composed chiefly of crystalline felspar and hornblende, with a small proportion of quartz. Felspar is the predominant ingredient, and generally gives more or less of a reddish yellow colour to the mass. It forms lofty conical peaks, (Lugwah near Noonyhath), and rounded hills, each sometimes composed of a single unbroken mass; (Panch Pahar, in the Bhagulpore district, and Chara Pahar, in Pergunah Currucdyah, between Palmow and Curhurbalee;) or it is broken into smaller overlying masses, either protruding singly from the surface (near Luchmipore and Suyapatam), or accumulated in rugged pyramidal hills (Nanegore, near Bunta-Rampore, in Pergunah Mellypore, Monghyr district).

"These syenites sometimes pass into the transition gneiss, (2 miles from Luchmipore, on the way to Serieah, and also at the base of Lugwah hill, near Noony,) and are also found in veins, along with trap, penetrating gneiss. (Bed of the Kuttooreah river, 7 miles from Luchmipore.)

"*Mineral Contents of Syenite.*—This syenite contains galena at Panch Pahar, (Sherwill,) as well as at Turee Pahar, and some other places in the Bhagulpore district. In the first mentioned locality the galena occurs in a decomposing bed of coarse granular quartz, glassy actinolite, or, (as Mr. Dodd suggests,) perhaps, coccolite and earthy felspar. The galena, in small crystals, constitutes about 2 per cent. of the mass."

At another part of the same district it is more abundant, and found by Mr. Dodd to be rich in silver.

"*Porphyritic Greenstone.*"

"This first appeared in the bed of the Kuttooreah river, 7 or 8 miles on the NW. side of Luchmipore, in the Bhagulpore district, where it occurs massive, as well as tabular and stratiform, consisting

of hornblende and quartz. It is extremely hard and unyielding. The quartz in the massive variety is distributed into numerous diffused crystalline points, which are dispersed throughout the mass. In the tabular variety the quartz occurs in plates and flattened nodules, disposed in parallel lines with the tabular structure, presenting the appearance of hornblende slate, with which it corresponds in structure, at Soorudjajah.

"In this shape it forms a belt of country 3 or 4 miles in breadth, alternating in places with transition gneiss, both rocks being much dislocated by eruptions of secondary trap, which last occurs abundantly, particularly at Luchmipore.

"*Hornblende Slate.*"

"Beds presenting the appearance of hornblende slate, but containing quartz aggregated in compressed and flat lenticular-shaped nodules and plates, instead of felspar, occur in the Rajmahal hills in the bed of the Goornara river at Kottycoon, where it forms in some localities the basis of the coal measures, and in others it gives support to thick beds of granular slate quartz.

"The same hornblende slate also occurs in the bed of the Brahminy river at Buktahn Pahar, likewise forming the rock on which the coal measures rest. It extends from thence to Curracutta, where its line of junction with the conglomerates underlying coal measures is well shown.

"This hornblende slate marks the boundary of the coal measures for a distance of 20 miles, and forms considerable tracts of the adjacent country, where the coal measures disappear.

"This hornblende slate appears to be identical with the Luchmipore porphyritic greenstone; the only difference is that the quartz is aggregated in lenticular nodules, or compressed into plates, so as to produce a slaty structure, more, however, in appearance than reality, for the rock can scarcely be said to possess a slaty fracture, being very difficultly frangible; so that there is little or no real distinction between it and the Luchmipore rock, except the lenticular or laminated form of the quartz.

"*Slaty Quartz.*"

"This consists of granular quartz, for the most part of thick slaty structure, sometimes thick-bedded, but always more or less disposed to split into thin hard flags. It occurs capping indifferently the subcrystalline and other trappean slaty rocks described in this section. The Dhunya mountain, at Kottycoon, in the Rajmahal hills, is com-

posed entirely of these beds, affording a thickness of at least 400 feet, resting on the transition gneiss, and hornblende slate of this place. It likewise occurs at the Oosilah pass, under similar circumstances, capping the outer range of ghauts below Suyapatam in the Bhagulpore district.

"The lower beds in both these localities assume a massive character, and resinous or waxy lustre, indicating an approach to the steatitic or greywacke quartzoze sandstone of Guidore, to which period they perhaps refer, being anterior to all the coal measure conglomerates, although it is difficult to fix the exact position of these quartzoze sandstones, from the circumstance of their forming isolated mountain caps, uncovered by other rocks. It contains no useful minerals.

"*Conglomerates underlying Coal. (Old Red Sandstone?)*"

"These conglomerates form a hilly tract, extending south from Curracutta, in the Rajmahal district, as far as the country has been examined in that direction.

"The northern boundary of this formation is well marked by the Curracutta hill, a prominent double-peaked mountain, 900 feet above the sea, situated about 5 or 6 miles south-west of Mussinia. About a mile west of the last mentioned village the coal measures insensibly disappear, and all traces of them are lost on a low ridge 2 miles distant, which is the only point in the Rajmahal hills where these coal measures are not bounded by trappean rocks.

"The conglomerates which here displace the coal measures consist of thick-bedded coarse sandstone, composed of gravel, sand, and various sized quartzoze pebbles, embedded in a fine argillacious matrix. These coarse and thick beds alternate with thin-bedded, close-grained, flag-like sandstones, of a fine texture, varying in thickness from 12 to only 2 or 3 inches, succeeded, again, by coarse and thick beds of the same nature.

"After several alternations of this kind for the space of a mile or more (extending across the direction of the strata), the rock assumes a more uniform character and a reddish colour.

"Curracutta mountain consists of a mass of syenite, covered by hornblende slate on the one side, and by the conglomerates under description on the other. The disruptive mass is prolonged on the north side into a large trap dyke, which has been traced for some miles.

"These conglomerates, resting on syenite and hornblende slate,

terminate a few miles north of Curracutta mountain, forming a narrow wedge-shaped tract, dipping to the east, beneath coal measures.

"West and south of Curracutta the conglomerates expand, in the direction of the strata, into broad and lengthened ridges and valleys, extending for several miles to Semanijoor, where they become covered beneath the secondary trap of the district.

"From the general aspect of the country to the south, it is presumed that it is composed chiefly of these conglomerates, extending towards the civil station of Soorey, in which direction, according to information received from that place, coal measures again occur.

"From Curracutta to Semanijoor these conglomerates are undisturbed, presenting an uniform dip of about 20°, for a distance of 5 miles across the outgoing of the strata; but approaching Semaijpoor, the strata there become invaded by, and covered with, outbursts of trap, which compose all the country lying to the north, except where small patches of altered coal measures occur.

"No fossils were found in this formation, the nature of which is therefore inferred merely from its position between the coal formation on the one hand, and the other trappean and slaty rocks on the other, as well as from its mineral characters, which differ very much from those of coal measure conglomerates.

"*Subordinate Beds.*—No carboniferous shale or clay iron-stone occurs in this conglomerate."

Such are Dr. M'Clelland's descriptions of his "Cambrian and Silurian Rocks," together with his "Old Red Sandstone": we have now to identify these deposits with similar strata in other parts, if possible; but, before attempting this, it is desirable to premise the following tabular summary of their principal characters:—

Table.

Old Blue Slate.	Old Blue Slate, superposed by beds of quartz and talcose Slates.
Newer Clay Slate.	Newer Clay Slate, alternating with the following subordinate beds:—
	Blue compact Quartzoze Breccia, veined, like marble, with white streaks, resembling Transition Limestone; in beds of 5 to 50 yards in thickness, alternating with newer clay slate.
	Greywacke or Steatitic Sandstone; consists of a quartzoze sandstone, containing steatite and diallage of a peculiar greenish-yellow colour, resinous lustre, and splintery fracture; alternates with newer clay slate.
	Rests on beds of quartz and talcose slates, which again rest on Old Blue Slate.

Transition Gneiss..	Gneiss in fine and coarse-grained beds, alternating; massive or in flags; composed of quartz, more or less hornblende, lenticular flattened nodules of felspar, coarse garnet pebbles, and mica; imbedded in a matrix of earthy half crystalline felspar; occurs sometimes in the form of sandstone flags, of a granular structure, slaty, quartzy, with more or less mica and hornblende; alternating with coarse beds of the composition above described. It presents micaceous and hornblende schistose beds, and even small beds of calcareous breccia. Rests on primitive gneiss or primitive clay slate, and passes into syenite.
Syenite....	Syenite, chiefly composed of crystalline, reddish-yellow felspar and hornblende, with a little quartz, the felspar predominating. Passes into "Transition Gneiss"; veins gneiss along with trap.
Porphyritic Greenstone.....	Greenstone of a porphyritic structure, stratiform or massive, consisting of hornblende and quartz; quartz disseminated in numerous crystalline points in the massive variety; in flattened nodules, as above stated, in the stratiform variety. Alternates with strata of "Transition Gneiss."
Hornblende Slate....	Hornblende Slate of a porphyritic structure, consisting of lenticular compressed nodules, and plates of quartz and hornblende. Underlying either the basis of cold measures, slaty quartz, or "Old Red Sandstone" conglomerate.
Slaty Quartz..	Granular Quartz of a thick slaty structure, becoming massive below, and of a resinous or waxy lustre (indicating an approach to the steatitic or greywacke quartzoze sandstone of Guidore). Capping the sub-crystalline and other trappean slaty rocks of this section; thickness 400 feet.
Old Red Sandstone..	Conglomerates in thick beds, consisting of gravel, sand, and quartz pebbles, in an argillaceous matrix, alternating with thin beds of fine-grained sandstone, flag-like; assuming, after a mile across the direction of the strata, a more uniform character, and reddish colour. Position, between the coal measures and older trappean and slaty rocks.

Such is a tabular view of these strata; and looking for their extension to other parts, we cannot help being struck with the great resemblance that exists between the composition of the "Greywacke or Steatitic Sandstone" and "*Transition Gneiss*" of the Curruckpore and Rajmahal hills, and the steatitic sandstone which immediately overlies the syenitic and greenstone hills of Kalinghur and Adjighur, so minutely described by Jacquemont. With his "porphyritic stratum" which traverses this sandstone, we have nothing to do just now; but he particularly alludes to the *steatite*, which divides the strata of sandstone into layers, and enters into the arenaceous structure of the rock

in parallel laminæ ; the *red felspar*, in portions of a laminated structure ; and rounded portions of quartz, with mica ; presenting here and there spots of a violet colour.

Moreover, as regards the origin of these materials, Jacquemont, in describing the syenite below them, notices varieties in which " mica s'associent à l'Amphibole, sans jamais la supprimer entièrement ; des roches de Felspath et d'Actinote, ou de Felspath et de Diallage douteuses, ici comme à Adjighur dans la nature de leurs elements" (Tom. i. p. 431).

We therefore may, I think, reasonably infer that the sandstone of these localities, and the " Greywacke or Steatitic Sandstone" and "*Transition Gneiss*" of the Bhagulpore district, were chiefly derived from the red felspathic rocks, and that too, probably, of the same age, even if we doubt the identity of the formations. As to the presence of " garnet pebbles" in the " Transition Gneiss," that may depend on locality ; as well as the eruption of syenitic and greenstone rocks. The "*Slaty Quartz*" rock, Dr. M'Clelland thinks, is allied in composition to his " Greywacke or Steatitic Sandstone."

Passing to the other side of India, viz. to the Southern Mahratta Country, we have here too, in the neighbourhood of Dharwar and elsewhere, a conglomerate, similar to the " Greywacke, or Steatitic Sandstone." Lieutenant Aytoun also gives a section of a hill about 3 miles south of Bhagulkote, which is composed of sandstone and schistose clay, alternating in very thick beds. In the valley between Yarkul and Bhagulkote, crystalline greenstone and green schistes alternate with each other in strata which are nearly vertical, and on each side of them are ranges of vertical strata of sandstone, consisting of jaspideous and quartz pebbles, with much felspar, in a sandstone cement (Aytoun) ; also in the bed of a watercourse at Kaludghee, Christie observed slates interlaminating with greywacke. Newbold also states that the sandstone overlying the granite between Gooty and Kurnool, which at the former place is red, and contains chlorite and actinolite mixed with the felspar, is composed of " white quartz pebbles, from the size of a filbert to that of a man's head," a few of trap and hornblende, and of tough actinolitic felspar, also flinty slate, the very hardest parts of the hypogene and granitic rocks ; but he saw no fragment of ordinary granite, or of gneiss. Going to the north, there is a decomposing conglomerate at Balmeer of the same description, the greatest part of the cement of which, as well as parts of the pebbles themselves, is composed of a chalk-white, fine, steatitic earth (Mm. Forbes). Of the existence of a green steatitic sandstone or greywacke in the Southern Mahratta

Country, composed of greenish chlorite, red felspar, and quartz pebbles, there can be no doubt; and with reference to the presence also of "Transition Gneiss" there, Christie observes: "All the transition gneiss I have seen in Dharwar is weathered, closely resembling loose sandstone." The only "primitive gneiss" he appears to have met with was at the falls of Gairsuppa.

The same remarks, however, apply to the identification of these deposits with those of M'Clelland's "Cambrian and Silurian Rocks" of Bhagulpore, that I made with reference to the confusion which exists between the Older Metamorphic Strata and the metamorphosed strata of newer formations. There is comparatively nothing definitely described respecting any of them, and it is evident that there are not only the Metamorphic Strata, and the "Cambrian and Silurian Rocks," provisionally so called, but also metamorphic rocks of the following group; all of which are at present so uncharacterised, that there is no possibility of finding out to which series the observations on such rocks apply. The slates of the Older Metamorphic Rocks appear to be most extensive; the deposits of the "Cambrian and Silurian" follow; and those of the next series the least by far, of all. Further than this we hardly know more than that such series exist.

Our last step is to identify the "*Old Red Sandstone*" of M'Clelland, but this cannot be well done until the following series is described, which we shall provisionally call "Oolitic."

V.

OOLITIC SERIES.

Tara Sandstone.

Kattra Shales.... { *Shales.* / *Limestone.* / *Coal.*

Punna Sandstone.

Previous to entering upon a separate description of the members of this series, which has already been stated to be the most interesting in India, on account of its almost universal occurrence, its mineral resources, and its organic remains, it will be as well to premise a few observations on the facts which have led to a knowledge of its existence, and of the parts into which it has been subdivided.

That tract of it which is most continuous, and appears to have been least disturbed by volcanic influence, extends from the eastern border of the trap of Malwa, near Saugor, to the alluvial deposit of the Ganges near Mirzapore; and it is therefore to this that we must chiefly look for its typical characters.

Captain Franklin, who first explored this district, pointed out, that in travelling SW. from Mirzapore into Bundelkhund, two ranges of hills or escarpments are successively ascended, each of which terminates in a plateau. The first range is entirely composed of sandstone, presenting no argillaceous strata whatever in its composition; but the second range, which rises from the plateau of the first, and is also of sandstone, does present argillaceous strata, viz. in its upper part, which again pass into limestone on the plateau.

Jacquemont, who followed Franklin, apparently with the description of the latter in his hand, recognised a third range of sandstone hills in Franklin's Punna range, which the latter appears to have regarded as merely an accidental elevation of the second plateau; and on ascending these, he observed that they were composed of fine-grained, reddish, and mottled or variegated sandstone, resting on the argillaceous strata, which accompanied the limestone of the second plateau. This range Jacquemont considered about 300 feet high.

Moreover, in a well from 36 to 45 feet deep, between Douzounepore and Puttrahut, he found small layers of anthracite between strata of compact limestone, the latter breaking with a conchoidal fracture, and presenting a dark, black-blue colour. These are his words:—"Le carbone, en quelques places, s'y resemble assez pour former de petites couches minces, qui ont tout-à-fait l'aspect brillant et la dureté d'Anthracite."

Lastly, Dr. Adam, who travelled across these sandstone ranges, states that at Lohargong the limestone is in a valley bounded on all sides by sandstone hills, which valley he compares to the bed of a lake, into which the Ken river enters on the south, and makes its exit at the northern border; and on leaving this valley to proceed southwards to Bellary, which is 45 miles distant, he passed over a ridge of sandstone hills. This fact, if it were necessary, might be adduced to support Jacquemont's observation, that there is a sandstone formation above the shales and limestone. Both Franklin and Adam allow that the limestone rests on the sandstone of the second plateau but, *they* go no further.

Let us now turn to a section afforded by the same tract of sandstone in the neighbourhood of Bidjighur, which is about 155 miles east of Lohargong, on the river Son, where the strata dip to the north, as in Bundelkhund, and present a scarped surface towards the south, which is but a continuation of that at Bellary; where, also, I might have mentioned that Dr. Adam, after he had descended the ridge between this place and Lohargong, again saw among quartz rocks (altered

sandstone?) in vertical strata, some, which had "a peculiar striped arrangement in the mass, and in colour, lustre, and compactness, not unlike the limestone of Lohargong." But to return to our subject. Mr. Osborne, who, upon the information communicated by Mr. Heydey, respecting the existence of coal near Bidjighur, was sent to examine that neighbourhood, states, that in going from Bidjighur to the river Son, by the Ek-Poway Ghaut, he saw limestone strata of all colours, and some of a lithographic structure, of which he sent specimens to Calcutta. Afterwards, he picked up black portions of limestone, which is better seen *in situ* in a nulla near Markoonda; and in the bed of the Son, pieces of coal; but he did not see any coal-strata there. One of his sections of the Son shows "limestone" cropping out under 500 feet of "quartzy sandstone," and below the limestone "greywacke." Altogether the following section, from above downwards, is computed from his observations:—

Sandstone, 60 to 80, and 700 feet; shale, with exudations of petroleum; sandstone interlaminated with shale; flinty slate; sulphate of iron; limestone of all colours, some lithographic in structure.

This gives 700 feet of sandstone above the shales and limestome, and when we follow the banks of the Son onwards to Rhotasghur, in the zillah of Shahadabad, we find it still thicker. Captain Sherwill, who surveyed this zillah, writes:—"One of the precipices in the fort of Rhotas I found by measurement to be 1,300 feet, a sheer mass of sandstone, without a bush or tree on its surface." And afterwards, in alluding to the limestone on the eastern scarp of this sandstone table-land, he states, that it forms "an unbroken bed from the foot of the fortress of Rhotas to the village of Dowdand, a distance of 30 miles north"; and, still "proceeding in a north-westerly direction, at the distance of 13 miles, we meet with the same limestone in the valley of Soogrea-Khoh, at the depth of 1,000 feet below the summit of the table-land." The general appearance of this limestone is of a dark slate colour, breaks with a conchoidal fracture, strikes fire with steel, is impalpable in texture, and quite free from any exuviæ. Portions of it were sent to Calcutta for trial in lithography. In a few cases it was nearly black, also of a pale yellow or buff colour.

Under the fortress of Rhotas, and in other places, Captain Sherwill also states is the following section:—"Sandstone 1,000 feet; indurated pot-stone 30 feet; dark schistose rock or ore of alum, 10 or 12 feet."

1 7 ★ There is this important distinction, then, between the sandstone of the ghauts or escarpments which lead to the table-land of Bundelkhund

near Mirzapore, and the escarpment of the sandstone at Rhotasghur, viz. that one has the shales at the top, and the other has them at the bottom.

Passing still further eastward, and leaving the valley of the Son, together with the great continuous sandstone tract of Bundelkhund, we, according to Captain Sherwill, first meet, in the zillah of Bahar, with granite hills capped with sandstone; then at Gya others which are completely denuded; and on arriving at the boundary of the zillah of Monghyr, granite peaks, projecting from amidst hills of quartz.

We have now reached that point on the Ganges, about 60 miles south of which, that is from Soorajghurrah, is the Curhurbalee coal-field, which rests on M'Clelland's "Old Red Sandstone," and forms one of the great coal deposits in this part of India; and although we are not, in the present state of our knowledge, able to connect it with the carboniferous shales of Bundelkhund, through Bahar, yet the latter may be traced from the banks of the Son to those of the Koyle at Palamow, which, again, is close to the western extremity of the Damoodah valley, where the greatest number of these coal deposits have been discovered, and not far from which, too, is the coal-field of Curhurbalee.

Thus the type of the Oolitic Series above tabled would appear to be established.

That keen, talented, and intelligent traveller Jacquemont,—who knew at once for what to seek, had the ability to discern, and was never at a loss to describe,—during his short visit to Bundelkhund, on his way from Calcutta to Delhi, first completed this series. Franklin, a brother of the great Arctic voyager, had gone so far as to show that the shales and limestone overlaid the sandstone, but Jacquemont added the Punna range of hills to the latter in 1830. Subsequently Malcolmson, in 1837, showed that sandstone overlaid shales and limestone in Southern India, and lastly, Newbold proved, by the following section of the Moodalaity pass, near Kurnool, from above downwards, that the lower sandstone also existed there :—

Section of the Pass of Moodalaity (Newbold).

Compact light-coloured sandstone, passing into quartz rock and conglomorate, 120 feet.

Beds of compact limestone, of light tints of green, red, and buff, often lined with dark red jasper, and light-coloured cherts, 310 feet.

Calcareous and argillaceous shales, usually reddish, and liver-coloured, passing into white; surfaces of laminæ often covered with light green (chloritic?) flakes, 50 feet.

Laminar sandstone, micaceous scales between the layers.

Massive sandstone.

Previous, however, to all these, Captain J. D. Herbert (1828) stated, respecting some coal which was found by Lieutenant (now Colonel) Cautley, in the vicinity of Nahn, about 40 miles ENE. of Umbala, in the Sub-Himalayan range, that it exists in a formation of fine sandstone above, shales and limestone in the centre, and conglomerates below; that this is the "Coal Rock" of India; and he further adds: "This sandstone is, I think it almost certain, part of an extensive secondary formation, which on the one hand includes the sandstone hills of Sylhet, and on the other the saltiferous range of Lahore."

Lastly, in 1837 Captain (now Colonel) Grant's valuable paper on the geology of Cutch appeared, and in it also may be traced a similar series to that of Bundelkhund, as the following section, from above downwards, compiled from his descriptions, will show.

Sandstone, coarse and soft, or compact and crystalline.
Slate-clay of vast thickness, alternating with limestone of a lithographic structure, and grey colour, also occasionally with slaty sandstone.
Thin beds of coal intermixed with blue clay or shale, thick beds of sandstone alternating with slate clay.

Having thus endeavoured to show the general distribution of the series above established, let us now proceed to the description of its members separately.

Tara Sandstone. (H. J. C.)

This name is derived from the Tara Pass or ghaut, which leads from the alluvial deposit of the Ganges, about 10 miles SW. of Mirzapore, to the summit of the first sandstone range of Bundelkhund, the route taken by Franklin and Jacquemont, who have described it.

Synonyms.—New Red Sandstone (Franklin and Jacquemont). Old Red Sandstone ? (M'Clelland).

From Franklin and Jacquemont we learn that the Tara Sandstone is composed of fine grains of quartz, with a little mica, which is held together by an argillaceous cement of a red colour, the latter varying in intensity. Its structure is "rather friable than compact," but in many places is sufficiently hard for architectural purposes. It is horizontally stratified, but presents nothing else, except a few nests of red clay here and there, to disturb its uniformity and continuity.

Towards its upper part the grains become extremely fine, and the colour of the mass changes to green; after which it passes into argillaceous (and talcose ? Jacquemont) strata of green and red colours alternating, but the latter still continues to predominate.

The thickness of this deposit has not been stated. It could not be determined at the Tara Pass, on account of the base of the hills being under the alluvial deposit of the Ganges. But Jacquemont remarks, on the authority of Captain Drummond, that the summit of the Tara Ghaut is 300 metres (900 feet in round numbers) above the valley of this river.

No fossils have been found in this sandstone, and no minerals, beyond the red oxide of iron which colours it.

At the pass of Moodalaity mentioned, Newbold describes this, or the lower sandstone there, as "laminar" and "micaceous," passing downwards into "massive sandstone," and above into shales of white and red colours, with green flakes of chlorite.

In Cutch the Tara Sandstone is not noticed by Grant, probably from the insufficient elevation of the masses; and his boring experiment appears to have only reached its upper part, if even that.

Identification with "Old Red Sandstone" *of M'Clelland.*—This consists in the great simplicity of composition in both; the absence of crystals of red felspar, which may be inferred from the silence of Jacquemont and M'Clelland on this point, and the situation of this formation immediately below shales and carboniferous deposits in both instances, which are evidently connected with each other. The presence of conglomerates at the Tara Pass is not seen, perhaps because they may be underneath the alluvial deposit of the Ganges; but the texture of the sandstone is stated by Jacquemont to become finer in ascending, and therefore probably becomes coarser in the opposite direction.

With reference to the lower limit of this sandstone, Jacquemont, in alluding to the difference between it and that of Bundelkhund reposing on the syenite of Bisramgundj Ghaut and Adjighur, close by, states:—"Malgré l'extrême ressemblance oryctognostique dont je viens de parler, j'incline à croire cependant, que les grès du Tara Ghaut et du Kuthra Ghaut appartiennent à une autre formation, et que cette formation est celle du *New Red Sandstone*; mais je soupçonne que le grès rouge ancien recouvre les Syenites du Bisramgandj Ghaut et de toute cette partie des montagnes de Bundelkhund."

He also states that he did not see the junction of the two, but that this might have been concealed by superficial detritus; while Coulthard observes of the sandstone at the opposite extremity of Bundelkhund, near Hirapur, between Saugor and Punna, that the granite is "capped by heaps of ferruginous conglomerate, which

conglomerate is connected with a stratum of iron ore, on which the 'New Red Sandstone' is seen to repose" : this sandstone, again, becomes covered with red and variegated shales in approaching Saugor, followed by the superposition of more sandstone, which here and there, as in a hill at Bhilsa, presents the flat top and scarped sides, which we shall by-and-bye find to be characteristic features of the upper member of this series.

Should this identification of the sandstone of the Tara Ghaut and the "Old Red Sandstone" of M'Clelland be correct, I would adopt the term of "Tara Sandstone" for both, particularly as the latter is provisional.

Kattra Shales. (H. J. C.).. { *Shales.* *Limestone.* *Coal.*

This term has been taken from the Kattra Ghaut, which is the name of the pass leading from the first to the second plateau of Bundelkhund, where Franklin and Jacquemont saw respectively the Tara Sandstone passing into argillaceous strata; limestone on the second plateau; bituminous shale cropping out in the glens of the Bajin river; and anthracite in a well; so that representatives of all three sub-divisions of this member of our Oolitic Series are thus found to exist in Bundelkhund, though more developed elsewhere.

Synonyms.—Clay-Slate Formation (Voysey). Argillaceous Limestone (Malcolmson). Laminated Series or Upper Secondary ? (Grant).

Shales.

These in their purest state are almost entirely composed of indurated clay, and arranged in strata of all degrees of thickness, varying from laminar to massive, and of all kinds of colours. When mixed with other substances in company with them, which is frequently the case, they may be calcareous, bituminous, quartziferous, micaceous, talcose, or chloritic. They pass into the sandstone both above and below them, and alternate with it in some places, to such an extent that "the cascade of the Ranj river," in Bundelkhund, according to Franklin, "shows a series of sandstone interstratified with slate clay, 390 feet thick." They are also interstratified with limestone and coal, either together or separately, and though sometimes almost deficient in both, they chiefly derive their importance from the presence of one or the other of these deposits. There is, therefore, little to be said about these shales by themselves, and their geographical extension will be best considered in connection with the other members of the series.

Respecting their fossiliferous contents, too, *per se*, there is little known. Dr. Bradley, in a letter on the sandstone at the northern border of the trap, writes:—"In the shales north of Ellichpoor was the only place where I found impressions of leaves, plants, and ferns. The ferns appear to belong to *Pecopteris*. In one, however, the pinnules differ. Stems, leaves, reeds, and matted leaves abound." But it is in connection with the coal strata, or overlying sandstone of this series, that the fossils of the shales have been chiefly found, and it is therefore with the descriptions of these that they will respectively, be noticed.

Limestone.

The principal characters of the limestone are its uniform lithographic texture, solidity, conchoidal smooth fracture, and hardness; dendritic surfaces; smoky grey colour, passing into dark smoky blue; and parallel thin stratification.

Everywhere it presents these characters: in Cutch, near Neemuch, Bundelkhund, on the river Son, near Bidjigurh and at Rhotasghur, Firozabad on the Bhima, Kaludghee in the Southern Mahratta Country, on the middle third of the Kistnah, and as far south as Cuddapah, in the Madras Presidency. Grant, Dangerfield, Hardie, Franklin, Jacquemont, Sherwill, Osborne, Meadows Taylor (P.MS.), Malcolmson, Voysey and Newbold, have respectively described this limestone in different parts of India, and all agree in giving it the characters above mentioned, while the Society's museum verifies most of their accounts by specimens of this formation from several of these places.

It differs, however, when departing from its genuine composition, just as the shales differ which interlaminate it, the coal strata, and the sandstone, in being more or less argillaceous, bituminous, or quartziferous; of different degrees of hardness, coarseness, and friability of structure; and of all kinds of colours, streaked and variegated; but I am inclined to think that the latter only occurs where it has been exposed to heat. It is sometimes quite black. Lucullite occurs in it between Dachapilly and the Kistnah (Voysey), near Bidjighur on the Son (Osborne), and in several other places.

It is occasionally veined and interlined with jasper and light coloured cherts, which projecting from it under weathering near Cuddapah, give it a scabrous appearance (Newbold); also contains drusy cavities, calcedonies, and cornelian, north of Nagpore (Malcolmson). Small crystals of quartz occur in the lithographic forms, which render them more or less unfit for lithographic purposes; indeed the presence of siliceous matter generally, more than the want of uniformity of structure,

seems to render this limestone too hard for lithography; but I question, among its infinite varieties, whether there is not some place which would yield forms as serviceable as those imported from Europe. The argillaceous varieties are frequently flaked with green chlorite; steatite of a white chalky nature is found in thin beds in it, in the Keymor range (Sherwill), and in the neighbourhood of Cuddapah, where it also passes into the compact form of "French Chalk," and is cut into pencils, which are used for smoothing lime-plaster, and writing on cloth prepared for the purpose (Newbold). A small detached hill at the fort of Rhotasghur is almost entirely composed of a dark blue pot-stone, which, with the small veins and beds of serpentine that are found in low hills in the zillah of Bahar (Sherwill), are not improbably associated with this limestone.

It is of a snow-white colour, and traversed by chlorite schiste in the bed of the Nerbudda between Lamaita and Beragurh, near Jubbulpore (Franklin); and beautifully granular and crystalline, with red and white steatite intermixed at Khorari, 6 miles north of Sitabaldi, near Nagpore (Jenkins). It also exists in many places in the form of granular, saccharoid, white marble; but in all these instances appears to be metamorphosed by heat. Jacquemont mentions, at Alwar, about 65 miles north-east of Jaipore, thin beds of amphibolic limestone (Hemithrene Bgt.) of a black colour, alternating with quartz in vertical strata, the latter becoming subordinate; and at Bessona (the first town in the territory of Jaipore coming from Alwar) a granular, white saccharoid marble, in some of which green amphibole and flakes of amphibole and talc are also disseminated; also at Rajghur, 7 miles west of Nusseerabad, where mica is added to the amphibole. Thus we have all the chief minerals of the mica and hornblende families in, and in connection with it, but this, as I have before stated, is under a metamorphosed state.

Wherever this limestone is situated throughout India, it has undergone more or less disturbance and denudation. Greenstone and trap appear to be the principal agents which have been engaged in the former, for these almost always accompany it, and are almost the only igneous rocks which appear to have invaded it. Yet it frequently rests on granite, by which it appears to have been upset more than penetrated, and in the Southern Mahratta Country the older metamorphic schistes have been forced up through it; but the only instance recorded of its being veined and enveloped in granite is at Kamari, near Ramteek, in the hills NE. of Nagpore (Jenkins and Malcolmson).

It is not unfrequently brecciated to a great extent, by fracture and

reconsolidation under a cement of calcspar. A remarkable instance of this exists near the village of Guddunkeeree, in the Southern Mahratta Country, where the dyke, so to speak, or edges of the strata brecciated, run along the plain NE. by N. and SW. by S. Lieutenant Aytoun, who describes it, states that it is composed on one side of rhombohedral calcspar, and on the other of breccia. On the WNW. "not less than 20 yards" of pure calcspar exist in contact with the unaltered limestone of that side; and on the ESE. side the unaltered rock gradually becomes more and more brecciated, until it passes into the calcspar. The strata are of course vertical, and the calcspar would appear to have been crystallized from a watery solution.

This limestone is frequently denuded of its overlying sandstone and shales in Southern India, and in this state is not uncommonly covered by trap, as near Ferozabad on the Bhima (Meadows Taylor, P.MS.).

Newbold gives this limestone a thickness of 310 feet at the pass of Moodalaity, near Kurnool; Meadows Taylor from 10 to 30 feet on the Bhima, with strata from 2 inches to 2 feet thick (P.MS.). Dr. Bradley mentions a sandstone hill north of Ellichpore capped with 6 feet of limestone (P.MS.). The Gupta caves of Bahar, about 40 or 50 miles NW. of Rhotas, are in limestone, and their entrance is stated to be from 10 to 12 feet high (Sherwill). Much more definite information, however, on this head, is required, to give an idea of its general thickness; which, probably, its interstratification with the shales, or its position generally, where exposed to view, may have rendered difficult to obtain. In no part mentioned does it appear to be so thick as at the pass of Moodalaity.

Geographical Extension.—If we allow the white crystalline marble generally of India to be metamorphic strata of this limestone, which I think we must do, until otherwise proven, then we should have this form of it in the Girnar of Kattyawar; the lithographic or original form, in Cutch; the white marble, about Oodeypore; the lithographic form, between Neemuch and Chittore; the white marble northwards, in the neighbourhood of Nusseerabad, Jaipore, Bessona, and Alwar; that of Mokrano in the Jodpore district, from which the white marble of the Taj Mahal was chiefly taken; a narrow strip in its original state 150 miles long in Bundelkhund; more again about Bidjighur and Rotasghur on the Son; in the state of white marble, in the bed of the Nerbudda near Jubbulpore; also the same at Ramteek, in the hills NE. of Nagpore; along the lower parts of the Wurda and Pyne Gunga towards their confluence, where they form the Pranheeta; thence to the Godavery, and along the latter and its neighbourhood, more or less, to the vicinity

of Rajamundry; in the district of Shorapore, on the Bhima; of every variety of colour, and greatly disturbed and broken up about Kaludgee, in the Southern Mahratta Country; along the Kistnah, from Kurnool to Amarawattee, and more or less all over the triangular area formed by the latter place in the east, Gooty in the west, and the Trepatty hills in the south; south-east of the latter place a narrow valley extends through it for 150 miles, where its strata are in many places vertical (Malcolmson). As yet it has not been noticed in the southern part of the peninsula, either in its original or metamorphosed state, any more than the sandstones and shales which accompany it; at the same time its absence there is by no means determined, for there is metamorphic limestone in the district of Tinnevelly, as has before been stated, which closely resembles that from the neighbourhood of Nagpore; but then all metamorphic limestones are so much alike, that, without more information than their mere locality, they only indicate places which may deserve further examination.

Minerals.—Galena in several places in the Cuddapah beds (Newbold); and Dr. H. in Voysey's journal, just after mentioning the limestone, states, that in a branch of hills south of Cuddapah, which runs east and west, he found "small veins of plumbago." This would be interesting if found in the limestone, since, as before stated, this mineral occurs in the metamorphic limestone of Tinnevelly and Ceylon (Major General Cullen).

Organic Remains.—Captain Franklin states, that at Nagound (Bundelkhund), in the bed of the Omeron river, where the lower and central beds of the limestone are exposed, "fragments of fossil wood and fragments of stems of ferns" are seen in them. He also gives a figure of a "gryphite shell," which, however, is too indistinct to be of any use; yet he partly upon this founds his opinion of the identification of this limestone with the Lias.

There is a cast of a large turbinated shell, like that of *turbo* or *pleurotomaria*, in the Society's museum, which was found by Captain Nicolls, who presented it, 10 miles NE. of Saugor. It is composed of calcspar. This is close upon the limestone of Bundelkhund.

Writing of this limestone near Neemuch, Dr. Hardie states that the organic remains in it are numerous, and then adds that one kind, when half exposed in the rock, appears in the form of a succession of cylindrical convex bodies, the length of which varies from 1 to 2 inches; they taper to a point, and frequently seem minutely ramified at both extremities. In one or two instances he observed the termination of such bodies to be in the mass itself, and in such cases they had

obviously been arranged in bundles or fasciculi. In other instances these cylindrical bodies appeared to send off anastomosing branches, which unite them together. They do not differ in composition or colour from the limestone in which they are found. He also mentions "longish tapering canals," and another fossil body, shaped like a pear bent upon itself; one of his figured fossils very much resembles the impression of a *Zamites*.

Newbold also mentions tubular and elliptical cavities in the limestone near Kurnool, and near Cuddapah, microscopic bodies of a spheroidal shape and multilocular structure, in the chert, which is imbedded in the limestone.

In the Shorapore district its upper surface in many parts presents a number of conical cavities from 0 to an inch deep, and about half an inch wide at the orifice; they are sometimes so close together as to form a honeycomb appearance, and some seem to have a spiral form, which is indicative of their having been fretted out by grains of sand agitated by the wind (Mm. Meadows Taylor).

Little or nothing fossil, then, has yet been found in this limestone, to determine its age or position geologically in India; and even in Cutch, where so many organic remains exist in the shales accompanying it, no fossiliferous peculiarity has been assigned to it; nor can we expect to find many in it, for in its purest form it appears to be always subordinate to the shales, and then possesses a compact, fine, lithographic texture, which is seldom, I think, accompanied by many organic remains.

The absence of fossils in this limestone, however, is of little consequence, since in the shales with which it is interlaminated, abundance both of marine and fresh-water have now been found; the former sufficient in number and species to enable geologists to place the shales of Cutch among the lower Oolitic deposits. And from the correspondence of the latter together with the Cutch sandstone, in mineral detail, relative position, and physical features, with the shales and upper sandstone of India generally; as well as the proximity if not continuity of these formations in the two countries, I have placed them all provisionally in this series.

The fossils from the shales in Cutch, which are figured in Colonel Grant's geology of that province, consist of impressions of plants and shells:—Lycopodites, ferns, reeds, zamites. Conchifera, terebratula, ostrea, pholadomya. Ammonites, belemnites, and a portion of the bone of a Saurian reptile. The following are Mr. J. de C. Sowerby's

descriptions of the shells; those of the vegetable impressions will be given at the end of the next section :—

N. B.—All the fossils which have not their localities mentioned were found at Charee, about 30 miles NE. of Bhooj, close to the borders of the Runn.

"*Pholadomya ? inornata.*—Transversely elongate, ovate, gibbose, concentrically corrugated; beaks very near the anterior extremity; longitudinal ribs very obscure, rounded. Width 1½ inch, length nearly 11 lines.

"*Pholadomya granosa.*—Ovate, subtriangular, gibbose, ornamented with four or five rows of transversely-elongated and but slightly-elevated tubercles; the anterior side nearly straight, flattened, the posterior produced; beaks very prominent. Length 2 inches, width the same.

"*Pholadomya angulata.*—Subtrigonal, gibbose, ornamented with four or five sharp ribs, which are most prominent near the edge; anterior side straight, nearly flat, length and width equal; in some specimens 2 inches.

"*P. angulata* approaches *P. Murchisoni* var. of Phillips. (Geol. of Yorks., pl. vii. fig. 9.)

"*Amphidesma? ovale.*—Transversely elongate, ovate, convex, slightly wrinkled, anterior side small, truncated; distinguished from the rest of the shell by a gentle depression; posterior extremity rounded, rather pointed. Length 11 lines, width 1 inch 4 lines.

"There is no proof whatever that either this or the following belong to the genus *Amphidesma;* they are, however, very nearly related to a *A. donaciforme* and *A. securiforme* of Phillips.

"*Amphidesma ? hians.* Transversely elongated, convex, slightly wrinkled; sides gaping, the anterior small; separated from the rest of the shell by an obscure depression; the posterior rounded, a little flattened. Length 1 inch, width more than 1¾ inch. The specimen being broken, we have not the measure complete.

"*Corbula lyrata.*—Rounded, triangular, convex, transversely ribbed: ribs about 15, prominent, rounded; posterior side of the larger valve formed into a distinct lobe, convex, nearly smooth; the beak of the same valve much incurved, the margin toothed. Length and breadth nearly equal, sometimes exceeding half an inch.

"Occurs grouped in dense masses with *Trigonia Pullus*, a smooth *Uncula*, &c.

"*Astarte unilateralis.*—Transversely obovate, anteriorly truncated, convex rather flattened, and marked with 8 or 9 concentric rugæ near the beaks; anterior side at right angles with the hinge lines; lunette concave, ovate, pointed. Width greater than the length, but variable in proportion, generally about 1½ inch.

"*Astarte pisiformis.*—Nearly globose, with pointed beaks; marked with 8 or 9 sharp transverse ridges; edge toothed. Length 3 lines.

"*Trigonia costata, var.*—This shell varies slightly, both in form and markings; generally the form is between that of *T. costata* Parkinson, or M. C. t. 85, and *T. elongata*, of M. C. t. 431; which Lamarck, apparently with justice, considers to be but one species.

"*Trigonia pullus?* (M. C. t. 508, f. 2, 3.)—The markings on the posterior side are not so regular as in the English specimens, but there is no other difference.

"*Cucullæa virgata.*—Transversely elongato-quadrate, with projecting incurved beaks, very convex, marked with many longitudinal, irregular, sharp ribs; posterior margin obliquely truncated. Length 1½ inch, width 2¼ inches.

"Loc. between Hubbye and Joorun.

" *Nucula tenuistrata.*—Obliquely oval, finely striated concentrically; beaks close to the anterior extremity. Length 4 lines, width 5 lines.

" Specimens very imperfect, along with *Cucullæa virgata.*

" Loc. between Hubbye and Joorun.

" *Nucula? cuneiformis.*—Transversely elongate, elliptical, gibbose, smooth; beaks close to the anterior extremity, small, incurved. Length 6 lines, width 10 lines.

" *Pecten partitus.*—Broad, short, elliptical, depressed, marked with two concave radii, which divide the surface into three parts, both externally and internally, the lateral parts being flattened; concentrically and minutely waved, waves alternately larger and smaller; ears small, nearly equal. Length 6 lines, width 5 lines.

" Loc. Hubbye hills.

" *Plicatula pectinoides.* (M.C. t. 409.)—If this differ at all from the British species, it is in having rather more the habit of an *Ostrea*, which is apparent in the expansion of the edge.

" *Exogyra conica.* (M.C. t. 26 and 605).—The few specimens most detached from the matrix appear not to be quite so deep as those figured in the ' Mineral Conchology.'

" Loc. Katrore hills.

" *Ostrea carinata?* (Lam. Hist. Nat. vi. 216; M. C. 365.)—The specimens being generally much concealed in the stone, or broken, the determination of the species is not possible; the most perfect individuals resemble the young state of *O. carinata*, but that species is so near in some slates to *O. gregaria*, (M.C. t. 3), and *O. solitaria* (M.C. t. 468), that fragments cannot be distinguished.

" *Ostrea Marshii.* (M.C. t. 48.)—The *O. Marshii* varies so much in different localities, that we find no difficulty in referring this shell to that species, although the plaits are more numerous than usual.

" This specimen is accompanied with an imperfect *Plicatula.*

" Loc. Katrore hills.

" *Terebratula intermedia.* (M.C. t. 15, f. 6.) *Var.*—A small specimen, and rather more deeply plaited than most of the European varieties of the species.

" *Terebratula biplicata.* (M.C. t. 90 and 437, f. 2, 3.) *Var.*—A variety of this variable species, found in the red chalk at Hunstanton, is precisely similar in form to our specimen, except that it wants the angle on each side of the beak, which is here obscurely visible.

" Loc. Jooria hill.

" *Terebratula sella.* (M.C. t. 437, f. 1.) *Var.*—A rather longer shell than the British fossil, and deficient in the central plait, which most generally occurs in full-grown individuals of that species.

" Loc. pass of the Hubbye hills.

" *Terebratula concinna?* (M.C. t. 83, f. 6.)—A larger shell than the one figured in M. C., and not so neat, but hardly possessing any character sufficiently strong to mark it as a species; there are, however, rather fewer plaits.

" Loc. Jooria hill.

" *Terebratula nobilis.*—Tetrahedral, rounded, sharply plaited; plaits about 16, extending to the beaks; 4 or 6 of them much elevated along the middle of the disk; beaks small and pressed; sides concave near the beaks.

"A large handsome species; when young, the general form is depressed, but the middle is even then much elevated. Length and width each 1¼ inch, depth of the valves united sometimes more than 2 inches.

"*Terebratula dimidiata?* (M. C. t. 277, f. 5.)—Whether this be *T. dimidiata or T. inconstans*, (M. C. t. 277, f. 4,) is a question the specimens are not perfect enough to settle. The flattened form of the specimen figured agrees with that of *T. dimidiata*, but the beaks of our specimens appear too much incurved (perhaps from pressure), and so to approach *T. inconstans*.

"Loc. Jooria hill, and near Charee.

"*Terebratula major.*—Transversely obovate, gibbose, plaited; plaits angular, extending to the beaks, about 30, half of them on one side of the front slightly raised; beak of the larger valve prominent, slightly incurved. A larger species than the last, of the same family, well distinguished by its width and even surface.

"Length, 1¾ inch, width 2¼ inches, depth of the valves united 1¼ inch.

"*Buccinum pumilum.*—Ovate pointed, transversely striated; spire small; whorls 4, smooth in the middle, slightly convex; aperture ovate, pointed at both extremities. Height 3 lines, diameter 2 lines.

"Loc. Mhurr.

"*Belemnites canaliculatus, Schloth?* (Zieten, t. 21, f. 3.)—The fragments we have of this *Belemnite* agree well with Zieten's figure of *B. canaliculatus*, which is very probably not distinct from *B. sulcatus* of Miller. (Geol. Trans. 2nd series, vol. ii. part 2, p. 59, pl. viii. fig. 3.)

"*Belemnites* — ?—A nearly cylindrical fragment, without a sulcus, very like *B. elongatus* of Miller.

"*Nautilus hexagonus?* (M. C. t. 529.)—Flattened, spheroidal, with a very small umbilicus; front approaching to flat; sides rather conical; septa 15 in a whorl; aperture wider than long; siphuncle unknown. Diameter 3¼ inches, thickness 2¼ inches, length of the aperture 1¼ inch.

"This differs from *N. hexagonus* in having a smaller umbilicus, and in being more rounded. It wants the lines that occur in the middle of the front of *N. lineatus*, which it nearly resembles.

"*Ammonites Herveyi.* (M. C. t. 195; Zieten, 19, t. 14, p. 3.) *Var.*—This differs from the English specimens only in having a wider umbilicus. It agrees well with Zieten's figure, which differs a little from the English specimens, to which *A. macrocephalus*, figured by the same author at tab. 5, f. 1 and 4, approaches nearer.

"*Ammonites elephantinus.*—Approaching to globose, with a very wide umbilicus exposing the inner whorl; whorls obtusely angular at their sides, crossed by very prominent rounded costæ, when divided into two, as they pass over the front; aperture transversely elongated, gently arched. Diameter 4 inches, thickness 2¼ inches, length of aperture above an inch.

"*Ammonites formosus.*—Discoid, with a rounded edge, umbilicate, radiated; umbilicus narrow, acutely conical; radii numerous, slightly elevated, obscure near the umbilicus, often forked near their commencement, passing in a direct course over the front; aperture sagittate, with truncated angles. Diameter 5 inches, thickness 2¼ inches, length of aperture 1¼ inch.

"*Ammonites lamellosus.*—Discoid, thick, with a rounded margin, umbilicate, radiated; umbilicus narrow, exposing a small portion of each inner whorl, smooth;

radii numerous, elevated into obtuse lamellæ, commencing with a curve upon the edge of the umbilicus, often forked upon the middle of the sides, bent forward as they pass over the margin. Diameter 4 inches, thickness 1¾ inch.

"*Ammonites Opis.*—Discoid, compressed, with an obtuse edge, radiated; inner whorls one-third exposed; whorls slightly convex on their sides, their inner edge rounded; radii, commencing with a curve at the inner edge of the whorls, numerous, prominent, rounded, often forked near the middle, slightly bent forward as they pass over the front; aperture elliptical. Diameter 4¼ inches, thickness 1¼ inch, length of aperture 1¼ inch.

"*Ammonites arthriticus.*—Discoid, thick, with convex whorls, and rounded margin, tuberculated and ribbed; whorls half exposed, about 4, their inner margin smooth; tubercles large, near the middle of the sides of the whorls, about 12 in each whorl; ribs prominent, rounded, 3 or 4 from each tubercle, and sometimes an intermediate one; aperture nearly circular, completed 3 or 4 times in each whorl with a thickened edge. Diameter 2¼ inches, thickness 1 inch.

Ammonites ignobilis.—Discoid, depressed, umbilicated, keeled, radiated; front rounded, with a slightly prominent entire keel; umbilicus small, with squarish edges, exposing a small portion of the inner whorls; radii covering half the whorl, in pairs or forked, commencing and terminating with obscure tubercles, waved; aperture sagittate, narrow. Diameter nearly 3 inches, thickness 10 lines. Length of the aperture 1¼ inch.

"*Ammonites corrugatus?* (M. C. t. 451, f. 3.)—An imperfect specimen, rather more strongly ribbed than the one figured in 'Mineral Conchology.'

"*Ammonites armiger.*—Discoid, inner volutions exposed; inner whorls radiated, and furnished with a row of tubercles on their sides; outer whorls with a row of tubercles near the inner edge, and a row of spines near the outer edge on each side; the tubercles and spines connected by thick ribs; margin flat; aperture oblong, squarish. Diameter 7 inches.

"Strongly resembling *A. perarmatus* (M. C. t. 352), but the whorls increase more rapidly in size, and the aperture is longer. Probably *A. catena*, *A perarmatus*, and this, are only varieties of one species.

"*Crinoidal stems*, apparently of 3 species.

Coal.

Before entering upon a particular description of the coal strata, which appear to be most developed in Eastern India, west of the Hooghly and Ganges, it is desirable to give further proof of their claim to a place in our Oolitic Series, and this can only be done in the present state of our knowledge by showing the connection of the latter with the carboniferous shales of Bundelkhund.

It will be remembered that Franklin found "black bituminous shale" cropping out "in all the glens" on the north-western side of Bundelkhund, "particularly in that of the Bagin river"; that Jacquemont found anthracite in the side of a well near Rampore; and that on the southern side of this sandstone tract Osborne found petroleum exuding from shale, with pieces of coal in the bed of the Son near

Bidjighur ; that about 40 miles east of this place the Son is joined by the Koyle, the banks of which are, according to Sherwill, composed of sandstone similar to that in which the "Rajhurrah coal mines" are situated, "18 miles from the Bahar boundary" ; and that 50 miles up the same river is Palamow, which, with its neighbourhood, has been the site of several coal operations ; while about 30 miles SE. of Palamow, again, is the source of the Damoodah, at which coal has been seen to basset ; and here and there eastwardly all along the valley of this river to Burdwan, where I believe the coal deposits of this part of India were first discovered, as well as the vegetable impressions (ferns) referable to the Oolitic period. Lastly, the latter being identical with some lately discovered by the Rev. Mr. Hislop in the sandstone near Nagpore, which is that about to be described as forming the upper member of the Oolitic Series of India, we could not have a much more direct chain of evidence than this, in proof of the connection which exists between the bituminous shales of Bundelkhund and the great coal deposits west of the Hooghly and Ganges, and of their containing fossils belonging to the Oolitic Series generally.

Carboniferous Deposits of the Oolitic Series in Bengal, West of the Hooghly and Ganges.

These consist of coal, shale, and sandstone, but of no limestone, so far as has been observed ; and they appear chiefly to occupy the depressions of the granitic and metamorphic rocks which form this part of India ; becoming exposed in the banks or beds of watercourses or rivers which have passed through them, or in escarpments which have been produced by upheaval of the rocks on which they were deposited. Perhaps the most powerful agents of the latter have been the trappean effusions, which will be described hereafter.

The coal occurs in strata from an inch or less to 9 or 10 feet in thickness, interstratified with shale and sandstone, the whole possessing a dark black or blue colour, of a greater or less intensity. There is no particular order in this interstratification, either in the thickness of the strata, or in the kind of strata which follow each other. The coal may be between two argillaceous strata, or between two sandstone strata, or have a stratum of either on either side ; and the shale and sandstone strata may vary in thickness ; but the thickest beds of the latter far exceed those of the former. Sometimes the coal is close upon the surface, at others it is covered by a variable thickness of shale or sandstone. This probably depends on the amount of denudation which the strata may have undergone. In one section of a shaft sunk at

Palamow by Mr. Homfrey, 200 feet of sandstone superposed the first bed of shale and coal, which occupied 6 feet 1 inch, and then followed a stratum of 30 feet of sandstone before the next shale appeared. At Singra, in the same neighbourhood, 20 feet of sandstone superposed a bed of coal and shale 2 feet 2 inches thick, followed by a bed of sandstone of 18 feet, and afterwards thinner beds of coal, shale, and sandstone, for 20 feet 10 inches, succeeded by a bed of sandstone of 60 feet. At China Coory, also, in the vicinity, clay and shale 7 feet 6 inches first, was followed by a bed of sandstone 85 feet thick; at Ranigunge, sandstone 24 feet 6 inches, shale 39 feet, and then coal. In the computation of the section of the Curhurbalee coal field by Dr. M'Clelland, there are altogether 800 feet, of fine and coarse-grained, micaceous sandstone with conglomerates (the former prevailing) between the upper and lower groups of coal, shale, and sandstone strata.

Some of the coal measures are very shallow, from denudation or intrusion of igneous rocks, others are deeper. One shaft sunk by Mr. Homfrey at the mines of Ranigunge reached 210 feet, passing through 17 beds of coal, none of which were more than 16 inches to 3 feet in thickness, and of inferior quality. As, however, it is not my purpose here to give a summary of all the shafts and sections of the coal measures that have been made in these districts, but to point out their position generally, their development, and their geological relations, I shall conclude what I have to offer on them in this part of India by inserting Dr. M'Clelland's excellent account of the Coal-field of Curhurbalee, which will serve as a typical description for the whole.

The deposit of which this is a continuation "extends from the Damoodah coal-field north-west, along the valley of the Barakar to Curhurbalee, where it rests immediately on crystalline rocks, and is distinguished by the numerous valuable beds described in this report under the head of Curhurbalee Coal-field. It also extends at intervals (the particulars of which have not yet been surveyed) from the Adji valley north into the Rajmahal hills; where it is in one place found resting on conglomerate sandstone [Dr. M'Clelland's provisional "Old Red Sandstone," our Tara Sandstone, provisionally,] and a complete series of Silurian and Cambrian Rocks."

"Curhurbalee Coal-field."

"This coal-field surrounds the village of Curhurbalee, Pergunnah Curruckdyah, and is situated 60 geographical miles south of the Ganges, at Soorajgurrah. The coal-field is bounded on the northern and eastern

sides by fine table-lands, composed of gneiss (villages of Suliah, Bissunpore, Mohunpore, and Dundeedee).

"The southern boundary is imperfectly made out, the coal measures being cut off in this direction by quartz dykes and syenite (Buddeah, Gophai, and Lopsahdee villages).

"The western boundary rests on mica slate at the village of Peppratahn.

"The coal basin is 4 miles from east to west, and 2 from north to south.

"The coal measures are thrown up in tabular-shaped hills, which traverse the basin from east to west. The south-western declivities of these correspond with the gentle dip of the strata, while the north-western declivities consists of broken escarpments, formed by the edges of the uplifted strata.

"The lowest level of the coal basin is 800, and the highest 900 feet above the sea.

"The upper series of the coal measures, where they are exposed in the sections formed by the Sookneid rivulet (on the northern side of the basin), are as follows:—

"Sandy slate, clay varying in thickness from 10 to 50 feet.
"Compact claystone passing into clay ironstone, 10 to 20 feet.
"Slaty sandstone with mica.
"Slate clay, with thin beds of coal and shale, varying from 50 to 500 feet.
"Fine sandstone of uncertain thickness, with thin beds of coal and bituminous shale.

"The lower series of rocks composing this coal-field consists of hard thick-bedded sandstones, composed of earthy felspar, enclosing fine and coarse quartzoze nodules, from the size of grains of sand to that of small pebbles.

"This conglomerate rests on gneiss, or in some places on mica slate, and is in places intersected by trap and quartz dykes: it alternates with beds of coal, bituminous shale, and clay ironstone, in the following order:—

"A bed of bituminous shale occurs sometimes, either alone, or in connection with a thin bed of clay ironstone.

"In the latter case it is succeeded by a second bed of bituminous shale, followed by a bed coal, which is again succeeded by another bed of shale.

"It often happens that a similar repetition of shale, ironstone, and coal, occurs two or three times in succession, with a vertical section of 50 to 100 feet.

"When clay ironstone is not present, a bed of hard ferruginous sandstone usually occupies its place.

"The whole series of sandstone, coal, bituminous shale, and clay ironstone, are represented in the annexed computed vertical section, in order to show the alternation of the several beds, which are disposed in strata dipping towards the centre of the basin, at angles varying from four to twelve degrees with the horizon.

"The relative proportion of each member of this series to the general thickness of the whole, is as follows:—

"Slate clay, arenaceous shales, &c. forming the upper measures.	500 feet.
"Sandstone conglomerate..	1,700 ,,
"Coal, 20 beds, total thickness	92 ,,
"Bituminous shale, 44 beds, including under-clays (which mean the same thing), total thickness..	54 ,,
"Clay ironstone 24 beds, total thickness..	16 ,,
	2,362 feet.

"The whole thickness of the upper and lower series of coal measures, both taken together, may therefore be estimated at 2,362 feet, as shown above, as well as in the computed vertical section. No limestone occurs in this coal-field, nor have any fossils been found, either in the sandstones, shales, or slate clay; but when the coal beds are once opened, sufficient fossil remains will then probably be found to throw some further light on the subject."

Leaving this district, and proceeding westwardly from the neighbourhood of Palamow, where many shafts have been sunk, coal has been seen about 16 miles south of Chergerh, in the district of Singrowla (Franklin); 30 miles E. of Sohajpore, at the confluence of the Tipan and Son (id.); at Jubbulpore, in digging a well, more than 35 years since (Herbert); 33 miles south of Hoshungabad, on the road to Baitool (Finnis); and at Shapore in the same neighbourhood, discovered by Captain Ouseley (id.). In the Mahadewa hills, a continuation of the Satpoora range, 100 miles due north of Nagpore (Mm. Jerdon); also by the late Dr. Walker 10 miles from the confluence of the Godavery and Pranheeta, with bituminous shale, limestone, and sandstone above it, on all sides; and by his people in the form of anthracite in micaceous sandstone in a seam 3 feet thick at Duntinapelly, 20 miles from Sangaum, which is 65 miles west of Chinnoor. Dr. Bell, who has also been conducting a boring experiment at Kotah, in the same neighbourhood, has kindly favoured me with the following interesting and valuable section of this locality, from above downwards:—"Conglomerate of no great thickness; sandstone in hills from 50 to 500 feet in height;

argillaceous limestone, 9 feet; bituminous shale, ¾ inch; argillaceous limestone, 1 foot; bituminous shale, 4 inches; fibrous carbonate of lime, impure limestone, and blue clay rock, 8 inches; bituminous shale 2 feet 1 inch; laminated sandstone, 8 feet ¾ inch; bituminous shale, 1 foot 6 inches; fibrous carbonate of lime, 1 inch; bituminous shale, 1 foot 3½ inches; impure limestone, 5 feet 3½ inches; black arenaceous clay, 3 feet 6 inches; sandstone, 23 feet; clay, 7 feet 6 inches; sandstone, 2 feet; clay shale, 1 foot 9 inches; limestone, 1 foot 8 inches; clay shale, 12 feet; red marl, 27 feet, and limestone which was only penetrated to the extent of 2 inches." Lastly, the late Captain Kittoe has given sections of coal strata at Talcheer and Ungool in Cuttack, where the coal is found within 13 feet of the surface, which, from the micaceous sandstone that accompanies it, is in all probability part of the formation we have just been considering. In the Oolitic sandstone of Cutch it was long since discovered by Colonel Grant.

Under the head of "Garrawarra," which is a town on the south side of the Nerbudda, about 80 miles above Hoshungabad, Ansted, in his "Elementary Geology," p. 541, states :—"On the Seeta Rewar river there appear to be three beds [of coal], whose thickness is 20, 40, and 25½ feet respectively: these are covered with a thin bed of sandstone." Again, under the head of "Jubbulpore," he states:—"At 9 miles from the station there is a large bed of first-rate quality, many yards thick, crossing the bed of the Son." The nearest part of the Son to Jubbulpore is 40 miles distant, so this would appear to be the largest bed yet discovered. No authorities are given.

Geographical Extension.—The extremes of this coal formation, so far as have yet been discovered in the tract of India under consideration, *including* the angular portion beyond Delhi and Ferozepore, are: the confluence of the Godavery and Pranheeta in the south, in about 19°, and Nahn, in the Sub-Himalayan range, in about 30° 30′ N.; Cutch Bhooj in the west, and Burdwan, about 50 miles NW. of Calcutta, in the east. But by far the greatest number of places in which it has been noticed, indeed I might say almost the whole, with the exception of the northern and southern extremes, are between the 20th and 25th parallels of latitude; and here the greatest development of this formation appears to be in the east, expending itself out towards the west. In the districts of Burdwan, Birbhoom, Moughyr, Ramghur, and Palamow, its great development appears to be at the expense of the upper and under sandstone, together with the limestone, for these are frequently unrecognisable, particularly in the first-named districts, where the coal formation appears to rest chiefly on the granitic or metamorphic

rocks. There are many other places, no doubt, between Bengal and Bahar on the north and east, and Orissa and Berar in the south and west, respectively, where this valuable mineral may be found; but it remains for future explorations to prove it more satisfactorily, and to point out whether the coal is so situated with respect to other minerals or water carriage as to make its working worth the consideration of the Government of India, or the speculation of a private company. Poor Voysey! who travelled through this country from Nagpore eastwards to Calcutta, through Sumbulpore, and met with black slaty limestone, black calcareous clay slate and sandstone on his way thither, states of them at Lowan and Bellagurh:—"I am convinced that the rocks of this formation are contemporaneous with, and [or?] prior to, the granite." But he did not live to communicate more about them, for he died (of the fever mentioned in his Journal) between the left bank of the Subunreeka and Calcutta, having been found in his palanquin 24 hours after his death.

For an analysis of this coal I must refer the reader to the table on this subject published in vol. vii. of the Bl. As. Jl. p. 197, which was extracted from one of the Reports of the Coal Committee. To this I have only to add, that the coal occasionally presents the spheroidal structure common to many formations. The so-called "Ball-coal" sent by Mr. Williams from the Burdwan mines to Mr. Piddington is of this kind, the spheroids of which are from the size of a "cannon-ball to a man's head"; some are 18 inches in diameter. Mr. Piddington states that the apparently concentric layers are oblique "rhomboidal prisms."

The following vegetable impressions from the "Sandstone and Clay, with beds of Coal," in Cutch, are described by Mr. J. Morris, at the end of Captain Grant's Geology of that province:—

"*Ptilophyllum.* — Stem —? Fronds pinnate; pinnæ closely approximated, linear, lanceolate, more or less elongate, imbricate at the base, attached obliquely; base semi-circular or rounded; veins equal, slender, parallel.

"*Obs.*—We have ventured to form these fossils into a distinct genus, conceiving that the circumstances of the oblique insertion of the pinnæ, and their overlapping each other at the base, are characters too important to admit of their being united to the genus *Zamites*, to which some similar fossils have hitherto been referred. The *Z. pectinata* of the "Fossil Flora" belongs to this genus, and a careful revision of the fossil *Cycadeæ* may probably discover other species having this mode of attachment. From the structure of the frond they may, however, be considered to belong to *Cycadeæ*, and to differ from *Zamites* in the oblique insertion of the pinnæ at the base, and from *Coniferæ* by the absence of a primary vein in the pinnæ.

" *Ptilophyllum acutifolium.*—Frond pinnate; pinnæ narrow, linear, elongate, acute at the apex.

" This species differs from *Z. pectinata* of the " Fossil Flora," in its pinnæ being narrower, longer, and more acute; and more nearly resembles the *Polypodites pecteniformis of* Sternberg.

" *P. Cutchense.*—Frond pinnate; pinnæ short, scarcely overlapping at the base; apex obtuse.

" This specimen has also been referred to the genus, from its pinnæ (although wider apart than in the other species) having apparently a rounded base; but the absence of all trace of venation in this fossil must render its correct determination very doubtful. It resembles in form the *Z. Bucklandii* of Sternberg, (parts 5 and 6, t. 23. f. 2,) or even *Z. taxina* of the " Fossil Flora," and it might also be compared to some pinnatified *Polypodiums*, as *P. plumula* and *P. taxifolium.*

" *Lycopodites affinis.*—Stem —? Branches linear, elongate, leaves distichous, alternate, ovate, lanceolate, acuminate, adnate at the base.

" This specimen has been referred to *Lycopodites* from its resemblance to the barren portions of *Lycopodium Jussieni* and *L. volubile.*

" *Fucoides dichotomus.*—Frond compressed? dichotomous, branches unequal, patulate, apex obtusely rounded.

To the " Report of the Geological Survey of India for the Season 1848-49," Dr. M'Clelland has appended the following descriptions of vegetable impressions found in the Burdwan Coal-field :—

" *Burdwan Fossils.*"

" I may here add in this place the following undescribed fossils of the Burdwan coal-field, which may serve as a term of comparison between the Burdwan and other coal-fields generally: most of them are in the collection of the Asiatic Society.

"*Zamia Burdwanensis.*—Leaflets linear-oblong, broadly inserted at the base, and rounded at the apex.

" *Sphænophyllum speciosa.—Trizygia speciosa,* Royle's Illust. 2. Fig. 8.—Leaves verticillate, fan-shaped, frequently bi-lobed; placed in threes at intervals on a slender floating stem.

" *Obs.*—There can be no doubt of this being a well-marked *Sphænophyllum,* having the furrowed stem and bifurcated venation of that genus.

" It is the most beautiful fossil hitherto found in the Burdwan coal measures.

" *Sphænophyllum fasiculatum.*—Leaves verticillate, fan-shaped, in dense imbricated fasciculi, probably at intervals, on a slender floating stem. Discovered by Mr. Theobald in the Burdwan coal formation.

" This fossil occurs in the form of detached lenticular bodies, from half an inch to an inch in diameter, and is so abundant as to give quite a character to some of the upper beds of bituminous shale of the coal formation.

" *Obs.*—From the shape and detached character of these bodies, they might be supposed to be the strobili of some coniferous plant, and, being composed of an infinity of densely imbricated scales, may still prove to be of that nature. But the fine leafy and membranous character of the scales, presenting the venation of *Sphænophyllum,* suggest the probability of their being dense whorls of leaves or fronds.

" *Poacites muricata.*—Leaf long and ensiform, upwards of an inch in breadth, and consisting of parallel unconnected veins.

" *Obs.*—It occurs in the Burdwan coal-field, along with *Fucoides venosus.*

" *Poacites minor.*—This is an ensiform leaf, usually half an inch in breadth, and of indefinite length, consisting of seven or eight coarse, longitudinal, equal veins, without any transverse connection with each other.

" *Obs.*—It is found in bituminous shale in the Rajmahal and Burdwan coal measures; and also in arenaceous shale in the Burdwan coal-field.

" *Glossopteris acaulis.*—Spreading and stemless; the fronds long, stipitate, linear-oblong, becoming irregularly narrow at the base; apex broad, obtusely pointed; primary veins bifurcate; secondaries and tertiaries reticulate.

" *Variety.*—In which the primary veins are dichotomous, and the secondaries bifurcate.

" *Glossopteris frondosa.*—Fronds oblong ovate, midrib slender, and continued to the apex of the frond; veins slender, diverging at an obtuse angle from the midrib; all of an equal size, and reticulated.

" *Obs.*—Only two incomplete fragments of the upper and middle portion of the frond have been examined, from which it would appear to be from 4 to 8 inches in length, and 1½ to 3 inches broad.

" *Glossopteris reticulata.*—Leaves oblong, ovate; narrow at the base; apex obtuse, lanceolate; midrib strong, gradually tapering, and terminating before it reaches the apex; primary veins close-set and numerous, curved, and arising acutely from the midrib; secondaries finely reticulated.

" *Tæniopteris danæoides.—Glossopteris danæoides*, Royle, Illust. l. c.—Frond ovate; veins bifurcate, parallel, without tertiary veins.

" *Obs.*—Various specimens show the fronds of this fossil to have been from 3 to 5 inches in length, and from 1½ to 2½ in breadth.

" *Note.*—Calamites occur both in the Burdwan and Rajmahal coal measures, but I have seen no specimens of them in collections. One large species occurs in the sandstone of the coal measures at Kottycoon, in the Rajmahal hills, of which, however, no specimens were collected.

" *Pecopteris Lindleyana*, Royle.—Bi-pinnate; pinnæ given off nearly at right angles with the midrib, linear-oblong and oblong-ovate; secondary pinnules having the vein in the centre of each pinnule nearly straight, and extending from the base to the apex of the pinnule, giving off obliquely six to ten small branches or tertiary veins on either side.

" *Variety.*—Secondary venule in the centre of each pinnule more curved, and acute at its origin; probably a distinct species, but the specimens examined are too imperfect to allow of the satisfactory determination of this point.

" *Pecopteris affinis.*—Bi-pinnate, central vein of each pinnule bifurcate; in other respects it is the same as *P. Lindleyana.*

" *Variety.*—Pinnules closely placed, so as to appear almost as the lobes of an incised leaflet.

" *Fucoides venosus.*—Frond simple, membrano-fleshy, hidden veined, spatulate, linear-oblong, base prolonged and narrow; apex obtuse and rounded; midrib broad at the base, gradually diminishing to the apex; the venation, where it is perceptible, is acute with the midrib, and arched. This fossil is contained in bituminous shale of the Burdwan coal-field.

"*Conclusion derived from the foregoing Fossils.*"

"*Obs.*—Comparing the above results with the general distribution of fossil plants, we find four genera, namely, *Zamia*, *Tæniopteris*, *Fucoides*, and *Pecopteris*, afford twenty species of lower Oolite fossils, and eleven coal measure fossils. Of eight genera of Indian coal measure fossils here described, four of them are common to the coal measures of Europe, namely, *Sphænophyllum*, *Poacites*, *Calamites*, and *Pecopteris*."

To these may be added Royle's *Vertebraria Indica* and *V. radiata* from Burdwan, figured in pl. ii. of his "Illust. Bot. Himalaya"; and Brongniart's *Glossopteris Browniana* and *G. Angustifolia*, from the Ranigunge mines, near Rajmahal.

Also the two Icthyolites found by Drs. Walker and Bell respectively, at Kotah, in the Nizam's territories, near the confluence of the Godavery and Pranheeta. That of the former, named by Colonel Sykes *Lepidotus Deccanensis*, in "bituminous schiste," is stated by Sir P. Egerton, who examined these organic remains, to be a new species. "The scales are perfectly smooth, and the free posterior margins entire, without any trace of serration. A ramus of the lower jaw is seen in one specimen, showing the teeth to be conical, with rather elongated bases. There is little doubt but that it is a true Oolitic form, and apparently of the date of the Lias." "The genus Lepidotus was probably an estuary or in-shore fish, from its frequent association with terrestrial vegetable remains, as in the Hyderabad specimens."

Of the specimen submitted by Dr. Bell to the Geological Society, and which Colonel Sykes has named *Dapedius Egertoni*, Sir P. Egerton states:—

"It belongs to the genus *Dapedius*, *with single-pointed teeth*; *Tetragonolepis* of Agassiz—not of Brown. It appears to be a new species, differing from those hitherto described, in the ornamental pattern of the scales. It is an Oolitic form, probably of the age of the Lias."

This fossil was found "in a slab of limestone," and therefore, should properly, have been placed under the head of "Limestone" in this sub-series; but this matters little, as by-and-bye these strata must be grouped according to the kind of organic remains which they contain, and not according to their mineralogical characters.

The following list of fossils from Cutch, and the Desert to the north-east of that province, which were described by Mr. J. de C. Sowerby to illustrate Colonel Sykes' observations on them in vol. v. of the Geol. Trans. 2nd Series, should have accompanied those extracted from "Grant's Geology of Cutch," p. 215:—

Astarte major, *A. compressa*, and *A. rotunda*; *Corbula pectinata*; *Trigonia Smeeii*; *Tornatella striata*; *Terebratula microrhyncha*; *Ammonites Mya*, *A. calvus*, *A. Pottingerii*, *A. fistus*, *A. torquatus*, and *A. Fornix*.

Punna Sandstone. (H. J. C.)

This name is derived from the town of Punna, in Bundelkhund, above which is a range of hills called by Franklin the "Punna hills or Second Range," but which Jacquemont, as before stated, found to be a third range.

Synonyms.—Diamond Sandstone (Malcolmson). Upper part of Voysey's "Clay Slate Formation."

It is to be regretted that Jacquemont, who first pointed out the existence of this range, was not able to explore more than the lower part of it, which the following extract from his work will show is composed of sandstone resting on the Kattra Shales :—"Je ne suis pas monté sur leur sommet [the Punna hills]; leurs pentes sont couvertes de bois, que plusieurs espèces de Mimoses rendent d'un accès très-pénible; mais je me suis élevé jusqu'à leur hauteur moyenne, dans le lit de quelques ruisseaux qui en descendent. Les fragments dont ils sont remplis sont une table abrégée des couches qui constituent les assises supérieures. Or, je n'y trouve qu'une seule variété de Grés, plus rouge qu'aucune de celles que j'ai observé dans la première et la deuxième rangée, lie de vin clair, à grain très fin, compacte. Quelques-uns de ces Grés sont mouchetés de blanc, et ressemblent grossièrement à des porphyres. Ces points blancs sont des parties ou l'oxyde de fer n'a pas pénétré." He then observes :—"Les seuls bancs de Grés que j'ai vus à découvert, vers la base des collines, offraient la structure concentrique que j'ai remarqué dans les couches de la base de la première rangée en montant de Mirzapoor a Lalgandje, mais avec cette différence que leurs surfaces étaient plutôt planes que courbes. Ce sont des sortes de parallélipipèdes emboités les uns dans les autres." I have added the latter observation because it coincides with a similar structure noticed by Captain Sherwill "at the foot of the hill of Sasseram, in the zillah of Shahabad, which forms the termination of a spur thrown off from the northern face of the lofty range of the Keymore sandstone mountains." This is at the eastern extremity of the sandstone tract of Bundelkhund, which we shall also find by-and-bye to be composed of nothing but the Punna Sandstone, resting on the Kattra Shales with their limestone, croping out at Rhotasghur and other places close by. The structure is so remarkable, that it has received a particular description by Captain Sherwill, who, like Jacquemont, first terms it "concentric," and then observes, that "the pressure above and laterally has caused them [the spheres, which are in rows,] to be so much flattened that they resemble square columns."

To return, however, to the plateau of Bundelkhund. We find that Franklin, in describing the escarpments of four waterfalls, ranging from 272 to 400 feet deep, all along the same declivity, and within 40 miles of each other, states, that they are all composed of the same sandstone formation; and in one instance, that it rests on argillaceous

strata. The latter fact establishes the identity between it and the Punna Sandstone. Moreover, the easternmost waterfall is not more than 30 miles from the banks of the Son, which banks we shall by-and-bye find to be composed almost entirely of the Punna Sandstone, resting, as before stated, on the Kattra Shales. Fortunately Franklin has been particular in his description of this sandstone at each of the waterfalls, and therefore from his and Jacquemont's observations, we shall be able to take our description of it from Bundelkhund, assisted by the remarks of others who have incidentally alluded to it, in this part of India.

Mineralogical and Geological Characters.—From these sources, and the specimens I have seen of this sandstone, it appears to be composed of very fine grains of quartz, and more or less mica, united together by an argillaceous material. The latter varies in quantity, and the mica may be entirely absent. It seems generally, to be of fine structure, and coloured with different tints of red, brown, lilac, grey, and white, or any two of these together, the one forming streaks, spots, or specks, in a ground of the other. Superiorly it appears to be compact and quartzy, becoming more friable and loose below. It has been horizontally deposited, and now presents massive and lamellar strata.

To these characters it appears necessary to add, that its texture may become so coarse as to pass into a conglomerate; at the same time that it is also necessary to caution the observer against confounding this conglomerate with one, apparently of subsequent formation, which may overlie this sandstone, and which will be hereafter mentioned.

The Punna Sandstone rests conformably on the Kattra Shales, which appear to pass into it, in the same manner as the Tara Sandstone passes into the latter. In some places in Southern India it rests directly on the limestone, without the intervention of any shales (Malcolmson).

Its thickness varies, either from original inequality or subsequent denudation. At present its greatest known depth is in the eastern part of the Keymore range, which is but a continuation eastwardly of the Vindhya range, and the north-eastern part of the sandstone tract of Bundelkhund. Here, it is 700 feet thick, near Bidjighur on the banks of the Son (Osborne), and 1,300 feet thick at Rhotasghur, in the zillah of Shahabad (Sherwill); at the scarps of the waterfalls in Bundelkhund, which were examined by Franklin, it does not appear to exceed 360 or 400 feet, and Jacquemont considered the Punna range of hills to be about 300 feet above the level of the second plateau. From 300 to 400 feet is the thickness given to it in South-western India, about Ryelcherro and Sundrogam, in the Ceded Districts

(Newbold). On the opposite side, however, viz. at Paloonchati, about 15 miles west of the Godavery, and in nearly 18° N. there is a range of entire sandstone hills, which appear to rest on argillaceous strata, that Voysey considered 600 feet high, but which Mr. Burr, who was then surveying these districts, thought 1,200 feet high. The falls of Gokak present a sandstone escarpment of only 178 feet high, with aluminous shales of various colours at the base (Newbold). In many places this sandstone is not only much thinner than this, but altogether absent, when the limestone or argillaceous strata of the Shales becomes the highest member of the series, as in the neighbourhood of the Bhima, in the district of Shorapore, &c.

It attains its greatest height on the banks of the Kistnah, viz. 3,000 feet (Malcolmson), while in the plains of the Carnatic, and the districts watered by the Penaar river, it is but a little above the level of the Sea (id.).

Frequently its upper part is in the state of quartz rock, presenting great fissures; occasionally also, in Southern India, it has a jointed rhomboidal structure (Malcolmson), and sometimes the concentric lamellar one. Christie and Newbold mention this in the Southern Mahratta Country, and the latter also at the Gundicotta pass: to its existence at Sasseram and in Bundelkhund I have already alluded. It is also sometimes brecciated from volcanic disturbance and subsequent reconsolidation.

The hills or mountains capped with this sandstone and the shales, generally, present a scarp of the former followed by an inclined plane of the latter, while the summit is either horizontal, or terminated by a rugged fantastic outline, not unlike old ruins.

Subject as this series has been throughout to the intrusion of igneous rocks, and the violent displacement which accompanies subterranean force, the Punna Sandstone has of course participated in the general overthrow, and appears in all kinds of positions and conditions; but no one mentions the intrusion into it of anything but dykes of the trappean rocks. Malcolmson states, that a few miles north of Nagpore the strata of "red sandstone are bent, fractured, and converted into compact quartz rock, at their point of contact with the granite, which has burst through it"; but I am not quite sure if this be the sandstone under consideration.

When metamorphosed into quartz rock, it would appear to have been sometimes called "hornstone." Tod, I think, calls it "trap"! in alluding to the formation of the plateau of Kotah in Mewar. He observes that this plateau consists of "trap," the prevailing colour of

which is white; it is of a compact and close-grained structure, of a white colour; and about Kolali, porphyritic; at Shahadabad, it is of a mixed red and brown colour, and when decomposed would be taken for a "gritstone." Dangerfield sets it down in his geological map of Malwa as "hornstone porphyry," the same as the ridge bounding the trap of Malwa close by, which rests on the shales; and Hardie gives a similar description of the capping of the hill of Chittore, which Tod includes in the district or plateau of Kotah. Hardie, however, calls this "quartzoze breccia," and states that it presents scarped sides, which terminate in a sloping plane of the shales on which it rests. We can hardly, I think, fail to recognise in this the Punna Sandstone. Sherwill, again, in his description of the Rajghur hills, of the Zillah Bahar, calls the latter "hornstone," and adds that they present lively colours of red, purple, blue, greyish-green, &c. Newbold mentions a similar rock in the Eastern Ghauts west of Nellore, and considers it to be altered sandstone. The quartz hills of Ajmeer, of a violet or purplish tint, and indeed all those alluded to by Tod, appear to be the Punna Sandstone metamorphosed; although I have placed them among the older Metamorphic Rocks, but this is only done provisionally.

Geographical Extension.—The Punna Sandstone appears to be almost unlimited in its extent over the tract upon which we are engaged. It appears to be present at Nahn in the Sub-Himalayan range, between the tributaries of the Jumna and Sutlej, and to extend as far south as the Nagerry hills, in the Eastern Ghauts WNW. of Madras, to Cutch in the west, and to the Rajmahal hills in the east. Grant states that the hills about Bhooj "assume, when capped by the sandstone, the usual form of an abrupt escarpment, with a long inclined opposite side." All the towns on the Jumna, from its confluence with the Ganges to Delhi, appear to be built of this sandstone, and among their edifices stands forth the Taj Mahal, edged with the beautiful white metamorphosed limestone of this? series.

The plains of Bikaneer, Jodpore, and Jessulmeer, appear to be covered with the loose sand of this formation, which every now and then projects above these dreary wastes in its concrete or metamorphosed forms. Our museum possesses specimens from Balmeer presented by Dr. F. Forbes; from Cutch, and from Kattyawar. It borders the northern and western sides of the trappean tract of Malwa (Dangerfield), and appears in the Bundair hills of Bundelkhund, on its eastern side, extending to the utmost limits of the Vindhya range, which in this direction may be said to reach Monghyr, on the Ganges. Westwards to Hoshungabad; and on the opposite side of the Nerbudda,

forming the north-eastern boundary of the great trappean tract of Western India, from which we have numerous specimens from Dr. Bradley; appearing at Nagpore, and extending from thence along the Godavery to its debouchment. In the Southern Mahratta Country, on the Bhima, along the Kistnah, and more or less continuously on the eastern side of the peninsula from this river to the Nagerry hills, beyond which its existence has not been recognised, nor does it appear to have been seen on the western side from the Ceded Districts to Cape Comorin.

Minerals.—If the quartz mountains of Ajmeer be this sandstone metamorphosed, then it contains lead, as has before been stated; and when we remember that the limestone about Cuddapah, which is intimately connected with this sandstone, contains galena in several places, it does not seen very improbable. Further than this I know of no other mineral worth working in it. In the introduction, it is stated that the Oolitic Series yields iron ore, but as yet I think there is no satisfactory evidence of its existence in it to any great extent, at all events in the unmetamorphosed condition of the strata. The resources of this series appear to be more economical than mineral; at the commencement of the group I have, by mistake, used the latter word, which is, perhaps, more applicable to the Older Metamorphic Strata. In what "clay-slate" is the copper of Nellore, &c.?

Organic Remains.—For many years past the sandstone of India has been known to yield impressions of plants. Captain Dangerfield, in his letter to Sir John Malcolm on the geological features of Malwa, written more than thirty years since, states that he saw between the slaty fracture of the sandstone at Jeerun, in Malwa, passing northward to Odeypore, "numerous vegetable remains or impressions of a species of fern, appearing to be in a carbonized state," and we know now sufficient to reasonably infer that this is the sandstone under consideration.

Grant, about 1837, found the impressions above described in the "sandstone and clay with beds of coal" in Cutch. We have only one specimen of the Cutch sandstone bearing a vegetable impression in the museum, and that very closely resembles the fine micaceous sandstone at the north of Elichpoor, and that in the neighbourhood of Nagpore, which also bears vegetable impressions.

But it is only within the last year that our attention has been forcibly drawn to the organic remains of this member of the Oolitic Series. The happy coincidence of a favourable locality and able inquirers have furnished us with a list of fossils that will establish a lasting interest in the organic remains of this sandstone, and soon set at rest all

discussions respecting the geological age of the series to which it belongs. I allude to the researches of the Rev. Messrs. Hislop and Hunter, whose "Geology of the Nagpur State" is published in the last number of our Journal, and from which the following descriptions of the fossils in the sandstone of Nagpore are extracted:—

"*Mollusca.*—These occur only at Mángali, 60 miles south of Nagpur, and consist of two species of minute *Cyrena*, (?) one, which is the smaller, being globular, and the other flatter and more elongated.

"The vegetable remains are exceedingly abundant, and are to be found in all places where the middle beds appear. They have also been recently discovered in a similar position near Elichpur, by Dr. Bradley. As they are met with at Nagpur and the surrounding country, they include seeds, leaves, and stems.

"*Seeds.*—Four species. Of these the first two discovered were found at Bhokára. Notwithstanding their being smaller, they are evidently related to two of the forms of *Carpolithes* figured by Lindley and Hutton in their *Fossil Flora*, vol. iii. p. 193. The third kind of seed was first met with at Kámpti, by Mr. Sankey, to whom I am under many obligations for this, as well as other favours. Shortly after Captain Wapshare and I found it at Tondakheiri, 14 miles NW. of Nagpur. A fourth seed, which occurs at Silewádá, is lanceolate, and very minute. Under this head may, perhaps, require to be comprehended a circular depression, resembling in size and form the impression left on wax by a pretty large key, which was discovered by Captain Wapshare at Bhokára.

"*Leaves.*—*Dicotyledonous* 2. One a leaf of a conifer, about 1 inch long and $\frac{1}{8}$ inch broad across the middle, midrib included. It has obviously been a strong inflexible leaf, and with its sharp point may have been rather formidable. A small piece of *Zamites* from Kámpti, not $\frac{1}{2}$ inch long, and yet it gives off from its tiny midrib 20 pinnules, each containing 6 or 7 microscopic veins. There are several leaves observable in the strata at Kámpti, apparently *Monocotyledonous*. One kindly contributed by Mr. Sankey is 17 inches long and $\frac{3}{4}$ inch broad. Before deposition it had been split in two for about two-thirds of its length. It may possibly be the leaflet of a large *Zamites*; but I am disposed to consider it rather a *Poacites*, with very minute venation. The same may be said of another curious object, which has left 42 parallel lines stretching across a confused mass of vegetation, for a distance of 3 inches, and with a breadth of $\frac{3}{4}$ of an inch.

"But the most common and beautiful leaves which the sandstone formation produces are the fronds of ferns. They include—

"*Pecopteris.*—Of this genus but few specimens have been found, and these at Kámpti only. They are, however, of two distinct species. A pinna belonging to one of these species is furnished on each side with 11 pinnules, with a central vein, reaching to the apex. A specimen of the other species is very perfect, and presents four bipinnate fragments, lying together in such a manner as to indicate a tripinnate frond, pinnæ with from 8 to 10 pinnules on each side, the venation much branched, and without a central vein extending to the apex.

"*Glossopteris.*—The species of this genus are very numerous, amounting to 10, and all in excellent preservation. With their large iron-coloured fronds and distinct veins, and in several instances with their perfect fructification, they form the most interesting fossils of the vegetable kingdom that I have ever seen. The species differ from each other in size, shape, venation, and arrangement of the sori. One of them is upwards of 20 inches long and 3 broad, while some slabs are entirely covered with a species little more than 3 inches in length. Some have the venation coarse, others fine; some have it starting from the midrib at a very acute angle, others nearly at right angles. The sori in all cases are dot like; but in some they are large and round; in others they are small and elongated; in some they are placed chiefly along the margin, in others with 4 or 5 rows they fill up almost the whole of the frond. This genus is the most widely diffused of any in the formation within the Nagpur State. It has been found at Chándá, and also at Chorkheiri, a distance of 120 miles, and at intermediate places. The locality that has furnished most species is Silewádá, whence I was favoured with a magnificent slab by Captain Wapshare.

"*Cyclopteris.*—One species of this genus has been discovered at Tondakheiri, along with the coniferous leaf; length 2½ inches, breadth 1 inch. The frond is crowned with fructification in form like the flower of a cultivated cockscomb. Another species met with at Kámpti is much larger.

"*Sphenopteris.*—The specimens of this genus which are imbedded along with those of *Pecopteris* are much mutilated; but the small fragments that are found exhibit a very elaborate, though clear, venation.

"*Tæniopteris.*—Two species, one narrow, with secondary veins straight and perpendicular to the median; the other very broad, with secondary veins curved and oblique.

"*Stems.*—These are very abundant at Silewádá, including genera of which I can find no traces in any *Fossil Flora* to which I have had access. They are apparently *Exogenous*, but do not preserve the

structure of the wood. They have possessed a well-defined bark, which is often obliquely striated, and exhibits the cicatrices of leaves, with a bud occasionally left after the foot-stalk had fallen off. Some of the scars are longitudinal; others are transverse, and embrace a considerable part of the stem. They are in general sparsely distributed, in one large stem 3 feet long, and upwards of a foot broad, there being only a single scar apparent. Besides these *Exogenous* stems, of which there are four or five different genera, there was one discovered at Mángali, along with *Cyrenæ*, which can be distinctly referred to the conifers, from the lattice-like disposition of its scars. The wood of a coniferous stem, converted into silex, but retaining no traces of its bark, was dug out from the road near Chándá. Other stems, preserving the wood, but so altered by iron that the structure cannot be determined further than that it must have been *Exogenous*, occur in abundance at Silewádá. On the other hand a stem embedded in the rock at Mángali exhibits every mark of having been *Endogenous*. The portion obtained is like a thin rattan, 14 inches long, without any apparent joint. Under this sub-kingdom must also be classed—

"*Equisetites*, or according to Bunbury *Asterophyllites*.—The peculiarity of the specimen of this genus, which was discovered by Mr. Hunter at Silewádá, as well as of a Yorkshire one, figured in the *Fossil Flora* (vol. iii. p. 186) under the name of *Equisetum laterale*, is, that it is always found associated with little round discs, having 'lines radiating from a common centre, something like the phragma of a calamite.' The authors of the *Fossil Flora* were uncertain whether the discs belonged to the stem, near which they are found; but in the Silewádá specimen, the round bodies, of which there must have been two and two opposite each other at the articulation, partly retain their original position, and partly have fallen out, leaving a radiating hollow to show where they once had been. A very common plant at the deposition of the sandstone was the—

"*Phyllotheca*.—In giving this name to the genus that has hitherto been called *Calamites* in India, I follow the high authority of Brongniart and McCoy, who have described specimens from Australia. The opposite sulcation of our Indian genus clearly separates it from *Calamites*. What place it ought to hold in a classification remains doubtful. Göppert ranks it among Monocotyledons, immediately after *Equisetites*, while McCoy compares it with the *Casuarina*. I have not been able, in the numerous specimens which I have met with, to verify the opinion of the latter eminent geologist, not having detected either bark or a phanerogamous fructification. There appear to be in

all nine species collected from Bhokára, Silewádá, and Kámpti, differing in the number of *sulci*, which range from 6 in the semi-circumference to 31. Two from Kámpti were sent to me by Mr. Sankey, and one from Silewádá by Captain Wapshare.

"*Vertebraria*.—This is the strangest genus among our Nagpur fossil plants. Hitherto it has been described from specimens obtained exclusively from the Indian and Australian coal-shale. This has led to a limited view of its nature. McCoy's generic character applies merely to the radiated body, which is found in connection with the main stem, and which he believes to be made up of a 'slender stem surrounded by densely aggregated whorls of verticillate cuneiform leaves, having a dichotomous venation.' Of the correctness of this description of what was before the author at the time, I have no reason to doubt, but it is quite inappropriate, when it comes to be predicated of the sandstone specimens. These have no slender stem or densely aggregated whorls of leaves. On the contrary, the main stem is thick, marked with two rows of oblong, rounded, or angular elevations and depressions, and giving off branches and twigs at different intervals, and in all directions. Mr. Sankey forwarded to me the first sandstone specimen from Kámpti, and in the same week I found it at Tondakheiri, and more recently at Chándá.

"Such are the principal fossils of the Sandstone, properly so called. Beneath it occur some beds of Shale, which may be held as part of the same formation. These strata are developed in the district north of Chándá, and between Korhádi and Bhokára, where the red shale contains the following organic remains:—

"*Reptilia?*—A footmark, of ⅛ of an inch long, and as much broad, with the impression of five (?) claws. Three specimens have been obtained, each exhibiting only one print. The shale, which is very brittle, does not admit of a surface of more than a few square inches being procured. On the same specimens as bear the footmarks are seen the tracks of—

"*Lumbricariæ* (Earthworms).—That these animals have been of the nature here indicated will be evident to any one who considers the appearance of the furrows: the way in which the head has occasionally been pushed forward, and then withdrawn; the tubular holes by which the ground has been pierced, and the intestine shaped evacuations which have been left on the surface. Worm borings have been found in the green shale of Tadádi, 70 miles south of Nagpur.

"The only vegetable organism which has been discovered in the shale is a sulcated plant, which most probably belongs to the genus

Phyllotheca, but, as a sufficient length of the stem has not been obtained to display the articulation, its precise character cannot be fixed."

Dr. Spilsbury sent to the Bengal Asiatic Society a specimen of silicified wood, which Captain Ousely obtained from a trunk of a tree that he observed passing through a cavern in this sandstone, near Pugra, on the left bank of the Nerbudda, on the road from Tendukira to Baitool. Do the "silicified palm trees" which Dr. Spry describes as resting on *limestone* about a mile from Saugor, belong to this formation, or to the thin intertrappean lacustrine one, to which we shall come by-and-bye? The Rev. Mr. Hislop states in his paper, that silicified wood abounds at Silewada; and Malcolmson observes that Mr. Geddes found it strewed over the country NW. of Mangapett on the Godavery, towards the junction of the latter with the Wurda, (Pranheeta?) which is in this Sandstone Formation; while Malcolmson himself found "coniferous" wood at Mangapett, resembling that of Pondicherry. But the latter may also have come from the lacustrine formation to which I have just alluded.

Newbold saw ripple marks in this sandstone at the falls of Gokak, and at the pass of Gundicotta.

Minute Coralline Limestone of Baugh.

There is a fossiliferous limestone, of which much of the ornamental architecture in the once famous city of Mandoo, situated in the Vindhya range, about 160 miles up the Nerbudda, is constructed, and which differs from any other in India that I have seen described. Specimens of this limestone were presented to the Society by the late Lieutenant Blake, among other many valuable contributions of the kind which this officer made to the museum.

It is of two colours, red and yellow, mixed with white, and of a coarse, compact structure. This coarseness, when examined with a Coddington lens, in a polished section, is found to depend on the presence of innumerable microscopic corals; and the colour, on oxide of iron, which is diffused through two-thirds of the mass. Many of the corals are branched, and their cellular arrangement varies with the species; of which there are several. The most prevalent appears to be one in which the cells radiate upwards and outwards in a curved form from the longitudinal axis, in the manner of *Favosites*. The points most worthy of mention in the organic remains of this limestone are the apparent absence of foraminifera, and, with the exception of a minute turbinated shell here and there, its almost entire composition of branches of minute corals, few of which exceed $\frac{1}{17}$ of an inch in diameter.

Jacquemont, who visited Mandoo, has also noticed this rock, and states that he could not find out the quarries from which it came ; but the following passage from Captain Dangerfield's geological description will, I think, supply the deficiency :—

"Passing from Malwa to Guzerat, to the SW., the first well-marked descent occurs near Tirrella, and continues gradually for 14 miles to Para. In the greater part of this distance occur the trap rocks of Malwa, succeeded by coarse sandstones and limestones, with immense quartz beds, siliceous grit-stone, and coarse conglomerates. The limestone is. in general, coarse, approaching in parts to earthy, of a deep brick-red, intermixed with white, and containing often much silex."

This limestone, which is identical in description with that of Mandoo, has a very limited extent in his geological map, where he designates it "coarse granular," and seems to exist in two small strips on the sandstone close to Baugh, and to the same extent on the fine or compact limestone near Sadree. The former is about 32 miles west of Mandoo, and the latter about 30 miles west of Neemuch.

It is at Baugh, then, that the quarries of this limestone appear to exist, and as it seems more connected with the Oolitic Series than any other formation, I place its description here for the present, merely adding that I think it deserving of further examimation, on account of its peculiarities, and the probability of its yielding fossils which might determine its geological age.

Diamond Conglomerate.

Connected with the Oolitic Series would appear to be the conglomerate which contains the diamonds of India, usually called the "Diamond Breccia," but why it should have been termed breccia I am at a loss to conceive. Franklin and Newbold comment on this, and both would call it a conglomerate. Heyne also calls it a "conglomerate."

A breccia is formed by a subterranean succussion or shock, which reduces more or less of the formation over which its influence extends to a fragmentary state, and these fragments are either retained *in situ*, and reconsolidated by a crystalline cement derived from the parent rock, or only carried to short distances, before they are united together by some foreign material. The fragments of a breccia are therefore necessarily *angular*, and this is its characteristic feature.

A conglomerate, on the other hand, is composed of such fragments after they have been rolled for some distance, or of the harder portions of disintegrated rocks which have undergone similar transportation,

and therefore have become more or less *round:* this is the characteristic feature of a conglomerate.

There is, therefore, a wide difference between the history of an angular portion of a rock, and that of a round one or pebble: the former can never have quitted far, the rock to which it originally belonged; the latter may have travelled hundreds of miles. Thus it may fall from its parent rock into the bed of a river, be rolled and rounded in its passage thence to the sea: there it may undergo a further attrition, and be buried in some beach. After a lapse of time, by the changes of level in the land, it may be situated in the middle of a continent, and the stratum in which it was last deposited having been fractured and raised above the common level of the country, it may again fall into another river; and so on, may be transported from place to place for ages, or so long as its integrity exists.

Hence it also follows, that during the migration of the pebble, it may be thrown into company with others from various formations besides its own, all of which may be widely separated, and once or more in its travels it may be imbedded with the angular fragments of a rock which has been shattered close to the place of its last deposit.

This appears to be the nature of the Diamond Conglomerate of India, which contains pebbles of quartz, jasper, lydian stone, epidote, micaceous iron ore, garnets, corundum, &c., varying according to the locality, mixed with semi-rounded and angular fragments of sandstone and shale, imbedded in quartz sand, which has become more or less consolidated; the former being the hardest parts probably of the Older Metamorphic Strata and Plutonic Rocks, which must have been brought from a great distance, or have undergone long attrition in some way or other to have attained their present roundness; and the latter, probably *debris* of the Oolitic Series, which, from their subangular and fragmental forms, indicate a much nearer origin. In the midst of this heterogeneous deposit, to which the term of conglomerate is certainly more applicable than breccia, the diamonds are scattered, and the whole spread over a great part of India in the way which will hereafter be mentioned.

The following table will afford the best sections of the deposits in company with this conglomerate that have been published. They have been compiled from Voysey's description of the diamond mines at Banaganpilly, a village in Southern India, about 12 miles west of Nundiala, and about 30 S by E. of Kurnool; and from Franklin and Jacquemont's descriptions of the diamond mines at Punna, in Bundelkhund, both of which would appear to have been taken very carefully:—

Sections from the Surface to the Diamond Conglomerate inclusively.

BANAGANPILLY (Voysey).	PUNNA (Franklin).	PUNNA (Jacquemont).
Feet.	Feet.	Millim.
	Soil, Red gravel 2	Blocks of neighbouring sandstone. Soil. Red gravel. Blocks of neighbouring sandstone, and portions of red, blue, and green shales, in red argil 0-3
Sandstone, clay state, and slaty limestone.. 50	Shale, argillaceous; calcareous slates and sandstone of red, blue, and green colours, interlaminated 12	Shale, red, green, and blue ..... Shale, green, speckled lilac ..... Shale, red, green, and blue 3-5
		Fine-grained sandstone of a green colour. 0-3
Pebbles.—Puddingstone; quartz; hornstone in argillo-calcareous, siliceous sand. Breccia.—Red and yellow jasper; quartz, calcedony and hornstone of various colours, in quartz sand; diamonds..... 2	Pebbles.—Quartz, white and green; jasper; hornstone; lydian stone; portions of argillaceous schiste in white quartz; sand, sometimes ferruginous; diamonds.	Pebbles.—Red jasper; lydian stone; milk quartz; white angular fragments of green and ferruginous sandstone; hyaline quartz; semi-rounded portions of micaceous shale, red, white, and green, in adamantine green quartz sand; diamonds ..... 0-3 to 1-6
	Compact sandstone..... 400	

From these sections it will be observed, that there is a distinct series of deposits overlying the Punna Sandstone. Franklin states that the rocky matrix of the diamond rests on 400 feet of Sandstone, beneath which there are "strong indications of coal," and that the rocky matrix is superposed by 12 feet of argillaceous shale, calcareous slates with dendritic markings and sandstone. Jacquemont confirms the latter part, with the exception of the "calcareous slates, &c." ; but gives a minute description of the composition of the strata, in which he states that there are *angular pieces of sandstone and shale* among the rounded pebbles of the diamond conglomerate.

In Southern India this little series would appear to be somewhat thicker, for Voysey states, that at one part he saw the "sandstone breccia" (diamond conglomerate) under 50 feet of "sandstone, clay slate, and slaty limestone" ; while Dr. Heyne, according to Franklin, observes, that "the diamond bed is of the same nature with the rocks both above and below it ; but is distinguished from them by its superior hardness, and that the floor is so hard that it strikes fire with steel," a peculiarity which Franklin states equally applies to the Punna mines ; and therefore the latter was of opinion that the diamond bed about Banaganpilly, to which Dr. Heyne referred, rested on sandstone. This, however, is not so evident as desirable.

But Newbold, in his description of the diamond mines of Banaganpilly, gives a section of the diamond conglomerate, (which he states is interstratified with "highly crystalline ferruginous sandstone,") resting on dark blue limestone ; and further states in his "Summary," that "fossil chert from the limestone is often found imbedded in the diamond breccias of Banaganpilly, &c." Also that "the pebbles from the limestone rocks are both rounded and angular," and that the diamond "conglomerate usually rests on limestone," in Southern India.

This is more conclusive with reference to its formation subsequent to the Oolitic Series than Dr. Heyne's observations, for two reasons, 1*st*, because it is more definite, and 2*nd*, because it brings two deposits together of totally different natures, one of which, viz. the limestone, we now know must not only have been denuded, but broken up, before the other could have been formed.

It would appear from the texture of the Punna Sandstone and the Kattra Shales, that for ages previous to the deposit of the diamond conglomerate, the currents of the water in which they were found must have been very light, and the material spread about by them very subtle ; and, therefore, that both must have been suddenly changed when the diamond conglomerate began to be deposited, if not

suspended altogether for a time, as the denudation of the limestone would seem to indicate.

The presence of angular portions of sandstone, and fragments of shales in the diamond conglomerate of Punna, with those of chert from the limestone at Banaganpilly, also supports this view.

All these observations tend to the conclusion that the diamond conglomerate is partly formed from the materials of, and therefore subsequently to the Oolitic Series, yet Voysey has stated that "the matrix of the diamond in Southern India is the sandstone breccia of the "clay slate formation," and his clay slate formation consists of the Punna Sandstone and Kattra Shales. It is possible that he may be right, but at the same time it is evident that the subject requires further investigation.

I should not omit to mention another diamond matrix which has been described by Franklin in Bundlekhund: it lies in crevices of the sandstone, or on the shales, and consists of a conglomerate of jasper, lydian, quartz, and more recent white sandstone pebbles, together with quartz sand, in a soft, plastic, yellow clay. In this are none of the green quartz pebbles, which indicate the presence of the best diamonds; and it is immediately covered by white quartz gravel, and then the red ferruginous gravel of the neighbourhood.

Among the pebbles from the metamorphic rocks in the diamond conglomerate of Southern India, Malcolmson mentions micaceous iron ore and corundum.

Lastly, in confirmation of the view above taken, of the existence of a conglomerate on the Punna Sandstone, and that conglomerate formed of *debris* of the Oolitic Series, would appear to be the following extract from the letter which Dr. Bell, of the Nizam's Service, kindly wrote me regarding the strata passed through in boring at Kotah. He states:—

"I observe in your section that you have omitted an important layer which exists in the Kotah district, namely the most superficial, which is a conglomerate: it is of no great thickness. Beneath this, we have sandstone, forming hills, varying from 50 to 500 feet in height, resting upon argillaceous limestone, 9 feet;" and then follows the list of the shales already mentioned. He afterwards adds:—"I mentioned the conglomerate bed as important, because in one of its water-worn fragments I discovered a crocodilian fossil, consisting of a mass of dermal scales, with a femur, and some fragments of other bones, upon which Professor Owen came to the conclusion that 'the character of the scales, as well as the length and slenderness of the femur, agree more with

those of the *Teleosaurus* and amphicœlian crocodiles, than with the existing gavials.' This is a most significant fact, as it was picked up 520 feet above the level of the Pranheeta river."

Professor Owen's remarks by no means establish an identity between these crocodilian remains and those of the Oolitic period, though they tend to it. Dr. Bell, in a subsequent communication, informed me that they were found in a fragment of the conglomerate itself, and not in a water-worn fragment contained in the conglomerate.

There can, however, hardly be any doubt, that a conglomerate does exist on the sandstone of the Oolitic deposits, made up partly of their *debris*, whatever may be its age; and that as this conglomerate is sometimes found resting on the limestone of the Kattra Shales, a considerable denudation must have occurred before this could have taken place; also that other rocks, which then presented a naked surface, might have this conglomerate resting on them as well as the members of the Oolitic Series.

Since writing the above, I have had an opportunity of reading Dr. Heyne's "Tracts," who, in his excellent description of the diamond mines of Southern India, states that the diamond conglomerate caps the ranges of hills about Cuddapah, the highest of which is "about 1,000 feet above the level of the country"; that this capping is "between 10 and 20 feet thick"; and that "a similar stony cap" exists "in other parts of India, particularly about Chittledroog and Hurryhur," but that at these places "the hill and cap consist of different kinds of rock, whereas here [at Cuddapah] they are similar."

Of the nature of this capping Dr. H. observes :—"All the different places in which the diamond has been hitherto found consist either in alluvial soil, or in rocks of the latest formation, and containing such a great portion of rounded pebbles as to have rather the appearance of a conglomerate than any other species of stone."

In describing the diamond mines of Ovalumpilly, which are about 6 miles from Cuddapah, Dr. H. states :—"The surface soil is sandy, and 1 foot thick, after which comes 3 feet of red clay; and then the diamond conglomerate." "In the Ellore district the diamond stratum is covered by a thick stratum of calcareous trap." The thickness of the conglomerate differs from 2 to 6 feet, perhaps more in some places.

At Ovalumpilly Dr. H. found in the heaps of stones from the diamond conglomerate which had been examined the following :—pellucid quartz, hornstone, a species of felspar; red, brown, bluish and black jasper; epidote, basaltic pebbles and sandstone; "small globular ironstone," fragments of corundum, and in the

northern diamond mines, viz. at Partel, in the district of Masulipatam, pebbles of colcedony, cornelian, and garnets. (With reference to the origin of the pebbles of epidote, it will be remembered, that I have already alluded to the existence of a beautiful felspathic rock from the Rewa Kanta, composed of epidote and red felspar; from the same district, also, comes a trappean rock, the vesicular cavities of which are filled with epidote alone, or in part with zeolite. On the Southern Coast of Arabia, too, I frequently met with both these rocks, but the epidote was combined with calcareous spar instead of zeolite in the amygdaloid. Epidote appears to be by no means uncommon in the red felspathic rocks throughout India.)

VI.

CRETACEOUS SYSTEM.

This system appears to have but a feeble representative in India, and to be entirely confined to the southern extremity of the peninsula, where a tract of limestone, containing fossils peculiar to the Lower Cretaceous and Upper Oolitic beds extends, from a point 9 miles inland of Pondicherry to Trichinopoly, a distance of 100 miles, and perhaps still further. This is sub-divided into smaller tracts by upheaval and denudation, as well as by the courses of rivers. It is stated that the fossils of the Pondicherry beds differ from those of the beds near Trichinopoly.

Newbold gives the following description of the limestone near the former:—

"It is usually of a light brownish or grey colour, texture sub-crystalline, graduating into earthy; tough under the hammer, and interstratified with argillaceous and ferruginous beds; of a loose structure, which often abounds with fossil shells. Some parts of the rock are so speckled with a dark-coloured sand as to resemble a *piperino*, though the nature of the sand, whether volcanic or not, cannot be safely pronounced upon. Other varieties are hard and compact enough to bear as fine a polish as many of our mountain limestones. It has been long used for the steps of doors, and in some of the pavements and old fortifications at Pondicherry; the remains of the old quarries are still to be traced, though choked up by rubbish."

It appears to rest on granite, hypogene, and greenstone rocks, unless these have been thrust into it.

Between the Velaur and the Coleroon river Captain Lawford saw fossiliferous limestone beds, divided by a stratum of fossiliferous marl, about 4 feet thick: the lowest beds contained most fossils. At

Garoodamungalum there is a ridge of blue fossiliferous limestone, which extends north and south for 5 miles each way, and at Valconda a calcareous schiste, also magnesite, the latter in loose nodules and masses, imbedded in the soil; hornblende rock also prevails.

The limestone of Trichinopoly is stated to be less crystalline, looser in texture, and darker in colour, than that of Pondicherry.

Of the collection of fossils from these beds which were presented to the Geological Society by Mr. Kaye and the Rev. W. H. Egerton, Professor Forbes, to whom they were submitted for examination and report, states as follows :—

"In the descriptive catalogue accompanying this report, and referring to remains of invertebrate animals in the valuable collection of fossils from Southern India * * * 168 species of Mollusca are enumerated, 156 of which, as far as can be ascertained, are undescribed forms. There are also a number of species of Radiata.

"The results of their examination may be briefly stated as follows :—

"1*st*.—The three deposits, viz. Pondicherry, Verdachellum [about 35 miles SW. of Pondicherry], and Trichinopoly, described by Mr. Kaye, are *Cretaceous*, inasmuch as there are characteristic known Cretaceous fossils in the collections from all of them, whilst no fossils of any other system occur. The nearest allies of the majority of the new species are Cretaceous; and among the genera and sub-genera are many which, as far as we know, are confined to, or have their chief development in the Cretaceous system. The three deposits are connected with each other zoologically by the associations of certain species common to two of them, with others found in the third.

"2*nd*.—Two of the three deposits, viz. Verdachellum and Trichinopoly, are of a different epoch of the Cretaceous era from the third, Pondicherry. The two former have several species in common (and those species among the most prolific in individuals), which are not found in the third. In them we found almost all the species identical with European forms. In several of the genera of which there are many species, the forms are altogether distinct, although, judging from the evidence afforded by mineral character and association of species, the conditions of depth and sea-bottom at the time of the deposition of the strata seem to have been the same. The difference, therefore, must have depended on a representation of species by species *in time*, and not *in depth*.

"3*rd*.—The beds apparently contemporaneous, viz. Trichinopoly and Verdachellum, may be regarded as equivalent to the upper greensand and gault; the European species they include being either

characteristic upper greensand and gault forms, or else such as occur in those strata. The species they contain are either closely allied to known upper greensand or gault species, or peculiar to the Indian beds.

"*4th.*—The Pondicherry deposit may be regarded as belonging to the lowest part of the Cretaceous system. In it almost all the fossils are new: such as are analogous to known species are allied to fossils of the lower greensand of English geologists, and Neocomien of the French. In the genus most developed in this deposit, viz. ammonites, three-fourths of the species belong to those sub-genera especially characteristic of the "Lower Neocomien" of the Mediterranean basin; whilst of the remaining, as many representatives of Oolitic fossils occur as of upper greensand. The resemblance between the ammonites of this part of the collection and those of Castellane, in the south of France, is very remarkable, though the specific identity of any of them is doubtful. Having seen no account of the conchifera of the Castellane beds, I cannot say how far the analogy is borne out among the bivalve Mollusca, among the Indian species of which there are many very peculiar forms."

Of the collection of fishes' teeth made by Messrs. Kaye and Cunliffe in the neighbourhood of Pondicherry, Sir Philip Egerton states as follows:—

"With the exception of two specimens, the collection is entirely composed of teeth of Squaloid fishes. Of these two exceptions, one belongs to the Ganoid order, and to the family of *Pycnodonts*, and is probably a *Sphærodus*; the other is referred to the Cycloid genus *Enchodus*, the teeth very closely resembling those of *Enchodus halocyon*, a species common to the chalk of England, Continental Europe, and North America. Of the Placoid remains, two species only belong to the section of the Squaloid family, with serrated teeth, and both of them are referable to the genus *Corax*, which Agassiz informs us is restricted to the chalk. One species is not distinguishable from *Corax pristodontus*, of the Maestricht beds. The other is undescribed. The Squaloid teeth, with cutting edges, compose the bulk of the collection. They are referable to at least a dozen species, all corresponding, in the absence of plaits or striæ on the surface of the enamel. Although there are close approximations amongst them to the species both of the Cretaceous and Miocene period, yet it is somewhat remarkable that I have not seen a feature nor a character which recalls in the remotest degree the forms of the Eocene period. They belong principally to the *Odontaspid* type; one species being closely allied to, if not identical with the *Odontaspis raphaiodon* of the chalk of Europe. Two or three species are referable to

the genus *Otodus*, one approaching *Otodus appendiculatus*; also from the chalk. Of the genera found in the Pondicherry beds, the following is the stratigraphical distribution assigned by Agassiz. The genera *Lamna*, *Odontaspis*, and *Oxyrhina*, extend from the recent period to the Greensand inclusive, the Jurassic species being now separated from Lamna under the generic title *Sphenodus*, and from Oxyrhina under that of *Meristodon*. *Otodus* extends from the crag to the Greensand, and *Corax* is restricted to the true chalk. The Ganoid genus *Sphærodus* ranges from the Tertiary beds to the Oolite, and the Cycloid *Enchodus* is restricted to the chalk. The distribution of the species is as follows:—*Lamna*, 5 tertiary, 1 cretaceous; *Odontaspis*, 5 tertiary, 4 cretaceous; *Oxyrhina*, 11 tertiary, 2 cretaceous; *Otodus*, 8 tertiary, 5 cretaceous; and *Corax*, 5 cretaceous. Of the five Placoid genera we have 29 species occurring in the super-cretaceous, and 17 in the cretaceous deposits; but not a single species has yet been found anterior to the latter period. The evidence, then, afforded by the Pondicherry fishes, appears to yield strong corroborative testimony to the accuracy of Mr. Forbes' views, derived from the study of the invertebrate remains of the same locality, and I fully coincide with him in assigning these strata to the Cretaceous period. I am, however, inclined—considering the number of species collected, which must be referred to genera which we know decrease in species as they descend in the stratigraphical scale, from the occurrence also of Maestricht species, and from the presence of the genera *Corax* and *Enchodus*, not yet found so low as the Neocomien,—to place this deposit higher in the systems than Mr. Forbes is inclined to do from his investigation."

Both this and Professor Royle's reports on the fossils of these calcareous beds are only considered by their respective authors provisional. The descriptive catalogue mentioned by Professor Royle was not published, but figures and descriptions of the teeth examined by Sir P. Egerton accompany the observations above transcribed.

The following is a list of fossils which were also collected by Messrs. Kaye and Cunliffe, of the Madras Civil Service, from the same beds, and named by Dr. M'Clelland:—

CLASS ANNELIDES.

Fam. SERPULACEA.
Serpula recta.

CLASS CONCHIFERA.

Fam. ARCACEA.
Cuculla crassatina (?) Desh.
Arca Cunliffei.
—— *crassatina.*

CLASS CONCHIFERA.

Fam. ARCACEA.
Nucula pectinata.

Fam. MALLEACEA.
Inoceramus.

Fam. OSTRACEA.
Ostrea trabeculata.
Gryphæa.

CLASS MOLLUSCA.

Fam. CALYPTRACEA.
Pileopsis plana.—Same, or allied to shell in coal formation at Cherra.
—— *rotunda.*

Fam. COLIMACEA.
Bulimus Indicus.
—— *Pondicerianus.*

Fam. MELANIANA.
Melaniana (?) Imperfect.

Fam. PERISTOMATA.
Paludina. Allied to *Paludina semicarinata.* Brand. Desh. Coq. Fos. pl. XV. Species of this genus existing in India and elsewhere.

Obs.—It is much to be regretted, that the only specimen in the collection is not sufficiently perfect to allow of the species to which it belongs being accurately determined; but the presence of a freshwater shell is important, as tending to show the deposit to have taken place near the mouth of a river, or in a basin alternately subject to salt and fresh water.

Fam. NERITACEA.
Nerita transversaria. (Single specimen, imperfect.)
Natica sulculosa.
Nerita speciosa (?)

Fam. SCALARIANA.
Scalaria annulata.
—— *zonata.*
—— *bicostata.*
—— *tricostata.*
—— *Kayeii.*

Fam. TURBINACEA.
Trochus linearis.

Fam. CANALIFERA.
Murex levis.

Fam. ORTHOCERITA.
Buculites. Compressed, tapering, consisting of short joints; margins unequal, both somewhat flattened.

Fam. NAUTILACEA.
Nautilus. Three distinct species.

Fam. AMMONACEA.
Ammonites.

"Echini, fishes' teeth, and Hamites, corallines of the Turbinalia species, and others of a pyriform shape. There are also shells of the families Myaria, Nymphacea (Astarte), Cardiacea, Mytilacea, Pectinides, Ostracea (resembling Exogyra), Turbinacea (Turritella?), Canalifera (Pyrula?), Alatæ (Rostellariæ?), Purpurifera (Buccinum?), Convolutæ (Voluta?), Ammonacea (Orbulites and Crioceratites). A number of sulcated cylindrical bodies, not exceeding the thickness of a quill, of different lengths, but generally from 2 to 3 inches long, and in all cases broken off, are scattered in the substance of the rock. They resemble somewhat the spines of echinites. There was also a found vertebra of a fossil, which Professor Owen pronounces to resemble that of Mososaurus."

It should be remembered, that although the limestone beds in the southern extremity of India have all been placed in the cretaceous group, yet that Professor Royle found in the collection of fossils from Pondicherry three-fourths of the ammonites expecially characteristic of the Lower Neocomien; while of the remaining, as many representatives of Oolitic fossils occurred as of upper greensand; and hence, that a part of these beds may belong to the Oolitic Series.

VII.

EOCENE FORMATION.

The most southern position in which this formation would appear to exist in India, is in the westernmost spurs of the Rajpeepla hills, which form the left bank of the valley of the Nerbudda, about 50

miles from the sea. It would appear also to exist in Bate island, which is situated at the north-western extremity of Kattyawar; but the presence of more fossils, if not of nummulites, is required, to prove that these are not deposits of the Miocene age. Cutch is the most southern province in India where the existence of nummulites has satisfactorily established that of the Eocene Formation, and here it only exists in a small tract; from which, however, it is probably continued on, under the alluvium of the Indus, to the neighbourhood of Hydrabad, where it again appears to a much larger extent; also extending between Roree and Dajikote, and probably under the alluvium on to Jessulmeer in the Great Desert, if the yellow limestone of this place, which is the same as that chiefly used for tombstones in Lower Scinde, belongs to the Nummulitic Series.

Nothing more is known of this formation at the Rajpeepla hills, or in Bate island, than that we possess several specimens from the former, charged with *Orbitoides Prattii*, which were presented to the museum by Major Fulljames; and specimens from the latter containing nummulitic fossils, which were presented by Lieutenant Taylor, of the Indian Navy. We have also several specimens of limestone from the north-western third of Kattyawar, which seem from their structure to belong to this formation; but this is all that can be stated of them, for they contain no fossils which are recognizable.

The only tract of nummulitic limestone, according to Colonel Grant, which exists in Cutch, is situated in its north-western extremity, near the mouth of the eastern branch of the Indus, where it appears to have dwindled away to a mere remnant, unless it was never very much larger. It extends from Luckput southwards for 30 miles, and its northern, which is its widest part, is 8 miles across. Where small sections of it present themselves, as in the banks of rivers, it consists of solid rock, of a cretaceous appearance, 60 or 70 feet in thickness, filled with *Nummulites*, *Fasciolites*, and *Orbitolites* (*Orbitoides* in the illustrations); in other parts it consists of "nummulitic marl," of the same depth. It is overlaid by loose fossils, and detached portions of its own surface, or by a thin stratum of gravel.

Near the hill called Baboa, the nummulitic marl is cut through by a dyke of "very compact dark green basalt," of which conical masses, capped with the marl, are undergoing spheroidal desquamation and decomposition at the line of contact between the two.

The nummulitic limestone of Scinde, that is to say at Hydrabad, which projects about 60 feet above the level of the alluvial plain, is
2 0 solid, white, and cretaceous above, where it is richly charged with

Fasciolites elliptica, and other nummulitic fossils, and yellow, plastic, and marly below. I failed to discover any nummulites in either portion.

At Sukker, the range of nummulitic hills, which, according to Dr. J. P. Malcolmson, do not exceed 400 feet high, are composed of friable or compact limestone, of a white or cream colour, resting on yellowish white plastic clay; the former richly charged with *Nummulites*, and plentifully interspersed with flints, which also envelope *Nummulites* and *Orbitolites*, that are silicified.

The following section comprises the three last divisions of that deduced by Captain Vicary from an examination of the beds about Kurrachee, and the composition of the Halla range; the other part of the section will be given under the head of "Miocene and Pliocene Formations":—

> "Pale arenaceous limestone, with hypponyces, nummulites, and charoideæ.
>
> "Nummulitic limestone of the Halla range.
>
> "Black slates, thickness unknown."

In his detailed descriptions, Captain Vicary almost always particularizes the existence of nummulites in the first division of this part of his section, whereas he uses the word adjectively for the second part, or nummulitic limestone, as if he had not seen nummulites so often in the latter; which, with my own observations on the coast of Arabia, induces me to think that they have not a very great vertical range, and that the limestone which follows them, although containing abundance of *Orbitolites* and *Alveolina*, contains no *Nummulites;* but I am by no means certain of this.

At Muskat, on the coast of Arabia opposite Scinde, there is a very clear section of this series exposed in many places, in the sea-cliff. It consists superiorly of coarse limestone, of a yellowish white colour, from 60 to 100 feet thick; then arenaceous limestone, containing a great many corals; afterwards this passes into sand, with veins of gypsum; and the sand again into beds of pebbles resting on serpentine rock with pinch-beck diallage, or on diorite. In this series, at Muskat, Newbold found a bed of nummulites, which I had not the good fortune to see during my examination.

A similar section is seen in the island of Masira, resting here, also, on diorite and serpentine rocks; but the pebble-bed seems to be replaced by red and dark-coloured clays, which, from their appearance, indicate a conformable transition of the latter into the former.

The arenaceo-calcareous strata in one part of this island abound in nummulites of a similar kind to those which Newbold found at Muskat.

On the mainland of Arabia, opposite the south-western extremity of Masira, is another section of the kind, but here the deposits are more or less white. The limestone, which is about 150 feet thick, rests on a greenish-white clay.

Does this marl or clay, or sandy deposit which underlies the nummulitiferous limestone respectively at Muskat, Masira, on the mainland of Arabia, in Cutch, and in Scinde, limit the vertical extent of the nummulitic beds?

That there are *Orbitolites* and *Alveolina* in great quantities under this, as before stated, the white compact limestone which underlies it on the coast of Arabia, and which appears to average upwards of 1,500 feet in thickness, furnishes abundant evidence, but I never saw any *Nummulites* in it; yet this appears to be the nummulitic limestone which Captain Vicary terms the "backbone of the Hara range," and which he states in one part "abounds with nummulites, &c." It is very desirable that more definite observations should be obtained of the Nummulitic Series, and in no part of the world, perhaps, could this be more satisfactorily accomplished than in Scinde.

I have been always struck with the whiteness, uniform fineness of structure, and great thickness of this limestone, which forms the chief feature of the South-eastern Coast of Arabia; and the few fossils I found in the coloured strata immediately under it on the coast of Arabia so resemble those of the lower greensand or upper oolite, that I cannot help thinking that this white limestone is the analogue of the chalk in these regions.

The following is a list of the fossils obtained by Colonel Grant from the nummulitic formation in Cutch, which been described by Mr. J. de C. Sowerby:—

"*Cardium intermedium.*—This shell, of which we have only casts, is very near in form to *Cardita intermedia* of Lamarck; the hinge, as we learn from the impression, however, wants the long marginal tooth which marks the genus *Cardita*. Length 1 inch, width the same.

"*Cardium ambiguum.*—The furrows upon the surface of this cast are deeper than they would be in a cast from the European *C. serratum*, which, in the general form of the shell, and number of furrows, it resembles more strongly than it does the *C. lævigatum* of the Indian seas. Length 2 inches 1 line, width 1 inch 10 lines.

"*Area hybrida.*—Transversely oblong, oblique, longitudinally costated; costæ strongly marked with the lines of growth, those on the anterior side furrowed along the middle; area narrow. Length 11 lines, width 14 lines.

"Nearly related to the recent *A. rhombea*, but with a narrower area between the beaks, approaching to *A. Indica* of Linnæus.

"*Pectunculus Pecten.*—Orbicular, convex, ribbed; ribs about 30, radiating, crenated by the lines of growth; hinge-line short. Length 10 lines, width 11 lines.

"Very nearly like *P. pectinatus* of Lamarck, but with more numerous and more distinctly granulated rays.

"*Nucula Baboensis.*—Transversely oval, convex, smooth? lunette sunk; beaks nearest the anterior side. Length ¾ inch, width 1 inch.

"Nearly resembling *N. Bowerbankii*, (Geol. Trans. 2nd series, vol. v. p. 136, pl. 8, f. 11,) but not truncated or pointed below the lunette.

"*Pecten lævi-costatus.*—Short, smooth, radiated; radii about 20, large, equal to the spaces between them; ears large; inside furrowed. Length 1 inch 4 lines.

"Length a little less than the width, but the ears enter so much into the sides that they confine the beaks into a small angle, and make the form appear more transverse than it really is.

"*Ostrea callifera?* (Lam. Hist. Nat. vol. vi. p. 218; Deshayes, Coq. Fossiles des Env. de Paris, vol. i. p. 339, pl. li. f. 1, 2.)—A very ponderous shell, with only a shallow cavity for the animal. Length 3½ inches, width 2¾ inches, thickness of the shell above an inch and a quarter.

"*Ostrea orbicularis.*—Orbicular, plaited; both valves convex; plaits angular, repeatedly forked; surface imbricated. Length and width about 2 inches. Resembling *O. Flabellulum*, but more regularly and finely striated.

"Loc. Luckput.

"*Neritina grandis.*—Short, conical, smooth; spire concealed; aperture very large; base convex, its margin rounded. Diameter 3 inches, height 1½ inch.

"This resembles *N. Schmidelliana*, but has a larger aperture in proportion, and a less excentric apex; it is also higher. The specimen is little more than a cast, and does not exhibit the edge of the inner lip, but still it shows the attachment of the ligament projecting from the lower surface, and that the aperture occupied more than half the base.

"*Globulus obtusus.*—Globose, with a very short spire; whorls about 6; aperture ovate, elongated, pointed above; umbilicus open, narrow. Height 1 inch, diameter the same.

"The short spire of 5 whorls gives this shell a very blunt aspect.

"*Turbinellus bulbiformis.*—Short, fusiform, smooth; spire pointed; whorls 6, flattened in the middle; aperture narrow, pointed at both ends. Height above 7 inches, diameter 5 inches.

"Resembles *T. Napus*, but has a more elongated spire.

"*Cypræa depressa.*—Obovate, with a blunt spire, and a flattened space across the middle of the back. Length 3½ inches, width 2 inches 7 lines.

"This being only a cast, we can give but a very imperfect description.

"*Nummularia acuta.*—Depressed; sides conical, decreasing in proportional height by age; when young radiated, when full grown granulated; volutions and septa numerous; edge sharp. Diameter 5 lines, thickness 1½ line.

"Distinguished from most other species of *Nummularia* by the conical form of the sides.

"*Nummularia obtusa.*—Irregularly orbicular, thick, smooth; sides flattened; margin rounded; volutions and septa very numerous. Diameter of the largest individual 10 lines, thickness nearly 5 lines. A remarkably thick species.

"*Lycophris Ephippium.*—Orbicular, depressed, curved so as to resemble a saddle, with a gentle elevated umbo on each side; margin thick, obtuse, with a narrow waved keel in the middle; grains on the surface small and equal. Diameter 1½ inch, thickness 3 lines.

"*Lycophris dispansus.*—Lenticular, thick, very thin, expanded, sharp-edged margin; grains on the surface largest in the centre of the disk. Diameter ½ inch.

"These two fossils may possibly be different stages of growth of the same species; for there occur along with them many curved plates, which are intermediate in form.

"The grains on the surface are the projecting extremities of internal columns, not merely granulations in the substance of the fossil, as in some species of *Nummularia*. The internal structure is totally different from that of *Nummularia*, as it is only on the inner surfaces of the two plates that any appearance of a spiral or concentric series of cells can be traced. In p. 300 these fossils are assigned to the genus *Orbitolites*.

"*Fasciolites* (Parkinson) *elliptica.*—Elliptical, with blunt extremities, bands curved. Length 5½ lines, diameter 3 lines.

"Several species of this genus occur in the tertiary formations of Europe, but they are longer in proportion to their thickness.

"*Echinus dubius.*—Orbicular, depressed; areæ granulated, concave, and nearly free from grains along the middle; the larger furnished with two rows of tubercles near each side; the lesser with one row on each side; pores of the ambulacra in numerous arched rows. Diameter about 3 inches, height about 1½ inch.

"This has apparently imperfect tubercles, and is much longer than *Cidarites variolaris* (Brongniart), which, however, it much resembles.

"*Galerites pulvinatus.*—Orbicular, depressed, spheroidal, covered, with minute tubercles. Ambulacra, obscure beneath, crossed by grooves above. Diameter 3½ inches, height 1 inch 10 lines.

"A species much like *G. depressus* (Lamarck), but more convex, and ten times the size of it.

"*Clypeaster affinis?* (Goldfuss, p. 134, t. 43, f. 6.)—Our specimen appears to be more orbicular than the *C. affinis* of Goldfuss, but it is too imperfect to be determined, the posterior half being nearly all broken away. Length about 2½ inches, width 2 inches, height 1 inch.

"*Clypeaster varians.*—More or less obovate, hemispherical; base slightly concave in the middle; ambulacra elongated; anus transverse. Length 2½ to 3 inches, breadth 2 to 2½ inches, height 1¾ to 2 inches.

"*C. Bonei* of Munster (Goldfuss, 131, t. 41, f. 7,) resembles this, but is more depressed, and has a circular anus.

"*Spatangus obliquatus.*—Gibbose; emarginate at the front; behind obovate, rather accuminated, and truncated obliquely upwards. Ambulacra deeply sunk in 3 large and 2 smaller ovate pits; base slightly convex. Length 2½ inches, width 2 inches, height 1½ inch.

"Strongly resembling *S. Bucklandii* (Goldfuss, 154, t. 47, f. 4). It is, however, much larger, and has unequal ambulacra. In this and the allied species,

with concave ambulacra, there is a reticulated band surrounding the ambulacra, which deserves attention.

" 23 *a. Spatangus accuminatus*? (Goldfuss, 158, t. 49, f. 2.)—Our specimen is not quite so much elevated posteriorly as the figure given by Goldfuss, neither is it quite so wide; in both these circumstances it approaches to *S. lacunosus*; but it is laterally crushed, which may account for the difference. Length 1¼ inch, width nearly the same, height 10 lines.

" *Spatangus elongatus.*—Elongated, ovate, depressed; front emarginate; base convex: ambulacra concave, with two of the rows of pores nearly central; apex excentric; mouth remote from the margin. Length nearly 2½ inches, width 1¾ inch, height 1 inch.

" The two posterior ambulacra and the posterior portion of the shell are broken; the description is therefore incomplete."

Localities.—All these fossils were found at " Baboa hill" or " Wagé-ké-pudda."

So far, my observation of the fossils which have come from the nummulitic formation in Scinde, leads me to the opinion that they chiefly differ in specific characters, from those of the Paris Basin which have been figured by Deshayes, and that very few new genera will be found among them. Some of the limestone at Hydrabad is remarkably like the " Calcaire grossier."

Although the fossils are abundant almost beyond conception, yet they are mostly useless for description, on account of being the internal casts, and not the petrified remains of the shells they represent.

There appear to be only two species of *Nautilus*: at least out of 180 specimens collected from all parts, I have only met with that number, viz. 150 of one and 30 of the other. The largest is the scarcest.

As they do not appear to have met with descriptions, the following may prove acceptable:—

Nautilus major.—(H. J. C.) (Cast.)—Sub-orbicular, discoidal, compressed; margin angular; widely umbilicated; sutures undulous, doubly sigmoid; siphon ventral. *Size.*—Longest diameter of largest specimens 12 inches; largest transverse diameter upwards of 6½ inches.

Obs.—This species, from its angular margin, resembles, in form, the sub-genus *Goniatites* among the *Ammonites*. In the position of its siphon, it agrees with *Nautilus zigzag*, but its sutures are simple, like those of *N. Danicus*. I have never seen a specimen of *N. zigzag* from Scinde, though we have one in the museum which Professor Orlebar brought from the Eocene of Egypt. *N. major* must, I think, be the largest nautilus on record.

N. minor.—(H. J. C.) (Cast.)—Sub-globular; margin round; umbilicated; sutures sub-sigmoid; siphon ventral. *Size.*—Longest diameter 3 inches; largest transverse diameter upwards of 2¼ inches.

Obs.—This species agrees with *N. hexagonus* in the position of the siphon and form of the suture; but it differs from it in not having a sulcated keel or margin.

Descriptions of most of the largest forms of fossilized Foraminifera in Scinde will be found in the last number of this Journal.

As yet we know nothing definite of the nummulitic formation of this country, although its features are so striking, that the most disinclined for observation or the study of natural objects come away from Scinde astonished at the geological sections of its rocks, and the vast quantity of organic remains which are distributed over them.

VIII.

VOLCANIC ROCKS.

Trappean System, 1st Series.. { *Trappite.* *Basalt.* *Amygdaloid.* *Laterite.*

Subsequent to the deposit of the Punna Sandstone, or the last bed of the Oolitic Series, in the interior of India, a succession of trappean effusions took place.

These were more profuse in some than in other parts, and, generally, more extensive, as the existing tracts and weathered blocks which are scattered over many plains respectively testify. The trappean dykes, too, which exist throughout the greater part of India, from the summit of the highest mountains (Neilgherries) to the level of the sea, and the crystalline metamorphosed state of the upper part of the Punna Sandstone in many places,—apparently from heat applied to the surface,—all tend to the inference that the trappean effusions extended over a much greater part of India formerly than at the present day.

The largest tract remaining is that on the western side of India, but sufficient time has elapsed since the last of *its* effusions were poured forth to weather down its cones, efface its craters, dissipate its scoriæ, break up its plains, and transform its surface to such an extent, that from an arid, black, undulating volcanic waste, it has now become a tract of mountains, hills, and valleys, covered with verdure and cultivation; and, with the exception of the crater of Loonar, without a known trace of any vents, to point out the localities from which the volcanic matter of which it is composed was ejected.

This tract, called by Malcolmson the "Great Basaltic District of India," extends continuously from the western side of the basin of the Malpurba, in the Southern Mahratta Country (P.MS. Aytoun), to Neemuch, on the extreme morthern limit of Malwa (Dangerfield); and transversely from Balsar, on the coast about 20 miles south of the Taptee (Lush), to Nagpore in Central India (Malcolmson). These

are its extremes north and south, and east and west; the former a distance of about 535, and the latter one of 350 miles. Between Balsar on the west and Nagpore on the east, it contracts northward to a width of only 80 or 90 miles, where the Nerbudda crosses it between Chiculdah and Burway (to mention the large towns close to its limits). After this it again expands out to form the tract of Malwa, which extends eastwards to Tendukaira, about 70 miles west of Jubbulpore, and westwards to Tandla (Dangerfield). From Nagpore south-westward to Beejapore it is bounded, as in Malwa, by an irregular and more or less abrupt border; and its coast-limits are Balsar in the north and Malwa in the south.

There is another portion, which extends eastward from Jubbulpore to Amerkuntak, the source of the Nerbudda (Spilsbury), and south-west towards Nagpore (Franklin); but I am ignorant if this joins the main tract.

As there is necessarily a great sameness in the trappean effusions throughout India, wherever they exist to any extent, we shall take our typical characters from the great district just described; and even here, a part would seem to suffice for the whole, for the remarks of Dangerfield on it in Malwa, of Coulthard in the adjoining district of Saugor, and of Sykes, Malcolmson, and Newbold in the Deccan, are but repetitions of each other.

Its two grand geological features along the anticlinal axis of the Western Ghauts, where it has attained the highest elevation, are flat summits and stratification. The latter arises from the alternation of compact and amygdaloid layers, which, on weathering, give to its lateral outlines that irregular step-like form, from which the trappean effusions have derived their name. Captain Dangerfield numbers "14 beds" in Malwa, the lowest and largest of which is 300 feet in thickness. These are equally numerous, if not more so, along the Western Ghauts, where the scarps are of much greater magnitude: that of the pass of Ahopeh is, according to Colonel Sykes, "fully 1,500 feet high, and that of Hurrichunderghur, about 20 miles north of it, scarcely less than double that height." The mountain of Mahableshwur is from 4,500 to 4,700 feet above the level of the sea. From these summits the trappean district slopes off suddenly on each side, but more abruptly towards the west, where it reaches the level of the sea within 40 or 50 miles of the anticlinal axis.

Besides its stratification, it presents in many places, on closer inspection, a columnar structure, which is chiefly confined to its compact beds, and which seems to have been more frequently noticed on the

summits of mountains, and in the beds of valleys and watercourses, than in any other part. Thus Colonel Sykes mentions a surface of pentagonal divisions in the hill-fort of Singhur, which is 4,162 feet above the level of the sea; also in the hill-fort of Hurrichunderghur, just mentioned; while Captain Dangerfield mentions them in the bed of the Chumbul and Nerbudda rivers. They are common on the surface of the overlying trap of Bombay, but with the lower part so continuous and so stratified, that, like that described by Newbold in the bed of the Hurri, near Beejapore, its divisions into "rectangular and rhomboidal prisms are similar to those of clay slate." Voysey has noticed its columnar form in the upper part of the hill of Sitabaldi, which is close to Nagpore, and Malcolmson on the elevated lands and crests of the Sichel Hills. Many other places might be mentioned where this structure occurs in like situations, but very few where it has been seen in the body of the mountains.

Wherever the trappean effusions exist to any extent, they appear to be composed of the rocks mentioned at the beginning of this group, viz. *Laterite* above, then *Basalt*, and afterwards *Trappite* and *Amygdaloid*, with here and there volcanic breccia. Where the trappean rocks are genuine, that is where they are neither mixed with foreign matter nor decomposed, they are chiefly compounded of hornblende and felspar, but differ from the diorites or greenstones, as before mentioned, in the former being finer in structure, less crystalline, and generally containing a portion of greenish, bluish, or reddish earth, according to the colour of the rock, in addition to their crystals of hornblende and felspar. The latter is never the case with diorite, and is, therefore, perhaps, the best distinguishing feature, but it can only be detected by a powerful lens. The diorites appear to have gained their coarseness of structure and more crystalline nature chiefly from the length of time they have been exposed to the percolation of water, while they have been totally excluded from the atmosphere. There are, however, fine black, red, and green, coarse crystalline hornblendes, here and there, among the trappean rocks, which in hand-specimens, would almost defy the best judges to say whether they are not diorities or amphibolites, but they are only of casual occurrence.

Before proceeding to particular descriptions of these rocks, it would be as well to devote a few moments to the consideration of the facts which bear upon the relative ages and positions of the trappean effusions. It should be remembered that there is this great difference between the supperposition of aqueous and igneous formations, viz. that the former must have been increased in thickness by successive

additions to their surface, and that the latter may be increased in thickness by additions also below their surface; the material in the one case coming from above, and the material in the other from below. Hence circumstances may so favour a horizontal extension, and oppose a vertical ascent of the latter, that it will be found in some places intercalating the interior of volcanic mountains which have been formed long anterior to its ejection. At the same time, this intercalation must have taken place before the whole tract was broken up, or the circumstances favouring it would not have been present. It is not our object here to enter into the theory of the elevation of the Western Ghauts, or of any other parts of the trappean district, but to try to acquire some idea, if possible, in the present state of our knowledge, of the relative ages of the effusions of which it is composed. One fact seems evident, viz. that there is an overlying basalt, which, generally capped with laterite, rests on the summits of the highest mountains, and on the tops of the lowest hills; and that the former are separated from each other by such wide and such deep valleys, that they never could have been capped with the same material, had they not all been united into one mass when the basalt and laterite were poured forth. The trappean effusions, then, had probably attained their greatest thickness along the anticlinal axis of elevation, that is along a line a little to seaward of the Western Ghauts, before this took place, for here the mountains being highest, and most separated, exhibit a thickness of trappean rocks far greater than in any other part; which tends to these inferences, viz. that in this direction there was a line of vents; that the greatest and latest effusions from them preceding the elevation of the Ghauts, made the trappean rocks thicker here than in other part; and that along this line of vents the subterranean force which elevated the Western Ghauts was most likely to be exerted. But it does not follow that the overlying basalt was the last effusion, for the intercalation of subsequent ones may have added, as I have before stated, considerably to the thickness of the general mass, before the grand disturbance occurred which threw the whole up into mountains; while there is evidence, as we shall see hereafter, of many minor effusions having occurred since this epoch.

With these few prefatory remarks, let us proceed to the description of the trappean rocks separately.

Trappite.

This rock is semi-crystalline, and consists of felspar and hornblende in nearly equal proportions, with a little argillaceous matter. Its

structure is massive, and its texture visible only under a high magnifying glass, when the ingredients of which it is composed also become recognizable. It is tough towards the surface, and softer below, where it breaks with a granular earthy fracture, sometimes conchoidal. It is of a black, red, bluish, or greenish-blue colour; is easily scratched with a knife; disintegrates in polyhedral masses, undergoing concentric-lamellar decomposition, and finally passing into a greyish or greenish brown earthy mass, which has been called wacken.

The reader will do well to remember, that wherever "wacke" or "wacken" is here mentioned, it means decomposing or decomposed trappean rocks. The name "Trappite" is taken from Brongniart's classification, to which I have already alluded, but it contains no mica.

Basalt.

There are two kinds of this rock which deserve particular mention: one is for the most part of a dark blue-black, and the other of a brown-black colour. Both are semi-crystalline, like the last rock, and composed of felspar and hornblende, or augite, with probably a little amorphous, argillaceous matter. Their structure is massive, stratified, columnar, or prismatoidal; and they are tough, and tesselated towards the surface, but frangible below. They disintegrate in polyhedral masses, which undergo infinite divisions, and, desquamating in concentric laminæ, assume the form of a bed of rounded nodules of various sizes, and of a greenish-brown colour, becoming smaller and more numerous as they pass into an earthy wacken, in which all traces of the hard rock disappear.

a. Dark blue-black basalt of the island of Bombay. This is so compact that its ingredients cannot be distinguished, even with a lens. Its structure is remarkably stratified, almost like clay slate; it breaks with a sub-granular, conchoidal fracture; is avesicular, but contains here and there a small mass of pale crystalline olivine.

b. The brown-black basalt of the Deccan. This is sub-granular, and the ingredients of which it is composed more or less visible; it is tough, and breaks with a sub-granular fracture; is avesicular, but presents many scattered masses of olivine; it is of the same kind as the basalt of the "Pouce," in the Mauritius. Sometimes the olivine seems to pass into glassy felspar, and then to form a great part of the rock.

That the first kind belongs to the overlying basalt, there can be no doubt; and from Voysey's having likened the overlying basalt of the Gwailgurh hills to that of the "*Pouce*" mountain, in the Mauritius, there can be little doubt, also, that the second form is also to be found

in the overlying basalt. At the same time, it would be very desirable, as will hereafter appear, to ascertain if the different forms of the overlying basalt possess any peculiarities which distinguish them as a group from the other trappean effusions.

Both the *Trappite* and *Basalt* are tesselated on the surface by cracks and veins, which would seem always to be present throughout their structure, though not always visible; those of the basalt tend most to a prismatoid arrangement. Both, too, even in their massive forms, present accessory minerals here and there: in the basalt these consist chiefly of small masses of olivine, and in the trappite chiefly of zeolites. The position and depth of the basalt appears to be overlying and thin, and that of the trappite for the most part inferior and thick; the structure of the former more or less prismatoidal, that of the latter more or less irregular. Occasionally the texture of these rocks is a little finer or a little coarser, a little more crystalline or a little more earthy.

Amygdaloid.

This is only a variety of one or the other of the foregoing rocks, but it is convenient to give it a specific name. With more or less of their characters, though never strongly marked, it is also more or less cavernous or vesicular, and the minerals which fill or line its cavities very various, while some appear to be peculiar to a trappitic, others to a basaltic base. Green earth, zeolites, calcspar, and calcedony or quartz appear to prevail in the former, and olivine, glassy felspar, and magnesia-mica in the latter. To each of these minerals we shall now turn our attention separately, as, upon the prevalence of one or the other depends greatly the character of the amygdaloid; and those found in a trappitic or earthy base being most numerous, we will take them first.

Minerals of the Trappean Rocks.

Green-Earth.—There is no mineral in the amygdaloids which is more general or more striking at first sight than this, from its bright blue green colour, and its frequent occurrence. It prevails chiefly in the red amygdaloids, lining their cavities, or mixed with the minerals which they contain, but never entering into a part of the composition of the latter. Nicol places it among the clays. It appears to be amorphous, is greasy to the touch, sectile, and presents a shining streak when scratched with a smooth pointed instrument. Its colour is apt to mislead those unacquainted with its elementary composition, into thinking it contains copper, but iron and manganese are the only metals which have been found in it.

Zeolites.—Next in prevalence are the following minerals of the zeolitic family, which is, perhaps, as well, if not better represented in India than in any other part of the world :—

Scolezite, is probably the largest and most plentiful of these, occurring in compact or crystalline, columnar, radiating masses, white, or of a pinkish tinge, opaque or translucent, and in small crystals transparent ; in some specimens the radii are from two to three inches in length. *Natrolite* or *Mesotype*, in mammillary masses of fine prismatic or acicular crystals, sometimes asbestiform ; it occurs at Akulpore, in the Southern Mahratta Country, in radiating columnar masses, extending six or seven inches from the centre (Sykes). *Apophylite*, in thick rectangular prisms, with truncated or pointed summits, is very common ; opaque or translucent ; when the summit is perfect the latter is generally transparent ; cleavage across the prism (macrodiagonal), leaving a pearly surface ; it also occurs foliated and massive. *Stilbite*, in compressed rectangular prisms, terminated by four narrow facets, is also very common, occurring in radiated, fan, sheaf-shaped or scopiform aggregates on free surfaces ; semi-transparent, like crystallized spermaceti ; also occurring in radiated masses of a white or pinkish colour, like scolezité, but with a laminar-columnar arrangement ; cleavage longitudinal, parallel with the compressed planes, leaving a pearly surface ; perfect crystals rare with the aggregates ; occurs frequently on apophylite in geodes. *Heulandite*, in compressed lozenge-shaped crystals, aggregated, and standing on their edges, with the upper angle replaced more or less by a facet on each side, and the free terminal one generally truncated. *Chabasite*, in very obtuse rhombohedrons, scarcely differing from a cube ; glassy, pearly, greyish, yellowish, reddish. *Phrenite*, of a sea-green colour, is not uncommon, crystallized on zeolites in rounded aggregates.

From the pearly cleavage of most of these minerals, it is difficult to say which is which in their amorphous masses, or when they fill the vesicular cavities of the amygdaloid.

Laumonite, appears to be the commonest zeolite in the neighbourhood of Bombay, occurring in oblique rhombic prisms, of which the inclination of the terminal plane is from one acute angle to the other, one of those angles being replaced by a facet. It is translucent when first exposed, but becomes opaque, white, and brittle in a short time afterwards ; this renders it easy of recognition.

Quartz.—Almost all the varieties of this family occur in the trappean rocks, but chiefly in large crystals in geodes, colourless or amethystine ; also in small crystals forming stalactitic, finger-like

prolongations, and capping large pyramidal crystals of calcspar in geodes. Calcedonies, agates and onyx which also abound, belong to this family.

Calcspar.—This occurs in rhomboidal masses, and in pyramidal crystals projecting into the interior of geodes. The latter seems to have been a very early crystallization, which has not only been succeeded by the capping of quartz just mentioned, but this capping itself is in most instances more or less hollow, from the re-absorption of the calcspar. The pyramidal form of calcspar had a great development at one time, for its crystals, now only represented by the quartz, far exceed in size those of any other trappean mineral. The rhombohedral masses are of three kinds, viz. colourless, hair-brown and green; the latter is found in portions of 2 feet in diameter, in amygdaloid forming the bed of a river near Gorgaum, north of Akulkote, in the Southern Mahratta Country (Newbold); also in the Buktapore hills near Kowlas, about 30 miles NNE. of Beedur (Voysey); and Grant mentions "thin beds or layers" of leek-green calcspar in an amygdaloid in Cutch. Besides these, various other forms of calcspar occur, but the ones mentioned are the most prevalent. Perfect crystals of both pyramidal and rhombohedral calcspar resting on zeolitic minerals are not uncommon in geodetic cavities.

Olivine.—This mineral, as I have before stated, is almost peculiar to the basalt, and is but sparingly scattered in the overlying portion. It, however, frequently forms part of an amygdaloid, with a black compact base, and, when mixed with *Rubellan*, seems to depart from its original faint colour to become of a greenish yellow, pistachio-green, brass or bronze yellow, brown, pitch black, or brown-red tint.

Glassy Felspar.—A porphyritic amygdaloid with a similar base to the foregoing, and thickly charged with tabular crystals of this mineral, is very common, the crystals having a vitreous lustre, and a faint yellow colour; but, when they occur in a reddish base, they have a whitish colour and pearly lustre.

The black porphyritic form exists in a thick stratum on the summits of Hurrichunderghur and Poorundhur, which are 4,000 feet above the level of the sea; also in the bed of the river Goreh, which is elevated 1,000 feet above it, near Seroor (Sykes). Dangerfield also states that at Cherole and Kuchrode, in Malwa, there "are some large overlying masses of trap porphyry," which is probably the same as the one described; and in the Society's museum are specimens from Khandeish (Aytoun), the neighbourhood of Poona (Malcolmson), and Belgaum (Aytoun). Olivine occasionally appears to pass into glassy felspar,

and then the latter, as I have before stated, increasing in quantity, to form, in an amorphous crystalline state, a large portion of the elementary composition of the basaltic rock.

Magnesia Mica.—Accompanying the glassy felspar are small laminated masses of a substance like mica, which are either separate, or in the midst of the tabular crystals of felspar. Its chief characters are its scaly, foliated, laminar form, rich brown-red colour, shining lustre, and softness, being easily scratched with a knife; but in its fracture it is less flexible than mica, if, indeed, it have any flexibility at all.

Besides this form, it appears to occur in a massive crystalline, transparent or opaque state, partially or wholly filling small vesicular cavities, and presenting a bloom on its free surface. When translucent, it is of a hyacynth-red, peach-blossom, or red-brown colour, and when opaque of a blood-red, dark brown-red, dark olive, or pitch-black colour like obsidian, to which it seems nearly allied. In the latter state it may also form a continuous scaly layer on the free surface of the basaltic rock.

It frequently coats the surface of the tabular crystals of felspar and olivine, and on the other hand lines vesicular cavities, like green-earth, to which in these instances it also appears to be closely allied.

When the tabular aggregates of this mineral loose their lustre, they assume the form of *Rubellan*; when it has a strong metallic lustre, it looks like *Rutile*. In another form, which I have not mentioned, it has a waxy appearance, and greenish yellow colour, like serpentine. Its colouring matter appears to be chiefly iron, which in the metallic varieties is easily detected by the blow-pipe and magnet. Sometimes this magnesia mica or *Rubellan* seems, in minute crystallization, to form the greater part of the base of the red amygdaloids, and on decomposing assumes the form and appearance of red clay. If the *Rubellan* of Breithaupt be magnesia mica, as Nicol seems to think, then this mineral is magnesia mica; but it requires further examination.

Besides the substances above mentioned, there is a fine red clay, of a compact, massive, or columnar structure, which is found in subordinate masses in the amygdaloids, sometimes pure, at others containing zeolites.

In this hasty outline of the minerals contained in the amygdaloid rocks, I am of course only describing the general characters of the amygdaloids themselves, and, therefore, must leave the reader to search for further details respecting these minerals in works especially devoted to the purpose; at the same time observing, that a separate description of them and their pseudomorphs, which have not yet been mentioned,

would form a most interesting and valuable contribution to the mineralogy and geology of India.

Of these pseudomorphs I need only notice here the passage of the radiated forms of zeolites into steatitic clay or steatite, and of glassy felspar by transition, into the latter; also the replacement of calcspar by crystalline quartz.

Basaltic Dykes.

These are of course numerous in the trappean tracts, as well as elsewhere, and their structure prismatic and compact where they are not decomposed, the columns being perpendicular to the surface planes. Colonel Sykes mentions one which cuts through the basalt and amygdaloid in the top of a mountain within the hill-fort of Hurrichunderghur, which, as before stated, is 4,000 feet above the level of the sea. He also mentions dykes in the hills about Poona and the Bhore Ghaut. All these must of course have existed before the trappean plains were broken up. Mention is frequently made of basaltic mountains, which are completely isolated from the main tract by a vertical fissure or ravine with perpendicular sides, of only a few feet in breadth, and of a great depth. These may have been formed by dykes of more perishable matter, which have become decomposed, and carried away by the rains.

Laterite.

This rock *par excellence*, that is where it caps the trappean mountains, is essentially composed of red iron clay, the iron of which, by means of segregation, has formed itself into cells and irregular tubes, chiefly at the expense of the clay which is contained in their interior; hence the lightness in the colour, diminished quantity, and soft and greasy nature of the latter, whilst that on the exterior of the tubes remains red, and retains its original harshness to the touch. This causes the white and red colour in the rock, and is a process which appears to be continually in operation. The inner surface of the tubes is smooth, and frequently mammilated, and the exterior, of course, rough; while their walls are composed of brown hematite, presenting more or less of a metallic lustre. A steel-grey oxide of manganese (Pyrolusite) not unfrequently takes the place of the oxide of iron, or, mixing with it, forms the greater part of the mass, and the purple violet tint which this rock sometimes assumes, Newbold thought might be owing to the presence of the former. The contorted, irregular tubes, which are frequently so numerous and near together as to give the mass a cancellated structure throughout, are generally about half an inch in diameter, but

vary every moment, in contracting and expanding to much beyond or within this size. They also frequently inosculate with each other, but seem, on the whole, to have a vertical direction, if we may take our type from the laterite at Beedur (Voysey). At this place, also, Newbold traced one downwards for 30 feet, which, after all, opened on the side of the rock. Sometimes the whole mass passes into pisiform iron ore without the tubes (Mm. Bradley). When exposed to the air, its surface becomes black, and presents the black or irridescent metallic lustre common to some forms of brown hematite.

Laterite of this composition and structure caps the highest trappean mountains, which terminate in level summits. At Mahableshwur it appears to be at least 100 feet thick, and at Beedur, on the opposite or eastern confines of the great trappean district, is in one part 200 feet deep (Newbold), where it rests on wacken passing downwards into basalt (Voysey). Wherever it appears on the trappean rock, whether in Malwa, at Ammerkuntak, on the Rajmahal hills, or in the Southern Mahratta Country, it presents the characters above given, and always rests on what has been termed "overlying trap." It by no means, however, exists continuously throughout the great trappean district, but chiefly on the summits of the highest mountains, where its scarped sides (like those of the overlying basalt beneath it) and horizontal summits characterize its presence from a long distance.

Various opinions have existed respecting the origin and geological age of the "laterite," but I shall only mention here those which appear to me most rational, and most in accordance with my own observations. Voysey and Christie classed it with the overlying trap, and Voysey made the following note upon it, dated 26th September 1819, viz. :—"I commenced on the hill of Beedur, and this morning rode to the north-westward. I everywhere saw basalt at the foot of the hill, passing into wacke and iron clay; in one place the transition did not occupy more than 3 feet, and was distinct."

Few who know the penetrating sagacity, ability, and truthfulness which characterize this author's observations, would be inclined to doubt the fact which this note reveals, viz. that the *basalt* passes into the laterite, whether by transition through the wacke is not clearly stated; but as the hill of Beedur is capped with laterite, the wacke to which he alludes must be between it and the basalt. "Iron clay" was Voysey's name for laterite; and when we reflect on the intense blackness of the overlying basalt, especially that of Bombay, compared with that of any of the other trappean effusions, and remember that in its course to the surface it must have passed through

or between the great beds of siderocriste (specular iron ore), of the gneiss, and other metamorphic strata abounding in oxidulated iron ore and manganese; and that circumstances which were not present when the former trappean effusions were passing through them might have caused the overlying basalt to have brought away a much larger portion of these minerals than any other effusion which preceded it, we shall not be altogether at a loss to account for the quantity of iron ore and manganese in the overlying basalt, and its tendency in particular to pass into laterite, where these minerals have become aggregated and exposed.

As it is the overlying basalt which passes into the laterite, the latter must be of the same geological age as the former; and as we have come to the conclusion that the great trappean mountains of the Western Ghauts were not elevated until this was ejected, the laterite must belong to some of the latest of the trappean effusions.

From what has been stated of this formation, it must also follow, that it may rest on other rocks which are older than itself, besides those of the trappean system, which is the case. Again, the percolation of water through a rock so highly impregnated with iron as the laterite, might induce a similar change in the one immediately below it, which also appears to be the case, while the *debris* of the former, descending to the valleys, or accumulating on the sea coast, may form secondary laterites. Hence it becomes necessary to find out some specific character for the laterite overlying the trappean effusions; and this seems to be the absence of all grit, gravel, and the fragments of foreign rocks. This, however, will not be sufficient when the basalt giving rise to the laterite may have formed a breccia with the rock through which it has passed, as in the granite hills of Ganjam in Cuttack (Sterling) ; but its local connections will then serve to explain the anomaly.

There are yet other instances in which laterite may be found, to which I will now briefly allude.

On the plateau of the Neilgherries, which is not without its dykes of trappean rock, viz. basalt, Benza states that there is 40 feet of lithomargic clay of a yellow-red colour, streaked with red and yellow beneath, formed from the decomposing surface of the syenitic and hornblendic rocks on which it rests; the felspar and hornblende going first, and then the quartz, in a friable condition; while lateritic conglomerates, too, of *rounded* pebbles, exist on each side of the Moyar river.

Again, in sinking a shaft in the vicinity of Bangalore, which is 3,000 feet above the level of the sea, Lieutenant Baird Smith, at 2 feet below the surface, came to variegated lithomargic earth, which at 15 feet

began to get slightly more tenaceous, and present felspar in the form of a white earth. This lasted till the shaft reached 20 feet, when the decomposed rock began to assume its real form, and at 22 feet proved to be a pegmatite.

On the opposite side of the raised land of the south of the peninsula, at the Bisley pass, it is stated by Newbold that sectile laterite overlies gneiss, which is veined with granite; and the Rev. Mr. Everest has stated that at Bancureh, on the road from Calcutta to Benares, granite is seen to be decomposing "into sand and grit, in which are imbedded masses of a quartzose reddish-brown slaggy-looking ironstone," the hollows of which are numerous, irregular, and mammillated inside, and which he considers to have arisen from the decomposition of the granitic rocks, which in two or three places present veins of it cutting through them.

So that there are various kinds of lateritic rocks and beds, but they must not be confounded with the laterite which caps the trappean mountains, or forms the upper part of the overlying basalt in other places.

IX.

Intertrappean Lacustrine Formation. (H. J. C.)

This name is derived from its position in the trappean effusions, where it has been chiefly noticed. No doubt it exists or has existed on other rocks, but it is only in one instance that this has been satisfactorily demonstrated.

It has now been found almost throughout India in connection with the trappean rocks, that is, a lacustrine formation exists under the columnar basalt of Cutch, of Malwa, on the Rajmahal hills, remnants on the isolated hills of Medcondah in the Hydrabad country, in the neighbourhood of Nagpore, in the Gwailghur hills, the Sichel hills, and in the island of Bombay.

Its position appears to be under the overlying basalt, and resting on amygdaloid, which, being a subsequent effusion, has separated it from the rock on which it was originally deposited.

It consists of argillaceous and argillo-calcareous shale, more or less indurated, chertified, or rendered jaspideous by heat, and from an inch to 40 feet in thickness; and in some places of limestone. Vegetable and animal remains abound in it, as will be described hereafter.

Voysey appears to have been the first who noticed this formation. He found, in 1819, fossil shells belonging to it 2,000 feet above the level of the sea, on the summit of the hills of Medcondah mentioned, which consists of trappean rocks resting on granite, about 150 miles due east

of Beedur, and therefore the same distance from the eastern border of the great trappean district. He afterwards saw it in the Gwailghur hills, *in situ*, and gave a descriptive section of it, from which the following from above downwards has been compiled:—

Nodular basalt, or wacken	10	feet.
Earthy clay, stratified, of different degrees of induration, containing flattened shells of the genus conus or voluta	2	,,
Wacken, or indurated clay (almost always amygdaloidal)	15	,,

Coulthard and Dr. Spry afterwards gave the following sections, respectively, of the trappean effusions at Saugor in Central India, which also appear to include this formation. The former of a "swell of trap," the latter of a "well":—

Section of the "Swell of Trap." (Coulthard.)

"Rubbish and soil	1	6	feet.
"Indurated wacken, in angular pieces of uniform arrangement.	10	6	,,
"Wacken changed into a species of puzzalama	1	0	,,
"A thin black streak, (rather remarkable,) a vegetable deposit	0	3½	,,
"A white hard earthy limestone, sometimes effervescing weakly with acid, sometimes not at all, with small yellow specks of calcareous spar.	23	0	,,
"Wacken, with fibrous carbonate of lime, and ditto in veins with calcedony	7	0	,,
"An amygdaloid wacken, similar to the toadstone of England.	6	0	,,
	49	3½	feet."

In allusion to the "Travertin" mentioned in this section, Coulthard states:—"but to the trap, not to the sandstone, belongs a hard, white, earthy limestone, harsh and gritty to the feel on the fracture, and in which, rather sparingly, are imbedded small round particles of calcareous spar, of a yellow colour. It belongs to the trap, and is, moreover, ever attendant upon it, throughout the range."

Section of the "Well." (Spry.)

"Surface soil	3	feet.
"Soft basalt	2½	,,
"Hard basalt	7	,,
"Soft basalt	1½	,,
"Wacken, with nodules of limestone	3	,,
"Travertin, with imbedded shells	1½	,,
"Coarse siliceous grit	2	,,
"Hard basalt		

The Society's museum now abounds in beautiful specimens of shells and other organic remains from this formation at Saugor, which have

been presented by Dr. Spilsbury and Captain W. T. Nicolls. The latter (P. MS.) confirms Dr. Spry's observations, with a little difference, and gives as a section 20 feet from the "well" :—regur ; columnar basalt ; brown or chocolate fine clay, breaking with a conchoidal fracture, and imbedding shells *(Physa)*, separate and in blocks of nodular limestone ; tuffaceous nodular limestone, mottled red ; and fine red clay again, resting on "volcanic indurated clay?" ;—while about 150 yards from this, the regur rests on chalky limestone which contains "*Physa Prinsepii*," and overlies blue or red clay, containing small quartziferous cavities.

The next notice we have of this formation is that by Malcolmson, who saw it and its fragments in several places, but particularly in a "narrow band" at the pass of the Sichel hills, near Nirmul, projecting from the escarpment of a steep mountain composed of "nodular basalt, and capped by a stratified rock, which also appeared to be basalt. And at Hutnoor, a little further north, he observed a bed of it 12 feet thick, resting on reddish granite, also capped by basalt. Here it chiefly consisted of stratified limestone, richly charged with bivalve shells (*Unio Deccanensis*).

From the shells and other organic remains which Malcolmson collected from this formation, the following descriptions have been given by Mr. J. de C. Sowerby :—

"*Chara Malcolmsonii*.—Oblong, spheroidal, with 10 ribs ; three of the ribs are produced at the apex.

"This capsule is composed of 5 tubes, each of which is curled twice round. The figures represent a cast of the interior, the tubes being split down, and the outer halves broken away, and left in the chert. The specimens are silicified, and constitute almost the entire mass of the rock, in which they occur associated with *Physæ* and *Paludinæ*.

"*Cypris cylindrica*.—Twice as wide as long, almost cylindrical ; front very slightly concave ; the outer surface, which is very rarely obtained, is punctured.

"*Cypris subglobosa*.—Sub-globose, triangular, inflated ; front concave.

"The outer surface of this crustacean is punctured, as in *C. cylindrica*.

"Both species occur abundantly in grey chert, with the *Unio Deccanensis* and other shells, and in various specimens of chert and indurated clay, containing *Gyrogonites*, *Paludinæ*, *Physæ*, and *Limneæ*, from the Sichel hills. The fossils are converted into calcadony.

"*Unio Deccanensis*.—Transversely oblong, rather compressed ; margin internally waved ; shell very thick ; surface finely striated. Fig. 6 is in limestone from the northern descent of the Sichel hills ; the others are in chert from Munnoor.

"This species has often a ridge, which bounds the posterior portion, and is variable in size and elevation. Fig. 9 is from a part of a group of many individuals of nearly one size, badly preserved in the same limestone as fig. 6 ; but as they are regularly oval, and do not show a waved margin, they may belong, as

well as fig. 10, which is in grey chert from Munnoor, to a species distinct from *U. Deccanensis*. Some flattened specimens from this limstone are 2¼ inches broad.

"*Unio tumida*.—Transversely obovate, smooth, gibbose; posterior extremity rather pointed; beaks near the anterior rounded extremity.

"The section of the two valves united is regularly heart-shaped. The shell is rather thin, and it has something of the contour of *Cyrena*. It occurs in the same limestone with fig. 6, and the substance of the shell is replaced by calcareous spar, which cannot be broken so as to show the hinge.

"*Limnea subulata*.—Subulate, elongated, smooth; spine equal in length to the body; whorls five. In a nearly white, soft, siliceous stone, from Munnoor and Chicknee.

"*Physa Prinsepii*.—Ovate, rather elongated; smooth; spire short, body-whorl largest upwards. The largest are 2¼ inches long, and upwards of an inch broad.

"*Melania quadrilineata*.—Subulate; whorls about eight, with four striæ upon each; aperture nearly round. Fig. 17, in grey limestone from the same locality as figs. 6 and 11.

"*Paludina Deccanensis*.—Short, conical, pointed, rounded at the base; whorls 5 or 6, slightly convex; aperture round."

Malcolmson also recognized shells of this formation in specimens of chert from the hills about the ruined city of Mandoo, in Malwa, already mentioned, which were presented to the Society by the late Lieutenant Blake.

Next in order of occurrence, but by far the most ample and satisfactory description that has yet been given of this formation, is the following by the Rev. W. Hislop, which is extracted from his "Geology of the Nagpur State," to which I have before alluded.

"The *Freshwater Formation*, which really does yield fossil fruits and other organisms, is nearly co-extensive with the great outpouring of basalt on the west of Nagpur. Whether it ever existed where there is now no trap to be seen is a question which I shall not stop to discuss. But it is a remarkable fact, that wherever there is overlying diorite to preserve it, there the freshwater deposit is almost sure to be found, unless it has been burnt up by the intrusion of amygdaloid. We have traced it well nigh without interruption for 100 miles towards Elichpur, and throughout the whole distance differing often in colour and composition, in outward appearance and inward structure, but still maintaining the same general relation to the enclosing rocks. It is to be met with of all hues, and of all mixtures of tints: at one place it is calcareous, at another siliceous, and at a third clayey. Here it is crystalline, there cherty, and again scoriaceous. In one spot it is full of fossils, in another and neighbouring locality it is utterly devoid of all traces of ancient life. I know not one intrinsic feature that is character-

istic of it. In judging of its identity, the only sure guide to go by is its position between the nodular trap above and the vesicular trap below. Though it must be spread over vast table-lands of different elevations, yet it is almost exclusively on the escarpments of these that we can acquire any knowledge of it. Generally the imbedded stratum occurs at a distance of 15 to 20 feet from the flat top of the eminence, just at the place where the water in the monsoon, running down the slope, has gathered strength sufficient to make an impression on intervening barriers, and whence it proceeds to plough up the soft subjacent amygdaloid, till it reaches the bottom, leaving an interval between each runnel like a rounded talus. In making your way up the ascent, your attention may be attracted by a number of blocks at the foot, which have fallen, or been washed down, from the site of the deposit. These increase the nearer you approach the exact spot; and if they suddenly cease, you may be sure, whether you have observed it or not, that you have just passed by the stratified rock, and come upon the nodular basalt. The thickness of the deposit is very various. It ranges from 6 or 7 feet to an inch. The former must have been its original development in this part of India; and where it has been reduced, the change must be attributed to the amygdaloidal intrusion from beneath. In the neighbourhood of Nagpur it does not average a thickness of more than one foot; where it is greater, the upper portion is generally indurated, and the lower remains soft. It is in the former that most of the fossils are found, though where the latter consists of a green and purple clay, the calcareous nodules, which have been aggregated in it, for the most part enclose organic remains. Among the fossils which this formation yields are the following:—

"*Mammalia or Reptilia* (?)—In addition to the part of a femur and the phalanx, before alluded to, as having been found at Junyápáni Choukí, which I am inclined to refer to this deposit, there have been discovered in it, about two miles west of Nagpur, a portion of a vertebral column, consisting, apparently, of eight vertebræ, and, not far from the same spot, a number of minute bones, in a detached and very fragmentary state, belonging to all parts of the animal structure. Whether these remains of quadrupeds are exclusively of reptiles, or whether some of them may not also be mammalian, I do not possess knowledge enough to warrant my expressing an opinion; nor is it necessary that I should, seeing they are to be transmitted to London, and will soon be examined by those who are competent to the task. But I may mention, that the teeth discovered among them indicate the former existence of saurians at the locality, one tooth being small and

obtusely conical, with a barbed point, and another species, which is very abundant, being comparatively flat and lancet-shaped, with the enamelled side of a darkish slate colour. To this class also may, perhaps, be referred a claw, half an inch long, brought to light at Telankhedi, three miles west of Nagpur; while the stratum at Machhaghodá has furnished the impression, apparently, of a freshwater tortoise.

"*Fishes.*—Remains of this class are found at Tákli and Machhaghodá, but chiefly at Páhádsingha. They consist for the most part of scales, some of the Ganoid and others of the Cycloid orders. The Ganoidians are probably to be referred to the Lepidotoids, to which the spinous rays collected with the scales may have belonged. The alternate depressions and elevations, which radiate from the centre of the Cycloidian scales, are beautifully preserved; some have 12 of each, and others a smaller number. One specimen, as was pointed out to me by that well-known naturalist Dr. Jerdon, has constituted part of the lateral line, and still bears the tube through which the mucus flowed that anointed the surface of the body. But the most curious object that has been met with in this department is a piece of a roe found at Tákli, in the two lobes of which the ova that had been matured are calcedonised, while countless minute granules are seen lining the ovarian membrane.

"*Insects.*—The exuviæ of this class are more numerous than might have been anticipated. They are found only at Tákli, and are chiefly elytra of beetles, of which 9 species have been discovered, 7 having rewarded the investigations of Mr. Hunter. Some are allied to the Buprestidæ, another, in the opinion of its accomplished discoverer, is connected with the (soft-bodied) Heteromera, while two tuberculated elytra may possibly have belonged to some other family of the same tribe. In one of the fruits, to be mentioned below, there was found a hollow tube, binding together several of the surrounding seeds, and absorbing the juice of their enveloping pulp: this was, perhaps, the work of some one of the Dipterous order; and on a piece of silicified wood, which at the period of its deposition must have been considerably decayed, there was discovered a large number of little round opaque bodies, regularly arranged in a hollow. Can these have been the eggs of one of the Lepidoptera?

"*Crustacea.*—Of this class no order occurs except the Entomostraca, comprising the genus Cypris, with 6 species, all new, so far as I am aware; and a very interesting genus, which I am disposed to consider allied to *Lynceus* or *Daphnia*.

"*Mollusca*.—These are very numerous, consisting of *Melania quadrilineata* (Sowerby), and perhaps another species of the same genus not described; *Paludina Deccanensis* (Sow.), and 8 species not named; 4 species of *Valvata*, new; of *Limnæa* besides the *subulata* (Sow.) 5 new species; of *Physa* in addition to the *Prinsepii* (Sow.) 4 or 5 new forms, that may constitute as many species; of *Bulimus* 2 new species, with 12 other species that may be referable to the same genus; *Succinea* 1 species, and *Unio Deccanensis*. Most of the Paludinæ have been found at Tákli, along with the two well-marked species of Bulimus. Telankhedi has supplied all the Limnææ, the doubtful Bulimi, which in many cases retain a stripe of colour on the shell, and the single species of *Succinea*, of which only one specimen has been met with. One species of *Valvata*, with a pretty striated spire, most frequently truncated, is found exclusively at Tákli. Another, also striated and conoid, leaves its impressions abundantly on the rock around Nagpur. Two without striæ occur at Machhaghodá, one carinated above, and sometimes conical, and at other times oblong-conical, and the other discoidal, and so minute as scarcely to be visible by the naked eye. *Physa* is the genus most extensively diffused, having been collected in all places where the deposit is fossiliferous. Besides the *P. Prinsepii* (Sow.) there is one new form found at Telankhedi, which presents obvious specific differences; and there are several others varying from both of these, but by such gradual changes, that under a sense of incompetency, I have sent them all to London for determination. The only remaining shell that has fallen in our way is *Unio Deccanensis* (Sow.), which was obtained by Mr. Hunter at Chikni, the locality pointed out by Malcolmson, which is the only locality for it that I as yet know of within the territory of Nagpur. The specimens of it that occur there are far from good, when compared with those kindly sent me from the neighbourhood of Elichpur by Dr. Bradley. That able and zealous geologist has also furnished me with excellent specimens of *Physa*, the forms of which agree with those common in the vicinity of Nagpur.

"We pass now to the vegetable kingdom, the specimens of which from the freshwater formation are both rare and varied. They may be classed under the heads of fruits and seeds, leaves, roots and wood.

"*Fruits and Seeds*.—Of these there are about 50 species. The order of the Exogenous sub-kingdom, that has most representatives, is the *Leguminosæ*, there being 4 species very obvious, viz. two *Hedysareæ*, and other two, including a *Cassia* of the more regular flowered division of the order. Under the same head may be arranged what appears to

be a *Faboidea* of Bowerbank, a double-seeded fruit resembling the *Xylinoprionites* of the same author, and a three-seeded one, occurring sometimes with two seed-vessels, and at other times with three, which may have been a *Hedysarea*. The most abundant order of Endogens is *Aroideæ*, of which there are two genera, with compound fruits, one with three-seeded ovaries, in size and outward appearance being exceedingly like a small pine-apple, and the other genus bearing a distant resemblance to a mulberry, having, however, the seeds in each vessel symmetrically disposed in sixes. This latter genus contains two species: one, that must have had a rich purple pulp, was upwards of an inch in length, and half an inch in breadth; and the other extended to 2 inches long, with a breadth not exceeding $\frac{1}{8}$ of an inch. Next to the *Aroideæ* the most interesting Endogens are *Palms*, of which there seem to be two genera, one a *Nipadites*, (Bow.) and the other one a transparent piece of calcedony, whose place in the order cannot exactly be assigned. For the latter rare specimen, as well as for the larger mulberry-like aroid fruit, and many other fruits and seeds, we are indebted to Captain Wapshare, whose co-operation in this field has proved of the highest value to Indian palæontology. The fruits above specified, in common with those not mentioned, are almost all found at Tákli. The only exceptions worthy of notice are one of the *Hedysareæ*, which was laid open in a stone from Machhaghodá; separate ovaries of the larger six-seeded aroid, which are found along with fish-scales at Pahadsingha, and the *Chara Malcolmsonii*, which is met with, though not abundantly, wherever the deposit contains organic remains.

"*Leaves.*—Of these there are 12 kinds, seven of which are Exogenous. In some of these the secondary veins strike off from the primary at a very acute angle, and in others not so acute, while in one of orbicular shape they radiate from a central point like the leaf of *Hydrocotyle*. The Endogenous leaves are five in number, some of which possess a considerable similarity to those found in the Bombay strata, and figured in Plate viii. of this Journal for July 1852. All these have been obtained at Tákli, as also the roots.

"*Roots.*—These amount to five in all, none of which are much above an inch in length. The most conspicuous forms among them are those that are somewhat like a cocoon, marked by the scars of sheathing bracts. Of such tubers there seem to be three, differing in certain respects from each other, and agreeing in number with the three aroid plants, with which they are found invariably in juxtaposition. The similarity of one root in all but the size to that given in Plate vii. fig. 1 of the able paper just referred to, cannot fail to appear on the most

cursory examination, and may serve to fix the place of the latter in the vegetable kingdom, as well as create the hope of finding near Bombay some aroid fruit which it has produced.

"*Wood.*—There seem to be three kinds of Exogens and two of Endogens. In some cases the former retain their bark, while the latter, as has been observed in other Indian localities, occasionally display their aerial roots. Specimens of wood are common in almost all fossiliferous parts of the territory.

"From a review of the whole fossil contents of this formation, the inference to be derived appears to be, that it cannot be more recent than the Eocene era. Bronn, in his Index, has set it down as of the same age with the Continental *Molasse;* but the facts, that out of the many shells it has embedded not one within my knowledge is specifically the same as any now existing, that there is almost an equal number of Ganoidian with Cycloidian scales, and that the fruits bear a remarkable resemblance to these found in the London clay of the Isle of Sheppey, in my humble opinion fully warrant the belief that it is one of the oldest of tertiaries. On the tempting theme of its extent throughout India I forbear to enter."

Lastly, we come to the lacustrine strata in the island of Bombay, which I examined in 1851, and have described in No. XVI. of this Journal.

These, which lie under 50 feet of black, stratified basalt, and rest on intruded amygdaloid, like the foregoing, consist entirely of argillaceous shales, which superiorly, where they approach the basalt, are of a light brown colour, and inferiorly, where they are intruded by amygdaloid, of a dirty green or blackish colour. They are laminate in structure, and homogeneous in composition, where they have not been altered by heat; the fossils, even, have all become argillaceous; and although here and there, may be seen a coarse, granular, and apparently heterogeneous stratum, lying between others of extremely fine texture, still the material of which that also is composed is soft, sectile, and argillaceous. It is only where these strata have been exposed to heat that they become altered, and their fossils, and every other part of them have passed from an argillaceous into a cherty or jaspideous state.

There is one exception, however, which is of much importance, viz. that here and there also imbedded in these strata are found fragments of unmistakeable *vesicular scoriæ.*

The deposit abounds in organic remains throughout, but they are much better preserved in the lower than in the upper part. Above, the vegetable remains have been entirely decarbonized, while below,

they are still carboniferous, and in many instances present thin laminæ of sparkling grains of coal.

The superficial stratum, or last deposit, which is about three inches in thickness, is characterized by its siliceous composition and oolitic structure, being almost entirely composed of the casts of *Cyprides*, with a few small fragments of stems of plants. Above this comes only two or three inches of argillaceous transitionary matter, which passes into the wacken of the overlying decomposed basalt, and the wacken again, into the compact basalt above all, through the nodular disintegration of the latter.

Fragments of reeds or stems of plants and their leaves, seeds, and numberless other fossils, apparently from the vegetable kingdom, the forms of which have become obliterated, abound in the light-coloured strata, the fragments particularly in layers, as if they had been deposited more at one time than another, perhaps by floods after heavy rain. About the middle, where the strata have not been wholly decarbonized, and the colour changes to dark green, cormiform roots abound, the remains of small frogs (*Rana pusilla*) in great numbers on black carboniferous laminæ of shale, and of a fresh-water tortoise (*Testudo Leithii*). Dr. Leith, who found several specimens of the latter, also subsequently presented to the Society part of the lower extremities (the *tibiæ*) of a frog, which he computes to have been about three inches long, from the same formation. Below this comes the most carboniferous part of the series, which abounds in large pieces of dycotyledonous woods, flat long ensiform leaves, and a number of seeds, seed-pods, and other remains belonging to the vegetable kingdom. This part is impregnated with a napthous odour, and presents small deposits of sparkling coal throughout, in connection with the vegetable remains.

Besides the fossils mentioned, *Cyprides* abound in every part; a long species, *Cypris cylindrica*, perhaps, of the deposits on the eastern margin of the trappean district; another species not well characterized, and *C. semi-marginata*, which appears to be a new species. The elytra of insects, and impressions of shells like *Melania*, are also present, but the latter are too indistinct for description.

Calcareous spar abounds in the lower strata, where much of the shale effervesces when acid is applied to it; and in one part I found the portions of vesicular scoriæ to which I have alluded, the presence of which is important, because it seems to indicate that the trappean effusions had commenced before this lacustrine deposit had begun to be deposited.

As I have before stated, the lower part of this series has been found

intruded by amygdaloid wherever it has yet been noticed, and therefore neither its whole extent, nor the rocks on which it was originally deposited, are yet known. Its strata in a chertified and jaspideous condition appear, here and there, in all the trappean effusions of the island, except in the basalt, which overlies it; and the plains are strewed with their fragments, contorted and twisted into various shapes, from the almost melting heat to which they have been exposed.

For a more elaborate account of this formation in the Island of Bombay, I must refer the reader to my paper on the geology of this island, published in the No. of this Journal mentioned.

There is yet another instance to which we should direct our attention before we leave this part of the subject, where a similar deposit exists under basalt, in an insulated hill 250 miles to the eastward of the great trappean district. I allude to that pointed out by General Cullen to Dr. Benza, in the Northern Circars. It is situated about 5 miles to the west of Puddapungulla, a village near Rajamundry, just above the delta of the Godavery, and consists of a bed of limestone, lying apparently in "wacke." Benza has stated that the limestone is white, and glimmering, from the sparry nature of the fossil shells which are in it, and that it breaks with a semi-conchoidal fracture. The shells consist of "oysters, unios, small melaniæ, &c." The hill is capped with basalt, decomposing in spheroids and concentric layers, and the "wacke" below the limestone is traversed by thick veins, and small ramifications of jasper, the whole apparently resting on sandstone conglomerate.

It is just possible that this may be a marine tertiary formation, as we shall see hereafter; but its position in the "wacke" or decomposed basalt, and the resemblance at first sight of large unios to oysters, which led Malcolmson and Voysey to mistake the former for the latter, and may also have misled Benza, makes it very like a deposit of the intertrappean lacustrine formation.* The presence of sandstone conglomerate below all may also be useful to remember, as this may be the diamond conglomerate.

* As further instances of the mistakes which have been made in the nomenclature of these freshwater shells, the following may be cited:—Thus, Voysey considered those of the Gwailghur hills to belong to "conus and voluta"; those which he found in calcedonies among the *debris* of trappean rocks in the bed of a river at Daigloor, near Bhuktapore, "buccinum, helix, and turritella"; while Dangerfield considered those which he saw in Malwa to belong to "buccinum," and a "species of muscle." There can be very little doubt now, but that all these were either *Physa Prinsepii* or *Unio*, or other shells of the intertrappean lacustrine formation.

We now come to the evidence that has been communicated of the existence of this formation on other rocks besides the trappean effusions, and this is very scanty indeed. No one can doubt but that further exploration alone is required to prove its presence in many places; but as yet there is but a solitary instance on record to substantiate the fact, and this I have already mentioned, viz. the existence of a series of limestone strata, 12 feet in thickness, and richly charged with unios, which Malcolmson saw resting on "reddish granite" capped by basalt, at Hutnoor, in the Muklegandy pass, a little north of Nirmul.

Voysey, however, in his last journey, viz. that from Nagpore to Calcutta, came upon a bed of "oyster shells," which I think must have been unios, in limestone, at Dooroog, about 120 miles east of Nagpore; and of this he states:—"In my vicinity are numerous excavations of considerable dimensions, for the purpose of making tanks—the bottoms about 50 or 60 feet below the surface. In one, SE. of the town, there is a thick layer of limestone, of a reddish colour, which at first appears to be a kind of breccia, or pudding-stone, but on narrow inspection, it is evident that the whole consists of a thick bed of oyster shells, which have been in some cases completely petrified, and changed into a compact limestone; and in others, on fracture, conchoidal laminæ are very distinct. Perhaps it will be difficult to convince some persons that these are really petrified oyster shells, but I have not the slightest doubt that an experienced geologist will at once admit the fact. It remains to be ascertained whether the rock has a bituminous or ammoniacal smell before the blow-pipe. They appear to differ very little from the shells at Miaglah Condee, except that in this instance they are entire, whereas in the former place they are broken; here, also, they appear to have been compressed. The bed extends beneath the diluvial soil as far as the bed of the river, where there are a few scattered blocks." He found it again at Ryepore, some miles beyond Dooroog, in the bed of the Karoonuddi, and in the wells dug by Colonel Agnew and Captain Hunter, which are 50 feet deep, resting therein on clay slate; and in a quarry at the same place where the latter passed into sandstone; also some pieces of the same shelly limestone on his way to Chandcoory, and on to Bhainsa. At Lowun he mentions "black slaty limestone" underlying the diluvial soil, and that it is to be found on the river Mahanuddi; and at Beliaghur clay slate succeeded by reddish sandstone, where he makes the remark on the geological antiquity of these rocks already quoted. This sandstone extended on to Jora Devi; and in the Silman pass a little beyond, he saw "sandstone conglomerate immediately followed by the clay slate and shelly

limestone." At Bilaipore a breccia of the clay slate in a paste of quartz, "very few of the masses of which seemed much rounded by attrition." Then the usual sandstone, followed by the calcareous clay slate. "At Laindurrah sandstone appeared to be the prevailing rock, and at the top of the pass the calcareous clay slate." In the beds of the nullahs, clay slate "under the sandstone, which is, generally speaking, the lowermost rock." At Cordeonah, sandstone, beneath which is clay slate. Then, after passing over sandstone conglomerate, he states:—"I came on large bedded masses of granite, but did not see their junction with the conglomerate, on account of the diluvial soil; Granite continued on to Sumbulpore, then gneiss, and a little argillaceous limestone, after which metamorphic rocks and granite all the way to the Subunreeka." While at Sumbulpore, he visited the diamond washings in the Mahanuddi. The diamonds were sought for in the sand and gravel of the river, the latter consisting of pebbles of clay slate, flinty slate, jasper, and jaspery ironstone of all sizes, from an inch to a foot in diameter.

At first it would appear useless to follow Voysey through this journey in the hope of identifying his bed of "oyster shells" in limestone with the intertrappean lacustrine formation, on account of no allusion having been made to the "shells at Miaglah Condee," from which he states "they appear to differ very little,"—in any other part of his journals. But when we observe the close resemblance, both in name and permutability of spelling that exists between "Miaglah Condee" and "Muklegandy," by which the pass leading into the valley of Berar from the Nizam's territories is called, and connect this with the fact that at Hutnoor, in this pass, Malcolmson saw the lacustrine limestone strata richly charged with what he then conceived to be shells of "*Ostrea* and *Cardia*," but which afterwards proved to be *Unio Deccanensis*, &c. resting on "reddish granite,"—that which seemed to be hopeless of explanation appears to be perfectly intelligible, and the identity in name and geological formation complete. When, also, we consider that Voysey did not recognize the lacustrine nature of these shells any better than Malcolmson; that the only bit wanting to complete his itineraries is that between Hyderabad and Nagpore; while Colonel Lambton's northernmost station in 1819 was Shivalingapah, near the south bank of the Godavery, not far from Nirmul, where the Muklegandy pass commences; and that in 1822 he had carried his triangulation across the valley of Berar to Ellichpore; there is every reason to believe, from the nature of the country, that he carried it through the Muklegandy pass, and that Voysey, who was attached to his survey, had then plenty of opportunities, which he never allowed to

escape him, of witnessing among the portions of the lacustrine formation which is here exposed in several places, the very limestone strata and its numerous *Unios* which Malcolmson himself saw in marching through this pass in 1835. But, as I have before stated, this part of Voysey's journal is unfortunately wanting, and the only place where he seems to allude to this locality, is in his last notes between Nagpore and Calcutta, where he mentions the place in question, "Miaglah Condee." Colonel Lambton died at Hingan Ghaut, on his way from Hyderabad to Nagpore in January 1823, and Voysey left the latter place or its vicinity for Calcutta in February 1824; but he states in his "Report of the Geology of Hyderabad," that he had seen shells in the trap of Medcondah, and in the wacken of Shivalingapah; and in his account of those which he saw in the Gwailghur hills, in April 1823, he mentions that he communicated in June 1819, as has before been stated, in a report to the Marquis of Hastings, the fact of their existence in Medcondah, though we cannot trace him in his journals to either Medcondah or Shivalingapah. Again, it is evident, from the concluding part of his paper on those of Gwailghur, that he had seen freshwater shells of the intertrappean lacustrine formation in more places than he has mentioned.

Besides, who has yet seen anything like "beds of oyster shells" in limestone or calcareous strata in the interior of India, and what indications are there of such a deposit existing there in the formations hitherto described; none that I can see. Thus everything tends to the conclusion that Voysey's limestone strata with oyster shells at Dooroog, and the other places mentioned on his way to Sumbulpore, were parts of the deposit under consideration.*

We shall have to recur to this subject again by-and-bye, but in the meanwhile let us direct our attention to the intertrappean deposits of

* *Miaglah Condee* and *Muklegandy* are almost undoubtedly the adjectival forms of مغل *Mughul*, viz. مغلي *Mughuli* or مغلية *Mughuliya*; and *Condee* or *Gandy* that of *Condah*, a common Telingi terminal affix to places in this part of India; while the Hydrabad country is called by the Mussulmans *Mughlai*; and then *Miaglah Condee* and *Muklegandy* pass would mean the *Mughli Condi* pass, (pronouncing the vowels as in Italian,) or the passage from the valley of Berar into the *Mughlai* country. At the same time, it is not improbable that the third stroke of the *m* in the MS. has been mistaken for an *i* by the compositor, and that this has led to the strange spelling, "*Miaglah*," which has such an uncommon orthography that it seems that it must be incorrect. I am not an advocate for this kind of reasoning in scientific inquiry, and therefore only add these observations for what the reader may think them worth, in connection with the facts above stated.

the lacustrine formation in Cutch, and to the coal formation resting on the trap of the Rajmahal hills in Bengal.

Of the former, Colonel Grant only describes one instance, viz. that at the village of Wurrowsow, on the SW. flank of the Charwar range, of which he gives the following section:—

"Columnar basalt	20	0	feet.
"Rubbly basalt	0	6	,,
"Crystalline travertin	1	6	,,
"Friable calcareous stone	0	3	,,
"Travertin	0	6	,,
"Friable iron clay	0	3	,,
"Solid basalt	1	6	,,
"Friable basalt			

In this section we have the superficial basalt becoming rubbly or nodular as it approaches the travertin, and that below, as is commonly the case, apparently passing into the latter through a transitionary ferruginous clay. No organic remains were seen in the travertin.

The following description of the coal strata in the Rajmahal hills, which has been given by Dr. M'Clelland, is provisionally placed here, because it rests on the trappean effusions:—

"Rajmahal Coal Formation."

"This consists of thin beds of coal, shale, clay-ironstone, and sandstone, forming the upper beds of coal formation, resting on enormous beds of secondary trap.

"These appearances were examined with great care at Mussinia, Dhomaripore, Taldee, Kottycoon, and Dubrajpore; and found to be everywhere so much alike, as to leave it in considerable doubt whether they do not all refer to one and the same set of strata, appearing at each of the various points alluded to.

"The district in which these appearances occur is mountainous, the levels varying from 50 to 1,500 feet above the sea. It is reasonable, therefore, to conclude, that if good workable beds of coal existed, they would be somewhere brought to view amidst so much local disturbance.

"The higher ridges of these mountains consist of scoriform masses of red earthy vesicular conglomerate (laterite), containing angular and other fragments of altered coal measure shales, ferruginous and micaceous sandstone, imbedded in a semi-vitrified and vesicular matrix. These ridges are without any signs of stratification, except where detached masses of altered coal formation occur; while the upper portion of their declivities, as well as all the lower and intermediate ridges, are composed either entirely of amygdaloid trap, containing

zeolites and calcedony, or altered coal measure sandstone and shale, the latter passing into the small isolated patches of coal measures which are found in some of the narrow valleys and ravines already mentioned.

"These coal measures would appear to have been the object of repeated and fruitless attempts on the part of coal finders, to discover workable seams.

"But such is the development of secondary trap throughout this district, that no hopes can be held out of any useful results from such trials.

"This remark is only intended to apply to that portion of the Rajmahal hills which has been examined by the survey, lying south of Patchwary, or between that place and Bulleah Narainpoore. It applies, however, to all those localities in which coal has been stated to exist in the Rajmahal hills (vide Reports of the Coal Committee), except Hurra and Siclygully, which yet remain to be examined, together with that portion of the hills extending from Patchwary Pass northward to the Ganges."

The computed section of these coal strata gives about three times as much fine and coarse, more or less micaceous sandstone and conglomerates as bituminous shale;—carboniferous shale about one-fifth as much;—the coal strata very trifling, viz. 1 to 6 inches in thickness, and near the surface;—with altered sandstone and conglomerates at the bottom, followed by altered shale, each about 22 to 26 feet,—resting on amygdaloid.

One section, viz. that at Kottycoon, is of 100 feet, and the stratum of coal 2 inches; the other, viz. at Mussinia, 116 feet, and the stratum of coal 6 inches.

The coal lies between bituminous shales, about 16 feet from the surface.

Of the coal measures at Kottycoon, Dr. M'Clelland states:—

"These thin coal measures rest in horizontal strata, on beds of hornblende slate (Ruttunpore Ghat). They occupy a small space at the western foot of Dabrajpore or Umrah hill, the highest mountain in the district.

"The mountain consists of amygdaloidal trap, and semi-vitreous earthy scoriæ, having conglomerates and shale of the coal formation resting on its sides in broken masses and outlines, everywhere altered, and invaded by amygdaloidal trap."

In speaking of the amygdaloid and common trap of the Rajmahal hills, he states:—

"Common jasper of inferior quality also occurs, in beds connected with the clay ironstone of the altered coal measures, in the same locality."

Overlying the amygdaloid is his "common trap," which is avesicular, and of this he observes :—

"The higher ridges consist of scoriform unstratified masses of red earthy vesicular conglomerate, containing angular fragments of alternated coal measure shales, ferruginous and micaceous sandstones and conglomerates, imbedded in a semi-vitreous vesicular matrix."

Under the head of "Inferior Oolite" is then stated :—

"Resting on beds of overlying trap in the Rajmahal hills are certain greyish and bluish-white indurated clays, rendered slaty in places by the abundance of leaves of plants they contain. These clays have been altered by the contiguity of trap. They were originally stratified, but now exist in the form of hard, broken, and detached porcellanous masses."

The following vegetable impressions from this formation have been described by Dr. M'Clelland :—

"*Zamia Indica.*—Leaf long, and very slightly tapering ; leaflets short, rhomboidal, oblique at the base; seven nerved, nerves crowded, and alternately terminating before they reach the apex of the leaflet.

"*Zamia Theobaldii.*—Leaflets alternate, oblong, obliquely accuminate.

"*Tæniopteris spatulata.*—Frond linear, 2 to 3 inches long, narrow at the base, becoming broader towards the apex, or sub-spatulate.

"*Obs.*—This occurs very frequently.

"*Tæniopteris accuminata.*—Frond 2½ inches long, linear-oblong, rounded at the base, accuminate towards the apex.

"*Obs.*—This is of more rare occurrence.

"*Tæniopteris crenata.*—Frond linear, 2 or 3 inches long, narrow at the base, and rounded at the apex ; margins laterally crenate.

"*Obs.*—These, together with *T. spatulata*, are so common, that it is chiefly to them the slaty structure of the bed in which they occur is owing.

"*Poacites minor.*—From beds of bituminous shale at Mussinia. It is the same as [*P. minor*, M'Clell.] of the Burdwan fossils."

In the Rajmahal hills, then, there is a formation, which, in the nature of its strata, its thinness (100 feet), and its connection with the trappean effusions there, closely resembles the intertrappean lacustrine formation of Central and Western India ; but more particularly, perhaps, that of the island of Bombay.

Yet its vegetable impressions, and the *Poacites* of the bituminous shale at Mussinia being the same as that of the Burdwan coal strata, would seem to point out that it belonged to the Oolitic Series, and hence

Dr. M'Clelland appears to have called it "Inferior Oolite," for I assume, that as the "Rajmahal Coal Formation" and "Inferior Oolite" of M'Clelland both rest on the "trap" of the Rajmahal hills, they are parts of the same system, if not the same deposits. One of three things, then, is evident here :—either the first trappean effusions took place during the Oolitic period; some of the species of plants of the Oolitic period continued to exist after its expiration; or (if by resting on the trap Dr. M'Clelland should mean adventitiously), these coal strata have been raised from the formation to which they belong, or from that on which they were originally deposited.

Pending the decision of these questions, I think the coal strata of the Rajmahal hills had better be provisionally classed with the intertrappean lacustrine formation.

In recapitulation of the facts given under this head which seem most deserving of our consideration, we find—

1*st*.—That in addition to resting on the trappean rocks, the intertrappean lacustrine deposit has been seen by Malcolmson to rest on granite in the Muklegandy pass, and that the limestone with oyster shells *(Unios?)* seen by Voysey on his way from Nagpore to Sumbulpore, would appear to belong to the same formation, reposing at one time on clay slate, and at another on sandstone.

2*nd*.—That the mention of the latter by Voysey, in connection with the existence of diamonds in the Mahanuddi which most probably came from the diamond conglomerate in the neighbourhood, has a resemblance to Franklin's description of the deposits accompanying the diamond in Bundelkhund; that this is increased by the fact that both in the neighbourhood of Saugor and Nagpore, where the trappean effusions become fringed out, the latter are attended by a distribution on the surface of fossils from the intertrappean lacustrine formation; and, that on the sandstone in Bundelkhund and the district of Saugor, a limestone exists which may hereafter prove to belong more to the intertrappean lacustrine formation than to the Oolitic Series.

3*rd*.—That there is a great similarity in position, and trappean disturbance and admixture, between the coal formation of the Rajmahal hills and the lacustrine formation in the island of Bombay; that the coal in the latter, too, which is described in vol. iv. of this Journal, p. 176, is not brown coal, such as we shall come to by-and-bye, in the deep blue clay deposits of the coast, which will also appear to come near its own age, nor lignite, such as we shall find in the more recent formations of the same locality, but a degree further advanced towards the old coal of the Carboniferous Series; also that we have,

in the island of Bombay, these strata subsequently intruded by trappean rocks in the form of conglomerates and amygdaloids, just as described by Dr. M'Clelland in connection with the coal formation of the Rajmahal hills. What influence the heat from the overlying basalt and subsequent trappean effusions may have had in approximating the carboniferous deposits in the lacustrine strata of Bombay to the state of old coal I am ignorant.

4*th*.—That the strata of the intertrappean lacustrine formation have, in many instances, been lifted out of their original position, and sometimes so divided, as to appear in thin strata, in differents parts of the trappean effusions which have invaded or enveloped them. This is very well seen in the island of Bombay, where in one place a stratum one foot thick lies under 90 feet of trappite, and then comes 20 feet more of the same rock below it, after which follows volcanic breccia, containing portions of the other parts of the lacustrine strata. In Malcolmson's description of the Muklegandy pass, he states that there are three terraces leading from the summit downwards into the valley of Berar. The summit of the pass is composed of basalt; and on descending to the first terrace, he found "fragments of a compact blue limestone, not to be distinguished from that of the diamond districts," the strata of which were much inclined and broken. Then, on descending to the second terrace, he found the white limestone strata charged with *Unio Deccanensis*, &c. already mentioned, lying on granite, and again overlaid by basalt. While we learn from Dr. M'Clelland's description of the coal formation on the Rajmahal hills, that this also rests on enormous masses of "secondary trap," and that it has been extensively broken up by subsequent effusions; also that there are porcellanous masses of indurated clays resting on the overlying trap of these hills, which contain fossils of the "Inferior Oolitic." He further mentions, that in one part, the coal strata rest "horizontally on beds of hornblende slate."

5*th*.—Lastly, that the intertrappean lacustrine strata in Bombay contain straggling pieces of hollow vesicular scoriæ.

From these facts, then, we may deduce the following conclusions, viz. that some of the lacustrine deposits might have taken place prior to the first trappean effusions; that in the island of Bombay the presence of scoriæ indicates that this deposit, at least, was going on during the trappean period; that generally, these lacustrine deposits in the Deccan, where they are connected with the trappean effusions, lie under a capping of basalt, and that they have all more or less been raised from their original position by the intercalation of amygdaloid.

X.

VOLCANIC ROCKS.

Trappean System, 2nd Series... { *Trappite.* / *Amygdaloid.* / *Volcanic Breccia.*

The second series of trappean effusions includes all those which have taken place in India since the elevation of the Ghauts.

Subsequent to the breaking up of the trappean plains, and the upheaval of the stupendous masses which form not only the Western Ghauts, but all the ranges of mountains upon the great trappean district, a series of effusions appears to have been ejected between the elevated ridges of the old trappean tract, as well as in other parts at a distance from it, all of which now assume the form of low hills or plains, occupying a variable extent of surface.

In the island of Bombay they consist of trappite, amygdaloid, and volcanic breccia; and they are all characterized by enveloping more or less of the intertrappean lacustrine strata, or of other rocks. The same is the case with similar effusions on the Rajmahal hills. Malcolmson also states, that on the banks of the Pennar he saw a breccia, formed of the "diamond sandstone" and a semi-vitrified rock, which he hesitated to refer to the trap family "until he had seen varieties of a red wacke," much resembling it, which constitutes part of the mountains in the island of Salsette; and Captain Meadows Taylor, in a private letter to me, accompanied by a sketch-map, points out the existence of large tracts of indurated trap-mud or clay, including blocks and nodules of basalt, which bounds the south-eastern border of the great trappean district between the Bhima and the Kistnah, and overlies in its outskirts the adjoining granitic rocks and limestone of the Oolitic Series. Many other instances of this effusion no doubt exist in other places, though they have not yet been mentioned.

*Trappite.**—The characters of this rock have already been given, and all that I have to add here is, that a bed of it exists in the island of Bombay, from 0 to 150 feet in thickness, the upper surface of which

* That which I have called "Diorite" in my "Geology of the Island of Bombay" should have been termed "Trappite," for it possesses throughout the character which we have assigned to the latter to distinguish it from diorite, viz. semi-crystallization and the presence of an amorphous earth. I would rather, too, not consider it a modified form of the overlying basalt, which led me to call the two in combination "the basalto-dioritic tract"; but as a separate effusion, until it may be more satisfactorily demonstrated that it is really a part of the overlying basalt.

is tesselated in the manner of other rocks that have from a semi-fluid state become consolidated in contact with the atmosphere; while it envelopes long tracts of strata, which have been thus isolated by it from the intertrappean lacustrine formation. In one instance there are 90 feet of trappite above, and about 40 feet below, a stratum of this formation, which is only from 1 to 2 feet in thickness. One ridge or dyke of this trappite presents the peculiarity of being mottled with darker coloured portions than the rest of the rock, and these remaining almost intact while the lighter coloured part weathers away, causes it to assume the form of a conglomerate of bullet-like masses, of different sizes, from which I have termed it "Orbicular Diorite"; it should be called "Orbicular Trappite."

Amygdaloid.—This, formed of a trappitic base more or less aphanitic or amorphous, is chiefly characterized in Bombay by the presence of laumonite, calcspar and quartz in its cavities. In some parts all three are present, in others they are alone, and are then most developed. It has invaded the lacustrine strata to a great extent, and broken them up into masses, which now lie imbedded in its structure, or in the form of chert and jasper, twisted and contorted in all directions and strewed about its decomposing surface. In colour it varies from blue to fawn or brown. In the latter state it has been called "White Trap," and in the quarries where it is least vesicular, presents a prismatic, columnar structure, like that of the black basalt. In many parts it is impregnated with calcspar, which only becomes visible when its planes of crystallization arrive at a position favourable for reflecting the rays of light towards the eye. In this state it appears to form spilite (Brongniart). The light colour, however, disappears on descending, and after a few feet, passes into blue, when the rock approaches the form of trappite, but appears to be more compact and less crystalline. The calcspar is sometimes in veins, sometimes in small crystalline masses forming part of the rock like the other ingredients, and sometimes diffused throughout its substance, only becoming visible in the way above stated; in this form it very much resembles diffused glassy felspar. The amygdaloid is not raised into hills, like the trappite, nor have I distinctly seen it overlying the latter, though it appears to be a subsequent effusion.

Volcanic Breccia.—This, which in the islands of Bombay and Salsette presents all the characters that heat, water, and decomposition can give to an effusion of the kind, is composed of angular fragments of sandstone and sandstone conglomerate, argillaceous shale, amygdaloid, basalt, diorite, and granitic rocks, to which may be added fragments

of the lacustrine formation; imbedded in a compact, jaspideous, granular, or cavernous, arenaceo-argillaceous, loose base; solid, unstratified, sometimes pseudo-prismatic; of a red, blue, grey, or black colour; passing, in decomposition, from the jaspideous, black, homogeneous form into a fine red clay; and from the loose, arenaceo-argillaceous, red state into a sub-granular, red, sandy earth; in both instances losing all traces of its original composition. The reason of its possessing all these characters is that it exists in the island of Bombay in the state of a breccia, and in that of a black jaspideous basaltic rock, with all the intermediate varieties and decompositions peculiar to either.

A person may walk from the red hills, where it is in a loose, friable, lateritic state, to the black hills, where it is in a jaspideous one, passing over a plain of it, which, gradually becoming more and more compact, at length assumes a darker colour, and finally, losing all heterogeneous composition, ends in a black, jaspideous, homogeneous mass. On his way, too, he will pass over parts of the surface where there is the polygonal division common to rocks which have been in a semi-fluid state, and here the fragments of which the rock is composed are most evident and striking; while the same effusion, in some parts under the trappitic crust, where it has been continually exposed to moisture, is throughout of a soft, cheesy consistence. The friable sectile state of this breccia, where it forms the red hills, is the only part where the fragments of the rocks contained in it retain any trace of their original structure and appearance, and even here the whole has undergone such alteration, that in hardness, all parts yield equally to the cutting instruments which are used to fashion it into blocks for architectural purposes. Still the structure of a conglomerate may be detected in many of these fragments, though this hardly amounts to more than the rounded cavities and black ferruginous shells of the gravelly pebbles which they formerly contained; while the various colours of the fragments, viz. deep black, red, chocolate, brick-red, violet, lilac, grey, and variegated with specks, spots, or streaks of one in a base of the other, together with a zonular arrangement in some, bear such a striking resemblance to the colours of the fine argillaceous sandstones and their nodules of the Oolitic Series, that no doubt, hardly, can be entertained of their having belonged to the latter.

At first I thought they must have come from the intertrappean lacustrine formation, for I knew little then of the characters of the sandstones and shales of the Oolitic Series, or how they were situated with respect to the trappean effusions. But since I began to reflect on the extent of the volcanic breccia in the neighbourhood of Bombay, and

remembered that the whole of the trappitic and basaltic crusts of the island are most probably underlaid by it; that it forms all the hills on the north-eastern part of the island, some of which are 130 feet high; that it also forms a great part of the mountains in the island of Salsette, and extends to its northern extremity, making in all a tract north and south of 28 miles, and probably a great deal longer, I have naturally come to the conclusion that the lacustrine formation could not have supplied all the fragments in this great mass, and that their origin must be sought from some other source. I therefore examined several of them carefully, and found what has been mentioned, but the subject deserves a much more extended investigation than I have been able to give it.

The lateritic character of this effusion, where it forms the red hills, is very striking, and a full description of it and of the effusion generally will be found in my "Geology of the Island of Bombay." Suffice it here to add, that the distinctive character of this volcanic breccia from the genuine laterite, consists in the presence of fragments of other rocks in it, as well as its position.

Dyking these red hills will be found a similar effusion, of a much lighter colour; so much so, that when fresh from wells which are being sunk in it, it serves for white-washing. This, on examination, appears to be a kind of trappitic kaolin, for if the white decomposing powder be brushed off in water, a gritty mass will remain, presenting the greenish tint and general appearance of trappite. This effusion has not only veined and burst through the trappitic crust in many places, but in one part it overlies the crust of one of the trappitic ridges, which is 100 feet high, and there, appears as a white amygdaloid, the cavities of which are filled or lined with siliceous minerals only, viz. quartz, calcedony or agate.

Many of these cavities or geodes are half as large as a man's head, and contain large crystals of colourless or amethystine quartz.

Lastly, there is an effusion, which has all the appearance of an old pisolitic pumite: it is harsh to the touch, breaks with a rough fracture, and presents the short-cut fibrous structure peculiar to pumite conglomerate. In it, too, are rounded pebbles of the so-called white trap to which I have before alluded, with its vesicular cavities filled with decomposed laumonite and general calcareous impregnation, besides fragments of other rocks belonging to the trappean effusions. I have only seen a few specimens of this, of a blue colour, which were picked up by Dr. Leith in the island of Salsette, where they were mending the roads with it. This is decidedly the nearest approach to modern

volcanic effusions that has come under my notice in the neighbourhood of the island of Bombay.

There is a fac-simile of it in a stratum at Aden some way up the base of the mountain, in Back-bay, but there it still retains the lightness, freshness, and looseness of structure indicative of more recent origin, while that of Salsette is heavy and consolidated, and, therefore, more nearly approaches trachyte.

All these effusions in the island of Bombay appear to have undergone elevation since they were ejected; they have a more or less sloping and a scarped side, the former presenting towards the east, the latter to the west.

The fragments of the sedimentary rocks in the volcanic breccias of the Rajmahal hills, and those in the trappean effusion on the Pennar, mentioned by Malcolmson, all appear to retain much more of their original structure, elementary composition, and appearance, than those in the volcanic breccia of Bombay; yet a large angular fragment of a granitic rock, found by Dr. Leith in the transitionary part of the volcanic breccia of the black jaspideous hills, still retains its original whiteness, and vindicates its right to a place among rocks, which, however near the surface of the great trappean district in the island of Bombay, are not found *on* it for hundreds of miles all round.

In his sketch of the geology of the "Bombay Islands" Dr. Thomson seems to have applied the name of porphyry to the volcanic breccia; but I have seen none of it which merits this appellation, though I should mention, that on comparing some blocks of red porphyry that were brought from Jiddah with the decomposed red breccia of the hills at the north-eastern extremity of the island of Bombay, and of others in Salsette, the two appear to be identical, but for the decomposition of the latter. The compact red paste, throughout which are disseminated small, white, well-defined crystals of felspar, with here and there fragments of other rocks, in the Arabian porphyry, (*Porphyre antique*, Brongniart,) appear to find their exact representatives in the red, loose, arenaceo-argillaceous base of the volcanic breccia of Bombay, with its white specks and spots corresponding to the felspar, and its fragments of other rocks, all of which seem merely to want general consolidation and crystallization to make the whole mass identical with the prophyry from Jiddah.

In this series of trappean effusions, masses of heliotrope and jasper appear not to be uncommon. A large block of the former was met with in tunnelling for the Bombay railroad through a low trappean ridge on the mainland, opposite the town of Tanna. The heliotrope

of the Cambay ornaments comes from a hill near Rajcote in Kattyawar, and at the village of Tullajah, in the same province, which is about 20 miles south of Gogah, there is a hill, composed of basalt below, laterite above, and on the top of all, a rock "like a large mass of bloodstone" (Fulljames). The heliotrope and jasper of the trappean effusions generally appear to me to be derived from fragments or masses of sedimentary rock with which the igneous ones have come in contact, or have enveloped when in a semi-fluid or incandescent state.

There are still more recent traces of volcanic outbursts in Cutch and India, but it will be more convenient to allude to these hereafter.

XI.

Miocene and Pliocene Formations.

Hitherto we have been viewing the geological formations of different epochs in India in detached masses and tracts, without much reference to their continuity, and none at all as to the parts which were deposited in deep or shallow water, or to the deposits of lakes, rivers, or estuaries, which may have been contemporaneous with these formations; nor, in the present state of our knowledge, is it possible to do otherwise: at the same time it must be obvious, that however much their mineralogical characters may aid in the commencement of this investigation, nothing but an acquaintance with their organic remains in the end, can enable us to determine with accuracy the boundaries and depths of the seas, lakes, rivers, or estuaries in which they were respectively deposited; or to place them in that part of the geological series to which they properly belong.

With the formations, however, which we are now about to consider, the matter is somewhat different; for their modern and fresh appearance, together with their comparatively undisturbed and unaltered state, will enable us to recognize and trace them, as a group, almost wherever they exist, without the presence of fossils; but when we come to separate these, also, according to their geological ages, the same impossibility of doing so without an acquaintance with their respective organic remains will be experienced, as in the classification of the formations which have preceded them.

Unfortunately with the miocene and pliocene, as with the older formations in India, very few of their fossils have been described; and while this arises from scarcity in the latter, it, perhaps, arises somewhat from their abundance in the former, which, with their freshness in appearance, renders them so much like the shells now on the sea shore,

that a collection or record of them seems useless and insignificant; and this impression is likely to remain so long as we are unacquainted with the great thickness of their strata, and the great and extensive changes which the earth's surface has undergone since the most recent of them were deposited. But when this is known to us, their antiquity becomes apparent, and the many thousands of species, including whole genera, that must have become extinct during the time that has been required for their formation, points out to us the necessity of making the collections of their organic remains to determine the relative ages of their different deposits, which before seemed so useless and unimportant. Indeed, it matters little about the freshness of shells, or their resemblance to species of the present day; a knowledge of those which actually exist on the coast that is bordered by these formations is as indispensable as that of those which exist in them in a state of fossilization, when we come to determine the geological age of the latter. Collections, therefore, of shells and fossils of all localities, however common and apparently insignificant, are as necessary, in a geological point of view, as the most uncommon and curious of the oldest strata on the surface of the globe.

With this short introduction to the miocene and pliocene formations, which have been placed together, at present, for want of data to divide them satisfactorily, let us endeavour, by the aid of the scanty knowledge we possess of their fossils, their mineralogical characters, position and resemblances, to draw parallels between their different deposits in different localities, and thus, by establishing their contemporaneousness, group them and place them provisionally in the divisions of the geological series to which they appear to belong. In doing which, in the present state of our knowledge, it will be necessary to go beyond the prescribed limits of the tract proposed for consideration, and to extend our observations, for comparison, to these formations on the western side of the Indus and the shores of Arabia which are nearest to Western India.

Miocene Formation.

Solid, coarse, shelly and coralline Limestone. Oyster-beds. Calcareous, argillaceous, quartzose or sandy Conglomerates. Ossiferous Conglomerates. Lower Blue Clay.

In the southern part of Cutch, the western part of Kattyawar, and the South-east Coast of Arabia, where there have been no rivers of any consequence to interrupt, by their transported matter, the continued deposit of the marine exuviæ and rolled detritus of these localities, the miocene formation is much the same. Thus, in Cutch it is stated by

Grant to consist of a hard argillaceous grit, interspersed with fossil shells. At the village of Soomrow, it is a "hard, compact, calcareous rock, full of shells, and burnt for lime; and below this rock is a coralline limestone." The former contains oysters near Eyeraio. These deposits "abut against the nummulitic beds"; but their thickness is not mentioned.

I am also informed by Lieutenant Constable, I. N., who has just been engaged in surveying the Western Coast of Kattyawar, that the whole of this coast is cliffless, and raised but a few feet above the level of the sea, which (by the specimens) throughout, breaks upon a compact, gritty limestone of a yellowish colour, raised here and there, a little inland, into mounds and hills, varying in height from 50 to 100 feet; on the top of one of these is a bed of oysters impacted in the rock. From the specimens of this limestone which Lieutenant Constable kindly brought me, with careful descriptions of the places from which they were taken, it evidently possesses the same characters as the compact calcareous rock of the miocene deposits on the South-eastern Coast of Arabia, and, therefore, is probably identical in formation with it and that of Cutch. But it is only on the coast of Arabia that I have had a good view of this formation, from which the following section, from above downwards, was carefully taken:—

Compact, coarse, shelly limestone, of a white colour, argillaceous.	20	feet.
Compact, coarse limestone, of a reddish-white colour, chiefly composed of gravel from the older limestone of the neighbourhood, in an argillaceo-calcareous cement	7	„
Compact, coarse, shelly and coralline limestone, of a greenish, reddish-white colour, argillaceous; (bivalves and ostreæ)	6	„
A bed of large, thick oyster shells, in a coarse, compact limestone cement	1½	„
Large, rounded, white limestone pebbles, in a compact, coarse limestone cement	2½	„
Coarse, compact limestone, of a smoky-brown colour, containing more or less of the neighbouring rocks in the state of rounded gravel; *remarkable for its cragginess where exposed to the action of the waves*	10½	„

This formation rests on the older limestone or igneous rocks of the locality, and constitutes the inferior two-thirds of a small cliff, which is continuous for many miles along the middle of the South-east Coast of Arabia, resting on the base of the scarped table-land which here slopes into the sea. Its strata dip slightly towards the latter, and throughout it is capped by the pliocene formation, which will hereafter be described.

The few fossils which I obtained from it belong chiefly to the family *Ostracea*, and they closely resemble those in Tab. XXV. of "Grant's Geology of Cutch." But near the village of Takah, in the upper part of the cliff, probably in the upper stratum of the above section, *Orbitolites* and *Orbitoides* abound. This, when I was writing a geological sketch of the coast, appeared to be a great anomaly, for I had thought, from seeing these fossils so frequently associated with nummulites, that this deposit must be a part of the eocene formation, which in some way or other had interrupted the continuation of the cliff; yet the same parallelism and lines of stratification of the latter being equally continuous at this as at any other part, and the brown limestone rock underlying all, as usual, though the cliff (about 100 feet high) had fallen forward in great rectangular masses into the sea, left me still in doubt as to the soundness of the conjecture. Now, however, this no longer exists, for specimens of this formation, brought from the coast of Kattyawar by Lieutenant Constable, also abound in *Orbitolites*, both plane (papyraceous) and convex. This, again, throws a doubt over the nature of the formation from which the specimens of limestone in the Rajpeepla hills, sent me by Major Fulljames, came, and which I have before set down provisionally, as part of the Nummulitic Series, from their containing *Orbitolites*; but the whole rock bears such a striking resemblance to the miocene formation, that it now seems to me more probable that it, also, should belong to this, rather than to the Nummulitic Series. Lastly, the occurrence of numbers of *Orbitolites* in another form of this tertiary deposit on the southern part of the Malabar Coast, which will presently be mentioned, sets the question at rest, in my own mind, respecting the formation to which the stratum on the Arabian coast containing these fossils belongs, viz. to the miocene, and not to the nummulitic deposits.

The extreme cragginess of the lowest stratum of this series, where it has been exposed to the action of the waves, characterizes it not only on the South-east Coast of Arabia, but on that of Kattyawar, and, apparently, even in the Laccadive Islands, judging from rock-specimens of the latter which were presented to the Society by Captain Moresby, who surveyed them. It is difficult to account for this peculiar cragginess, unless it be owing to the more perishable nature of the portions of the older limestone rocks (which here and there form a great part of this deposit) yielding to the fretting and dissolving action of the waves, and thus leaving the cement which held them together in the peculiar form mentioned. But to whatever cause it is to be attributed, the rugged appearance of this rock, where exposed to the waves, is very

striking. Its geological age, probably, as well as its composition, induces this peculiarity.

The following descriptions of fossils illustrating this formation in Grant's "Geology of Cutch," have been given by Mr. J. deC. Sowerby :—

"*Clypeaster oblongus.* (*C. scutiformis?* Lam.)—Oblong, sub-pentagonal, convex above, concave beneath ; ambulacra very broad, obtuse. Length 2⅞ inches, breadth above 2 inches, height 7 lines.

"*Clypeaster depressus.*—Pentagonal ; much depressed ; ambulacra oval ; anus very near the margin. Length in the oldest individual about 2 inches, breadth rather less, height about ½ inch.

"This differs from *C. Laganum* in the position of the anus, which in that species is half-way between the mouth and the margin, in the greater size of the papillæ, and in being much thinner.

"*Serpula? recta.*—An oval, free, slightly waved shelly tube, which we have provisionally called a *Serpula*, although it is more like the tube of a *Teredo* ; but it appears to have been formed in loose sand. Diameter ¼ inch.

"*Siliquaria Grantii.*—Spirally striated, striæ crossed by numerous cracks ; fissure composed of a series of oval pores. It differs from the recent *S. anguina* only in the smallness of the pores which form the fissure.

"*Balanus sublævis.*—Sub-cylindrical, with curved valves ; nearly smooth operculum ; diameter 1 inch, height 9 lines. Parasitic upon shells.

"*Corbula trigonalis.*—Trigonal, with the front rounded, gibbose, antiquated ; valves nearly equal ; posterior side truncated obliquely, with a carina upon each valve, and pointed ; umbones equal, central. Length 6 lines, width 8 lines ; but these proportions vary.

"*Corbula rugosa.* (Lam. vol. v. p. 497.)—This differs from the last in being a much wider shell, with more regular and prominent laminæ upon the surface. Length 2½ lines, width 3¼ lines.

"*Tellina exarata.*—Ovate, compressed ; ornamented with many erect concentric laminæ ; the posterior extremity pointed, much bent. Length nearly three-fourths of the width, which is nearly 2 inches. Strongly resembling *T. virgata*, (Lam. Hist. Nat. vol. v. p. 52,) but wider, and more bent.

"*Venus granosa.*—Obovate, truncated, posteriorly convex ; ornamented with erect concentric laminæ ; crossed by numerous striæ, which cut these (near the margin) into rounded grains ; lunette broad, pointed, convex ; beaks nearest the anterior extremity. Length 1¾ inch, width more than 2 inches.

"This belongs to the same family of *Venus* as *V. corbis*, and *V. puerpera*, and is scarcely distinguishable from *V. puerpera.* β (Lam. Hist. Nat. vol. v. p. 585.)

"*Venus cancellata.*—Obovate, approaching orbicular, gibbose ; ornamented with erect concentric laminæ, and many longitudinal striæ ; lunette wide pointed, convex ; beaks nearest the anterior extremity. Length 1¾ inch, width 1 inch 11 lines.

"This resembles the last, except that it is rounder, with thinner laminæ, which are not cut into round grains.

"*Venus non-scripta.*—Transversely oval, convex, smooth, concentrically undulated ; lunette elongated, pointed, concave ; beaks near the anterior extremity.

Length 1 inch 4 lines, width 1¼ inch. A smooth and thin shell, with little of the aspect of a *Venus*.

"*Pullastra? virgata.*—Transversely oval, elongated; decorated with smooth concentric ridges; beaks nearest the anterior extremity. Length 13 lines, width 1 inch 7 lines.

"Several recent species of *Pullastra* are like this, but no described one appears to be identical with it.

"*Cardita intermedia?* (Lam. Hist. Nat. vol. v. part i. p. 23; Brocchi, vol. ii. 520, t. 12, f. 15.)—This strongly resembles several species of *Venericardia*. (Lam.)

"*Cardium triforme.*—Orbicular, ventricose, longitudinally striated; anterior side covered with round granules, formed by decussating striæ; the posterior side crossed by oblique sets of reflected ridges. Length and width 1 inch 4 lines. Somewhat resembling the recent *C. æolicum*.

"*Arca radiata.*—Transversely elongated, oblique, rather convex, radiated; radii elevated, furrowed; beaks almost close, nearest the anterior side. Length 7 lines, width 1 inch.

"*Arca tortuosa?* (Linn.)—This is only a fragment, and what there is seems to differ from the recent *A. tortuosa* in the degree of curvature.

"*Pecten Somrowensis.*—Obovate, convex, radiated; radii about 24, squamose, subdivided in one valve into 3, in the other into 5; ears unequal, striated, and squamose. Length 2 inches 2 lines, width nearly 2 inches.

"In form this *Pecten* approaches to *P. varians*, but in the structure of the surface it is like *P. plebeius* of the crag, and many recent species.

"*Pecten articulatus.*—Orbicular, with pointed beaks, depressed, radiated; radii about 28, simple rounded, crossed by distant scales: ears large, striated, and squamose. Length in an old specimen about 1 inch 8 lines, width 1 inch 6 lines.

"*Gryphæa globosa*, (M. C. t. 392; *Ostrea vesicularis*,) Lam. Hist. Nat. vol. vi. part i. p. 219; Cuv. and Brong. Env. de Paris, 383, t. 3, f. 5; *Podopsis gryphæoides*, Lam. Hist. Nat. vol. vi. part i. p. 195.)—This exactly agrees with old specimens found in the chalk of Norfolk.

"*Ostrea angulata.*—Sub-orbicular, arched, compressed, plaited; plaits angular, numerous, branched towards the margin; laminæ of increase regular, distant, raised at their edges. Length about 1¼ inch, width the same.

"*Ostrea flabellulum.* (M. C. t. 253; Lam. Hist. Nat. vol. vi. part i. p. 215; *Chama plicata*, Brander, 84 and 85.)—The identity of this oyster with the *O. flabellulum* of the tertiary formations of Europe is unquestionable.

"*Ostrea tubifera.*—Orbicular; laminæ of increase thick, raised into a few large, nearly erect tubes, arranged in about 6 rows. Diameter 2 inches.

"*Ostrea lingua.*—Much elongated, smooth, approaching to even; upper valve flat or concave, the other very convex; squamoso-fimbriated at the edges. Length 2½ inches, width 1¼ inch.

"So variable are *Ostreæ* in form, and so much do the species resemble each other, that it is hardly possible to define some of them clearly. That before us is very like *O. tenera*, (M. C. t. 252, f. 2 and 3,) yet in the depth of the attached valve it approaches to *O. Meadii*, (M. C. t. 252, f. 1 and 4,) but is not waved like that.

"*Bulla lignaria.* (Linn.)—This agrees perfectly with the recent species, as far as

we can ascertain from specimens which are not perfect; but it is quite distinct from both the fossil shells described by Deshayes under the same name.

"*Natica obscura.*—Globose, umbilicate; spire small, pointed; whorls about 5. convex, flattened, and ornamented at the upper edge with fine diverging plaits; umbilicus partly filled with a semi-cylindrical, obliquely truncated callus. Height 1¼ inch, diameter the same.

"Nearly related to *N. Epiglottina* (Lam.), but distinguished by the flattened upper margins of the whorls; and to *Nerita canrena* of Brocchi (vol. ii. 296).

"*Natica callosa.*—Obliquely depressed; spire small, hardly projecting; umbilicus covered by the thickened and expanded inner lip; aperture very large. Height 2 inches, diameter 1¾ inch. A very distinct species.

"*Globulus? anguliferus.*—Oblong, obliquely striated; spire produced; whorls about 4, with their sides and upper edge flattened; umbilicus open, rather large. Height and diameter ¾ inch.

"The elevated lines or striæ advancing towards the aperture as they descend the sides of the whorls, form a peculiar character. The aperture appears to be small.

"*Solarium affine.*—Convex above, flattish beneath, marked with diverging striæ on both sides; whorls 4 or 5, with a deflected entire carina, above which are 4 furrows, placed at nearly equal distances, and below, 2 furrows near the carina, and 2 near the umbilicus, which is large, with a crenated edge. Diameter 1½ inch, height ¼ inch. Perfectly distinct from *S. perspectivum*, which it somewhat resembles.

"*Trochus cognatus.*—Conical, with straight sides; whorls numerous; ornamented with several rows of granules, which sometimes (especially towards the apex) are united by elevated lines, and a row of tubercles upon the inferior edges of the upper whorls, succeeded by 2 rows upon the middle volutions, and crenated ridges of slight elevation on the rounded border of the lowest whorls; base flat, concentrically furrowed, containing a thick plait within.

"Like *T. maculatus.* Height 2 inches, diameter of the base nearly the same.

"*Turritella angulata.*—Turrited, conical; whorls convex, decorated by about 7 carinæ, of which the lowest but one is much the most prominent. Height 1¼ inch, diameter 8 lines.

"*Turritella assimilis.*—Turrited; whorls convex, ornamented with 6 or 7 carinæ, of which 2 or 3 are obscure, the 2nd and 5th being prominent. Height 1¼ inch, diameter 5 lines. A smaller, narrower species than the last.

"*Terebra reticulata.*—Subulate; sides of the whorls flat, cancellated; a narrow upper portion of each whorl divided from the lower in the form of a band by a ridge and furrow; beak short, curved.

"In some specimens the transverse or spiral lines are less conspicuous, particularly on the band, and the upper half of the whorl.

"*Cerithium rude.*—Subulate, with curved sides, ribbed and furrowed; ribs numerous, cut across by about 5 square furrows, of which the uppermost is distant from the suture; whorls 10 or 12, nearly flat, with an obtuse varix between each; the last varix very prominent; aperture nearly round, with a canal at the upper angle; inner lip thick, with a callus at the top; beak broken. Height 2 inches 8
2 3 lines, diameter about 8 lines.

"*Cerithium corrugatum.*—Subulate, ribbed, and coarsely striated; ribs

numerous, arched, and prominent, crossed by deep striæ; whorls 8 or more, rather convex, with a distinct varix upon each.

"This has much of the contour of an elongated *Fusus*. The lip and beak are wanting in the only specimen found.

"*Fusus? granosus.*—Short, fusiform, ribbed; ribs about 12 upon each whorl, divided into grains by 6 or 7 transverse ridges; convex; spire half the length of the shell; beak suddenly contracted. Height 4 lines.

"A pretty shell, much resembling some species of *Nassa* which occur in the crag.

"*Fusus lævisculus.*—Short, fusiform, ribbed, and striated; ribs irregular, mostly very short; whorls 6, angular; base conical; beak short. Height 10 lines, diameter 5 lines.

"*Fusus nodulosus.*—Fusiform, elongated, ribbed, and strongly striated; ribs short, broad, about 8 in the middle of each whorl; whorls 6 or 7, concave above, convex below; beak contracted.

"*Fusus (Murex?) hexagonus.*—Short, conical, with an elongated beak, 6 angled; whorls about 6, with 6 ribs on each, which form the angles of the spire, and are crossed by 3 strong ridges upon the spire, thickened where they cross; convex; beak suddenly contracted.

"*Ranella bufo.*—Conical, with 2 rows of thin expanded varices, and several ribs, the whole crossed by 3 or 4 prominent and several intermediate thin ridges; whorls 7 or 8, convex; varices obtuse at their edges; aperture oval; beak short, oblique. Height 1 inch 4 lines, diameter 1 inch. Nearly resembles *R. bituberculata* of Lamarck.

"*Rostellaria rectirostris.* (Lam. Hist. Nat. vol. vii. p. 192.)—The elongated form induced us to refer this fossil to the recent *R. rectirostris*, in preference to any other species.

"*Strombus deperditus.*—Turbinate, tuberculated, and transversely striated; tubercles united by a slight carina, gradually increasing in size; lip thickened, produced above into a short pointed lobe. Height 2¼ inches, diameter 1 inch 4 lines, including the wing.

"*Strombus nodosus.*—Turbinate, elongated, tuberculated, transversely and longitudinally striated; tubercles equal, numerous, prominent, obtuse. Height 1¾ inches. Distinguished by the rounded tubercles, of which there are about 12 to each whorl and the elongated spire.

"Rare: we have seen but one specimen, and that is very imperfect.

"*Cassis. (Cyprœcassis*, Stutchbury.)—Sculpta ovate, transversely sulcated; aperture narrow, the outer lip plaited, the inner smooth. Height 1¼ inch, diameter 1 inch. Strongly resembling *Cassis (Cyprœcassis*, Stutchbury,) *Testiculus*, (*Bucc. Testiculus*, Linn.) but smoother, and with a narrower aperture.

"*Turbinellus affinis.*—Sub-fusiform, swelled in the middle; ornamented with many transverse ridges, and a row of flattened tubercles near the upper margin of each whorl; beak produced transversely, ribbed; columella 5-plaited. Height 4 inches, width 2 inches.

"Very nearly related to *T. Scolymus* (Lam.), but it is more elongated, has smaller tubercles, and 5 not 3 plaits on the columella.

"*Mitra scrobiculata?* (Brocchi, vol. ii. p. 317, t. 4, f. 3.)—This is the same as the fossil found at Piacenza. It is often larger than our figure.

"*Mitra fusiformis.*—Fusiform, pointed, striated; striæ distant, deep, punctated; suture entire; columella with 4 plaits. Height 2 inches, diameter 0½ lines.

"*Volupta jugosa.*—Fusiform, pointed, transversely striated; costated; costæ many, rounded, terminating in points above the suture; aperture elliptical, elongated; columella with 3 plaits. Height 2½ inches, diameter 1¼ inch.

"This differs from *V. Mugorum* of Brocchi, in the form of the ribs, and the small number of plaits upon the columella, and from *V. costata* (M. C. t. 290,) in the form, and in the greater number of the ribs.

"*Voluta dentata.*—Turbinate, striated; spire short, conical, pointed; whorls crowned with tubercles, which surround a concave space; aperture elongated; the outer lip thick, crenato-dentated within. Height 1 inch 7 lines, diameter 1 inch.

"*Cypræa humerosa.*—Obovate, depressed with 3 protuberances upon the back, and one on each side. Length 2 inches, width 1¼ inch.

"*Cypræa Prunum.*—Oval, ventricose; aperture narrow, slightly curved, with about 20 teeth on each side; base convex; beak small, not much produced; a very even shell. Length nearly 2 inches, width 1¼ inch.

"*Cypræa digona.*—Ovate, ventricose, slightly depressed; base flattened on each side; beak expanded, prominent, with sharp edges; teeth on each side the aperture, above 20. An obscurely marked species. Length 13 lines, width 9½ lines.

"*Cypræa nasuta.*—Ovate, elongated, ventricose; beak projecting, large; posterior extremity of the lip produced; apex of the spire sunk. Length 10 lines, width 6 lines.

"*Terebellum obtusum.*—Ovate, much elongated; spire 2 or 3 whorls, obtuse. Length about 2 inches, width 6 lines.

"This is more like the recent *T. subulatum* than the fossil *T. fusiforme.*

"*Oliva Pupa.*—Elongated, sub-cylindrical, with a produced, pointed spire, a broad smooth band at the base, and a slightly plaited callus on the columella. Length 1 inch 9 lines, width 8 lines.

"*Conus brevis.*—Short, conical; spire flat; with a produced apex, marked with 4 concentric striæ, decussated by the lines of growth; base ornamented with several small, rather distant ridges. Height 1¼ inch, diameter 1 inch.

"*Conus militaris.*—Conical, elongated, slightly contracted towards the edge of the spire; coloured by many triangular spots, arranged in zigzag rows; spire flat; upper surfaces of the volutions concave; base nearly smooth. Height 1½ inch, diameter 11 lines.

"This shell, and the following, retain traces in a remarkable manner of the original colouring.

"*Conus catenulatus.*—Conical, elongated; coloured with transverse rows of white spots upon a dark ground; spire flat, elevated in the middle, concentrically striated, mottled with white, the edge sharp; the base obscurely furrowed. Length 1¼ inch, width 8 lines.

"*Conus marginatus.*—Conical, much elongated; spire conical, short, surrounded by an obtuse ridge from its base to its apex; base of the shell striated. Length 1¼ inch, width 8 lines."

The principal part of the above fossils came from the tertiary deposits at Soomrow; the rest (11) chiefly from Kotra, and the borders of the Runn.

*Lower Blue Clay.**

Contemporaneous and parallel with the foregoing calcareous formations is a blue clay, which appears to exist throughout the Western Coast of India, from Kurrachee to Cape Comorin, but chiefly in the neighbourhood of bays and inlets into which rivers have long been discharging themselves.

The following table will exhibit this better, perhaps, than separate descriptions of this deposit and its accompaniments, at the different places therein mentioned :—

Kurrachee.	*Cutch.*	*Cambay.*	*Travancore.*
Feet.		Feet.	Feet.
Blue clay, with lignite and septaria. 60	Blue clay, with lignite; and "olive brown earth with pieces of amber or mineral resin."	Blue clay, with septaria and lignite.... 22½	Blue clay..... 4
Yellow clays, sand, and conglomerates..... 24		(Bore at Gogah, Fulljames.)	Lignite; and mineral resin in olive brown earth 18
Blue clay..... 74	Yellow marl, with lignite.		Sandy blue clay. 3
(Bore at Ghizree, Major Turner.)	(Near Baboa Hill, Grant.)		Slabs of gritty argillaceous limestone, of a bluish-green colour, containing orbitolites, &c. with rubbly matter above and below, abounding in tertiary fossils.

Having thus shown that the existence of this clay is general on the Western Coast of India and in Scinde, we have next to point out its contemporaneousness with the coarse limestone of Cutch, Kattyawar, and Arabia, which may be inferred from the following facts :— 1*st*.—That, like the latter, it is immediately overlaid at Kurrachee and on the coast of Travancore by the pliocene deposits which will be presently described, while, on the other hand, it forms the lowest part of the cliffs of Travancore, which probably rest on the metamorphic or granitic rocks of that locality. 2*nd*.—Near the hill called Baboa, in the western part of Cutch, which is within 10 miles of the eastern mouth of the Indus, it, with the yellow marl beneath, lies immediately on the nummulitic limestone, and is again immediately overlain by the

* This clay has been called "lower" in contradistinction to a more modern deposit of the same kind, which will hereafter come under our consideration.

same conglomerates, apparently, which are stated by Grant to overlie the calcareous parallel of this formation at the village of Soomrow, 24 miles further to the south. The difference in the nature of the deposits in these two places having probably arisen from the lesser distance of Soomrow from the sea, and its much greater distance from the Indus, than the neighbourhood of Baboa hill. 3*rd*.—On the coast of Travancore the blue, argillaceous, gritty limestone, with the rubbly calcareous material on each side of it, forms the base of the blue clay and lignite deposits, and abounds in fossils that are identical with those which illustrate the tertiary formation in Grant's "Geology of Cutch," together with *Orbitolites*. Further proof is hardly wanting to establish the identity of these two formations. But the account of the cliffs on the coast of Travancore, which General Cullen has kindly sent me, is so instructive, and so much more satisfactory than anything published on the subject, that I cannot do better than give it in his own words:—

"The first well I opened was on a laterite cliff or point, 4 or 5 miles NE. of the town of Quilon. Having observed some yellowish slabs of dolomite [argillaceous limestone?] at the base of the cliff or strand of the back-water, which there suddenly deepens to 40 feet, and, therefore, prevented my tracing it further downwards, I laid open several feet of the face of the cliff, and, still finding the dolomite slabs apparently passing under it, I then went above, for about 100 feet inland, and there sunk a large well, and met with the dolomite at the depth of about 38 feet.

"I then ascertained that the dolomite appeared everywhere to prevail below the laterite round Quilon, at a depth of about 40 feet from the surface.

"This was determined by the examination of wells in different localities, and by further sinking several which had not been carried down to that depth.

"I think there was a loose rubbly bed or stratum, of exactly the same composition as the compact limestone, both above and below the slabs, and in which the greater number of the organic remains were found; but the limestone itself (though extremely hard and tough) also contained numerous specimens, in the most perfect state of preservation. The limestone is of a bluish-grey inside, but externally, where exposed to the weather, of a dull yellowish colour.

"The laterite and lignite cliffs of Varkalay, which are also near
2 3 * Quilon, that is about 12 or 14 miles south, extend along the coast,

about 6 miles, varying in altitude from 40 to 60 feet. Below the laterite is a series of beds of very beautifully variegated coloured sands and clays, and below them, again, the carbonaceous clays or shales and lignites. At the north end of the cliffs, where they are only 80 feet high, the lignite bed is level with the beach; but to the south, where the cliffs attain an altitude of 140 feet, there appear to be 3 or 4 successive deposits of lignite, each of which is from 4 to 6 or 8 feet thick. To ascertain, also, if this lignite bed extended inland, I sunk a well 20 feet in diameter, at a distance of about 100 yards from the cliff, and after passing through 22 feet of laterite only (because the well was here sunk in a hollow) came to the lignite clays. I then sunk a small well, about 5 feet in diameter, on one side of the large one, to determine the thickness of the lignite bed, which was penetrated after 7 feet, meeting then with a bed of loose, white sand, from which the water immediately sprung up so rapidly as to oblige the people to leave off working. I have not found any traces of organic remains in these cliffs, nor any traces of limestone. The carbonaceous lignite beds abound with resin and iron pyrites (white), both in lumps of considerable size. I have a lump of the resin 10 inches in diameter.

"The variegated coloured sands that I have spoken of as lying between the laterite and lignite beds are exceedingly beautiful—at least fifteen different and perfectly distinct tints. It has strongly reminded me of what I have often heard, but never seen, except in geological drawings, viz. the strata of Alum Bay, in the Isle of Wight.

"Plumbago and graphite, in small thin scales, abound in the gneiss and granite both of Travancore and Tinnevelly, and of course also in the laterite; sometimes in the latter in great profusion."

These observations furnish us with two important facts, of which one has been mentioned, viz. the existence of tertiary fossils (miocene) below the blue clay and lignite; which is also pointed out in another part of General Cullen's letter, and further confirmed by the identity of several specimens of a small collection which he kindly sent me from these beds, with the tertiary shells of Cutch figured by Sowerby in Grant's geology of that province. The specimens of the limestone, too, which General Cullen formerly presented to the Society through Dr. Buist, not only bear the colour of the clay, but, with its imbedded tertiary shells, also contain portions of lignite, indicating its intimate connection with it. The other fact is, that this limestone, clay, and lignite, underlie the lateritic deposits. General Cullen is also of opinion that the laterite consists of *debris* of the older rocks of the neighbourhood; and the whole, as before stated, probably rests on

the granitic and metamorphic rocks of the coast of Travancore, for there appears to be no other in this part of India, at all events inland.

On the other side of the Ghauts, however, the matter is different, for General Cullen states:—

"On the Tinnevelly side are also granite and gneiss, but, in the low country, crystalline limestones and sandstones, as well as others of the above rocks towards the sea coast, containing organic remains." This is worth remembering, because the lateritic deposits of the Coromandel Coast will probably be found to have been formed as much from the *debris* of their neighbouring rocks as the lateritic deposits of the Malabar Coast have been formed from the rocks in their vicinity.

The following is a condensed section of two bores on the Coromandel Coast, made at Madras in October and November 1832 (Newbold) :—

Sand and clay alternating	13 feet.
Black clay	20 ,,
Blue arenaceo-calcareous clay	12½ ,,
Granitic gravel	10 ,,
Granite	——

The presumptive evidence, then, (when we remember the thickness of the lateritic deposits overlying the blue clay on the coast of Travancore,) that the lateritic conglomerate forming the low undulating ground called the "Red Hills," which run parallel with the coast north of Madras, and the "Red Hills" which are in a similar position a short distance inland from Pondicherry, has been derived from similar sources, and formed in a similar way, is very great; but to the consideration of this we shall come by-and-bye. Let us now return for a few moments to the blue clay, which, by the above section, would appear to exist on the Eastern as well as on the Western Coast of India.

I have already cited reasons for considering the lower blue clay contemporaneous in deposit with the coarse calcareous beds of Arabia, Cutch, and Kattyawar; and the identity between the deposits of this clay at the different places mentioned in the table, p. 300, seems, with its position, &c. to be established by the following facts, viz. that at Kurrachee it contains lignite and septaria, also capsules of chara (five-striated, similar to that now growing in the tanks of Bombay); in Cutch lignite and mineral resin; at Gogah in Cambay septaria; and, on the coast of Travancore, lignite and mineral resin;—while on the Coromandel Coast, the similarity of the blue clay at Madras, in relative position and general characters, to that on the coast of Travancore, although it appears to be unaccompanied by lignite and limestone, yet seems sufficient in itself to establish also their identity.

Ossiferous Conglomerate.

Of the same period as the two foregoing formations, viz. the coarse shelly limestone and the lower blue clay, appears to be the ossiferous conglomerate, which is characterized by its number of mammalian and reptilian remains, together with more or less silicified wood.

This conglomerate forms part of the capping of a little island in the Gulf of Cambay, called "Perim," which is opposite the mouth of the Nerbudda. It exists, also, in the tributaries to the upper part of the Nerbudda, and in the valley of the Nerbudda itself; also in the Godavery and Payne Gunga; in the bed of the Jumna, in the Doab; and over a great part of Upper Scinde on the western side of the Indus.

The following is a tabular view of its relative position with respect to other formations in these parts respectively:—

Perim Island.	*Burman Ghaut, Nerbudda.*	*Godavery, near Aurungabad.*	*Jumna, Doab.*	*Scinde, Gauj River.*
Feet.	Feet.	Feet.	Feet.	Feet.
Yellow conglomerate, alternating with sandy clay, containing bones of mammalia and reptiles: together with silicified wood, perforated by the *Teredo*, and infiltrated with calc spar 21	Calcareous conglomerate. 42	Alluvial deposits..... 40	Alluvial deposits, and beds of concretionary limestone, (travertin or kunkur.)..... 100 to 150	Clays and sandstone. 150
	Bones of mammalia and reptiles. (Spilsbury.)	Silt 3		Upper bone-bed.... 60
	Omer Nuddi.	Pebble-beds, containing bones of extinct elephant..... 4	Clay-bed, and bones of mammalia.	Sandstone and many fossils 60
(Ethersey.)	Regur 3	Trachyte.	(Smith.)	Lower bone-bed. Marly clays, with *Turritella* (arenaceo-calcareous rock of Kurachee).
	Yellow friable loam, with layers of calcareous conglomerates, containing fossil bones ..... 30 to 80	(Bradley.)		(Vicary.)
	(Nicols.)			

From this table, it will be observed that the ossiferous conglomerate in the Omer Nuddi, the Godavery, Jumna, and of Scinde, is covered by a great thickness of superficial deposits, and hence, from the great time required for their formation, I am inclined to place it, for the present, in the same group with the coarse shelly limestone and lower blue clay.

At the island of Perim, it is composed of a quartz-grit, clayey base, of a yellowish colour, imbedding rounded fragments of argillaceous strata, but never any evident portions of the trappean rocks that I have seen; and at its lower part, fragments of the skeletons of mastodons, elephants, and, indeed, species of most of the larger forms of extinct mammalia, together with those of chelonian and crocodilian reptiles. There is also a considerable quantity of silicified wood present, all the portions of which, so far as I have seen, appear to have been thoroughly perforated by the *Teredo*, and worn at the ends as if they had been long floating and washed about in water before they were deposited. Portions of the bones are also rounded by attrition.

There appears to be this difference, which it is as well to remark here, between the vegetable remains of the blue clay and those of the quartzose or gravelly conglomerates, viz. that in the former they are carbonized, and in the latter silicified.

Perim island, which is situated on the Eastern Coast of Kattyawar, opposite the mouth of the Nerbudda, appears to be nothing more than a disconnected portion of the mainland, from which it is separated by a deep channel, which is about 1,200 yards in width. The island is 1,300 yards long, and 500 yards broad, and its highest part is 21 feet above the level of the sea. Of this portion Captain Ethersey, who surveyed it, gives the following section from above downwards :—

" Reddish mould or rubbish	3	0	feet.
" Yellow pudding-stone	1	6	,,
" Sandy clay	1	0	,,
" Dark-coloured pudding-stone	0	6	,,
" Sandy clay	4	0	,,
" Yellow pudding-stone	1	0	,,
" Sandy clay	0	6	,,
" Recent sandstone	0	6	,,
" Sandy clay	8	0	,,
" Yellow pudding-stone	1	2	,,
	21	2	feet."

In the lower "pudding-stone," or conglomerate, the fragments of bones and fossil wood are chiefly found.

One of the most remarkable features about this island is the depth

of water that surrounds it. The channel between it and the mainland is from 180 to 360 feet deep, and on its outer or eastern side from 198 to 1,060 feet; so that since the deposits took place which form the island, they have not only been partially raised above the level of the sea, but the great subterranean shock has occurred, which produced these immense fissures, and thus isolated the part forming Perim from the mainland of Kattyawar. On many parts of the latter, too, opposite Perim island, a similar ossiferous conglomerate exists.

It was seen by Major Fulljames in several places between Gopanah Point and Gogah, as well as some distance inland, and on the road from the latter place to Rajcote by the Rev. Dr. Wilson. Major Fulljames alludes to an interruption of its continuity by trappean rocks, but does not state whether this has taken place since it was deposited. The small capping of deposits over the ossiferous conglomerate in Perim island may be from the early elevation of this part of the formation above the level of the sea, or, if they were ever thicker, from subsequent denudation.

What river brought the materials of this conglomerate to the coast is of course unknown, but it is not unreasonable to infer, from its position opposite to, and only 15 miles from, the mouth of the Nerbudda, which is the largest river of Western India, that it was brought down by this river; especially when we connect the existence of similar animal remains, in abundance, in the valley and tributaries of the upper part of it.

There are two kinds of fossilized bones in the valley of the Nerbudda, both of which are completely deprived of their animal matter, but one is almost friable, white, and calcareous; while the other is tough, of a dark brown colour, and siliceous. Captain Vicary has also noticed this in Scinde, for in describing an escarpment at the Rund pass, on the Maulmaree river, he states:—

"In the *debris* at the base of the cliff, I found some fossil bones, evidently disengaged from the arenaceous rock above, as they differ greatly from the fossil bones usually found in Scinde, which for the most part owe their hardness to hydrate of iron. The bones found here are soft, and with a calcareous infiltration."—The remains of the extinct species of elephant found in the banks of the Godavery, and sent to the Society's museum by Dr Bradley, are in the same state; but those of the island of Perim are all hard, brown, and siliceous. If we were to see fossil shells in these two conditions, we should say that the soft friable ones were deposited at a much later date than the others. Can this be the case with these two kinds of fossil bones? The

great tusk of an extinct species of elephant seen by Mr. Dean in the bed of the Jumna, those by Captain Nicolls in the neighbourhood of Saugor, and those by Dr. Bradley in the Godavery, were all of the white friable kind, while the remains of tusks from the island of Perim are almost as hard as flint. A large collection of fossil bones which was made by Major Partridge, in the neighbourhood of Sehwan, in Scinde, and which he kindly allowed me to inspect, were, in appearance, so like those of the same species found on the island of Perim, crocodiles and mammals, that had I not known from whence they came, I should have set them all down as Perim fossils.

I do not know of any published or private section of the Nerbudda or its tributaries, where the conglomerate containing the fossil bones is seen to rest on the older rock; neither does the clay in which those bones were found by Captain Smith in the bed of the Jumna appear to be the lowest of these deposits; while the conglomerate in which Dr. Bradley saw the bones of the extinct species of elephant in the banks of the Godavery rests on trachyte with large crystals of glassy felspar, and this, again, on red amygdaloid. The conglomerate of the Godavery is composed of large and small pebbles of trappean rocks, calcedony, onyx, agate, heliotrope, laterite, and obsidian, (2½ inches in diameter,) all of which, Dr. Bradley states, have a vitreous surface, as if they had been exposed, in the general mass, to great heat. But in Upper Scinde, viz. in the Deyrah valley, among the Murree and Boogtie hills, which form the south-eastern angle of the mountainous tracts on the western side of the Indus, near its confluence with the branch formed by the union of the other four great rivers, this conglomerate was seen by Captain Vicary to rest "conformably" on the nummulitic limestone; which may be a further proof of its contemporaneousness with the coarse shelly limestone and blue clay. Near the pass leading into the western extremity of this valley, he states, "These hills are interesting, from the vast quantity of fossil bones and fossil wood which has been entombed within them; both are scattered about in vast profusion, and many cart-loads of the bones could be collected from off an acre of ground.

"The wood bears the appearance of having been drifted and water-worn previous to fossilization. I noticed palms and dicotyledonous trees, one of which had a structure resembling pine; some of the stems had a diameter of 2 feet, and the quantity exposed upon a small area was truly wonderful."

The same kind of formation exists on the Sewalick hills, where its extinct fauna has been magnificently illustrated by the labours and

under the direction of Colonel Cautley and Dr. Falconer, but as both the Sub-Himalayan ranges and the mountainous parts of Upper and Lower Scinde are beyond the limits of geological description prescribed for this summary, it is not desirable to allude to the ossiferous conglomerate which they present, further than it may appear necessary for establishing the geological position and relations of this formation in India.

Cornelian Conglomerate.

There is still another conglomerate that is connected with the lower part of the Nerbudda, which, from the composition of the matrix, appears to be identical with that of Perim island—I allude to the conglomerate in which the so-called "cornelian mines" are situated.

The chief of these are about 40 miles inland, at the foot of the westernmost extremity of the Rajpeepla hills, close to the town of Ruttunpore, which is about 4 miles from the Nerbudda, on its southern side. In describing them, Dr. Copland states that the soil in which the cornelians are imbedded consists chiefly of quartz sand, reddened by iron, and a little clay. "The nodules may weigh from a few ounces to two or three pounds, and lie very close to each other, but for the most part distinct—not in strata, but scattered through the mass, and in the greatest abundance." The sand and clay in which they are imbedded is stated by Malcolmson to bear an intimate resemblance to that of the ossiferous conglomerate of Perim island. Dr. Copland, also, states, in describing the kinds of cornelians:—"I saw none of a *red* colour at the mines; some were blackish olive, like common dark flints, others somewhat lighter; and others lighter still, with a slight milky tinge." Some nodules, on being broken, showed a mixture of quartz and agate, and others, in a crust of quartz minutely crystalized on the inner surface, contained black oxide of iron, of a powdery appearance." Hematite, [heliotrope?] chiefly of the brown and green (with red spots) varieties, Mocha stones, and jaspers of various colours, are very common."

The shafts through this bed of pebbles are about 50 feet deep. Malcolmson, contrary to what Dr. Lush has stated, observes that there are trap pebbles among the rest here, as well as in the conglomerate of Perim island.

It requires but a short examination of these flints to see that they have chiefly come from the cavities of trappean rocks. Their agatoid structure for the most part, and the white dimpled crust of calcedony which here and there remains impressed on them, where the attrition to which they have been subjected has not been able to reach, are

proofs of their having been formed in cavities of volcanic rocks; while their roundness, and the minute curvilinear lines on their surfaces, are also proofs of the great friction to which they have been exposed. At first they have very much the appearance of the chalk flints of Europe, and it is not improbable that some are from a marine formation; indeed, a section of one which I possess has an organic form in it, but this is the only instance I have met with among some hundreds, and I am not quite sure that this came from the cornelian mines, though it came from that neighbourhood. Still, as this deposit appears to have been formed by the sea on one side, and the Nerbudda on the other, it is not improbable, that, like other beaches of the kind, it contains specimens of all the rocks in the surrounding country.

From its distance inland, as well as from its similarity in composition to the conglomerate of Perim island, it appears to have been an early formation, and, therefore, probably belongs to the miocene deposits.

If any inference may be drawn from the position of the cavernous trappean rock in the island of Bombay, which is more or less filled with large bullous cavities and agates, those of the cornelian mines must have come from some of the latest trappean effusions. Be this as it may, these cavernous rocks, when exposed to the air, appear to undergo rapid disintegration. Colonel Grant mentions one place in Cutch where "the sides of the hills (of amygdaloid) are covered with heaps of rock-crystal, as if cart-loads had been purposely thrown down"; and in many parts of the great trappean district, the surface is strewed with a profusion of agatoid flints, onyx, hollow spheroids of quartz crystals, and zeolitic minerals. Do such rocks, containing these minerals, form a part of the lower or earlier trappean effusions? It would be useful to determine.

Silicified Wood-deposit of Pondicherry.

Lastly, we have to return again to the southern part of the peninsula, to consider the nature of a silicified wood-deposit near Pondicherry, which overlies the limestone formation of that locality, already described as containing fossils referrable to the lower cretaceous and upper oolitic beds. Of this wood-deposit, Newbold has given the following description:—

"A short distance inland from Pondicherry, beds of a loose ferruginous grit rise into a low range of hills, called, from the colour of the rock, the Red Hills. They run in a NNE. direction, almost parallel with that of the coast. They are about 2 miles in breadth, and about 8 or 9 in length. The deposit, probably, extends further in a southerly

direction than the north bank of the Ariacoopang river, to which I traced it from the vicinity of Camlaput on the north. The locality where the silicified wood is found in greatest abundance is in the vicinity of Trivacary, about 15 miles west of Pondicherry. Between the Red Hills and the sea extends a plain, covered with an alluvial sandy soil, and underlying it a greyish-black or dark clayey loam, resembling that of Madras, imbedding fragments of grit and recent pelagic shells. The descent from the hills towards Pondicherry is gentle, but steeper on the western flank, where the strata have been evidently stripped off, and the subjacent fossiliferous limestones denuded, leaving a shallow valley, marking the discontinuity of the strata between this point and where the beds again appear in the vicinity of Trivacary, on the opposite or western side of the valley.

"Here they form a low broken range of hills, not rising higher than from 50 to 100 feet above the general level of the plain, having a parallel direction with the beds on the eastern side, and sloping gently towards the east. The western flank is rugged and precipitous where it meets the hornblende schiste, which flanks it to the west near the village of Trivacary. A narrow valley marks the junction line, covered with the detritus of both rocks. Here silicified trunks of trees have been imbedded in the grit in a nearly horizontal position. The stems are both straight and crooked, generally without roots or branches, though the former have been found, and the places of the insertions are frequently strongly marked on the stem. They are monocotyledonous and dicotyledonous, coniferous and non-coniferous. Dicotyledonous wood is, however, most abundant. One of the trunks I found to measure 20 feet in length, and from 1 to $2\frac{1}{4}$ feet in diameter.

"Lieutenant Warren, in the 'Asiatic Researches,' describes a trunk about 60 feet long, and from 2 to 8 feet in diameter." Another mentioned by Mr. Kaye was nearly 100 feet long. (Mad. Jl. vol. xii.)

"The imbedding rock is for the most part composed of angular grains of quartz, often stained with iron, and loosely cemented together by red and whitish clays passing into a conglomerate, and into a tabular and cellular rock, differing in no respect from some varieties of laterite. * * * The beds near Trivacary are shattered by vertical fisures."

Such is an abstract of the short description of this deposit given by Newbold, the silicified wood of which, like that in Upper Scinde, and, therefore, unlike that of Perim island, appears to bear no marks of the *Teredo*, although in conglomerates in all three places. That part near Pondicherry called the "Red Hills" will come under

the next division of the tertiary formations, for reasons which will then appear.

It may now be reasonably asked, how comes this miocene formation to immediately overlie the Pondicherry limestone, which contains fossils of the lower greensand and upper oolitic beds? And this question can only be answered by assuming that the latter must have undergone depression since it was raised above the level of the sea. For whether the upheaval of this limestone took place just after its last particles were deposited,—or whether it was after the deposit on it of the formations which occurred between this and the miocene one that now rests upon it, and these intervening portions became washed off as the whole mass rose to the surface, or during its depression,—still, in either way the Pondicherry limestone must have begun to descend at the time the silicified wood-deposit began to accumulate upon it. Could this silicified wood-deposit, which overlies a limestone close upon, if not of the oolitic period, have been contemporaneous with that of the diamond conglomerate overlying our Oolitic Series? for this series, too, might have undergone temporary subsidence for the reception of the latter,—that it also underwent great denudation previous to the deposit of the diamond conglomerate has already been noticed;—while Newbold observes, at the end of his description of the silicified wood-deposit of Pondicherry: "I am rather inclined to refer this to the freshwater chariferous limestone and chert formation than to the laterite of Pondicherry."

If the silicified wood-deposit of Pondicherry be a miocene formation, then depression of the Pondicherry limestone seems necessary for its position; while, if it be a conglomerate of the oolitic period, then it and the diamond conglomerate might have been deposited just as the Oolitic Series generally was being raised above the level of the sea. In this case, the upper beds of the Oolitic Series must have previously undergone partial dislocation and fracture, at the same time that large plains must have been left intact. For, in the first instance, we have fragments of sandstone (oolitic?) in the diamond conglomerate, and then we have the diamond conglomerate capping the hills of large districts throughout, some 1,000 feet high, near Cuddapah, where, it should also be remembered, that Dr. Heyne enumerates, among the pebbles of the diamond conglomerate, those of basalt. Further and still more precise information on this subject is much needed.

Again, Newbold remarks that "the silicified wood of the Egyptian Desert closely resembles that of Pondicherry, not only petrologically, but in *gisement*"; and certainly we cannot fail to see a great resemblance,

when we compare the relative positions of the two, assuming, from what has been before stated, that the latter is a miocene formation.

Mr. Orlebar, who was formerly Professor of Mathematics in the Elphinstone Institution of Bombay, carefully inspected the deposits in Egypt which seem to bear directly upon this point, and the following section is compiled from his account, given in vol. ii. of this Journal:—

Sand and sandstone conglomerate, with silicified trees (drift-wood).
Yellow limestone, with nummulites in the lower part, 60 feet.
White limestone, with nummulites.

Of the sandstone he states as follows:—"The structure of this rock is very various, although its sole mineral constituent is quartz. It forms the whole of the red hill near Cairo, where it may be studied with great advantage. In some parts it is a light yellow sand, in others a hard black rock, in others a conglomerate, in another a compact white quartz rock; and frequently it has a red tinge. The brown Egyptian pebbles belong to one of its conglomerate forms.

"The well known fossil trees lie in this sandstone, which is found overlying the yellow limestone throughout the desert."

Hence, when we remember Captain Vicary's statement, that the ossiferous conglomerate of Upper Scinde, which abounds in silicified wood, rests "conformably" on the nummulitic rocks in the Deyrah valley, and was probably a deposit of the Indus; that the ossiferous conglomerate of Perim island and Kattyawar also abounds with silicified wood, and was probably a deposit at the meeting of the sea and the Nerbudda; while the silicified wood of Pondicherry appears to be of the same age, and might have been a deposit of the Cauvery—we cannot help leaning to the view, that one and all, the Egyptian formation included, were deposited under similar circumstances, and about the same geological period. The comparative absence of shells, too, in all, should be remembered, as indicative of a detrital commotion particularly unfavourable to the existence of invertebrated animals, and just such as might be expected to exist at the union of a rapid river with a heavy sea-swell.

Pliocene Formation.

Semi-consolidated or loose calcareous or siliceous Sands, Grits, or Conglomerates, with more or less Marine or Freshwater Shells, according to the nature of the deposit.

In describing the "tertiary strata" of Cutch, Colonel Grant observes:—"A calcareous grit, which soils the fingers like chalk, also

occurs in patches, and contains innumerable small shells. It is used for building, and is burnt for lime; the beds are horizontal, and the surface of the country is generally covered with a fine rich soil." It is not distinctly stated whether this "calcareous grit" overlies the miocene formation just described; but, on the Western Coast of Kattyawar there exists a similar deposit, particularly in the neighbourhood of Porebunder, that does rest on the miocene formation. This is a kind of free-stone, in parallel, horizontal strata, which, yielding easily in the lines of the latter, afford slabs, that have for a long time been imported in great quantities at Bombay for architectural purposes, under the name of "Porebunder stone." The whole deposit would appear to be but a few feet (6 ?) in thickness, but, from its uniform structure and compactness, it serves excellently for flooring and for facing buildings. In 1848 I examined portions of it, both microscopically and chemically, and found it to be composed of minute foraminiferous shells, and a few grains of quartz and hornblende; the former semi-consolidating the whole mass, by a partial solution and recrystallization of their surfaces, and, when dissolved in acid, yielding yellow ochre casts of the foraminiferous animals they formerly contained. It thus became evident, that the so-called Porebunder stone was the marine type of a formation, which, from the presence of gritty particles of foreign matter, might vary in impurities of this kind to such a degree that in some parts it might be a coarse conglomerate, while in others it might be wholly calcareous. Portions of this formation from the creeks of the Runn, 9 miles north of Bhooj, were submitted to me for examination by the Government, to whom they were forwarded on account of their auriferous appearance. The speckled golden colour seems to be caused by the interlamination of yellow ochre with the nacreous layers of the foraminiferous shells. I state "appears," because I am not certain that this is the explanation, though I am certain that it contains no gold. The foreign particles in it consist of fragments of the trappean rocks, among which may be seen those of green-earth, their usual accompaniment.

From Cutch and Kattyawar let us turn our attention to the South-east Coast of Arabia, where there is a much better illustration of this formation. Here we find it plainly developed throughout, but it is only where the miocene formation presents the continuity of cliff mentioned that its position is clearly defined. There, it is seen to form the upper third of the cliff, and to consist distinctly of an elevated beach about 6 feet thick, composed of more or less conglomerate from the older rocks of the neighbourhood, which,

when traced into expanded plains between the base of the mountains and the sea, which have also undergone elevation, or over lowland parts unbacked by any mountains, becomes of greater thickness, and of greater purity. Opposite the northern extremity of the island of Masira, where the latter is the case, it presents an escarpment of about 100 feet, and, in composition, is a fac-simile of the Porebunder stone of Kattyawar. I have called it in my memoir on the geology of the Arabian coast "Miliolitic Deposit," from the facts mentioned. It is very oolitic in structure, but any name of this kind might confound it with "Oolite," while any one connecting it with an abundance of foraminiferous remains tends more to associate it with the tertiary formations to which it belongs.

On the western side of the Indus, where this formation is developed to a great extent from the vast quantity of *debris* brought down by that river, it chiefly consists of sands and conglomerates, formed in a great measure from the *debris* of the nummulitic or eocene deposits, and the shells of its own period, in greater or less abundance. It should be particularly remembered, in tracing out the limits of this formation in Scinde, that it may abound in fossils from the detritus of the Nummulitic Series, which, if not examined carefully, may be mistaken for deposits of this period.

The following section from above downwards of this formation at Minora Point, which is the western extremity of the entrance to the harbour of Kurrachee, has been given by Captain Vicary:—

"Conglomerate	60 feet.
"Sandstone	3 ,,
"Oyster-bed	2 to 4 ,,
"Sandstone, becoming highly calcareous, and containing innumerable *Turritellæ*	5 ,,
"Fine-grained sandstone, no fossils apparent	——

Beneath this (I am informed by Mr. H. B. E. Frere, Commissioner in Scinde,) comes the lower blue clay; he also mentions that the hills at Jerruck, on the Indus, which are of this formation, rest on blue clay, as evidenced by a well sunk there, and that the former so covers the nummulitic rocks in Lower Scinde, that it is not until arriving north of Jerruck, which is upwards of 70 miles up the river, that they become exposed.

The Lesser Haroo range in Luss appears to be of the same formation, (Sub-Appenine of d'Orbigny?) and the greater one too, perhaps, among the mud volcanoes of the same province. In a rough sketch of a scarp of this formation in Luss, made by the late Mr. John Macleod,

and forwarded to the Society with specimens of its composition by Mr. Frere, its thickness is estimated at 1,000 feet. The specimens, besides being identical with the sandstone and light-coloured arenaceous clay which superposes the lower blue clay at Kurrachee, are almost identical with those which Lieutenant Constable presented to the Society as illustrative of the same formation on the islands of the Persian Gulf.

The only place where Captain Vicary appears to allude to the lower blue clay underlying this formation is in his description of the cliff at the Rund pass, on the Maulmaree river, which is "about 450 to 500 feet" above the latter, where he states that "an arenaceo-calcareous rock, agreeing closely with that of Kurrachee, rests at the base of the cliff on a variegated (red, white, and blue) laminated clay, apparently devoid of fossils."

In the following section, from above downwards, of the "relative position of the formations existing in Scinde," which is the upper part of that given at p. 250, there is also no mention made of this clay, though the upper blue or "black clay," which he considers a "post pliocene formation," seems to be included under "clays and sandstone":—

"Conglomerate.
"Clays and sandstone.
"Upper bone-bed.
"Sandstone (fossils rare).
"Lower bone-bed.
"Coarse arenaceo-calcareous rock, with *Cytherea exoleta*? and *exarata*; Spatangi; no Nummulites."

But in his section of the cliff on the Gauj river, (p. 304,) which is about 400 feet in height, and as far north as Larkhana, he observes that the bone-beds are underlaid by the "Kurrachee non-nummulitic rock," which is the last member of the section just given; in this case the ossiferous conglomerates may have to be grouped with this formation, instead of the lower blue clay, as they now stand.

Overlying the upper ossiferous conglomerate in the Gauj river is a bed of sandstone 150 feet thick, which, being the uppermost or last deposit, is probably continued on to the base of the Murree hills, where the confluence of the Indus with the branch formed from its four great tributaries takes place.

Passing across from this to the Doab of the Ganges, between Agra and Allahabad, we find the bone-bed, according to Captain E. Smith, from 100 to 150 feet below the level of the plain through which the Jumna now runs. In Dr. Spilsbury's section of the Omer Nuddi,

(p. 304,) the fossil bones were found 60 feet below the surface ; and in the following section from above downwards, of the banks of the Godavery at Rakishbone, kindly sent me by Dr. Bradley, and to which I have before alluded,—between 40 and 50 feet of fluviatile deposits above the situation of the bones :—

" Soil.
" Fluviatile deposits, full of nodules of kunkur (travertin), 40 feet.
" Silt laminated, 3 feet.
" Large and small pebbles of trap, calcedony, onyx, agate, heliotrope, laterite, obsidian (2½ inches in diameter). All glazed with a rich brown vitreous coating, and their interior presenting the appearance of having been subjected to intense heat. The whole mass looking as if it had once been in a state of viscidity, 1 foot.
" Another bed like the former, compact in the upper part, and marly below where the bones of the extinct species of elephant were found.
" Below this trachyte, followed by red amygdaloid."

How much of these fluviatile deposits have taken place subsequently to the deposit of the bone-bed, and are to be given to the pliocene formations, future observation must determine. Captain Dangerfield states, that the banks of the Nerbudda between Mundlesir and Chiculdah present a fluviatile deposit of 70 feet in thickness, the upper part of which, viz. 30 to 40 feet, is light-coloured, and the lower one, from 10 to 15 feet, is of a redder hue,—the latter rests on basalt. At Hoshungabad, two wells of 70 feet each were dug in the Nerbudda conglomerate, without passing through it (Finnis) ; and at Gogah, in Kattyawar, immediately opposite the mouth of this river, where the late Captain Fulljames conducted his experimental bore, the following section, which I have condensed from his detailed one, was obtained :—

Rubble	4	0	feet.
Sandstone	45	0	,,
Sandy clay, and sand and clay bands	66	0	,,
Blue clay (septaria and lignite)	229	2	,,
Blue clay			

We have now to turn our attention to the southern part of the peninsula, and in connection with what has been stated, we cannot help seeing the similarity in relative position that exists between the lateritic deposit, with its red and white clay and variegated sands, and the lower blue clay of the coast of Travancore, and that which obtains between the pliocene deposits and lower blue clay, or its equivalents on the northern and western shores of India and its adjoining countries. Nor can we, when we look at the following table, fail to see the great

resemblance which exists between these deposits on both sides of the peninsula :—

Coast of Travancore.	*Bore at Madras*, 1832.	*Madras.*	*Pondicherry.*
Feet.	Feet.	Feet.	Feet.
Loose brown sandy clay soil..... 6	Sand & clay alternating..... 13	Soil.	Surface gravel..... 2
Lateritic deposits, (iron & graphite) 14–80	Black clay..... 20	Red Hills.—Lateritic conglomerate, composed of rounded pebbles of sandstone, &c. in clay 6	Loose grit, red..... 4
Variegated clay, and sands.	Blue sandy clay... 12½	Yellowish tenacious clay with no pebbles.	Grit, with weathered fragments of quartz, and felspar..... 3
Blue clay.	Granitic gravel.... 10	(Cole.)	Red grit, with rounded pebbles of greenstone and quartz, passing in its lower portion into a variegated & yellow grit. 5
(Maj. Genl. Cullen.)	Granite.	Blue clay?	Variegated red and yellow grit..... 4
	(Newbold.)		All the beds below the gravel are interstratified with thin layers of greenish and white lithomargic clays.
			(Newbold).

I have thought it proper to place the blue clay below the lateritic conglomerate of the Red Hills, both at Madras and Pondicherry, because in the section of the bore made at the former, which is given in the table, it will be seen that black and blue clay rest on a thin bed of gravel belonging to the granite immediately below; in fact may be considered the lowest deposit, just as it probably is the lowest deposit on the Malabar Coast, where it also underlies the lateritic deposits. Newbold's section of the Red Hills at Pondicherry being only 23 feet, and not reaching down to the blue clay, and Mr. Cole, not having been able to obtain a section of the lateritic conglomerate of the Red Hills beyond 15 feet, affords us no assistance in this way.

This is all that I have to offer on the pliocene formations, which I shall not attempt to divide here, as in the present state of our information it is impossible. But I cannot help thinking that there are two ossiferous conglomerates, one of which, perhaps, belongs to the miocene, and the other to the pliocene deposits.

The fact, too, of *Charoideæ* existing with Nummulites in the upper member of Captain Vicary's nummulitic deposits, (p. 250,) and the presence of the capsules of *Chara* in the lower blue clay at Kurrachee, to which I ought to have before alluded, should not be forgotten.

Evidence of Volcanic Disturbance and Effusion between the deposit of the Eocene and the end of the Miocene and Pliocene Formations.

Commencing with Grant's "Geology of Cutch," which gains our confidence the more we examine that of the adjoining countries, it is perfectly evident, that since the deposit of the oolitic beds of that province, they have undergone the elevation which has raised them to their present level; and that during their ascent through the sea, they may or may not have been denuded of the subsequent formations which took place between the oolitic and the commencement of the miocene periods; the previous existence of these formations upon them depending on the oolitic beds having been above or below the water when they were deposited.

If the whole of the oolitic beds had been below the water during this time, and had undergone gradual, or, as it is termed, "passive" elevation, then it seems reasonable to infer that they would now have had more of these formations upon them; whereas they have only the small patch of nummulitic limestone, in the north-western part of Cutch, mentioned. If, again, the whole, viz. the nummulitic, cretaceous, and oolitic beds, had undergone paroxysmal elevation together, then also the latter, in their highest parts, might have been expected to have retained at least some small portions of the nummulitic and cretaceous beds. It seems, then, reasonable to conclude, that the nummulitic and cretaceous never did rest upon the oolitic beds of Cutch, to any great extent, any more than they have rested on the oolitic beds in any part of India; and, therefore, that those of Cutch, for the most part, having been above water when the nummulitic limestone was deposited, must have descended to have received the miocene and pliocene formations which now rest upon them.

A question, then, arises, whether the nummulitic beds in the north-western part of Cutch, and in Scinde, which rest on the oolitic beds, did not also descend with the latter at this time to receive the miocene and pliocene deposits which rest upon part of them? And to this it must be answered, that the fact of the flat-topped, isolated tracts of the Nummulitic Series, which project above the alluvial plain of the Indus, presenting no miocene or pliocene deposits on them, so far as my observation and knowledge extend, and Colonel Grant's statement that the tertiary formation "abuts" against the nummulitic limestone also in Cutch, proves one of two things—either that the part of the Nummulitic Series on which the miocene and pliocene formations now rest never rose above the water until the latter were deposited, or that it

went down partially or wholly, after the convulsion had occurred which threw up the Hala range, and isolated tracts of the alluvial plain; the intervening portions of the Nummulitic Series having at that time been more or less broken up, and taken into the formation of the miocene and pliocene deposits.

It seems plain, then, that the Nummulitic Series underwent great displacement and destruction before the deposit of the miocene and pliocene formations; and it is also plain, from the height to which the latter have been raised, that a great paroxysmal change also took place after they had been deposited; but it is not so plain that the Nummulitic Series underwent any depression previous to, or during the formation of the miocene and pliocene deposits; though the descent of the oolitic beds of Cutch, close by, to receive it, would suggest this inference.

These facts, and this reasoning, then, tend to the conclusion that the Nummulitic Series of Scinde and of Cutch has undergone two successive elevations, if not a depression also, since its formation and the end of the miocene and pliocene periods.

To what degree the elevation of these formations has extended may be conceived, when the former would appear to cap the table-land of the central part of the South-east Coast of Arabia, which is 4,000 feet above the level of the sea, (Geol. SE. Coast of Arabia, this Jl. vol. iv. p. 21,) and the miocene and pliocene is seen capping Gibbel Ghara, at Makalla, which is 1,300 feet above it. Scinde and Beloochistan would furnish similar facts if they were needed; but the extremes given are only instances of the displacement of the eocene, miocene, and pliocene formations, which in a more modified degree has taken place throughout the countries mentioned.

With such disturbances, we must of course expect here and there to have volcanic effusions; but to separate these effusions into those which took place through the nummulitic limestone previous to the deposit of the miocene and pliocene formations, from those which followed the latter, necessitates, where the miocene and pliocene formations are not present, a knowledge of the differences in the mineralogical characters of the rocks effused, if there be any, which at present we do not possess; while the large tracts of basalt which we shall find overlying the miocene and pliocene deposits, as well as breaking through them in many parts, claim our attention, from the assistance they may afford in recognising effusions of the same age in India—more than those which may or may not be confined to the Nummulitic Series.

As usual, we must return to Cutch, where Colonel Grant, under the head of "*Distinct Periods of Volcanic Eruption*," states, with reference to the tertiary deposits :—

"At the village of Doonee above mentioned, [in the southern part of Cutch,] the banks of the river present a perfectly perpendicular wall, from 15 to 20 feet high, and are composed of calcareous grit or coarse limestone, alternating with basalt, in the following order: first grit; then a horizontal bed of round pieces of basalt; and next, another stratum of the grit 15 feet in thickness; the whole being covered by the basalt forming the hills." Near the village, again, of Kerooee, is a second instance, where the banks of the river are "composed in some places of the basalt forming the Doura range; and in others entirely of the limestone grit, which in some places overlies the basalt, but forced up into anticlinal lines, as if the igneous rock had been protruded from below; the broken state of the strata showing that it was not originally deposited in this position. The bed of the river at this place is entirely composed of basaltic columns; their horizontal sections forming a regular pavement; and large masses of the columns, occupying from 200 to 300 square yards, and being about 8 feet in height, remain, every here and there, similar to a field of corn partially reaped. The columns are very regular, generally four sided, with smooth even surfaces, and are composed of a hard, compact, dark-blue basalt."

In a third instance, he adds, at the end—"Further on, * * where the dykes of basalt occur [in the calcareous grit], the limestone lies in immense masses, evidently broken off at the time of the projection of the upper bed of igneous rock; being itself of subsequent formation to the lower basaltic bed of rolled masses. This is very distinctly shown at one part of the pass, and it should be mentioned that the bed of the ravine consists throughout of irregular broken basalt."

It will be remembered that Colonel Grant's "calcareous grit" forms a part of his tertiary, and of our pliocene formations.

To the superposition of basalt on travertin, which is also underlaid by basalt, in Cutch, I have already alluded (p. 281), the superficial bed of basalt being 20 feet thick, columnar, "very hard, compact, of a dark-blue colour, and smooth surface."

But it is on the South-east Coast of Arabia that the basaltic effusions of this age are best seen, where they overlie the miocene deposits on the flat belt extending from the base of the mountains to the sea. There are three of these tracts almost touching each other, midway between Ras Sharwain and Ras Makalla, with one or more cones in each, and they all form a striking contrast in colour with the white

limestone of the mountains behind, and the white deposits over which they are spread. Their general flatness, rising almost imperceptibly from their well-defined borders to the cone or cones about their centres respectively, which do not appear to be above 200 feet in height, is also very remarkable. At their circumference they are reduced to large detached blocks and loose stones, but further in, the mass is continuous and columnar. Altogether, they extend over an area of about 45 miles long by 10 broad, the latter being the breadth of the plain between the base of the mountains and the sea at this part of the coast, so that they occupy about 450 square miles, and I dare to say, if we could trace them under the sea, into which they have flowed, more than double this amount. Towards their south-western extremity, where the miocene formations have been raised about 100 feet above the sea, the basalt not only covers the surface, but, having been effused subsequent to its elevation, appears in the beds of the watercourses which open upon the beach.

I have alluded to these striking effusions on the South-east Coast of Arabia for comparison, because its geology is so linked with that of Cutch, and because this coast is so near the western part of India.

Having thus established the existence of great basaltic outbursts over the miocene and pliocene formations of Cutch and Arabia, let us now see if there be any evidence of volcanic disturbance or basaltic effusions in connection with the great trappean district of India, which have also taken place since these periods.

That there have been great disturbances since the ossiferous conglomerate was deposited on the eastern side of Kattyawar may be reasonably inferred from the detachment of Perim island, which is not only capped with this conglomerate, but is separated from the coast of Kattyawar by a channel or chasm 240 feet deep, while on the other side it has, in one part, 1,060 feet of water. Dr. Malcolmson, too, who visited the so-called cornelian mines, on the mainland of India opposite, states, in alluding to the presence of "trap pebbles" in them, that they have been altered by the intrusion of more recent igneous rocks, which he proposed to describe in detail at a future period; but he did not live to carry his intention into effect, having died of fever on a subsequent geological excursion in this direction.

For direct proof, however, of basaltic effusion since the deposit of the ossiferous conglomerate, it seems that we must go to the upper part of the Nerbudda, near Jubbulpore, where, according to Dr. Spilsbury, we shall find the calcareous conglomerate in one part covered by a bed of compact basalt, "conformably stratified," and "presenting

a clear section" in "three hills." The hills are about 150 feet in height, and the capping of basalt, according to the section, (which is given on scale,) about 40 feet in thickness.

Over this, unfortunately, Prinsep has thrown the following conjectural doubt, which I do not think the expressions in inverted comas above mentioned justify, viz.—in alluding to the basalt stated by Dr. Spilsbury to overlie the calcareous conglomerate containing the fossil bones, Prinsep states, "unless that the breccia containing them [the bones] occurs only in exterior patches, formed of their detritus, and containing also portions of the basalt, which one or two of the specimens, whose labels are lost, seems to render probable," that is, in other words, "unless the ossiferous conglomerate *abuts* against the basalt." In opposition to which, it might be observed, that the portions to which Prinsep alludes may have been a subsequent formation of the *debris* of both basalt and conglomerate; but of course it is impossible to say who is right, Dr. Spilsbury or Mr. Prinsep; though, in making use of the facts contained in Dr. Spilsbury's communication, it seems much safer to lean to the view of one who appears to have seen the basalt overlying the conglomerate repeated in "three hills," and to have examined them on the spot with no inconsiderable attention, than to one who, at a distance, doubts the correctness of the author's observations from the examination of a hand-specimen.

Bearing upon this question is the following extract from an unpublished account of the "Fossil Sites" about Saugor, in Central India, by Captain Nicolls, of the Madras Army.

Under the head of "Narrainpore," a village situated among sandstone hills and small tracts of trappean rocks, about 17 miles south-east of Saugor, and about 9 miles due west of Railey, another village which is just beyond the eastern border of the trappean district of Malwa, and at the south-western extremity of the extensive tract of limestone which partly overlies the sandstone of Bundelkhund, Captain Nicolls states:—"I found fossils in three spots on the surface of the regur soil. At the first spot, fragments of dicotyledonous wood, with one fragment of palm, one fragment of fossil bone, and a fossil palm (?) seed converted into tuffaceous lime. At the second spot fragments of large bones strewed on the surface of the black regur soil, and one or two fragments of fossil wood, together with irregular flat pieces of tuffaceous limestone loose upon the surface. These bones are silicified: one small specimen is contained in the limestone sent to you (which is dendritic in the specimen). In the concave end of a vertebra found here, the tuffaceous limestone is present independently of any exterior

connection, and having something the appearance of nodular kunkur. I can observe no medullary canal in these fragments, the largest of which is like the head of an elephant's humerus, 14 inches broad, by 11 long. The third spot is about 150 yards from the last, and here I found dicotyledonous wood only. All the wood of the above three places was in fragments not more than 7 or 8 inches long. They lie on the black regur soil, and I see nowhere else that they could have come from but out of it. As will be observed by the map, there is sandstone in the neighbourhood of these fossils, about three quarters of a mile off. At the third spot, the under strata are remarkable, viz. about 2 feet of black soil, then 2 feet or 18 inches of concentric lamellar trap, with a hard central nodule. This trap continues for some distance of the same thinness; below it is a chalky friable white earth, the bottom of which was not seen." Again, he states of the latter:—"Half a mile from Soorkee the white chalk-like earth is seen to the depth of about 15 feet immediately below the regur soil."

These interesting facts, then, indicate—1*st*, that fossil wood and bones silicified are found together; 2*nd*, that they are in or upon a thin stratum of regur (black soil), which overlies a thin stratum of nodular or decomposing trappean rock; 3*rd*, that this trappean rock is underlaid by a white chalky earth; 4*th*, that a tuffaceous limestone, which is dendritic, surrounds and fills some of the silicified fossils; and 5*th*, that all this exists in the midst of sandstone and trappean hills, which, as before stated, are within 9 miles of the south-western extremity of the limestone tract overlying the sandstone of Bundelkhund, the trappean hills being, in fact, the fringed out border of the trappean district of Malwa, which also rests on the sandstone of this side.

Now it seems extremely probable from this, that the white chalky earth does contain fossil wood and bones, and that this deposit is overlaid in some parts by basalt, as in Dr. Spilsbury's section. It seems also likely here, that the regur is the decomposed basalt (a subject to which we shall have to recur hereafter), and that the fossils which are on its surface have come from the white chalky earth below. Lastly, that the overlying limestone tract of Bundelkhund, which Franklin considered equivalent to the lias, and which I have placed among the Kattra Shales of the Oolitic Series, seems now so likely to be a part of this white chalky earth, that I doubt very much whether I have not given it a wrong position. There is no part of India which is so interesting in a geological point of view as the district of Saugor and the adjoining part of Bundelkhund, because it appears to offer a clear explanation of so many points of this kind now in doubt.

I would also add, that independently of these fossil bones and wood bestrewing the regur, like the fossils of the intertrappean lacustrine formation in many parts of India, the siliceous infiltration of the great cancellated bones which Captain Nicolls has kindly presented to the Society has the same bluish, transparent, opaline or calcedonic appearance as that of the silicified masses of small shells of this formation which are found in many parts of India, and also in the neighbourhood of Saugor itself.

To the above evidence of trappean effusions having occurred since our pliocene formations were deposited, I have only to add a short description of the crater of Loonar, which is situated near the village of that name, about 70 miles east of Aurungabad.

Throughout the whole of the great trappean district of Western India this is the only spot which has hitherto afforded any traces of a volcanic vent, and, therefore, we may infer, that it was probably here that the last outburst, to any great extent, took place. Of this extinct crater, Dr. Bradley has kindly furnished me with the following account:—"There cannot be a doubt of the origin of the lake of Loonar. I found, in 1852, scoriaceous rocks that fully told its history. Its upper edge, [which, according to Malcolmson, who has given a short account of it, is "circular or oval,"] is about 5 miles in circumference, and the Natron lake, which occupies its centre, about 3. Its sides are about 500 feet above this lake, to which they slope at an angle of about 18°, and are breached by fissured chasms, in various directions, but chiefly through the northern and eastern scarps. Dykes of greenstone are plainly seen just under the temple with the cow's mouth. The lavic currents seem, principally, to have found vent at the north-east, and to have escaped through a deep narrow gorge, the sides of which are burnt and semifused by the passage of the molten rock. The stream rolled onward beyond the city now occupied by the town of Loonar, and is seen forming step-like masses, on to the bed of a deep ravine, a little to the eastward of this place.

"Viewed from a point in a line with the axis of the plateau on which the crater is formed, little elevation is apparent, but looking at it across, you become aware of a tumular-shaped rise in the undulating ground around it, which on the south presents a mound about 60 feet high, the sides of which slope at an angle of about 50°. This slight elevation does not arise from volcanic accumulation, but simply from the tumefaction occasioned by the gaseous expansion that has hurled its central parts into the air; evidence of which may be seen in the ravines, where a true section of the walls of the crater exposes the

beds of which they are composed, inclining from the crater outwards. Beneath the basis of the mound, on its outer and south-eastern side, is a hillock, upon which rests a thin layer of scoria, apparently the thinning out of a lavic current."

These are the latest traces of volcanic disturbance and outburst in India which have been recorded. That the disunion of Perim island from the coast of Kattyawar, and the effusion of basalt which overlies the ossiferous conglomerate near Jubbulpore, took place at least after the formation of some of the tertiary deposits, there can be no doubt, and the active state of the crater of Loonar appears to be equally modern; but unless the dark-blue, compact, columnar basalt, overlying the tertiary formations of Cutch, and that of the great trappean district of Western India, can be identified by their sameness of mineralogical characters,—and that sameness is peculiar to a basalt of India which overlies a tertiary deposit of the same geological age as that of Cutch,—there can be no means, that I see, of distinguishing, or of separating, generally, the basalt of this age in India from the other trappean effusions.

Fortunately we have the intertrappean lacustrine formation to assist us in this respect; and if it shall be hereafter proved that this is of the older pliocene period, as the presence of the remains of frogs in that of Bombay would seem to indicate; that this formation exists towards the summit of the isolated mountains of the Western Ghauts; and that it is never capped but by a basalt possessing peculiarities which distinguish it from all other trappean effusions that have preceded its advent,—then we shall not only be able to identify the latter as a post-pliocene basalt, but have a strong chain of evidence to show that the great trappean district of Western India was not broken up until the last volcanic effusions had been ejected, and that the Ghauts were not elevated until the post-pliocene age.

That the intertrappean lacustrine formation took place after the trappean effusions had began to be poured forth is indicated by the presence, as before stated, of *scoriæ* in some parts of its strata in the island of Bombay.

As an instance of an extinct volcano in Cutch, Colonel Grant gives a description of a crater near the shores of the Runn, which is called Denodur; it is the highest hill in the country. In its north side is a large gap, and a wall of basalt apparently continues all round the top. He also adds, that all the other volcanic hills in that part appear to be similarly constructed.

Near the village of Wagé-ke-Pudda, also, is "a space of about two

square miles, blown out into a flat basin, the sides being broken into fissures, with craters, ravines, and hollows, and the interior or bed of the basin interspersed with hillocks, and cones of every variety of colour,—black, red, yellow, and white,—and with patches of cinders similar to the refuse of a furnace; the whole looking as fresh as if the igneous agents were still in operation. Within the circle, also, are several small craters, or circular spaces, surrounded by walls of basalt. One more perfect than the rest is about 40 feet high, and composed of compact columnar basalt, with a talus of sand and scoriæ."

The same author also observes of this space:—"The cones and banks of loose scoriæ must be yearly washing away, and it is difficult to conceive that the walls of solid basalt forming the sides of the craters can belong to a similar period, having all the appearance and texture of very old basalt; but it is possible that a recent eruption may have taken place in the site of one of more ancient date, thus presenting a mixture of old and recent volcanic products. If it is true that basalt owes its columnar structure to its cooling slowly under a great pressure, it is impossible that these masses of columnar basalt and the loose cones of scoriæ can be contemporaneous."

Lastly, partial alterations in the level of the country in Cutch have taken place even as lately as 1819, when they were produced by an earthquake; and passive elevation still appears to be going on insensibly throughout India.

XII.

POST-PLIOCENE PERIOD.

Marine.....	*Sands and Conglomerates, with more or less Marine Shells, loosely united.*
	Upper Blue Clay, with Marine and Freshwater Remains.
Freshwater.	*Regur.*

Marine.

The example of these formations with which I am most familiar is in the island of Bombay, where I have had an opportunity of studying them.

Here, their maximum thickness is about 20 feet, two-thirds of which is below the level of the sea at spring-tides; and from the horizontality of their surface, they appear rather to have been deposited in the sea, and afterwards raised bodily, than to have been formed by beach-accumulation, from which the sea had gradually retired.

As with the tertiary formations just described, so with these, we have a deposit of blue clay, covered with sands and sandy conglomerates.

Blue Clay.—This is a stiff, plastic deposit, of a fine uniform texture; of a brown colour above, and blue below, also yellowish where it mingles with the decomposing rocks on which it may chance to rest. When pure, it does not effervesce with acids. Its maximum thickness is about 10 feet, but this of course varies with the irregularities of the surface on which it has been deposited. Towards the sea it thins out, and is there concealed by the beach, which is now in process of formation, while, further in, it is covered by the sands and shelly conglomerates of its own period. It exists throughout the island resting on the trappean rocks, or the intertrappean lacustrine formation, where the latter has been denuded.

Like most argillaceous deposits, it contains, comparatively, very few organic remains, these being chiefly confined to the overlying conglomerates, as in the tertiary formations. Here and there, however, fragments of wood occur, in greater or less number, which appear to be the stumps of mangrove trees. These are in a soft, spongy state, when first exposed, but, on drying, shrink greatly, and assume the form of hard lignite, breaking with a smooth conchoidal fracture, and presenting a shining, dark brown colour. In this state, if lighted, it burns for a short time, with a feeble flame, gives out a woody odour, and then smoulders into a white ash. This wood has for the most part been perforated by some large xylophagous *Teredo*, which has left a number of undulous tubes in it, averaging about three-quarters of an inch in diameter, and these have subsequently become thickened by the addition of more carbonate of lime to their surface, and filled with blue clay or kunkur.

A few bivalve shells, together with remnants of crab-claws and pholadine tubes, are also found in the clay, but there appears to be a strong tendency in the calcareous material to pass off by solution, and leave nothing but their impressions. Beds of oyster-shells also exist on detached blocks and large stones, on the trappean formation beneath the clay.

Nodules of concretionary carbonate of lime, called kunkur, abound in it, similar to those of the interior of India. They are more or less impure, on account of admixture of the blue clay in which they are formed, and from which they appear to derive their bluish colour. Some few portions are white and chalky, when they are entirely composed of carbonate of lime. They are more or less hard, of a compact or earthy structure, and break with a uniform dull fracture. A

fragment of wood, grass, or a shell, frequently forms the nucleus of the nodule, around which the carbonate of lime accumulates by segregation, tending always to a globular form, after which the nucleus becomes absorbed, and its mould alone remains. The globular form of the nodule does not always depend on the presence of a central nucleus, as it is occasionally seen attached in this shape to the side of the organic body.

In some localities this concretionary calcareous formation is irregularly continuous, when it is called "sheet kunkur," and in Bombay lies at the bottom of the clay, imbedding more or less gravel.

There is also another formation, of the kind called "old kunkur," and this has a concretionary botryoidal form, not unlike globular magnesian limestone; when compact, therefore, it presents on fracture a spheroidal structure, but with the interstices filled up, and each spheroid presenting a central nucleus. This kind would appear to belong to the tertiary deposits.

The kunkur formations, in Europe called travertin, are prevalent throughout India, but do not exist in the recent deposits, except in transported fragments; neither does kunkur exist on the Neilgherries (Benza).

The blue clay immediately under the surface soil at Calcutta appears to be of the same age as that of the island of Bombay. Like the latter, also, it contains logs and branches of a red wood. After a covering of 20 feet of mould, sandy clays and sand, the blue clay extends down to about the 60th foot below the surface, (see section of a "bore" which was made in Fort William in 1829,) when it passes into a yellow clay with kunkur; this, after the 125th foot, is followed by "grey sand" for about 45 feet, which rests on granitic gravel at 170—176 feet. The extreme thickness of these deposits, compared with the blue clay of the island of Bombay, may be explained by the former having been brought down by a great river from a vast extent of country, and the latter by the rivulets of the neighbouring mountains, which only flow during the monsoon.

The other details of this experimental bore, which appears to have been carried on till 1837, I have not seen, but Newbold states, that at 250 feet came a bed of quartzose and micaceous sand, from which, "at 350 feet, the augur brought up the lower half of the humerus of some animal of the canine species." Then came "black peat clay, imbedding black carbonised wood, between peat and lignite, and perfectly carbonised wood, resembling the coal of Assam, in rolled lumps"; the latter from a depth of 392 feet. "Lastly, two fragments

of a fossil *Testudo*, and a rolled fragment of vesicular basalt, were brought up from the depth of 450 feet."

The deposits below the quartzose and micaceous sand may, perhaps, be referred to the miocene period.

Sands, Shell-Concrete and Conglomerates.—This formation, which overlies the blue clay, occupies several square miles of the plains in the island of Bombay, and presents a horizontal surface, raised, as before stated, about 20 feet above high-water mark, at spring-tides. It is chiefly composed of yellow sand, and beds of small shells, which in some parts pass into a coarse conglomerate of gravel and rounded pebbles, formed from the *debris* of the trappean rocks of the locality.

The sands chiefly occupy the upper part, and, becoming more shelly downwards, pass into beds of shells and shell-concrete; which, again, changes to coarse conglomerate at the bottom.

The shell-concrete is sufficiently consolidated to form a rough building material, and has been a good deal quarried for this purpose; but it is only used in the construction of the meanest buildings, on account of its cheapness on the one hand, and its indurability on the other.

The shelly beds are chiefly composed of small bivalves which have lost their colours, *Cardium* and *Tellina*, with which are mixed a few univalves, *Turbo*, *Cerithium*, and *Nerita*, and here and there a large *Trochus* and *Turritella*, and a thin pearly *Placuna*;—in short species of all the genera now to be found on the shores of the island of Bombay. Yet, if a handful of the former be taken up indiscriminately, and compared with one from the latter, a perceptible difference between them, independently of want of colour, will be seen, in the peculiar prevalence of one species over another.

These beds rest on the blue clay inland, and are covered by the present beach towards the sea. In no instance have I ever seen a trace of anything like artificial remains or human bones in them.

At Kurrachee there is a similar series, consisting of sands and conglomerates above, with blue clays below, resting on the sands and conglomerates of the miocene period; also in the back-waters on the Malabar Coast, near Quilon, and at Cape Comorin (Genl. Cullen).

Freshwater.

Regur, or Black Soil.—This is in some parts from 20 to 40 feet in thickness, and is considered the best cotton ground. It consists of a fine, black, argillaceous mould, which contains in its lower part nodules, and even beds of kunkur and pebbly alluvium, and presents on

its surface scattered angular fragments of the neighbouring rocks, particularly fragments of chert and jasper from the intertrappean lacustrine formation, with calcedonies, fragments of quartz, geodes, agates, &c. from the trappean rocks. It exists in large tracts here and there, and seems to have been chiefly derived from the disintegration of the trappean rocks; but on this there is a difference of opinion.

Voysey and Christie give it this origin, to which Newbold is opposed. The latter objects to it on the grounds that the disintegration of the trappean rocks yields a "red" and not a "black" soil, and that the elevation of the surface of many of the tracts of regur above that of the beds of the present rivers, together with its extensive horizontality, indicate a deposit from general submergence rather than fluviatile transport. He also considered its black colour due to carbonaceous admixture, but owns that it is as difficult to point out "the origin of one as that of the other."

Here Newbold seems not to have recollected the black surface presented by the trappean rocks, which clearly proves that when their particles are thus thoroughly exposed to the action of the air, sun, and water, for a certain time, they do become black; while the disintegration of these rocks below the surface is generally red, but not always, for sometimes they pass into a grey or greenish brown wacken. Hence, then, the red disintegrated particles beneath the surface, when equally exposed to the air by transport, might also become black. With reference to the elevated position of the regur in some parts, and the great horizontality of its tracts in others, these might be accounted for by the changes of level which have taken place since their deposit, or since the miocene era, for the lower part of the regur must, I think, belong to this period; and its horizontality may have been effected previous to its upheaval, in the same way as that of the alluvial plain of the Indus or any other great river, the streams of which, constantly varying in their position from side to side, at last leave an almost even plain.

The origin of the regur, again, seems to be answered by the following questions:—What has become of the enormous amount of material that has been weathered and washed off the trappean effusions, among which there is now hardly a crater or a piece of scoria to be found? Where does any part of the trappean effusions overlay the regur? And from what older rocks than the trappean could the regur have been derived? Or if it could have been, or was derived from the older rocks, what, again, has become of the material arising from the disintegration of the trappean ones?

That the regur may have been partly blackened by the growth and decomposition for ages of vegetable matter in it no one, I think, will deny; but that the last detrital formation in India, which appears to have been immediately preceded by the trappean effusions, should be chiefly derived from any other rocks, and in any other way than that which I have mentioned, seems to me incompatible with the facts at our command. Were the trappean effusions confined to a small space, the matter would be different; but when we consider that one-fourth of Hindustan Proper is now covered by a continuous sheet of trappean rocks, and that dykes and small patches exist in the greater part of the other three-fourths, all of which are inconceivably reduced from their original dimensions, the existence of large tracts of black earth throughout India seems to be as natural a consequence as the formation of older strata from an eruption or destruction of rocks in their vicinity. —Thus the miocene formations in Scinde are so made up of the fossils and *debris* of the Nummulitic Series, which immediately preceded their formation, that it becomes a matter of difficulty sometimes to say which is which.

Lastly, the facts mentioned by Captain Nicolls, viz. that at the village of Narainpore, in Central India, 9 miles south of Saugor, 2 feet of black soil in one place rests on 2 feet or 18 inches of nodular basalt, which, therefore, must be decomposing, shows that the whole of this basalt will soon become a part of the black soil; while Dr. Adam, after having stated that this is the prevailing soil in the part of Bundelkhund over which he travelled, adds:—

"The black soil has evidently been derived from the decomposition of some of the many varieties of trap rock, most probably amygdaloid or green earth, which appear to have rested at one time over the granite in the hills of Bundelkhund. The trap rocks at Gerawah and Bisramgundj, and the globular variety of Kalinghur, may also have had a share in forming it. As I remarked before, many of the trap boulders are now in a soft state, bordering on earth, and can be reduced to powder with the greatest ease. The soil immediately around, there can be no doubt, is formed of their *debris*, and as the plain in general resembles that, we may reasonably infer that it also acknowledges a similar source."

XIII.

Recent Formations.

These I need not describe; they may be seen on our beaches, and in the alluvial deposits of the rivers which form the boundaries of the tract we have had under consideration.

Theory.

As a theory of the geological formation of a country is frequently desirable for the right understanding and remembrance of the facts contained in its geological description, so I feel called upon to terminate this "Summary" with a few observations on the manner and sequence in which the different formations of India appear to have been produced. At the same time I feel that it is perfectly useless to attempt this further back than the commencement of the Oolitic Series, for it will have been seen by the foregoing pages, that there is little or nothing to assist us in theorizing respecting the formation or position of the Plutonic Rocks and Metamorphic Strata previous to this period, and that even since, our knowledge of the subsequent formations is so scanty that it hardly justifies a conjecture.

Leaving the reader, then, to supply with his imagination the state and position of the Plutonic Rocks and Metamorphic Strata previous to the commencement of the Oolitic deposits, I would suggest for consideration—

1*st*.—That the Oolitic Series, which appears to contain the coal beds of India,* was deposited by rivers flowing from the north.

2*nd*.—That the marine beds of this series, (indicated by their shelly nature,) at the southern extremity of India, and in Cutch, seem to point to the outskirts of this delta, or the margin of pure salt-water, during this period.

3*rd*.—That this delta, viz. the greater part of India, was raised above the level of the sea before the Cretaceous and Nummulitic Periods commenced, while its eastern and western borders, extending to the Himalayas on one side, and in the direction of Scinde and Beloochistan on the other, still remained under water.

4*th*.—That the deposits of the Cretaceous and Nummulitic Periods, which now form part of the sub-ranges of the Himalaya mountains,

* It might be supposed by some, that because this coal is of the Oolitic Period, it can never beat the English coal of the Carboniferous Series out of the Indian market; but the following extract from a note which accompanied a present of a specimen of Burdwan coal to the Society, by J. Ritchie, Esq., Superintendent of the P. and O. Company's Steamers in Bombay, furnishes most satisfactory evidence to the contrary. Mr. Ritchie states:—"I consider that it will be a valuable coal for steam purposes.—At the Mint, and also at this Company's Workshops in Calcutta, it has been converted into coke nearly equal to that from England, and costing considerably less." When the proposed railway, then, is completed, which is to connect the Western Coast of India with Calcutta, the coal beds of India will become still more available, for this must pass through the districts in which they appear to abound most, and to be nearest the surface.

and the Hala range of Scinde, &c. were formed and raised above the level of the sea, leaving a gulf on each side, one in the present course of the Ganges, and the other in the course of the Indus rivers.

5th.—That the Miocene and Pliocene deposits were formed in these gulfs, and were also raised above the level of the sea, causing the latter to retreat almost to its present margin.

6th.—That the alluvia of the Ganges and Indus were deposited.

With reference to the advent of the trappean effusions, it would seem—if the coal formation resting on "secondary trap" in the Rajmahal hills should hereafter prove to be a part of the Oolitic deposits, as Dr. M'Clelland supposes, and also to have been deposit on this trap,—that the Trappean Period extended from the deposit of the Oolitic Series down to the breaking up of the Miocene and Pliocene deposits, inclusively.

The Diamond Conglomerate would, then, have been formed after the commencement of the trappean effusions, as it rests upon the Oolitic Series.

The deposits of the Intertrappean Lacustrine Formation seem to indicate a long interval of volcanic cessation previous to the outpouring of the basalt, which overlies them in the Great Trappean District.

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Abbreviations.—Journal of the Royal Asiatic Society, Jl. R. A. S.—Asiatic Researches, As. Res.—Gleanings in Science, Gl. in Sc.—Journal of the Asiatic Society of Bengal, Jl. A. S. Bl.—Madras Journal of Literature and Science,

* It was my intention to have given a list of the titles of these papers *in extenso*, but it would take up more room than can be afforded. I must therefore be content with giving the names of the publications only in which they are to be found respectively.

Provisional Table of the Igneous and Sedimentary Rocks of India.

	XIII. RECENT.	.....	Deposits now taking place.	
POST-TERTIARY	XII. POST-PLIOCENE.....	*Marine*	Sands, Shells, and Conglomerates. Upper Blue Clay. Kunkur (Travertin).	
		Freshwater...	Regur. Kunkur.	
			.....	X. Trappean Effusions, 2nd Series.
TERTIARY	XI. PLIOCENE	*Marine*	Semi-consolidated or loose calcareous or siliceous Sands, Grits, Shells, and Conglomerates.	
		Freshwater...	River Conglomerates. Old Kunkur.	
	MIOCENE	*Marine*	Solid, coarse, shelly Limestone. Oyster-beds. Calcareous, argillaceous, quartzose or sandy Conglomerates. Lower Blue Clay. Ossiferous Conglomerate.	
	IX.	*Freshwater* ..	Intertrappean Lacustrine Formation.	
			.....	VIII. Trappean Effusions, 1st Series.
	VII. EOCENE.....	.....	Nummulitic Beds and White Marl.	
SECONDARY	VI. CRETACEOUS.....	*Marine*	White Limestone, Arabia and Scinde ? (1,400 feet ?) Upper Greensand and Gault, (Albien, d'Orbigny,) Trichinopoly and Verdachellum. Lower Greensand, (Neocomien, d'Orbigny,) Pondicherry.	
			Diamond Conglomerate ? Punna Sandstone.	.... (Trappean Effusions ?)
			.....	Eruption of Felspathic and Hornblendic Rocks.
	V. OOLITIC	*Freshwater* ..	Kattra Shales..... *Freshwater* ? . Shales. Limestone. Coal.	
			Kattra Shales..... *Marine*..... Cutch. Pondicherry.	III.
			Tara Sandstone. (Old Red ? M'Clelland.)	
PRIMARY	IV. CAMBRIAN AND SILURIAN (M'CLELLAND).	.....	Transition Gneiss, with micaceous and hornblende Schistose Beds. Newer Clay Slate, with quartzose and steatitic Sandstone Beds.	
			.....	Eruption of Felspathic Rocks.
	II. METAMORPHIC STRATA.	.....	Gneiss. Mica Schiste. Hornblende Schiste. Clay Slate. Granular Limestone.	
				I. Primitive Plutonic Rocks.

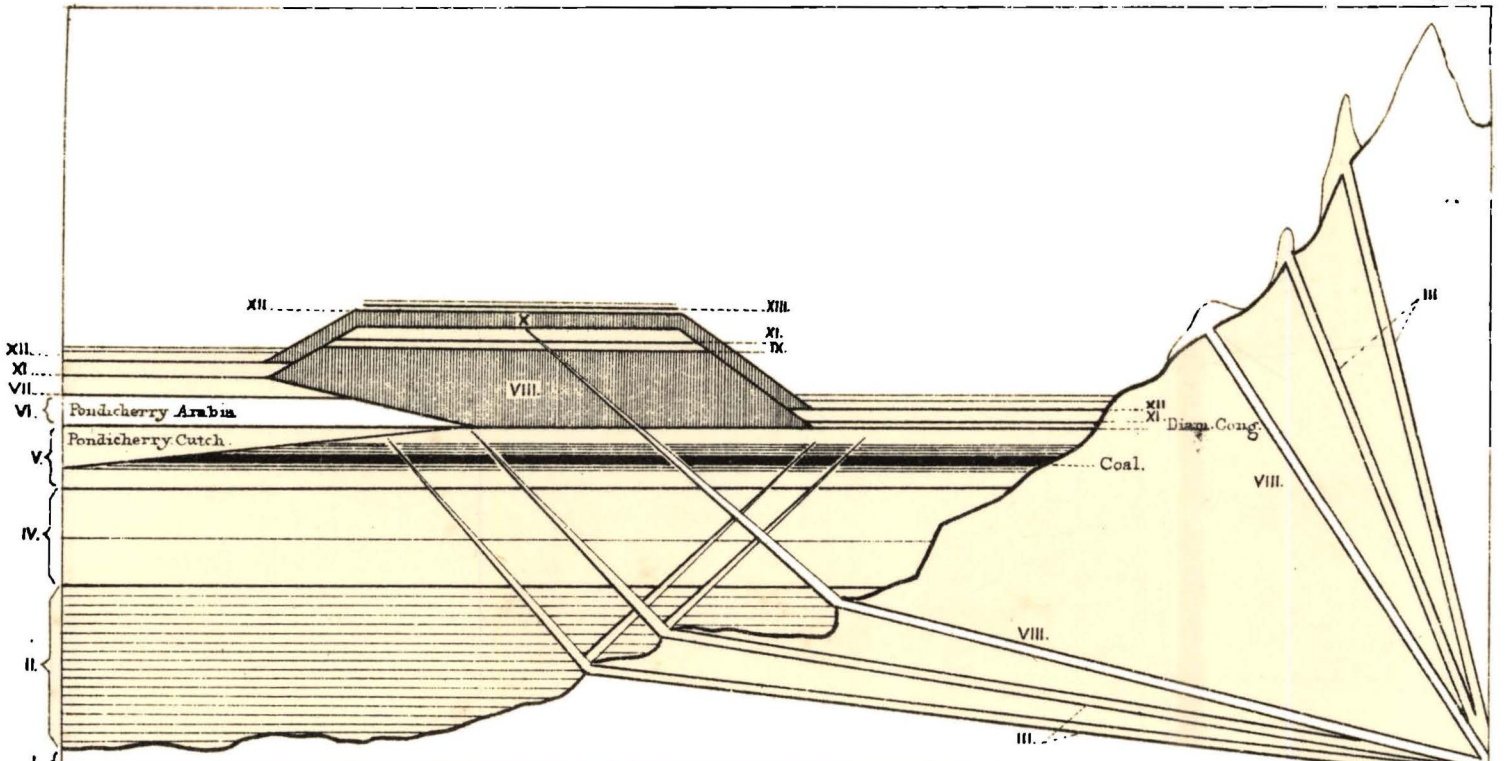
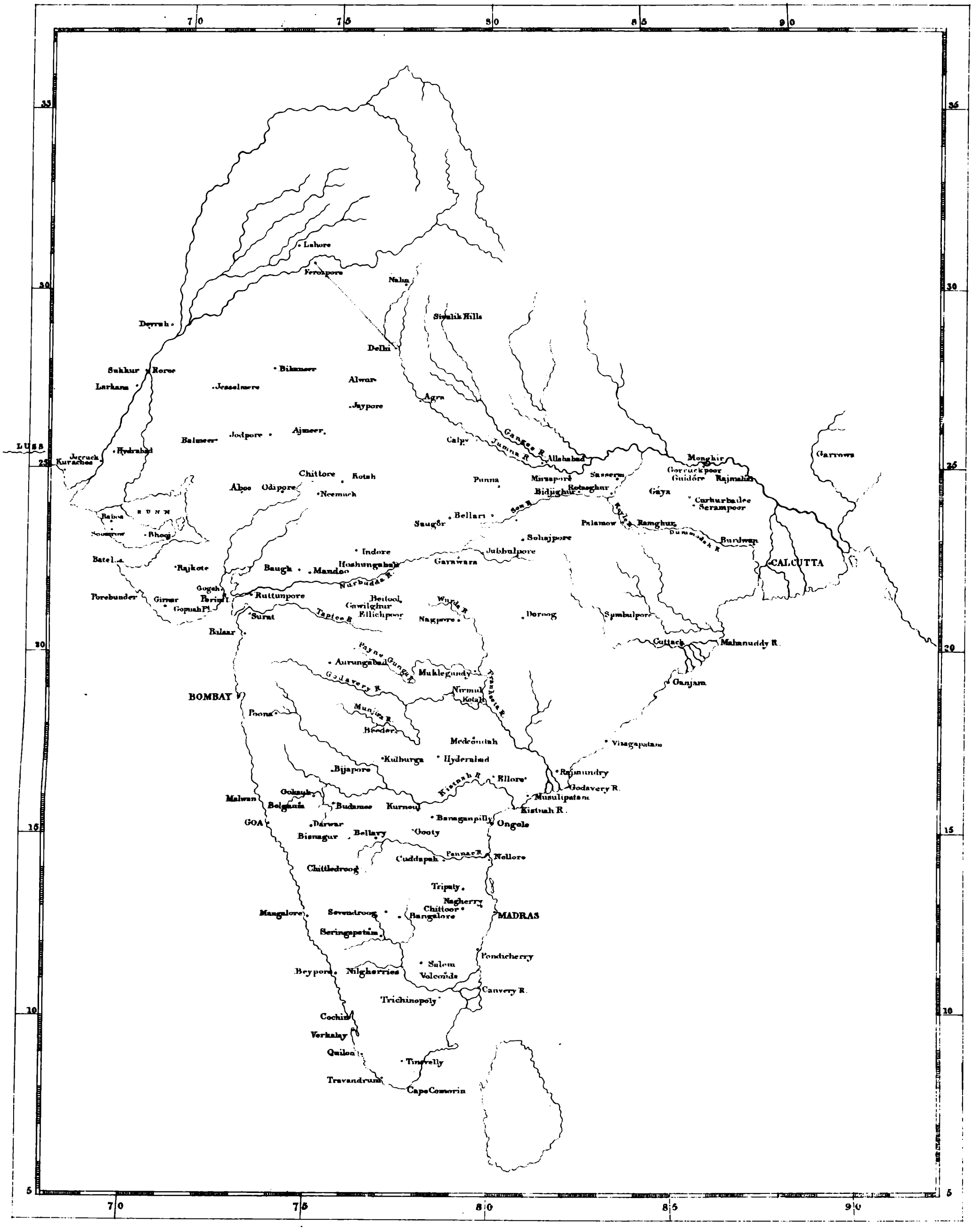


DIAGRAM.

For explanation see Table p. 334.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Lahore
Ferozpore
Nalun
Sivalik Hills
Deyrah
Delhi
Sukkur
Roree
Bikaneer
Larkana
Jesselmere
Alwar
Jaypore
Agra
Jodpore
Ajmeer
Balmeer
Hydrabad
Jeruck
Kuraches
Calpy
Jumna R.
Ganges R.
Allahabad
Monghir
Gorruckpoor
Guidore
Rajmahl
Garrows
Chittore
Rotah
Aboo
Odipore
Neemuch
Punna
Mirzapore
Sasseram
Rotasghur
Bidjighur
Gaya
Curhurbalee
Serampoor
Rahoa
RUNN
Nowanuggur
Bhooj
Saugor
Bellari
Son R.
Palamow
Ramghur
Damooda R.
Burdwan
Sohajpore
Indore
Jubbulpore
Batel...
Rajkote
Baugh
Mandoo
Hoshungabad
Garwara
CALCUTTA
Narbudda R.
Gogah
Porebunder
Girnar
Gopnah Pt.
Ruttunpore
Beitool
Gwilghur
Ellichpoor
Wurda R.
Nagpore
Doroog
Sumbulpore
Surat
Tapee R.
Balaar
Cuttack
Mahanuddy R.
Payne Gunga R.
Aurungabad
Mukkergundy
Godavery R.
Nirmul
Kotah
Wyne Gunga R.
Ganjam
BOMBAY
Poona
Munjra R.
Beeder
Medcondah
Visagapatam
Kulburga
Hyderabad
Bijapore
Rajamundry
Ellore
Kistnah R.
Godavery R.
Malwan
Gokauk
Belgaum
Budamee
Kurnoul
Musulipatam
Kistnah R.
Banaganpilly
Ongole
GOA
Darwar
Bellary
Bisnagur
Cooty
Penner R.
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Nellore
Chittledroog
Tripaty
Nagherry
Chittoor
Mangalore
Seringapatam
Bangalore
MADRAS
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Salem
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* Mr. Fraser's paper in the Geol. Trans. Lond. 4to, New Series, Part 1 of vol. v. I have not been able to obtain.

ART. III. — *Description of the Caves of Koolvee, in Malwa.*

By E. IMPEY, Esq., Residency Surgeon, Indore.

Presented 19th May 1853.

THE discovery of another series of Budhistical caves in Central India, in the neighbourhood of Ujjayuni, is not perhaps so much matter of surprise, considering the Budhistical tendency for so many centuries of Avanti, the country of the great Asòka's conversion and reign, as that they have been so long undivulged and undescribed, though within a few miles of a military cantonment.

Their existence cannot be said to be altogether unknown; for notwithstanding their situation in the wild district of Soandwara, every village within several miles round proves to know them by name; but this only tends to show how much may be brought to light when diligent inquiry is set on foot, and that it is only by such means, perseveringly or systematically pursued, that what are termed discoveries are made, and hidden, but still patent, treasures revealed.

Few things are perhaps so much to be regretted, as that the exigencies of the service, or rather the financial requirements of the State, should have led to the arrest, or certainly the curtailment, of the enlightened views and directions of the Honorable Court of Directors, regarding the record by means of illustration and description of the different architectural and antiquarian remains that are known to be spread over India. Were the commission for this purpose at work organized, as sketched out by the Honorable Court, their labours, extensive as they were intended to have been, must still reach beyond the limits of delineation, and embrace and end in many discoveries, and, which is quite as important, the correction of many descriptions of antiquities, literally and faithfully given, perhaps, but artistically and critically deficient.

Instead of deterring from notice, the likelihood of such a body being at work appears to me rather an incentive to accuracy in detailing unknown objects, for few have the opportunity of acquiring knowledge on these points by personally comparing the antiquarian remains in

the different parts of India, and fewer still the inclination to enter on it, though in the Transactions of the Societies of Bombay and Bengal, Colonel Sykes' notes, Dr. Wilson's researches, and Mr. Fergusson's works and plates, something more than superficial knowledge may be acquired.

Central India, as defined by Sir John Malcolm, having Bundlekhund and Guzerat for its eastern and western boundaries, the Hurowtee and Vindhyan ranges for its northern and southern, has been the centre of as many religions as dynasties; and though the limits above given are still retained by the paramount power for political reasons, the tract geographically considered has very much larger scope.

If the limited portion, or Malwa, can claim from Vikramajit a Brahmanical association almost syncronous with our era, it can also enumerate among the records of its creeds that of Budha, two centuries previous, in the person of the great Asòka, while several centuries after, Raja Bhoja and the Jains re-established the same religion in a different and corrupted form, and were still later succeeded by the Mussulmans in the eleventh century A. D.

Each of these persuasions have left in the country ample records of their existence; the Budhistical being, however, the most difficult to fix with any certainty, both from their greater antiquity and the absence of inscriptions or other insignia than the structures themselves, which are useful for the purpose of chronology only by comparison with similar or co-eval buildings elsewhere.

More is unnecessary in this place than an enumeration of the latter mentioned, and foremost of these is the great Sthupa (in the country termed Bittha) at Sanchi, near Bhilsa, with its elaborate and singular gateways and balustrade, its attendant tumuli and the detached but inferior ones, amounting to six or seven on the Jinea hill, about 6 miles distant, and, if I mistake not, a few minor ones at Gyaraspore, 20 miles to the eastward; all these have been recently opened by Major Cunningham, Bengal Engineers, who found, I believe, relics of different kinds, and as his work is about being published at the expense of the Honorable Court, the world will find at his hands a more critical notice than could be brought to bear on them by most archæologists in India.

The next Budhistical monuments of importance are the caves of Bàgh, in Rath, said to be four in number, but which I discovered to amount to eight, four of them large vihars, and also a second series much dilapidated. Except at Ajunta, and I doubt if even there, there is so continuously large a series.

Through the liberality of Mr. Hamilton, the Resident of Indore, I have a native artist employed in copying some paintings al-fresco, which I happened to hit upon on the conjoint exterior wall of two of these caves, and their completion will enable me to render a more intelligible description of them to the Asiatic Society.

The caves of Dumnar, near Chundwassa, fully 80 miles NNW. from Bàgh, were the only other set heretofore known, but I have now to add those of Koolvee, about 40 miles to the east of Dumnar, and I may mention incidentally, report of one at Ahoor within 15 miles of Koolvee, and one at Augur, 24 miles south. The latter I visited, and found that it had fallen in; there were in front evidences of four large plain pillars; the measurement along the rear wall was 24 feet, which was its width, the length being about 40 feet, it was diminutive in height, and the laterite roof had given way and tumbled in at the centre. It is now appropriated to one of the various forms of Vishnu, the trisool being stamped in several places on the red meaningless surface, which was thus converted and elevated into a divinity without "*form* or void" by the present race of Hindoos.

The Koolvee caves I visited first in December 1851. I was then, I believe, the second European who had been there, and they came to my knowledge through an accidental meeting with Captain Morrison, Officiating Political Agent at Kotah, who had joined the Resident's camp that year on its backward march to Indore, from a tour which had included the memorable Mokundurra Pass, and Holkar's stronghold and foundery, Hinglaisghur.

I consequently took an opportunity of the camp being in the neighbourhood to make a detour to the caves from Gungrar, the town and fortress so remarkable in the history of Malwa, and the annals of the Holkar family, for the exploits of the famous or infamous Toolseeah Bhaie, while in possession of the person of Mulhar Rao Holkar, and for the murder of Balaram Seth, events immediately preceding and conducing to the battle of Mehidpore, and the connection of the British Government with Malwa more immediately. I notice Gungrar thus prominently, because I there met in an open field a large erect slab, with a sun or chakra as an emblem, and below a lengthened inscription in a form of Sungskrit, of which I had a fac-simile taken, and as it is, I believe, for the first time made public, I send it to the Society for translation.

A hasty summons back to camp prevented my completing a report on the caves, and both on that account and a desire I always feel to

revisit a place of interest to test the record of first impressions, I made a second inspection of them.

They were first named to me as the caves of Kyesra, but I found it both a misnomer and misdirection, for they are close to, and overhang the town of Koolvee, 2 miles distant from Kyesra.

The nearest town of any importance is Dugh, longitude 24° E., latitude 76° 1′ N., it is the head of a purgunna, forming what is called the Chaomehlah, in the principality of Kotah, which passed to that State by treaty with us after the battle of Mehidpore; it is distant from Koolvee *vid* Malpore, about 6 miles, and visible from it. The other large towns near are Augur, 24 miles, Mehidpore 40, Ujjayun 60, Jalrapatun 35.

The hill in which the caves are, is isolated, perhaps 200 feet high; its general direction east and west, contrary to the axis of the hills around. Running all round it, but principally in the north and south faces, where the principal caves are, is a low scarp, nowhere 30 feet high perpendicularly, broken and split up by fissures and slips into irregular masses and projecting blocks. These conditions prevent anything like continuity being expected, or any height or magnitude to the objects.

The surface of the hill is flat, and the declivity below the scarp very gradual, and covered with brushwood of babul, behr, kuntar, &c. The only tree of any size being a tamarind, at the entrance of the temple, probably like them, the work of men's hands.

Geologically the formation of the hill is of laterite, of which a series of small hills extends SE. from Chundwassa, terminating at Augur, a stretch of 50 miles in length and 10 in breadth. The towns of Dugh, Augur, Barode, &c. are situated on it, the formation does not engage the valleys (where the black soil occurs as usual over Malwa), but the hills solely, capping basalt and trap, and it is the only instance of laterite that I have met so far westward. In substance it is very coarse, and in large fragments like conglomerate, or pudding stone, abounding in iron which imparts the colour to it. Such characteristics of course are ill adapted for minuteness of detail or fineness of execution, and with these disadvantages the selection of the hill would be unaccountable, but for the softness of the materials, and for its being, with the exception of Chundwassa, the only hill which has a scarp of any kind.

In many respects therefore, topographically, and as will be seen hereafter in other ways, the excavations at Koolvee resemble Dumnar, and these latter, I am inclined to think, have not received at the hands of

Colonel Todd or Mr. Fergusson the attention they merit. The antiquity assigned to them by both is open to question, but conceding this, and that they indicate a religion in a state of transition, such and their extent would demand for them more than a passing remark.

Colonel Todd seems to have concurred too readily in the conceited assumption of the caves by his Jain Gùrù, and transfers them at once to the Tirthankars; the only tangible cause, that I can see, being the presence of an antelope under one of the figures of Budh, but the same occurs at the Bàgh caves, which are unquestionably Budhistical though of recent date; and Mr. Fergusson very quietly disposes of them in the 8th or 9th century A. D., sailing past them on his ship of the desert almost without a hail.

I hope, hereafter, in a future paper, to notice these caves of Chundwassa or Dumnar more leisurely, but at present, even while according to Mr. Fergusson all the credit he deserves for the enterprise and research he displays in his delineations of Indian antiquities, I cannot pass over without note the sneer he indulges in (in his "Illustrations of Indian Architecture") at the incompetency of the Honorable Company's Officers to acquire and understand what he has so quickly grasped, it would seem, from his aërey in the city of palaces.

His animadversions would lead the public to suppose that the servants of Government are not only grossly ignorant, but indifferent to the objects and subjects of ancient history in India; but I must claim for them this much, that it is to their unbidden exertions alone, he himself and the world at large are indebted for the principal knowledge extant regarding them.

The caves of Koolvee, besides their mere numerical amount, possess some striking peculiarities, among which are their simplicity and primitiveness, the isolation of the cells instead of their assemblage in a vihar, the absence of a chaitya or cathedral cave, daghob worship, conjoined with image adoration and decoration of the daghoba, which are, with one exception, in the open air.

They are cut literally round the entire circumference of the hill, and are about fifty in number, including the daghoba, but not the unfinished scratchings. Their chief aspect is to the north and south, the scarp being deepest at those points. There are amongst them six daghobas, exclusive of the largest and ornamented one, all of which are cut from the solid rock.

With the exception of two (the 9th and 12th) none are pillared caves, and even these, it is evident, are not excavated as vihars, but as shalas or halls of assembly; and although the general character of the

caves evinces the same religious sentiment, "cœnobitism," there would appear to be less of centrality and communism in it, in fact less corruption; the dwellings being nearly all single.

Immediately in connection with each daghob, here as at Dumnar, is one large cell for the chief Arhan or Thero, I presume, and these are generally vaulted, and with the usual stone-couch and pillow characteristic of these caves.

The dimensions of both the pillared caves are much the same, 32 feet by 24, oblong. In one, (No. 9,) the double row of plain square pillars is still standing. These are the shalas or assembly halls above referred to; they are vaulted length-ways, and at the extremity of the left centre is a recess of the usual shape and ornament of the place for a small daghob. One of these caves is subordinate to a daghob, which stands in a court-yard in front of it, flanked by an erect colossal figure of Budh, in the attitude of expounding, and the other to a seated image of Budh, which is in a cell opposite the porch flanked on the other side by diminutive daghoba in relief.

The rest of the caves are all solitary, in groups of two or more, attached as appendices to the daghobas or figures of Budh, the largest one being nearest to the object of adoration. Their peculiarities consist in there being in each cell a stone-couch and pillow, cut from the rock, usually in the verandah, and of the roughest kind; in the caves being vaulted, and lit by one or two small openings; and in their having an inner room leading from the verandah.

The cells generally are from 8 to 12 feet in length, proportionate to the intended occupancy, and seldom above 6 feet wide: the inner room, which is frequently lit by two slits, or openings into the verandah, is seldom above 6 feet square, and as there is no general plan for these dwellings, fancy or the softness of the rock would appear to have dictated their form.

The entrances to the verandahs are sometimes in front, at others at the extremities, and those of the inner cells either directly opposite to the outer one, or leading from a side passage. Their being lit invalidates the idea of their being store-rooms. Some have pillars at their exterior entrances, some interiorly; the largest single cell, 21 by 7, is at the rear of the chief daghob, and next to it the largest double cell, 27 by 7.

In workmanship, as in plan, these caves are of the most simple character, as simple as the wants of their tenant hermits, and though the adjuncts of the ornamented daghob and image prevent their being

reckoned coeval with these in Cuttack, their *tout ensemble* would place them earlier than any in Malwa certainly.

The daghoba of the series are also deserving of attention, from their size and number, and what would be styled *corruption*, but which admits, I think, of explanation on other grounds. They are seven in number, and the highest must have been from 30 to 40 feet.

They are all in the open air, and cut from the solid rock, and have indubitably been the great objects of worship, notwithstanding that the image of Budh is carved without and within them. In shape they differ from others only in being at present without a *tee* or umbrella, and not lengthened upwards with so many beadings, fillets, and subdivisions of these as are met with in those of modern execution, which make them look like turreted pillars.

The dome or cupola is supported generally by a circular frustrum, that rests on a square basement, their junctions being relieved by a few borderings. All, however, are distinctly connected with a figure of Budh in a sitting posture, which (when they do not occupy small recesses in the exterior) are placed in an excavation in the body of the daghob, a position unknown in the caves of Western India.

In the chief one, two pillars and a porch have (not been) added to the daghob, but form a part of the design, and it is besides profusely ornamented; this latter is not, however, diversified in the least, but everywhere a repetition of the same subject, which I take to be an outline of the daghob itself, between two plain pilasters. The daghobs are seldom solitary, and from this fact most likely successive in date; the four largest are within a space of 100 yards, the smaller ones in pairs.

The chief one, like the others, is cut out from the side of the hill. Its lower basement is 30 feet square, and 10 feet high, and above it rises a circular frustrum 10 feet high and 28 feet in diameter; and as the top of this is on a level with the tabular summit of the hill, the dome, *tee* and umbrella, if it had any, must have been constructed, and given it a maximum height of 40 or 50 feet.

On examining it closely, I found evidences of this in the shape of several large stones *in situ* on the top, bearing out the supposition, and a small square hole in the centre, evidently the bed of a support. The destructive hand of time, but more likely the bigotted zeal of the Mussulmans when holding the country, have conspired to leave but this remnant of the dome. That the latter is probable, I argue from the removal of the very large stones of which the dome was made, for the occurrence of any natural phenomena would have done more general

damage. As Koolvee is visible from Dugh, which, with other towns, have still the fortifications made by the Mussulmans, this cupola would have been a conspicuous object; and, except at Oonkar and Juggernath, not a single emblem of any religious faith escaped their ruthless and vindictive zeal.

Still the daghob at Koolvee is altogether the largest and most curious single one I remember to have seen anywhere. On approaching it from the west, and ascending the constructed parapet in front, and first setting foot on the chabootra, so formed, my first impression was that I had at last met a constructed temple of the Budhists; but a closer inspection induced me to regard it as a daghob ornamented, and Mr. Fergusson would say corrupted.

There is no interior, properly speaking, but a recess for a seated figure of Budh, about 8 feet high, in front of which a small porch is made to project, cut from the same rock as the daghob itself, and the plinths of the porch pillars being 3 feet lower than that of the base of the daghob, makes them look lofty, viewed in front from the landing place, which has been saved from the hill to create this effect.

It has at one time been plastered over, and the ornament is, to my thinking, a diminutive daghob, within an archway, with pilasters at the sides flanked by similar arched decorations.

I cannot help imagining these are mere outlines of a daghob, and adapted for such purpose by a few curvatures and ornaments, and it strikes me still further that such is the origin of the pointed decorative arch of the caves and of the great *windows* of the cathedrals at Ajunta, Karli, and Keneri. I do not mean to view the arch in its constructive or architectural light, but as simply designed and suggested from a type, familiar to the Budhists in their daghoba; at least the outline is precisely alike.

Though dug from the hill, two sides of the large daghob only are free, that with the image and porch and the adjoining outer side at right angles to it, and furthest from the hill which, save in the porch, is the counterpart of the other. That nearest the hill is separated from it by a passage which leads to the large single cell before mentioned, and the other has had a frieze or screen cut on the side of the hill opposite to it, of the same character as the daghob, viz. alternate small daghoba and the ornament. This being visible from the approach up the hill, may have been considered in keeping.

Daghob No. 2, instead of a porch, has a vaulted excavation, for the image; No. 3 is the most remarkable of the series, and suggests another idea, that it is the original and type of the chaitya caves

improved on at Dumnar, and brought to perfection centuries later at Karli and Ajunta.

The daghob is here within a long ovoid cave, intended and cut for itself solely, 21 feet by 16 ; it has neither ribs, aisle, nor gallery, but an open doorway. The image is enshrined in the body of the daghob, which is prolonged forwards, and the sides terminate in pilaster-like fronts, surmounted by small daghoba, and charged with two erect warders below, and two small seated figures of Budh above them. I rather think this was done as an after-thought to protect the deity ; for the roof appears to have fallen almost during the excavation, the crust being very thin, and to this miscalculation very likely this addition is attributable.

The decorations of the daghob generally are only of any moment as indicative of the idea they embody, and the execution and progress of art they evince, and certainly very little can be said in either respect, whether as to novelty or variety. The ornament of the basement of the large daghob, the screen in short wherever seen, is a mere repetition of the same notion, and I take it to be, as said, an outline of the daghob between simple and plain pilasters.

The execution is as good as the nature of the stone admitted. Of ornamental figures there are none whatever, and those of Budh, with one or two exceptions, are seated cross-legged on a sinhàsa. The roughness and coarseness of the stone, and its disintegration by the weather, render it very difficult to say what the figures may have been originally, artistically viewed.

There appear to be no records connected with them in the shape of letters, pictorial or other illustrations, and no fabulous history (not even of the Pandus) within the knowledge of the present race of Natives who live near. All I could elicit as to their structure resulted in the happy conjecture that they were the work of gods, not mortals.

From the above data and descriptive detail there remains to be drawn the important deduction as to the antiquity of these caves. In many points they bear a strong resemblance to Dumnar, viz. in their size and height ; in short, what may be termed their physical character ; and the analogy is carried somewhat further, and embraces a similarity of worship, that of the Daghob, and in decoration ; but the caves of Koolvee have no chaitya or cathedral cave, the daghob being in the open air ; there is no attempt at a vihar, as intended in Bheem Singh's bazar, at Dumnar, and no emblematical or mythological figures, as the antelope ; they are consequently of anterior date.

Mr. Fergusson places the Dumnar caves in the 8th or 9th century, and makes the remark from their want of "simplicity and majesty, that it only requires sufficient familiarity with the degree of downward progress to be enabled to use it as a graduated scale by which to measure the time that must have elapsed before the most perfect could have sunk into the more debased specimen." This is doubtless true to some extent, though a state of perfection implies an epoch of time, as it is against reason to suppose that art could have sprung at once to positive excellence; but it is not easy to reconcile simplicity and majesty, where both material and size are against the sculptor.

It seems to me, however, that these caves leave with the beholder a perfect equivalent for the want of finish in the primitiveness of their design. The figures are all simple; the daghob, with one or two exceptions, the same; while the absence of a cathedral cave, or, to give another definition, a finished receptacle for the daghoba and its manifest worship in chief, confirm their antiquity. To add to this, there is no grotesqueness or disproportion apparent in the remains of the figures, no flying figures, Budhsutwas or subordinate divinities, and the only semblances of corruption are the alterations and additions in the daghoba, which may be accounted for in my estimation.

The Budhists in Malwa had before them but one form or type to regulate their worship, embody their faith by, and to guide them in the utterance of their creed; that was the great Sthupa at Sanchi, which I venture to say will turn out to be the Chaityagiri mentioned in the Mahavanso erected by King Asòka's wife, and visited by Mahindro their son, on his way from Oojein, (prior to the conversion of Ceylon,) and from which he is said to have sprung. This would place it in the 2nd century B. C. Its form has naturally given the character to all their after-sculptures, and originated the daghob a century or two later. An image of Budh was afterwards placed at the cardinal points in connection with it, and still later, the gateways and balustrade were added, as evidenced by the gifts towards them, in a language which has evidently undergone change.

The figures of Budh at Sanchi are seated and squatted, and the remains of pillars exist, showing that a canopy was over him.

The latter Budhists, a century or two afterwards, in copying from this in the rock, and finding the necessity to enshrine the deity somewhere in connection with the daghob, and working on the solid rock, but still in the open air, would naturally excavate a place for it within the daghob, to protect it from the vicissitudes of the weather, or have a portico in imitation of that at Sanchi, and I am inclined to think

that No. 6 daghoba, thus hollowed out from the hill, was the first attempt at having one in a cave, which was further improved on at Dumnar, where the cave was lengthened, the daghob placed at the end, and the light admitted by two lofty verandahs, the outer one higher than the inner; this being afterwards replaced by the more perfect chaitya-shaped window at Ajunta and elsewhere.

The worship of the image is thus scarcely inferior to that of the daghob itself; more properly it is associated with it. Altogether I incline to think these caves were the early attempts of the Budhists at caves in the 3rd or 4th century A. D., the second era of Budhism of Malwa.

Were they of the 8th or 9th century, there would certainly have been more perverted ornament, or some copy from the Brahmanical decorations which pervaded both the Budhist and Jain architecture at that period; but there seems no variety in it, and it almost compels the conclusion that what is seen is original. The pillars evince the same, being plain and square with the abacus merely lineally rounded.

The ornament is figurative, resembling the outline of the windows of the cathedral caves, and is the same at Dumnar and Bàgh. As it may be interesting to notice the embellishments this self-same decoration has gone through, I give in juxtaposition copy of a Budhist one, and also one from the Jain temple at Gyraspore, and from the Brahmanical monolithic temple at Dumnar. Any argument from so insignificant a part of a building as a mere decoration is not likely to be material or to justify a rational conclusion, but it is well worth while noticing it *en passant*, and remarking that had the caves been near the period of the richer one, or had the architects been Jains, the resemblance would have been closer, and partaken of its character.

In one or two cases the figures of Budh were alone in a small sanctuary for itself, but their position with reference to the other caves was so irrelevant and misplaced, that they must have been after-conceptions and posterior in date, which I take to be the rationale of the unfinished caves, which do not number half a dozen.

The following is the description of the caves in numerical succession:—

No. 1.—A single cave, 21 feet by 7, leading from the passage at rear of the large daghob. It has a stone-couch and pillow at each end; the inner room is large, the doorway being two pillars; it is dark and gloomy.

No. 2.—The largest combination of the cells opposite the landing-place, and close to the chief daghob. It is 28 feet by 7, in the shape

of a ⊥ inverted, with side rooms from the passage; it has a triangle over the door.

No. 3.—A flight of steps at the outside, and furthest extremity of this, leads to a cave over this, unconnected with it, but of corresponding length; nearly at the end are a couple of pillarets for windows, the hill projects over them admitting the light from below, but screening the verandah from the weather. There is a stone-couch near this window. The inner room leads off from a side passage, also furnished with a couch.

No. 4.—A large daghob by itself, in the open air, with a recess in its base for a figure of Budh.

No. 5 consists of a long vaulted verandah, entrance at one extremity. At the other, a small room with two windows, and a resting-place; in rear is one room, with a stone-couch in the passage.

No. 6.—The vaulted cave for the daghoba, 21 feet by 16 and 12. The roof has fallen in, and the daghoba is prolonged forwards, ending in fronts, on which images of Budh are seated over erect darpals. There is a passage round the daghob, which has a tee and double umbrella over it. The excavated portion of the daghob contains a seated figure of Budh colossal, the doorway is capped by two small daghobas. This is, I imagine, the origin of chaitya caves.

No. 7.—The cell of the attendant on the above, which is larger than ordinary ones.

No. 8.—A large daghob, 12 feet in diameter, cut from the solid rock. It stands in front of a small court 22 feet by 8, one side of which is occupied by a colossal figure of Budh, 15 feet, his right hand extended and expounding.

No. 9.—A hall or chankman, 32 feet by 24, containing a double row of plain pillars, and vaulted roof, leads from this court. One-half of the doorway before the small pillars is cut away, and the other was probably meant to be enlarged also for light, which the daghob in front blocks out; on the outer pillars is the curious inverted crescent figure noticeable in almost all Budhist caves, Keneri particularly. Above the short pilasters is the usual characteristic ornament; the doorway is 12 feet high and 4 broad, and required the additional 4 feet below for light.

No. 10 has two rooms from a verandah, in which is a large hole dug; the entrance of one room has two pillars to it, the other is plain. It is the attendant room to No. 9.

No. 11.—Entrance at the end, with a window and couch. Steps lead up to the hill between this and the above; they are now broken considerably.

No. 12.—A pillared hall, same size as No. 9; has a porch like the large daghob; a frieze along both it and the front above the windows similar to the ornamented screen of the same; the windows are small square openings; the court is flanked by daghoba in relief, and the image of Budh is in a smaller cell opposite the porch. The entire roof has fallen in, so much so that it escaped my observation on my previous visit.

No. 13.—Two caves, one a single plain cell, without verandah, and opposite to it an image of Budh in a cell also. It is observable that all the figures, however met, are under cover; if connected with the daghob they are placed in a hollow *in it*, if single or unconnected they are protected by a cell.

Nos. 14 to 22.—A range of 7 cells, plain, without verandah, or inner room or couch; in rear another figure of Budh facing outwards.

Nos. 23 to 26.—A series of three, parallel to one another, and a figure of Budh, which seems an after-idea. They are double cells with verandah, resting-places, or rooms, separated from one another by narrow passages; at the extremity of one of these is the image in a cell.

No. 27.—Two daghobas in a court in the air, cut from the hill.

No. 28.—The image, too large to admit of being placed in conjunction with them, so put into a cell adjoining, strongly marking the inseparability of both.

No. 29.—The poojaree cell, attendant as usual on the object of worship.

Nos. 30 and 31.—A large double and single cell, extending up a long passage cut in the rock, opposite the furthest; a figure of Budh in a cell.

No. 33.—A vaulted cell, with verandah, but with a large arched fronting, evidently begun for some other purpose; bears marks of having been plastered over.

No. 34.—A long vaulted chamber, too small for any purpose but a dwelling.

No. 35.—An ordinary habitation of two rooms, entrance at the extremity.

No. 36.—Approachable from above, two rooms with an open verandah and bench outside, the sun being seldom on this part.

No. 37.—A long large cell, cut high on the rock. It has a parapet in front, and a door and six rude windows; an inner chamber runs backwards from one end, entered by two pillars, and another at an angle with that. There has been a large platform for walking about in front

of this, which has now fallen. A vaulted chamber has also been commenced underneath; a flight of steps lead up to the hill from one extremity of this.

The series is here terminated by the cessation of the scarp, but is continued a little further on.

No. 38 is a cell which has lintels cut in the doorway, which none of the others have; the stone bench is outside, excavated grotto-like.

Nos. 39 and 40.—Similar to the above; the rooms being vaulted.

No. 41.—Two rooms and a verandah; door being lintelled, as all seem to be in this range.

No. 42.—Cut high on the hill, and approachable only by a ladder, like 37; there is an attempt at windows; the door has a regular arch, the windows half arched; a recess leads off from extremity.

No. 43.—A daghob, with dome broken, in a court; has a receptacle for the image projecting from the circular frustrum.

No. 44.—The attendant cell to 43. The next is the great ornamented daghob.

ART. IV.—*Descriptive Notices of Antiquities in Scinde.* Communicated by H. B. E. FRERE, Esq., Commissioner in Scinde.

Presented at different periods.

CAIRNS AND CROMLECHS.

"4. Mr. Macleod, Deputy Collector, informs me that cairns and cromlechs, such as are described by Captain Meadows Taylor, are common on the road to Shah Billawal, in Beloochistan, and also in the hills on the direct road from Kurrachee to Kotree. They are generally known as "Kaffirs' graves," and are attributed to the "Wudwas," as described by Captain Preedy. The name has been variously explained to me as meaning the "great" or the "old" people. The Hindoos claim them as Hindoos, because they buried their dead with their heads to the east, and were therefore clearly not Mahomedans. But they

could give no other reason, nor could I hear of any images or Hindoo emblems having ever been found near the graves. Tradition states that their capital was "Hubb Sarona," some distance beyond Shah Billawal, and that they worked the lead mines at Kundroj, 12 coss from the latter place; that theirs was an older city than Beila, which boasts a history of 3,000 years. Their tombs, as found thereabouts, are circles of slabs of stone, placed upright, and consist, sometimes, of several chambers, connected together. The last of the race, it is stated, were rooted out, and destroyed by Mahomed bin Cassim, when he conquired Scinde. Pieces of their money are sometimes found near the sites which the Wudwas are said to have inhabited, but they are simply squares of copper, about the size of a pice, without stamps or mark."—*Extract of letter* 1841 *of* 1851, *from H. B. E. Frere, Esq., to the Government.*

"3. Throughout the hilly tract which extends from Capo Monze upwards, and which forms the western frontier of Scinde, traces of an ancient people, distinct from those of the Soonnahs and Summahs, found in the valley of the Indus, are apparent. These are usually found most numerous in the vicinity of natural springs, and consist of stone enclosures, wells, cromlechs, caves, cairns, and graves or barrows, of unusually large dimensions.

"4. *Stone Enclosures.*—These are numerous, but the three principal ones which I have observed are situated, the first near Kurrachee, the second near Dunraj, on the direct road to Sehwan, and the third in the valley of the Hubb, near the village of Oomed Alli Chootah, about 100 miles north of Kurrachee.

"5. The first is situated near the Kurrachee cantonments, and when I first observed it, some twelve years ago, its external walls were about 3 feet high. At present merely the foundation remains, the stones having been carried away by camp followers for building purposes. The plan of the enclosure is, however, still distinctly visible.

"6. The whole of these enclosures face east and west, and are constructed of large unhewn stones, piled together without cement: they are in the shape of a parallelogram, and are usually divided by transverse walls into several departments. They vary in dimensions, that near Kurrachee being 112 paces in length by 15 in breadth, the one near Dunraj about half that size, and the third, near Oomed Alli's village, being still smaller. The first is divided into seven apartments, the second into three, and the third has no division at all. The first is known amongst the natives by the name of the "Sath Ghur," or seven houses. The traditions, or opinions rather, held by

the natives of Scinde, regarding these and the other ancient remains, are various. Some, amongst whom was Nuwab Ahmed Khan Noomujah, informed me that the enclosures were erected thirteen centuries ago by the 'Wudwa Log,' of whom nothing certain was known, except that they were either Jews or Kaffirs, and that they were driven out of the country or extirpated by the Prophet's son-in-law Alli.

"8. *Cromlechs.*—These are not numerous; indeed the only one which I have observed is situated a few yards in front of the stone enclosure near Dunraj. It appears originally to have consisted of four stone altars, each composed of four upright stones of large dimensions, with a large flat slab on the top. The altars are erected in an enclosure of unhewn stone, which is built in an exact square, each face of the square fronting to one of the cardinal points. The square is equally divided into four parts, in each of which is erected an altar. The entrance to the enclosure is in the northern face. The whole of the altars are more or less injured; but I am not aware of any excavations ever having been made to ascertain what is deposited beneath them.

"9. *Cairns.*—These are piles of unhewn stone, varying from 6 to 10 feet in height. They are very numerous, and are said by the Scindees to be of modern erection. The Natives call them 'Chors,' and report that they are erected, when found singly, to commemorate the site of some private murder, and, when found in clusters, to mark the battle-fields, and the numbers slain in engagements which have taken place in former years, between the several nomadic tribes inhabiting the hills.

"10. *Graves or Barrows.*—These are frequently met with, either singly or collectively, and are always spoken of by the Scindees as the graves of the former Kaffir inhabitants. They are found most numerous in the vicinity of the hot springs. They are usually covered with large loose stones, and are about 2 feet in height, 8 or 9 feet in breadth, and from 15 to 20 feet in length. I am not aware that any of them have ever been opened; but I purpose opening some of them during my next tour, and hope to report the result. The valleys of Naing and Kahee, in the Janghar purgunnah of Sheinstan, appear to have been the head quarters of this ancient race. Both valleys are watered by beautiful and copious springs of water, which, rising considerably above the level of the valleys, rush down on the fine alluvial plains below, affording an abundant supply of water all the year round for the cultivation of four or five hundred acres of land in each valley.

"11. The graves are most numerous in the valley of Naing, where I also discovered a rude kind of tope, of which I beg to annex a rough

sketch. It stands on the top of a small limestone hill, in which the spring which waters the valley has its source. It is constructed of large unhewn stone, put together with much regularity, but without any cement. The Nohannee tribe of Beloochees, who inhabit and cultivate the valley, state that it is erected over the heads of a vast number of their tribe who were slain in battle, when opposing a detachment of troops sent against them from Delhi under the command of a certain Nuwab. They have, however, no tradition as to when the action took place, and the Nuwab's name, if he ever existed, has long ago perished. I am decidedly of opinion that the tope is much more ancient than the Nohannee Beloochees, and I hope, on my next visit to the spot, to open it, and to ascertain its contents. Judging from its appearance, it has never been disturbed since its erection. The dimensions of the tope are as follows:—Height of the lower story 7 feet; ditto second ditto, 6 feet; ditto third ditto, 3 feet.

"12. Each story is circular, and apparently solid, the lower one being 12 feet, the second 6 feet, and the third 3 feet in diameter. There is a flight of steps in the eastern face, leading up to the top of the first story. I could discover no inscription on any of the stones.

"13. About 300 yards in front of the present village of Naing, a conical-shaped hill rises about 100 feet in height: it is very steep, and appears to have been fortified at some distant period. A winding pathway leads to the top, on which is found one of those enormous graves or barrows which I have before described. The foundations of walls are also apparent, and some modern graves. Tradition reports that this was the stronghold of the Kaffir chief whose name was Luckmere; that he here made his last stand, and, being overcome and slain, was buried here. Noor Mahomed Kullora intended to have fortified the neighbouring hills, where the spring has its source, and had gone to considerable expense in collecting stones for this purpose. Vast quantities of stone still remain piled up in heaps at convenient distances for the workmen when they should commence building. The Meer died before he could carry out his project.

"14. *Caves.*—In the valley of Kehm, at a short distance from the spring head, there are several rude caves hewn out of the rock, which have evidently been used as human habitations, though now used as cattle sheds. These, also, are ascribed to the former Kaffir inhabitants. There is a small cave between the town of Sehwan and the bunder, called the 'Ek-thamb,' or one pillared, which was visited by Dr. Wilson, and is noticed in his 'Memoir on the Cave-Temples, &c. of Western India.' This is supposed to be of Hindoo origin, but it would seem

that the ancient race whose remains are found in Scinde, and which I have attempted to describe, were not Hindoos, as the former buried their dead, and would appear to have had amongst them none of the Hindoo symbols—at least none have as yet been discovered."—*Extract of letter* 2060 *of* 1851, *from Captain Preedy, Collector, Kurrachee, to H. B. E. Frere, Esq.*

"2. Owing to the long-continued drought, the hill districts are almost deserted, so much so, that on my route from Kurrachee to Janghar I seldom met with even a solitary goatherd, except in the vicinity of a natural spring, of which several are found in the valleys. All these springs are hot, the temperature of them varying from 100° to 110°. In the valley of Longa, a spring rises at the extremity of an extensive plain, of which it waters about 300 beegas. This land is included in the jagheer of Nuwab Ahmed Khan Noomujah.

"3. Two other fine springs, called Kahee and Naing, rise a few miles to the westward of Janghar. The former fertilizes about 200, the latter about 400 beegas. The lands watered by both these springs are cultivated by the Nohannee tribe of Beloochees, the former on account of Government, and the latter on account of Kumber Allee Syed, Jagheerdar. The vestiges of an ancient people are observable in the vicinity of both of these springs, and also in many parts of the hills. These consist of rude stone enclosures, usually in the shape of a parallelogram, varying in length from 50 to 100 yards, and in breadth from 10 to 20 yards. These are constructed of rough unhewn stone, piled together in regular order, but without cement. The enclosures are generally found about 3 or 4 feet in height. They are divided by partition walls, of the same material and thickness as the outer walls, and usually face east and west.

"4. Near the springs at Kahee there are several rude caves hewn out of the rock, which have evidently been used as human habitations. They appear to be of great antiquity, but tradition is wholly silent as to who the people were that inhabited them."—*Extract of letter dated* 24*th November* 1849, *from Captain Preedy to H. B. E. Frere, Esq.*

"2. The cross-shaped erection described in the 7th paragraph of Mr. Macleod's letter is the same as that which I have described as a square of four stone altars. It is situated about half way between Truck and Dunraj, on the direct route to Sehwan.

"3. The stone graves alluded to by Mr. Macleod are found in great numbers throughout the hilly district which extends along our western

frontier. They are usually met with in elevated positions, and consist of three or four large stones set on edge, with a flat stone placed horizontally on the top. There would appear to have been no uniform rule observed as to the direction in which these graves were placed, as in the groups I have met with they are found in all directions. I had the pleasure of pointing out one of these groups to you a few days ago, on the hills near Waghodur, and I think we both agreed, that with the exception of the hole in one of the side-stones or walls, the graves exactly resemble those described by Captains Taylor and Congreve, and we are, I think, therefore, justified in regarding both as the remains of the same Scythic Druidical race."—*Extract of letter* 2154 *of* 1851, *from Captain Preedy to H. B. E. Frere, Esq.*

"2. With reference to the Commissioner's instructions on this subject, I have the honour to submit to you, for his information, that no ancient remains of the precise nature adverted to by Captain Meadows Taylor have come under my observation since my arrival in Scinde in 1843. There are some objects of interest, however, to the antiquary, which, as they are distant from the scene of my labours, I will take the liberty of mentioning to you, that the attention of others whose duties may admit of visiting and describing them may be directed thereto.

"3. In the hill country west of the Indus, graveyards far from human habitations are frequent. They are the burial grounds of particular tribes and families, to which the dead are brought, at times from a considerable distance. In such places certain graves are pointed out as those of Kaffirs; they are generally well defined, with large stones set on edge, and are easily distinguished from the more modern graves of Mahomedans. These are in all probability the graves of the inhabitants previous to the Moslem invasion.

"4. In sequestered spots, clusters of somewhat similar memorials of the dead may be found without any admixture of Mahomedan graves: they consist each of four stones, forming a small square, within which particles of calcined bones may be observed. Occasionally they are arranged in a circular form around a few, which form a centre. I may mention that between Run Pittana and Moulmacharee, in the direct road between Hydrabad and Kurrachee, is a small valley, formed by the cliffs on one side, and the hillocks on the banks of the river on the other. These remains are numerous.

"5. Scattered over the hill country in every direction, enclosures of stone, called by the Natives 'Kaffir Kote,' are to be found. What

they may have been I shall not attempt to conjecture; they are of too small a size for dwellings. Some of these may be seen on the right bank of the Gugger river, in the bed of which an inscription is reported to have been observed, in a strange character, by one of the Surveyors attached to the Chief Engineer.

"6. At Jhareejah-ka-Bootea, between Jokundee (an extensive burial ground of the Jokeeas) and the Guggur river, is a bund, composed of large unhewn stones, which was apparently made when the country was more thickly populated, and the people more industrious than at present. It is called 'Bamdelleo,' and the 'Kaffir Bund.' My inspection of it was a very transient one, but I have an impression that it is the monument of a remote era, and, in connection with the former history of the province, is worthy of the attention of the antiquarian.

"7. Near the village of Truck, on the direct road from Kurrachee to Sehwan, is a remarkable erection, not, I think, of modern date. It is composed of a double row of upright stones, and is in the form of a cross, the arms being in the direction of the cardinal points. The top is yet in part covered in with large stones, the length of which may range from 6 to 9 feet.

"8. Monuments elaborately carved are common enough; but they are all of comparatively late date, and may easily be distinguished by the head lying a little to the northward of west, which is in Scinde the supposed direction of Mecca."—*Extract of letter* 262 *of* 1851, *from J. Macleod, Esq., to H. B. E. Frere, Esq.*

Budhist Remains near Jerruck.

SIR,—I have the honour to inform you that I have forwarded to the Society two boxes containing specimens of terra cotta architectural ornaments, dug up in the neighbourhood of Jerruck on the Indus, and presented by W. Cole, Esq., Deputy Collector of Kurrachee. (Plate vi.)

2. They appear to me to be extremely interesting, for more reasons than one.

3. As mere specimens of ornamental brick-work, they are of a style superior to anything now to be seen in Scinde; but their chief interest consists in the great apparent antiquity of the building to which they belonged.

4. I have seen no remains in Scinde to which a higher antiquity than the fourteenth century could be assigned on any clear and conclusive data. The castle of Sehwan is said to be very ancient, and so may be the Kaffir remains described by Masson, as well as the numerous

Hindoo shrines which have been converted into Mahomedan peers; but the claim of all these edifices to antiquity is conjectural or traditional, and not founded on any very decisive proof, such as coins, inscriptions, architectural remains of manifest antiquity, or on trustworthy historical testimony.

5. But the ornaments of the building discovered by Mr. Cole appear to me to be clearly Budhist; and unless I am mistaken in this belief, they would give very high antiquity to the building to which they belonged.

6. All the ornamental parts strike me as very similar in character to those found in the later Budhist cave-temples; and fragments are found bearing the figure of Budha, sitting in the attitude of contemplation. The head is invariably cut or broken off, probably by the Mahomedan Iconoclasts who destroyed the temple; but the large pendulous ears and other characteristics of Budha are still clearly traceable. One of these fragments will be found in the boxes now sent.

7. Some of the ornaments are stamped; others appear to have been cut while the clay was soft; and the patterns are of great variety. Those now sent are only a selection.

8. The spot where the remains were discovered is a low hill overlooking the Indus, about 3 miles below Jerruck, and close to the hamlet of Shaik Taroo.

9. It was pointed out to Mr. Cole as a "Kaffir Kote"; the only local tradition was that it was the residence of "Munjeera," an infidel king, who reigned before the Mahomedan invasion of Scinde.

10. The flat top of the hill, (pl. v. fig. 1,) which is of small area, appears to have been formerly surrounded by a wall of large stones, the remains of which are in places still traceable. A projecting portion at the east side appears to have been separated by a wall still traceable by a raised ridge of loose stones and rubbish; and there are traces of stone enclosures inside, the character of which may, perhaps, hereafter be discovered, when the rubbish which covers them has been removed.

11. Outside of the part thus cut off from the rest of the hill are the remains of three separate enclosures: those marked (*b*) and (*c*) on the sketch are, as far as has been yet discovered, rough stone walls; the mound marked (*a*) is that from which the ornaments now sent have been dug.

12. Mr. Cole's attention was attracted to the mound by finding a fragment of a very large and fine-grained brick, one side of which had been bevelled off. It struck him as unlike any brick he had seen

before in Scinde, and he employed men to trench across the mound. They soon came to the top of a wall, and, by clearing it down to the level of the surface of the hill, and following the wall, he exposed the remains of a building 85½ feet square, constructed of large and heavy well made bricks 15½ × 9½ × 2¾ inches, laid with very little cement, and that apparently the fine mud of the Indus, mixed, occasionally, Mr. Cole thinks, with some fibrous substance.

13. The base of the building was ornamented by a bold moulding, the character of which will be seen by the section (fig. 2). At intervals of 6 feet on the ledge marked (*a*) there were square projections, as if for pilasters.

14. The mouldings were made by rubbing down the large bricks to the form required.

15. With the exception of the moulding, none of the ornaments were found *in situ*. They were dug out of the rubbish which buried the remains of the walls, as though they had belonged to the structure above, and all bearing human figures had been defaced with some care.

16. Since writing the above, Mr. Cole has discovered an inscribed stone at a spot a few miles from the remains of the temple. It was lying about a quarter of a mile from one of the large square enclosures, built of unhewn and uncemented stones, of great size, which are commonly known to the hill shepherds as "Kaffir Kote." A description of one will be found in "Masson's Travels," and in some papers by Captain Preedy and Mr. Macleod, which I forwarded to the Society some time ago. I enclose Mr. Cole's copy (fig. 3) of the inscription, which may serve to identify the character. I hope to get one more exact when the stone reaches Kurrachee. The stone itself shall be forwarded if the Society would wish to have it.—*Letter* 1217 *of* 1853, *from H. B. E. Frere, Esq., to the Secretary B. B. R. Asiatic Society.*

Ancient Remains of the Kurrachee Collectorate.

SIR,—I have the honour to enclose a copy of a letter from Captain Preedy, with a sketch map in original, showing the positions of a number of ruins, apparently belonging to an ancient people who inhabited the hilly districts of the Kurrachee Collectorate. These remains are generally known to the present inhabitants as unbelievers' forts ("Kaffir Kote," or "Koteera," the diminutive of kote).

2. There are many of them identical with the ruins described in letters from Captain Preedy and Mr. Macleod, already transmitted (with letters No. 1841, dated 9th Sept., and No. 1960, dated 22nd

Sept. 1851—pp. 354, 355,) to the Society by Government, to whom they were addressed. Some of them are mentioned by Masson,* who gives a description and sketch of that one which stands No. 2 in Captain Preedy's list, and frequently notices others incidentally.

3. I have added to Captain Preedy's letter a ground-plan (pl. v. fig. 4, *a*) of that particular building of which Masson gives a wood-cut, and a few notes made during a journey through these hills.

4. With the exception of the small buildings described as roofed with slabs of stone, none of them bear any trace of a roof. If they ever had any, it must have been of such perishable materials as to leave no fragment now remaining.

5. The size and shape of the buildings, their frontage, and their frequent occurrence at distances of a stage or half a stage from each other, always along lines of road, and at good halting-places, impress me with the belief that they were built as shelter for travellers. Asóka is said to have ordered such buildings to be erected throughout his dominions, and, certainly, even without roofs, those described by Captain Preedy must have been very acceptable to travellers as shelter against the winds which sweep these dry and desolate valleys, in winter bitterly cold, and in the hotter months like the blast of a furnace.

6. The uniformity in the plan, materials, and mode of construction, *i. e.* huge blocks of stone, roughly squared, and laid without cement, go to prove, that whatever the buildings may have been, they were the work of one age and one people.

7. It will be seen from the map, that the lines of road from Kurrachee through the hills to Sehwan and Kotree are those on which these remains are most common. These routes are still much used by kaffilas from Khelat and Upper Scinde, and the number of travellers has much increased since the conquest of Scinde rendered the road safe, and freed the traders from the constant exactions of transit dues and black-mail. The population is now, and appears for ages to have been, almost entirely nomade. Even the few fixed inhabitants live in temporary huts made of reeds and boughs of trees, nor is any house of more substantial materials to be met with on this hill road for 140 miles, from Kurrachee to the Munchur lake. One considerable tribe, the Gubbools, between Pokrun and the Munchur lake, appear to live almost exclusively in caves and fissures of the rocks.

8. Yet the buildings described by Captain Preedy are not the only evidence of there having been once a fixed and more civilized

* Vide Masson's Travels in Beloochistan, vol. ii.

population. Rubble stone foundations, as of houses, often met with in considerable numbers, and built in regular lines, with fragments of pottery, testify to the existence of a settled people, who lived in permanent towns or villages, and who must have been much more civilized than the rude shepherds who now inhabit these valleys, and whose traditions hardly extend beyond the last few generations. It is remarkable that all inquiries for coins or other remains of the former inhabitants of these valleys, calculated to throw further light on their history or character, have hitherto been unsuccessful, with the exception of the inscription, a copy of which was forwarded with my letter No. 1217, of the 6th May 1853, (pl. v. fig. 3,) and which was found near the remains marked No. 16 on the map.

9. I have marked on Captain Preedy's map (by the word "Ruins") the sites of some of these vestiges of ancient inhabitants, which appear to mark the sites of former towns.—*Letter* 2109 *of* 1853, *from H. B. E. Frere, Esq., to the Secretary B. B. R. Asiatic Society.*

Sir,—In reply to your letter No. 56, of the 10th of January last, which I much regret should have so long remained unacknowledged, I have the honour to report that the following are the koteeras which have as yet come under my own observation.

Obs. 1.—Koteera means a small fort.

No. 1.—Near Kurrachee, containing seven divisions, called by the Natives the "Sath Ghur." The rooms or divisions are nearly square, and vary in extent from about 40 to 45 feet in length and breadth. The external and divisional walls are composed of large undressed blocks of stone, without cement, and vary from 6 to 9 feet in thickness. Many of the stones appear to have been exposed to the action of fire, and are burnt quite red. The koteera faces east and west, and each division has an entrance in the eastern face. These peculiarities are observable in all those yet discovered.

Obs. 2.—Vide annexed sketch [similar to figs. 4, *b*, pl. v.]. The rooms are about 30 to 40 feet, interior measurement.

No. 2.—Near Dumas, on the direct road to Sehwan, containing two or three (4?) divisions, each of about 35 feet square. The walls are constructed in the same manner as those of No. 1. Fronting east and west there is a curious cross-shaped building near this koteera, composed of huge perpendicular slabs of stone, with horizontal slabs above, which would appear to have been used either as a tomb, a temple, or an altar for sacrificial purposes.

Obs. 3.—This ruin is about 4 miles on the Dunraj side of Truck.

For a description and drawing vide "Masson's Travels in Beloochistan," vol. ii. Annexed is a tolerably correct ground-plan (pl. v. fig. 4, *a*). The ruin is known to the Noomrea shepherds around as the "Soosee-ke-Atun," or spinning-house of Soosee, the heroine of a popular Scindee legend, one version of which is given in "Burton's History of Scinde." Captain Preedy does not mention a single upright slab or rude obelisk still standing 10 or 12 yards from the NE. angle of the temple (?) or the remains of a similar slab at a similar distance from the SE. angle (*c c*). The Noomreas have a tradition that there is in the neighbourhood a fine spring, which was purposely choked up and concealed by the "Kaffirs" when the true believers first invaded the country.

In the neighbourhood are two buildings of the same kind, not described by Captain Preedy, and which I have marked on his map as No. 2 A and No. 2 B. The former is between Ahmed Khan and Bhoola Khan's Tanda, and is a single room about 35 feet square, of the construction usual in these buildings. The other, similar in shape and size, lies between Bhoola Khan's Tanda and Soombuk, near the "Durwat," the pass by which the Bharun river escapes from the hills.

No. 3.—A large koteera on the Veroo plain, situated a short distance to the SW. of the bund. This koteera has seven divisions, is 125 yards in length, and 22 in breadth. The walls are similar in construction and dimensions to those of the "Sath Ghur."

No. 4.—A small koteera near the former one, of which only a portion of the foundations remains, the rest of the material having been removed and made use of by Captain Partridge in the construction of the large bund.

No. 5.—Also on the Veroo plain, distant about a mile from No. 3, with which it corresponds in length, but is deficient by 4 yards in breadth. The stones of which it is composed are also of inferior dimensions.

No. 6.—On the Veroo plain, distant about 1½ miles to the westward of the bund. This is a circular koteera, with only one entrance, on the eastern side. The circle is about 10 yards in diameter, the walls about 4 feet in thickness, 3 inches high, and put together in the same manner as those of the quadrangular koteeras.

No. 7.—Between Rodh and Kotree, on the direct route from Kurrachee, containing three divisions, dimensions not recorded.

No. 8.—A small one near the former.

No. 9.—About a mile to the eastward of the two last, containing three divisions.

Fig. 1.

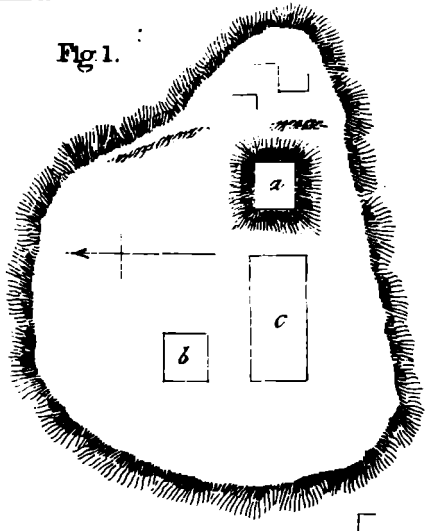


Fig. 2.

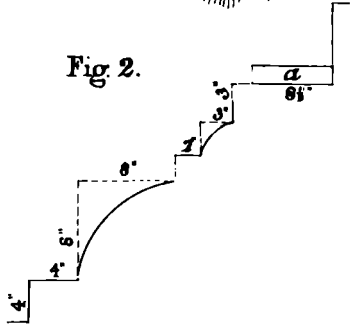
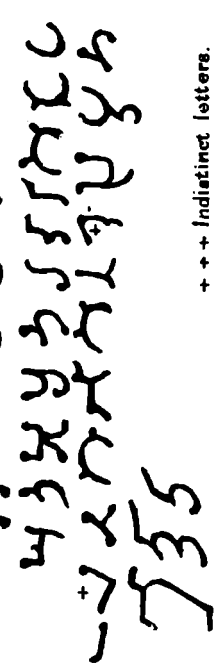
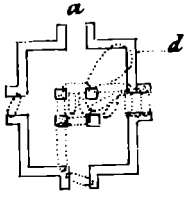


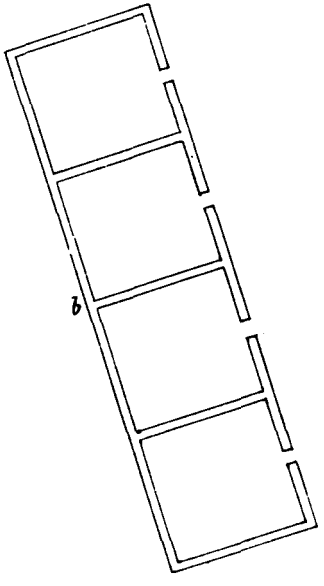
Fig. 3.



+ + + Indistinct letters.

A.C.





A.C.

Fig. 4.

Inscriptions.

on the octagonal Talisman in old Gufic

اَللّٰهُ وَعَلِيٌّ لَوْعَزَمَ هُوَّ وَاحِدٌ

God and Ali, if they wish any thing, it is the same as an order

لَاهُوَ اِلَّعَلِيَ اِلَّاوَ هُوَعظِيمًا بِاللّٰهِ

Ali is not, but by the aid of God he becomes great

مايَحْفَظُ بِاللّٰهِ وكَبُرَحَقًّا كَمَايُوْجَدُ

Whatever is protested by God a greater than that in truth cannot be found.

بَايْدِ اللّٰهُ وبحا بِاَمْرِ طَاهِرِيَجِدَهُ

By the assistance of God (rest of the line not understood.)

اَللّٰهُ مَلِكٌ وَعَلِيٌّ وَلَااِلٰهَ اِلَّااللّٰهُ اَلْجَبَّارُ

God is the King and Ali is (——) there is no God but the Lord the powerful.

لَهُمَا اَلْكَلَامُ اَلْمُغْفَرُ اِلَّا اَمَرَ مَاهَنَا

For them is the (——) word as a boast (and there is none) except the order that saves us

Appended are also the inscriptions which have been deciphered from some of the Seals and Coins.

Inscriptions on the Seals.

یاخدا یا مالك یاحافظ

Oh God! Oh Master! Oh Protector!

امام باقر

Imaum Bakur - a proper name.

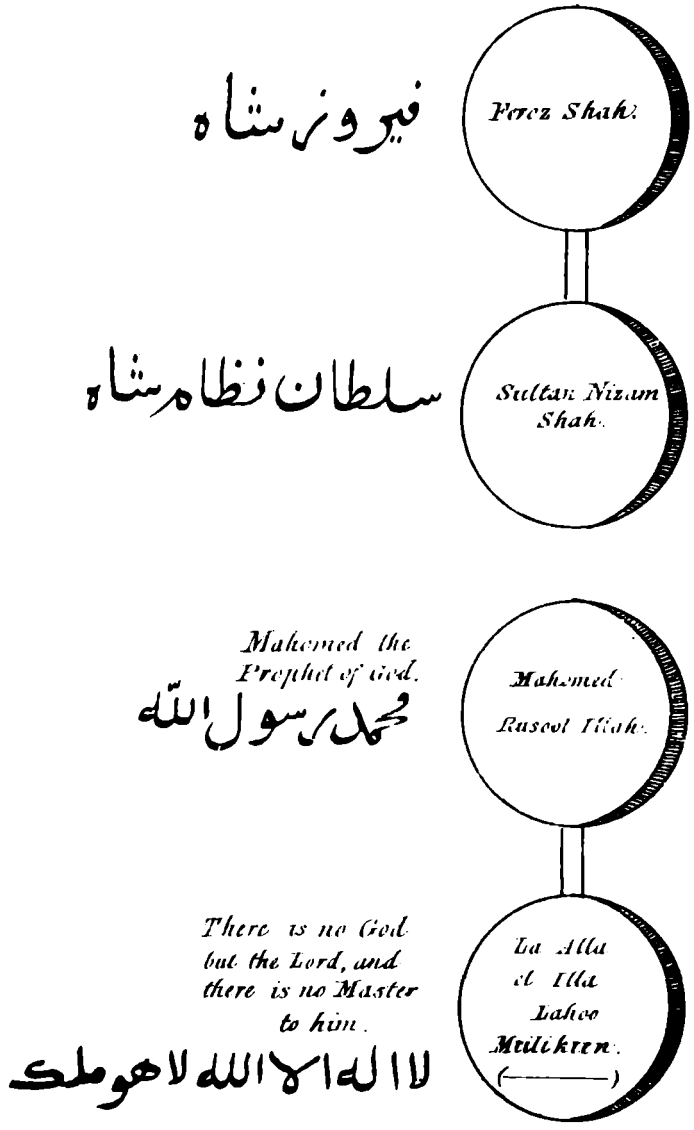
पाराणा.

Vanrana or pa rana ... King.

Another inscription supposed to be Arabic but unintelligible

There are several other inscriptions in characters which I have not been able to decipher.

Inscriptions on the Coins.



Obs. 4.—Length (walls not included) 30 yards; breadth ditto 20 yards, divided by a wall into 2 equal parts, into each of which a door, situated 7 yards from either extremity, leads. Faces to the east.

No. 10.—Between Jerruck and Soombuk, near Loonee fort, on the Bahrun river, has two divisions. There is a curious stone altar near this koteera, composed of two perpendicular stones, with a large slab at least a ton in weight placed horizontally on the top of them.

No. 11.—Between Soombuk and Murraee, containing three or four divisions, dimensions not recorded.

No. 12.—Near Murraee, containing two divisions.

No. 13.—Between Kudjoor and Pokrun, containing two divisions; a circle of stones near it, divided by a cross of white stones, the limbs of the cross directed towards the cardinal points.

Obs. 5.—This stage from Kujoor to Pokrun is particularly rich in such remains. At Kujoor itself the stone foundations of a town or large village are visible, and thence to Pokrun are numerous vestiges of former habitations. The principal remains commence about 4 miles before reaching Pokrun, at the ruin numbered 13 by Captain Preedy. It contains two chambers, each 35 feet square. The circle is a little distance to the north, and is 25 feet in diameter.

About 150 yards further on is a koteera, containing a single chamber 35 feet square.

One mile nearer Pokrun is a very curious ruin, exactly the same in materials and construction as the square ruins, but consisting of two circular chambers adjoining each other, each circle 25 feet in diameter, and each with a doorway to the west.

One mile further on is another koteera, containing only a single chamber. This is about 2 miles from Pokrun, where there is a very large and perfect building, (No. 14 on Captain Preedy's list,) very similar to that near Truck (No. 2).

No. 14.—At Pokrun, dimensions and divisions not recorded. There are several small koteeras in this neighbourhood.

Obs. 6.—One of considerable size, and surrounded by marks of the foundations of houses is to be seen at Dull, the stage between Pokrun and Jungar.

No. 15.—In the valley of the Hubb river, near Oomed Alli's village, containing two divisions.

Nos. 16 and 17.—On the post road between Murree and Kotree, both small.

2. In addition to the above, I found several koteeras in the valleys

of Naing and Kahee, all of a rectangular shape, and possessing the usual characteristics as regards frontage, construction, &c.

3. In the valley of Nallie or Nurree, through which there is a mountain pass leading to Khelat, and by which kaffilas occasionally enter Scinde, I found two other circular koteeras, of similar dimensions and construction to No. 6. These were erected parallel, and a few yards distant from each other.

4. The above are all the koteeras that I have as yet met with, but there doubtless are many others to be found scattered throughout the hill districts on our western frontier.—*Letter* 1166 *of* 1853, *from Captain Preedy to H. B. E. Frere, Esq.; the "Observations" by the latter.*

ART. V.—*Abstract of the Proceedings of the Society for the Year* 1852-53.

MEMBERS ELECTED,

FROM 9TH DECEMBER 1852 TO 28TH NOVEMBER 1853.

The Right Honorable Lord F. Fitzclarence, G. C. H.
The Honorable Sir C. M. Jackson, Kt.
H. W. Reeves, Esq., C. S.
W. Simson, Esq., C. S.
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FOR THE MUSEUM.

Argillaceous Limestone, dark grey, and black, from the district of Shorapur, presenting on the exposed side excavations, conical inwards, from 0 to 1 inch deep, and 0 to ½ inch wide.....	Capt. M. Taylor.
Basalt, dark grey, brown, with spots of Olivine, specimens of, possessing a strong polarity, from the summit of the mountain called the Pouce, in the Mauritius.....	Dr. G. Buist.
Bricks, mouldings and cornices from the remains of a Buddhist building, discovered by Mr. Cole in a mound 3 miles below Jerruck, on the Indus, Lower Scinde, bearing designs slightly allied to Grecian (?) style, viz. human figures, a running pattern of pelicans and the lotus with its shoots and leaves in the form of scrolls, lions' heads, the lotus by itself, &c. &c. On the surface of one brick is a figure of Buddha seated cross-legged on the lotus, with the hands in front of the lower part of the chest, and the little finger of the left between the thumb and forefinger of the right hand; a vest over all the body except the neck. Two rams erect,	

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one on each side, their backs turned towards the figure; and two lions couchant under the lotus. Other figures appear to have existed on each side of the head, (crocodiles' mouths?) but they, with the head of Buddha himself, have been broken off	[Esq. H. B. E. Frere,
Burmese Manuscript on palmyra leaves	Dr. J. Welsh.
Chert, containing *Physa Prinsepii, Paludina Deccanensis, Melania quadrilineata*, and *Cyprides*, specimens of, from the neighbourhood of Saugor, in Central India	Captain W. T. Nicolls.
Coal, specimens of, from the Eastern Archipelago, viz. from Port Raffles, Northern Australia, Borneo, Islands of Lingui and Junkseylan, Indramayer Point on the North Coast of Java, Labuan, Sarawak, and Cumberland	J. Ritchie, Esq.
Coins, Copper, (71,) bearing Arabic characters, from the Mahee Kanta	Capt. R. Wallace.
——— (2,) with Devanagari characters on them, from Saugor, Central India	Captain W. T. Nicolls.
——— Silver, (1,) discovered by Lieutenant Phillips in the ruins of the old town of Shakapur	[Esq. H. B. E. Frere,
Cornelian, agate, and opaque blue glass, fragments of, from the ruins of Shakapur	Lieut. Phillips.
Elephas Africanus, cranium of, without lower jaw and tusks	Capt. Campbell, I. N.
Elephant, extinct species of alveolar processes of, with parts of the tusks *in situ*, from the banks of the Godavery at Pytan	Dr. W. H. Bradley.
——— extinct species of, tusk and fragments of the long bones of, found in the bed of the Godavery, to which the alveolar processes just mentioned belong. The portion of the tusk is solid, and measures 7 inches in its widest diameter, while the hollow part in the alveolar process gives an arc of a circle which is 9 to 10 inches in diameter	———
Fossil-bones found near the village of Narainpur, 18 miles south-east of Saugor	Captain W. T. Nicolls.
Fossil-bones of two extinct species of Elephants,	

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fragments of, from the Siwalik hills, consisting of 3 portions of the lower jaws, with more or less of a tooth in each, and 3 condyloid extremities of the large long bones	Dr. G. Buist.
——— of extinct animals, fragments of, from the island of Perim, opposite the mouth of the Nerbudda; consisting of 9 portions of the jaws of 3 or 4 species of mastodon; 3 portions of 2 species of rhinoceros; front part of the lower jaw of hippopotamus; fragment of a crocodile's head; 2 large vertebræ of proboscidian (?) animals; and 3 fragments of other bones.....	———
——— of extinct animals, fragments of, from the island of Perim, consisting of 12 portions of the teeth of mastodons; 6 portions of lower jaw, and one of the upper jaw, with teeth of 2 species of rhinoceros; one portion of lower jaw of hippopotamus; 3 crania of small mammalia (posterior portions); 2 crania of reptiles, one of which is a large crocodile's head; teeth of horse, pig, and ruminant; vertebræ of reptiles and small mammalia; and 10 fragments of other bones.....	Dr. A. H. Leith.
Fossil echinodermata, (8) specimens of, from Scinde.	———
———palm-wood, (3 large specimens,) from Prome.	Dr. J. Welsh.
Fossils from the tertiary, lacustrine, and Oolitic (?) formations in the neighbourhood of Nagpur:—Tertiary and lacustrine—fragments, large and small, of endogenous and exogenous woods, seeds, and fruits, and also of freshwater shells from the former. Oolitic (?)—impressions (red-coloured) in white micaceous sandstone, of ferns and other plants, among which are *Glossopteris Browniana, G. angustifolia, Cyclopteris, Calamites, Vertebraria* (?) &c. &c..	Rev. S. Hislop.
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Geological specimens, collection of, made by a party who visited the Mud Volcanoes near Hinglaj, in the district of Luss, consisting of tertiary conglomerate, sandstone, and shells from the Hara Range; also specimens of consolidated and soft clay from parts of the mud effusions, together with pyrites, crystallized fibrous calc-spar, and a mixture of calcareous mud, sulphur, and gypsum	[Esq. H. B. E. Frere,
Gold sandstone, specimens of the so-called, from Cutch, in the creeks along the coast.....	[Esq. A. D. Robertson,
——— Ditto ditto ditto ditto....	P.M.Dalzell,Esq.
Group of 75 Rhahans (Burman Monks), listening to their Superior expounding the Buddhist Scriptures, dug out of an old Pagoda in the fort of Bassein, July 1852.....	Dr. J. Welsh.
——— of Figures in Relief, in white marble, from a Hindu temple in Guzerat.....	R. Willis, Esq.
Hornblende, green and idocrase (?) in granular calc-spar rock, from near Tinnevelly	Maj.Genl.Cullen.
Impressions of stems of endogenous plants, and small mollusca, (*Cyrena ?* 2 species,) in red argillo-micaceous sandstone, also silicified dicotyledonous wood, from between 60 and 80 miles S. of Nagpur (4 specimens).....	Rev. J. Hislop.
Iron Ore, possessing strong polarity, specimen of, from Kuneswar, 80 miles SE. of Nagpur....	———
Laterite from a mass *in situ*, specimens of, on the highest point of Worlee hill, a few yards north of the flag-staff.....	H. J. Carter, Esq.
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Lichen geographicus, on petro silex, from the Great End Crag, Borrowdale, Cumberland ..	Dr. A. H. Leith.
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Metallic and earthy minerals, (20) specimens of, illustrative of the economic geology of Southern India.....	A. Spens, Esq.
Micaceous, argillo-siliceous sandstone of various colours, (upwards of 30 specimens,) white, red, purple, brown, variegated; some bearing vegetable impressions; one portion of a fern (*Pecopteris*) from the neighbourhood (north) of Ellichpur; portions of the same formation indurated by heat.....	Dr. W. H. Bradley.
Monocotyledonous and dycotyledonous silicified woods, specimens of, beautifully cut and polished; also cut and polished silicified fossiliferous shale and shells from the lacustrine formation, in the neighbourhood of Saugor; fossil bones from the calcareous conglomerate of the upper part of the Nerbudda and its tributaries, among which is a transverse section of an elephant's tusk, friable, 7½ inches in its widest diameter (solid); all from the neighbourhood of Saugor, in Central India.....	Captain W. T. Nicolls.
Ornamental architecture, (8) fragments of, and one terra cotta mould from the ruins of the Buddhist temple near Jerruck, on the Indus.....	W. Cole, Esq.
Ostrea hyotis, specimen of, taken from the keel of one of the frigates of the Imam of Muscat.	Dr. G. Buist.
Physa Prinsepii, and *Unio Deccanensis*, free and imbedded specimens of, in semi-chertified	

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portions of the lacustrine deposits from the neighbourhood of Ellichpur.....	Dr.W.H.Bradley.
Remains taken from cairns at Andôla, Chikănhălli, Moul Ali, and Narkailpalli, alluded to, and figured in Captain Taylor's paper on cromlechs, cairns, &c. (vide Nos. XIV. and XVII. of the Society's Journal,) viz. of adult human bones, two copper bells, a copper chain ornament, spear-heads, arrow-heads, a tripod, spoon, pottery (7 large and 26 small vessels).....	Capt. M. Taylor.
Rock-specimens from granite, trap, and metamorphic and tertiary limestone in the Rewa Kanta.....	Major G. Fulljames.
——— (95,) illustrative of the geology and mineral wealth of the Salt Range, in the Punjab; also of the Murree, Huzara, and Cashmere hills.....	Supreme Govt.
——— consisting of granite, gneiss, mica, schiste, talc, diorite; metamorphic shales, limestone and sandstone; trap, basalt, and laterite, with a great number of the varieties of each; micaceous iron ore, copper ore, gold sand, and diamond breccia, all from the Southern Mahratta Country.....	Lieut.A. Aytoun.
——— (24) specimens of building materials, useful and ornamental, from the Salt Range in the Punjab, squared and polished	Bd. of Adm. of Lahore.
——— from the neighbourhood of Nagpur, consisting of saccharoid, crystalline, white dolomite, with and without red steatite; diorite, and vesicular basalt, the vesicles coated with a mineral like obsidian; freshwater shells, and portions of the bones of mammalia, from the pliocene deposits in the neighbourhood of the Nerbudda	Rev. J. Hislop.
——— graphite in a highly crystalline white granular limestone from Tinnevelly.....	Maj.Genl.Cullen.
Sandals, (a pair,) made of the leaves of the date-tree, worn by the tribes of Beyla.....	[Esq. H. B. E. Frere,
Selenite, portion of, in the cavity of a geode lined	

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with laumonite and calcspar, from the trap of Bombay (rare)	Dr. G. Buist.
Scoriæ, specimens of, from the Loonar Crater	Dr. W. H. Bradley.
Sepulchral Urns, (3,) from a mound in the vicinity of Bagdad, excavated under the superintendence of W. H. Barker, Esq., I. N.	[Esq. W. H. Barker,
Shells, (35) specimens of, in duplicate and triplicate, of 15 genera of land and freshwater, collected from the island of Bombay	Dr. A. H. Leith.
Stalactites of Salt, from a cavern in the island of Kishen, Persian Gulf	Lieut. C. G. Constable.
Umbrella, (gilt,) used by the Burmese as an emblem of rank, and by the War Chiefs as a standard; taken at the capture of Bassein on the 19th May 1852	Dr. J. Welsh.
Vegetable impressions from the coal strata near Newcastle, consisting of a large fragment of *Lepidodendron elegans*, (2 feet 3 inches long, and 11 inches broad,) and a long ensiform leaf, with parallel veins (1 foot 7 inches long, and 1½ inch broad)	Dr. A. H. Leith.
Water, specimens of, from the Aghor river, and different localities in the Mud Volcano district, in the province of Luss	[Esq. H. B. E. Frere,
Woods, fossil monocotyledonous and dycotyledonous, specimens of, found near the village of Narainpur, 18 miles SE. of Saugor	Captain W. T. Nicolls.

ORIGINAL COMMUNICATIONS.

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Africa, Copy of a Map illustrative of the Travels of the Rev. D. Livingstone, and Mr. Oswell, Madras C. S., in the interior of Africa, NE. of the Colony of the Cape of Good Hope, embracing a Visit to the Great Lake Ngamee.—*15th September* 1853. (*a*)	[Esq. H. W. Reeves,

(*a*) Recorded.

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Barr (Capt. C. W.), Vocabulary of Slang Language used by the Mangs and Ramoosees of Kolapore. —*20th January* 1853. (*b*).....	Govt. of Bombay.
Bradley (Dr. W. H.), A short Description of the Cave-Temples of Baitalbarree and Doulatabad, first brought to the notice of the Society by Captain Rose, with 30 Fac-similes of Inscriptions from these and other Cave-Temples. —*17th March* 1853. (*c*).....	The Author.
Brahminabad, River of, extract (paragraphs 6 to 9) from a letter dated 28th February 1853, from the Acting Collector of Hydrabad, relative to, situated about 9 miles ESE. of Shadadpoor.— *21st April* 1853. (*d*).....	[Esq. H. B. E. Frere,
Carter (H. J., Esq.), Description of *Orbitolites Malabarica* (new species), from the Tertiary Limestone of the Coast of Travancore, illustrative of the Spiral and not Concentric Arrangement of Chambers in D'Orbigny's order *Cyclostegues*.—*17th February* 1853. (*e*) ..	The Author.
——— Summary of the Geology of India between the Ganges, the Indus, and Cape Comorin.— *18th August* 1853. (*f*)	———
De Crespigny (Dr. E. N. C.), Short Descriptions of 23 Species of Freshwater Fishes from the Rivers in Guzerat, with a drawing of each.— *17th November* 1853. (*g*).....	———
Edwards (T. E.), Report on a Survey of the River Taptee.—*16th December* 1852. (*h*).....	Govt. of Bombay.
Framjee (D., Esq.), Comparison, and Re-examination, with Notes, of the Bilingual Inscriptions of Haj-i-Abad, near Nuksh-i-Rustam, published in Sir Ker Porter's Travels in Persia, and in Professor Westergaard's edition of the Zend-avesta.—*17th February and 20th Oct.* 1853. (*i*)	The Author.
Frere (H. B. E., Esq.), Account of the Remains of a Buddhist Building, 85½ feet square, discovered	

(*b*) See Selection of Government Records, Part I. (*c*) p. 117.
(*d*) Deferred. (*e*) p. 142. (*f*) p. 179. (*g*) Recorded.
(*h*) See abstract of, Proceed. Off. Lit. &c. (*i*) See next No.

	COMMUNICATED BY
by W. Cole, Esq., Deputy Collector of Kurrachee, in a Mound 3 miles below Jerruck, on the Indus, in Lower Scinde, with specimens of the Bricks and Ornamental Parts, which are all in terra cotta. Also copy of an Inscription some miles off.—19*th May* 1853. (*j*) ...	The Author.
Fulljames, (Maj. G.), A Description of the Salt-water Lake called the Null, situated on the Isthmus of Kattyawar (with a Topographical Sketch).—17*th March* 1853. (*k*)	————
Hislop (Rev. S. J.), Geology of the Nagpur State. —17*th March* 1853. (*l*)	————
Impey (E., Esq.), Description of the Caves of Koolvee, in Malwa (with Ground-plan and Drawing).—19*th May* 1853. (*m*)	Govt. of Bombay.
Kurrachee, letter enclosing one from Captain Preedy, with Sketch Map in Original, on the Remains of an Ancient People in the Collectorate of.—15*th September* 1853. (*n*)	[Esq. H. B. E. Frere.
Leith (Dr. A. H.), Note on an apparently undescribed Genus of *Gasteropod.*—17*th March* 1853. (*o*)	The Author.
Phillips (T., Esq.), Memorandum on the Ruins of Shakapur.—16*th June* 1853. (*p*).....	————
Romer (J., Esq.), Brief Notices of Persian, and of the Language called Zend. By John Romer, Esq., M.R.A.S., formerly President of the Society.—20*th January* 1853. (*q*)	Rev. Dr. J. Wilson.
Stevenson (Rev. J.,D.D.), On the Násik Inscriptions.—17*th February* 1853. (*r*)	The Author.
——— Sahyádri Inscriptions.—20*th October* 1853. (*s*)	————
——— on Buddhist Antiquities in China. 15*th September* 1853. (*t*)	————
——— Tithyas or Tirthakas of the Buddhists and the Gymnosophists of the Greeks, Digambar Jains.—20*th October* 1853. (*u*)	————

(*j*) p. 357. (*k*) p. 109. (*l*) p. 58. (*m*) p. 336. (*n*) p. 145.
(*o*) p. 145. (*p*) Recorded. (*q*) p. 95. (*r*) p. 35.
(*s*) p. 151. (*t*) See next No. (*u*) See next No.

	COMMUNICATED BY
Sunjana (P. D. B.), Translation of the Pehlivi Inscription at Haj-i-Abad, near Nuksh-i-Rustam, corrected from Professor Westergaard's copy in his lithographed edition of the Zendavesta.—17*th February* and 20*th October* 1853. (*v*)	The Author.
Translation of a Copper-plate Edict appointing a Fee to be paid from the Punchanum and other Tribes to one Gajankoosh Wuntpoolee, dated *Shalivahan Shaka* 1022 (A. D. 1100), found in the possession of a Gang of Dacoits in the Southern Mahratta Country.—17*th November* 1853. (*w*)	Govt. of Bombay.
Westergaard (Prof. N. L.), The Ancient Iranian Mythology; a Letter to the Rev. Dr. Wilson, Honorary President of the Society.—21*st April* 1853. (*x*)	Rev. Dr. J. Wilson.

PROCEEDINGS, OFFICIAL, LITERARY, AND SCIENTIFIC.

IT having been stated by the *Secretary* that His Excellency the Commander in Chief, Lord Frederick Fitzclarence, wished to become a Member of the Society, the Rev. Dr. Wilson, *Honorary President*, seconded by the Rev. P. Anderson, proposed that a deputation, consisting of the *President*, A. Malet, Esq., *Vice-President*, and the *Secretary*, should wait upon his Lordship at the earliest opportunity, for the purpose of soliciting him to become *Vice-Patron* of the Society.

Captain T. Barr's letter intimates his intention to furnish the Society with a vocabulary of the dialect spoken by the Mangs of Kolapore, to accompany his sketch of the manners and customs of this people, read at the last meeting of the Society.

In Captain Nicolls' letter is contained a short account of the specimens of silicified monocotyledonous and dycotyledonous wood, &c. mentioned (p. 371). These specimens, which are beautifully cut and polished, form a valuable addition to others already forwarded from the

(*v*) See next No. (*w*) Recorded. (*x*) p. 77.

same neighbourhood, and partly by the same officer. Captain Nicolls states that they were found strewed on the surface of the black (regur) soil near the village of Narrainpoor, associated with similar sized pieces of chert, and occasionally jasper and radiated zeolite. The fossilized bone, which is a phalanx of some large animal, was obtained from the same locality.

The survey of the river Taptee by T. E. Edwards, Esq., extends over 232 miles of the river Taptee, viz. from the Wanjore branch, on the road between Malligaum and Boorhanpoor, to Surat. The width of the river, until emerging from the Daung jungles into Guzerat, is from 800 to 1,200 feet; afterwards it is from 1,500 to 3,000 feet wide; that over the gravelly shoals is from 1,500 to 1,300 feet wide, and the depth of the water from 1 foot 6 inches to 2 feet 9 inches, with a stream running from 2 to 3 miles per hour. The banks in Khandeish are about 60 feet high, of which the upper part consists of black, and the lower of yellow earth. Where the spurs of the Satpoora hills and the tail of the Western Ghauts come upon the river, the banks are 150 and 200 feet high. The bed of the river is gravelly the whole way. On emerging from the Daung jungles into Guzerat, the banks are low. Mr. Edwards proposes to deepen the water over the shoals by narrowing the channel; and after removing a few rocky obstructions in other parts, to navigate the river with flat boats of a particular kind, which he describes, and which might be tracked the whole way. He then considers "that a great portion of the trade of Berar, (Oomrawutty being only 130 miles distant,) the trade from Bundelkhund passing through Hoshungabad, and the whole of the traffic from Lahore along the Agra road, would be diverged down the Taptee to Surat"; and not improbable, but that at some future period it might be found advantageous to send coals from the coalfields near Hoshungabad by the same course.—16*th December* 1852.

With reference to the deputation appointed at the last meeting to wait on the Right Honorable Lord Frederick Fitzclarence, Commander-in-Chief, &c. &c. to solicit his Lordship to become *Vice-Patron* of the Society, the *Secretary* reported that his Lordship had expressed himself much pleased to comply with the Society's request, but would have prefered a *Vice-Presidentship*, that he might have had an opportunity of being more useful. The Society regretted that there was not a vacancy among the *Vice-Presidents*, to take advantage of his Lordship's kind consideration.

The Government circular No. 124 of 1853 intimates that the Council

of the Society of Arts have resolved on embodying their proposed exhibition of the products and manufactures of India with a great International Exhibition to be held in Dublin this year, and requests the Society to give the same publicity to this as it did to the original intention. The *Secretary* was directed to act accordingly.

Dr. Fleming's letter No. 89, dated 9th December last, states, that in compliance with the request from the Secretary to Government with the Governor General, in his letter No. 77, dated 17th March 1851, and which was made known to the Society through Sir H. M. Elliot about the same time, he has prepared for the Society's museum "a collection of specimens illustrative of the geology and mineral wealth of the Salt Range in the Punjaub," also "a collection of rocks, &c. from the Murree, Huzara, and Cashmere hills." These had been carefully packed in a strong box, and forwarded from Jhelum on the 28th October last, to the care of the Secretary of the Board of Administration at Lahore, from whence Dr. Fleming had received advice of its despatch to Bombay, *viâ* Mooltan and Kurrachee. The letter is accompanied by a descriptive catalogue of the specimens, which bears evidence of their forming a most interesting and valuable contribution to the Society's museum.

A large roll of impressions of the inscriptions in the caves at Junir, with a plan of the latter by Lieutenant Brett, was laid on the table; also a letter from Mr. Brett, stating that he was now at Karli, taking impressions of the inscriptions in the caves of that place. The Rev. Dr. Wilson stated that the time sanctioned by the Supreme Government, viz. one year, for Mr. Brett to take these impressions, had nearly expired, and that although Mr. Brett had laboured very diligently during the whole of that time, yet as many, if not more, inscriptions remained to be taken, he therefore submitted to the Society the desirableness of getting Mr. Brett's appointment prolonged. The Cave-Temple Commission were requested to communicate their views on the subject to Government direct.

Accounts had been received from Mr. Fallon at Karli, stating that he was progressing rapidly with his illustrations of the caves at that place.

The Rev. Dr. Wilson, seconded by Thomas L. Jenkins, Esq., proposed, that as the overland carriage had been so much reduced, the subject of having the Society's supplies forwarded by this route instead of round the Cape be submitted for the consideration of the Committee, and brought forward for discussion at the next meeting. This was unanimously agreed to.

Dr. Wilson, in directing attention to the paper entitled "Brief Notices of Persian, and the Language called Zend," which had been forwarded to him for presentation to the Society by Mr. Romer, formerly *President* of the Society, remarked, that the languages connected with Iran, genuine and spurious, to which attention of late years had been directed, are the Zend, in which the books esteemed sacred by the Parsis are found, and which by some, though not by our best British linguists, had long been held to be the parent of the modern Persian; the language in which the Achæmenian inscriptions at Besitun and other places are composed, which is now denominated by German philologists the old Persian, and of which the Zend is undoubtedly not the parent, though it is in some respects cognate; the Sasanidan, in which the inscription at Haj-i-Abad, which would presently form the subject of conversation, and some similar inscriptions of the dynasty of Sasan, translated by the Baron de Sacy, are specimens; the Pehlivi, in which translations of the Zend writings, and a few other works are found in the hands of the Parsis, which is held by Westergaard to be only a dialectine form of the Persian, misread by the Parsis in consequence of the use of an imperfect and ambiguous alphabet, and which is denominated by Spiegel the "Parsi," and said by him to be intermediate between the language of the Sasanidan inscriptions and that of the Shah-Nameh of Firdausi; the Asmani Zaban of the Desatir, now admitted by all to be a fabrication; and the Persian, properly so called, in which all the works of Iran since the days of Firdausi appear. Respecting the last mentioned language, Mr. Romer maintains that its connections with the other languages, with the exception of the so-called Pehlivi, which appears substantially identical with it, notwithstanding the assertion of certain of the Parsis to the contrary, are exceedingly remote and insignificant, and by no means of the character long alleged by the able and zealous orientalists of the continent. The claims to genuineness urged in behalf of the Zend he disputes, as resting on insufficient grounds, particularly as no vestiges of it as a language ever spoken can be found: its historical connections cannot be traced; its structure and form are entirely diverse from the Persian, especially in its having inflexions, while the Persian has none; its literature is frivolous and absurd in its character, and its undoubted relations to the Sanskrit are artificial and suspicious. He calls upon Dr. Wilson to "undertake the task of a careful re-examination of the points which have satisfied him as to the genuineness of the Zend," particularly as he has renounced all faith in the authenticity of the Pehlivi as a distinct language, by giving in his adherence to the views of Westergaard. Dr. Wilson stated, that

though his views of the Zend remained unchanged, and are founded, not only on the analogies which it bears to most of the languages of the Indo-Germanic family, both near and remote, on various though brief geographical and historical allusions which it contains, and on certain analogies, and at the same time antagonisms, to the oldest forms of Hinduism which it expresses, yet the request of one so much venerated in Bombay as Mr. Romer, and who conducts his discussions with a happy union of spirit and courtesy, was received by him with the greatest respect. He concluded by moving, that the Society express the high gratification with which they have received Mr. Romer's communication, and resolve to insert it in the Journal of the Society.

Dr. Wilson's motion having been seconded by A. Malet, Esq., *Vice-President*, was unanimously adopted.

A letter was read from Manockjee Cursetjee, Esq., who had been requested at last Meeting to communicate his views regarding the decipherment and translation, by the Parsi Dastur, Pestonjee Behramji, of a rock inscription in what is called the Pehlivi language, found at Haj-i-Abad, near Nuksh-i-Rustam, which is understood to refer to Sapor the son of Ardeshir (Artaxerxes, the restorer of the Persian monarchy in the 3rd century). An animated conversation took place as to the value of the Dastur's labours. As no authoritative translation of the important inscription in question exists,—Mr. E. Thomas (Jl. As. Soc. vol. xii. page 263) expressly states that no translation whatever has been made,—the Society requested that the Gujarati version forwarded by the Dastur through Mr. Green should be rendered into English, and submitted to the Society. A letter from Mr. Dhunjibhoy Framji was also read, in which he stated that upwards of two years ago he had deciphered and translated the same important inscription, arriving, however, at considerably different results from those of the Dastur's labours. The *Secretary* was requested to communicate with Mr. Dhunjibhoy Framji (who was not present), and obtain a copy of his translation, and the remarks which he stated himself prepared to make on the paper of Mr. Pestonji Behramji, in the hope that the communications of both these gentlemen on this difficult ancient record might ultimately be inserted in the journal of the Society.

Mr. Green also stated that the same Dastur was preparing a critique on Professor Spiegel's version of the 19th Fargard of the Vendidad, as given in Mr. Mitchell's paper in the last number of the Journal. The Society expressed its readiness to receive the communication.

The *Secretary* stated, with reference to the specimen of laterite

mentioned, (p. 370,) that he had broken it off from a mass *in situ* on the highest point of Worlee hill, a few yards north of the flag-staff. That the mass reposed on the basaltic rock there, and that it was decomposing into red earth, just the same as that of the basalt, only of a deeper colour, from the greater abundance of iron in its composition. There was no question of its not being genuine laterite, and all could see that it was identical with the specimens of laterite from the Southern Mahratta Country which lay on the table. It was composed, just as these were, of a mass of iron clay, permeated with sinuous cavities, presenting a smooth polished surface internally, and empty, or filled with a greasy whitish yellow earth—while here and there in the general mass were spots of blue iron ore common to this rock. It could not be confounded with the rolled pieces of laterite found about the declivities and shores of the island of Bombay, which may or may not have come from similar sources, because on the top of Worlee hill it was to be found not only *en masse*, but *in situ* reposing on the basalt, just as it does elsewhere. The portion of rock would be deposited among the other specimens illustrative of the geology of the island of Bombay, and might be compared by any one with the specimens of laterite from the Southern Mahratta Country, in the glass-case immediately opposite.—*20th January* 1853.

The Government letter No. 440 of 1853, accompanied by the box of specimens above mentioned, from Dr. Fleming, encloses also a copy of a letter, No. 1783 of 1852, from P. Melvill, Esq., Secretary to the Board of Administration of Lahore, announcing the despatch of the same from Mooltan to Bombay, *viâ* Kurrachee.

This valuable collection, which had arrived safely, and had been laid on the table, was ordered to be put in a convenient place in the museum, and the *Secretary* requested to acknowledge its receipt, with the most grateful thanks of the Society to the Supreme Government, through the Government of Bombay; also to transmit the best thanks of the Society to Dr. Fleming, for the care and trouble he had taken in the preparation and packing of this handsome and instructive present.

Lieutenant Brett's letters, dated 23rd ultimo, and the 14th and 15th instants, forwarding respectively "Fac-similes of the Inscriptions in the Cave-Temples of Karli," a memorandum of contingent expenses during the time that he has been thus employed; and a request that the application for the extension of his appointment might be withdrawn, were submitted for the consideration and reply of the Cave-Temple Committee.

The copper coins above mentioned, forwarded by Captain Nicolls, were handed over for the examination of the *President*.

The Rev. Dr. Stevenson, in his paper mentioned, (p. 375,) stated that he had found four dates in the Násik caves, and two of them repeated in the Karli caves. Most of them were both in words and figures of the ancient type given by Prinsep. (Jl. As. Soc. vol. vii. pl. xx.) The dates are given in years, seasons, fortnights, and days, but no months. The numbers of the years range from 7 to 24, which made the *President* at first think that the dates were merely the number of the years of the reign of the monarch who caused the inscription to be executed. He found afterwards, however, that a Dukhunee prince, Gotamiputra, was celebrated as the reigning king, while the date was in the year of a Gujarat sovereign named Padma. This is the name of the son of the monarch who is supposed to have instituted the Balabhi era, and the father's name, which on the inscription is Vasava, by the aid of Ferishta, the Aqueen Akbaree, and a Hindu work called the Vikrama Upakhyana, quoted by Wildford, he identified with the Sridhara of Wathen's Gujarat copper-plate inscriptions. The caves, then, that bear these dated inscriptions, were all executed between A. D. 326 and 343.

The translations of the Pehlivi inscriptions at Haj-i-Abad, with the observations of the translators, Messrs. Dhunjibhoy Framji, and Pestonji Dastur, which accompanied them, were delivered to Professor Harkness, for examination and report at the next meeting.—*17th February* 1853.

In reply to the letters from the Managers of the Royal Institution of London, forwarding the notices and report mentioned, (p. 364,) and requesting that copies of the Society's Journal might be presented to the library of the Institution, the *Secretary* was directed to acknowledge the receipt of the letter, &c. and to forward by the first opportunity a complete set of the Society's Journal,—could a copy of each of the numbers be spared.

To the Royal Geographical Society, the *Secretary* was also directed to send the numbers of the Journal applied for, viz. i. and ii. of vol. i., and x. of vol. ii.

Professor Harkness' report on the Pehlivi inscriptions deciphered and translated by Messrs. Dhunjibhoy Framji and Pestonji Behramji having been read, it was resolved that the transcripts and English translations of both should be printed in the next number of the Society's Journal.

The following letter and its accompaniment were received from H. B. E. Frere, Esq., C. S., Commissioner in Scinde:—

Sir,—I have the honour to enclose the accompanying translation, with which Mr. H. B. Ellis has favoured me, of a letter which has caused some stir among the Mahomedan population of this province, as it may be of interest to the Society.

2. For some years past there has been great mortality, especially from cholera, among the pilgrims at Mecca; it was said that the cause of this had been revealed by the Prophet in a vision to one of his faithful disciples at Mecca. The Prophet attributed the plague to the evil lives of his disciples, and directed general promulgation of an exhortation to repentance and reformation of manners. This led to the issue of the letter now forwarded, which was brought to Scinde some months ago, and has been everywhere received with respectful attention.

3. I have received more than one formal application, consequent, I believe, on the receipt of this letter, to permit the ancient rigour of the Mahomedan law to be enforced, not only against all kinds of immorality, but against infractions of the ceremonial law, neglect of prayers, and breaches of fasts. One petitioner offered, if Hindoos and non-conformists were taxed according to ancient custom, to perform the right to levy the tax for four lakhs of rupees.

28th February 1853. (Signed) H. B. E. Frere.

Firman.

In the name of God, who is gracious and merciful!

God be praised, who is the Creator of all the creatures, and of the world to come for religious people; he is an enemy to none but to tyrants, and may the mercy of God and peace be on our Lord Mahomed, and upon his descendants! Now this is the revelation from the Prophet (upon whom be the mercy of God!). Sheikh Humza, the servant of the Tomb of the Prophet, says, that one night while I was asleep, I was (in a dream) reading a chapter from the Koran, when I saw the Prophet, who told me to acquaint him with the circumstances of his sect. In reply I said:—"Prophet of the Lord! Do you inform me thereof." The Prophet then said that a hundred thousand of them are dead, and not one of them but was a sinner and liar: truly they were false accusers, and bearers of false witness, nor had they any mercy among them, great or small; and in truth their faces were black; and they had been wholly engaged in the affairs of the world, and with their

children, women, and property, and had not the slightest fear of chastisement in the grave; they amused themselves with conversation while the Koran was being read, and listened not to it; they conversed much in the mosques, and did not pay proper attention in saying their prayers, but were thinking at the same time of the world and its vain wealth, and of deeds of infidelity. The Almighty Lord said to him :—"Mahomed, look to the people of your sect: they are indeed on the wrong way, and I desire to change their appearance." He (the Prophet) then begged that time might be granted him until he could give them an injunction, and inform them of his (the Lord's) anger, and if they did not attend to it, the Lord should then carry out his intentions. The Prophet then said :—"Sheikh Humza! were the people to abstain from drinking wine, from murdering, from appropriating forcibly the property of orphans, backing theft, abuse of virtuous women, and from all that is forbidden by God; warn them to visit Mecca, be attentive to prayers, and give alms. Verily, upon them will come the day of judgment, which is near at hand, and the gates of repentance will shortly be shut: enjoin them to follow the right path, and abstain from evil deeds, and order them to repent; for in this year there will truly be a very great plague, and men will be neglectful of it. This is a revelation to put them on their guard, and at last I will solicit the Lord on their behalf. Tell them they must keep fasts for six days, and on the seventh give alms according to their ability, and then, in truth, God will assuage his wrath with them." When I awoke I saw this written in red colours on the palm of my right hand. And it was written at the close, that if any one fail to say his prayers, you should not communicate with him, nor visit him when he is ill, nor attend his funeral when he is dead; and it was written therein, that whoever promulgated this notice from city to city, and from place to place, for him I will make solicitation, and whoever, on reading the notice, fails to promulgate it, his face the Lord will make black in the day of judgment. I swear that I have not added a word in this letter, and I now set off to visit every city, and promulgate this abroad. Do you strive also, and hope for grace through Mahomed the Prophet of God. O God! do not turn us to be proud or ungrateful, nor make us as those who prefer the world to their faith. O God! cause us to repent of our sins before death, be merciful to us when dying, and do not punish us after death. O Lord! confirm us in the faith of Mussulmans, and join us with good men. Amen and Amen.

The bearer of this Firman is Syed Abdoolla Khoorshan Hoosainee, who left Medina in Shaban 1268. Copied by Abdoorahman at Mehur.

True translation (Signed) H. B. Ellis, Assistant Commissioner.—*17th March* 1853.

The letter from the Geographical Society, dated 12th instant, in reply to the Society's, dated 17th ultimo, offering a place in the library to the globes which form part of the "Ross Testimonial," if the Society considered their usefulness would be thereby extended, states that the Geographical Society will be happy to take advantage of this offer, and intimates that instructions have already been issued for transferring the globes to their new destination.

The Geographical Society's letter, dated 9th instant, mentioning that a large collection of philosophical instruments had been received, and requesting a place for the exhibition of the barometers in the Society's library for a few weeks, had been considered by the Committee of Management, who had offered, in reply, any unoccupied part in the library for the purpose mentioned.

No. XVII. of the Society's Journal was placed on the table.

Dr. Wilson, in laying Professor Westergaard's learned paper on the Arian Mythology before the Society, proposed that, as it is more suitable for the studious perusal of the orientalist than for a hasty reading at a hurried meeting, it should be inserted in the next number of the Society's Journal. It notices the coincidence, and at the same time discrepance, of several of the Zendic with the Vedic legends ; endeavours to trace their origin to traditions of a primitive era of physical and moral bliss, and to aspirations for a renewal of happiness both in the present and future life ; and points out their subsequent corruption in the interpretation of them as historical notices of kings, heroes, and prophetical personages. The oldest of these legends affords an insight into the ante-historical time, when the Japhetic nations of Iran and India began to develope their religious and social existence, putting their own interpretations on the phenomena of nature and the wants of the human soul. The more modern of them, though still very ancient, mark a growing estrangement from one another of the two branches of the Arian nation, the Indian and Persian. The discussion of them in a calm philosophical spirit, with a remarkable knowledge of the documents in which they are embodied, and of the discussions of which they have given rise, both in Europe and the East, constitutes a claim to attention in behalf of Mr. Westergaard which all will willingly accord.

The *President*, having expressed the gratitude of the meeting for this peculiarly valuable communication, seconded the proposal for its publication, which was unanimously agreed to.

The ruins of Brahminabad, in Mr. Frere's communication mentioned, (p. 374,) are stated to extend over an area of many miles, and the dry bed of a river to be close to them, which was probably a branch of the Lohana or Pooran, when it was running. Several hardly contested fields are stated to have been fought there between the armies of the Caliphs and Hindu Governors, and mounds are still pointed out as covering the remains of the slain. The ruins of the old city are said to be well worth visiting, chiefly from their being among the few remains of antiquity that exist in the neighbourhood of Shahdadpoor.

The plans of the vihara cave called Guttoor Duz, in the Circar of Baitalbaree, and of that in the Pipal Khora, Circar of Dowlatabad; with a sketch of the sphynx figures *in situ* in the latter, by Dr. Bradley, alluded to in his descriptions of the excavations read at last meeting, were laid on the table.

Mr. Fallon's oil-painting of the interior of the great chaitya cave at Karli, with sketches of the head-dresses of some of the figures there, were laid before the meeting, and much admired.

The *Secretary* requested the attention of the meeting to a learned paper, with sketches, by E. C. Bayley, Esq., of the Bengal Civil Service, in the last No. (VII.) of the Journal of the Bengal Asiatic Society, on sculptures found in the district of Peshawur, similar to those which Dr. Arnott and Captain Shaw had presented to the Society from the same neighbourhood, in all 45 pieces. The ruined temple from which these appear to have come is called Jamal Giri, and is situated on a hill about 30 miles from Peshawur, by the road into the Eusofzye country from the Swat valley. The author considers them to be of Buddhist origin, though this fact is not so self-evident as their indebtedness to Greek art. He concludes "that the earliest *possible* period to which these figures can be assigned is 287 B. C., and the latest 200 B. C., while there is every probability that the age of their execution was between 271 and 225 B. C., a period of only 46 years." Other ruins of the same kind had been seen in the same neighbourhood, from which it was hoped that still more satisfactory information might be obtained respecting their history.

Dr. Buist then explained, in a most interesting and instructive manner, the nature and comparative advantages of several kinds of portable barometers, in which the superiority of those lately received by the Geographical Society was made very evident. He also mentioned the advantages and disadvantages of the aneroid and sympiesometer, several of which were laid on the table; and then drew the attention of the meeting to the working of a pluviometer, and the means of

correctly ascertaining the amount of evaporation during a given period with the same instrument; adverting, in conclusion, to the unsatisfactory data afforded by the wet-bulb hygrometers.—21*st April* 1853.

The *Secretary* stated, that on account of the first number of the Society's Journal being out of print, it was impossible now to supply, either as presents or on purchase, a whole set to any one who applied for it, or to any one to whom the Society, out of respect, or return for favours, might wish to present a complete copy. Mr. Firth, the Superintendent of the Education Society's Press, had made an estimate for reprinting this number, which for 200 copies would amount to Rs. 137, without colouring the plates. It was resolved that Mr. Firth's terms should be accepted, and the number reprinted.

T. L. Jenkins, Esquire, seconded by the Rev. Dr. Wilson, proposed, that as the Society had not determined on having its books sent out overland by the Peninsular and Oriental Company's steamers, the subject of getting a certain number of them sent through the Post Office be referred to the Committee of Management for consideration as a more preferable arrangement.

The following is an abstract of a letter from Dr. Thom, H. M. S., to Dr. Buist, which accompanied the specimens of polarized basalt mentioned, (p. 367,) from the Mauritius:—"By the Captain of the *Shah Allum* I send you a piece of basaltic rock from the peak called the Pouce, which possesses a high degree of polarity, as you perceive when you bring it near to a magnetic needle. My attention was called to this by a vague account of the compass being disturbed at the summit of the Pouce, and I determined to ascertain the real nature of the disturbing cause, which seemed, by the extraordinary reports which I first read, to point to something of an electro-magnetic current. After two ascents to the peak in question, which is about 2,500 feet high, rising directly behind the town of Port Louis, and terminating in a point barely accessible, and not more than eight or ten feet at the summit, I was enabled to get some definite idea of the phenomena in question.

"The whole of the basaltic mass of rock which forms the highest part of the peak is charged with magnetic fluid, whether forming a part of the central mass, on jutting angles, or in detached and broken bits; and whether with the surface corroded and disintegrated, or with the compact, crystalline, grey fracture of the interior when exposed by breaking off a corner.

"Our artificial magnets were completely reversed, and the poles alternately turned to every point of the horizon, according to the

relative position between the currents of the local poles of the rocks. Without removing a step from a particular spot, by carrying in the hand a surveying compass quickly round any of the jutting points of rock, it acquired a circular motion, which lasted for nearly a minute. The magnetic force is most powerfully developed at the *projecting* and *highest* points of the peak, and decreasing in intensity downwards, so that one hundred feet below the summit all traces of local influence on the compass disappear, yet the whole of the peak, and the mountain from which it shoots up, is one, and apparently similar mass of trap basalt.

"But the most curious fact is, that not only the summit of the Pouce, but every other peak of the serrated edges of the mountain near Port Louis, which have been examined, are found to possess an amount of resident magnetism which overpowers the artificial magnet. Yet the same inclined stratum of basalt, which possesses so high a degree of polarity when terminating in a point, and projecting into the clouds, is without any influence of this nature, as it sinks down to form the sides of the valley, table-land, and plain of the island, while every peak that has yet been tried shows a local magnetic force. Neither I nor any one else has yet seen any sign of this in the sides of the mountain, or rocky masses of the plain. The only pieces of magnetic stone found below the summit of the mountain have all the appearance of rolled stones, which have come down from the heights above.

"The investigation of all the facts nicely, to warrant us in arriving at any right conclusion on this curious question, will be a very slow process, but I have got the Government Surveyor now in the act of surveying Government ground to note down, at all points, where there may chance to be any sign of local magnetism which he may observe. With the cold weather, and a little less office work, I too shall visit as many of the other peaks of the island as possible, and in another year be able to reduce all our observations to order. As yet Mr. Corley, the Surveyor, says that every peak is magnetic, but he has not found any rocks in the valley so; what further observation may show, it is now to say.

"As far as the facts go, they are suggestive of many new views on the subject of local magnetism, especially when we recollect that the whole island is little more than a terrestrial galvanic battery, surrounded by the ocean, and annually subject to give to, and receive from the clouds, intense charges of electric fluid at particular seasons through these magnetised peaks.

"As the mountains of the Deccan and Western Ghauts of India exactly resemble those of Mauritius in geological formation, aspect, &c. and those of Mahabuleshwur contain far more iron than either our Pouce or other ridges, it would be a curious inquiry to ascertain whether any phenomena such as I have noticed at the Mauritius may not also be found among the sharp peaks of the former. I hope you will get some of the many scientific persons who visit the hills to examine this question.

"The large piece of rock which I send to you was broken off the very highest point of the Pouce, and its natural structure is nearly that of the whole stratum as it dips down to Port Louis. The second specimen is partially disintegrated on the surface, but it was in a cleft within a foot of the summit."

Captain Meadows Taylor states, in his letter accompanying the piece of limestone with excavations in it mentioned, (p. 367,) as follows :—

"The great part of the Shorapore district is a limestone formation, I think identical with that of Kurnool, which Captain Newbold wrote upon. The best portions of it are of a fine hard grain, and of an iron-grey colour, and are very similar to lithographic stones indeed. I sent a good many slates to Captain Wingate, and some to Dr. Buist, for the purpose of being used in lithography, and believe they answered to a certain extent. The stone varies in hardness and in colour, the hardest peaks breaking with a conchoidal fracture, the softest and most argillaceous with a direct one. The colours are from dark-bluish grey, nearly black, to light yellowish and pinkish grey. Wherever the formation has not been disturbed by the granite, it is perfectly horizontal, lying in laminæ of from two feet to two inches in thickness, some being even thin enough to serve for slates, for which purpose they are made use of in the country villages.

"Now the upper strata of this formation is everywhere pierced by small holes, such as you see in the specimen I send you.

"These holes are nowhere found in the lower strata or laminæ of the formation. I have examined many places in the Bheema, where the rock is bare, and other places where the stone has been quarried for building, but can only find the perforations on the surface: perhaps they are more remarkable in the fields, where the surface-rock protrudes from the soil, or where the soil may be cleared away in a field with a shallow covering of earth over the rock. It will be found having the same kind of perforations nearly everywhere.

"I have never been able to find any fossil remains in the district, though I have searched very diligently for them.

2 C *

"Some of the hardest of the limestone rests upon soft argillaceous shale, very friable, and of all colours from whitish-grey to yellow, pink, red, bluish, &c. greys, generally, (indeed invariably, where there is no disturbing cause at hand,) horizontal, agreeing with the limestone strata above.

"The specimen I send you is of the darker limestone, but whether in that or the lighter kind I sent to Dr. Buist, the perforations are exactly of the same shape and character, some longer and some smaller than others.

"In many parts near granite the limestone has been disturbed by the granite eruptions, and blocks are found as it were on their sides, and at various angles, having the perforations on the side uppermost, that is not perpendicular to the grain of the stone, as they would be if the stone had lain horizontally, but with the grain not on the surface, but on the side which is uppermost. It is evident from this that the perforations took place after the granitic disturbance.

"This limestone is identical with that of Kurnool, &c. and part of a very extensive formation in the Deccan. Here it is very interesting to see how the granite has thrown it about in some places, and actually raised up large masses of it, showing that it must have been older than many of the granite hills about. We have it, too, overlaid by a wave of trap-mud from the westward, which has reached as far as the edges of the limestone hills."

Of the two Hindu copper coins mentioned in the minutes of the Society's meeting held on the 17th February last, submitted to Dr. Stevenson for examination, Dr. Stevenson states that "they belong to the second Canauj series, described by Mr. Prinsep in the 4th volume of the Bengal Asiatic Journal, although not among the number therein mentioned. As far as I can make out from the broken state of some of the letters, the legend is *Srimad Lakshman Raja*."

The silver coin from the ruins of the town of Shakapur, which accompanied Mr. Frere's letter, was submitted to the Rev. Dr. Wilson for examination. Mr. Frere states in this letter, that he has requested Lieut. Phillips, who found this coin, to forward an account of Shakapur, copy of which, when received, will be sent to the Society. —*19th May* 1853.

The letter No. 113, dated Pind Dadun Khan, 17th ultimo, from W. Purdon, Esq., announces the despatch, *viâ* Mooltan, per coolies, of a box containing specimens of useful and ornamental building material, obtained from the Salt Range, and forwarded to the Society under

instructions from the Board of Administration for the affairs of the Punjab at Lahore. The letter enclosed a descriptive catalogue of the specimens.

Professor Lassen's letter, dated Bonn, 5th August last, acknowledges with thanks the receipt of Nos. XII., XIV., and XV. of the Society's Journal, and applies for No. XIII. This number to be forwarded by the earliest opportunity.

Of the Canarese inscriptions presented by Messrs. Reeves and Manson, C. S., to the Society, submitted to the Rev. G. H. Weigle for translation, and now returned with his note dated Dharwar, 29th April last, Mr. Weigle states as follows:—

"The inscription was put into my hands about a year ago, and I did my best to decipher it, but found it impossible. The first line is easy to read, and contains a well known distich. Having got thus far (before the inscription was presented to the Asiatic Society), I thought it would be easy to make out the rest, but I regret to say I found it far otherwise: neither I, nor any of the numerous Natives whom I consulted, could make out more than a few letters here and there. I sent the inscription to Mangalore, where it was examined by the Rev. H. Moegling and by his Moonshees, who, I am convinced, are the most learned Canarese men to be found at the present day, but the result was the same.

" It therefore seems that the copy is not an exact fac-simile of the inscription, which supposition is confirmed by the evident inequality of the letters and lines."

The ruins of the city of Shakapur, in Scinde, anciently called Mehmetpoor, Mr. Phillips states to be situated in the southern part of the Shah Bunder district, about ten miles south-east of Meerpoor Buttora, the chief town of the zillah.

At present there are only 50 houses there, situated on a large water-course called the old Goongra, where the ruins may be traced for three miles in extent. These consist chiefly of mounds of burnt bricks of different sizes. The largest is situated close to the existing village, and is about 300 yards in circumference. This has not been opened. There is also a small burying ground, in which there are tombs of carved sandstone slabs, but without inscriptions.

A silver coin has been found, which was submitted to the Society by Mr. Frere at the last meeting, and some fragments of opaque blue glass, cornelian and agate which accompanied this paper: several copper coins have been found, but so corroded that the inscriptions are effaced.

The traditional history of Shakapur is, that the present village was named after the famous Cutch Saint "Shahputti," who travelled in that direction about 200 years since; that Mehmetpoor was founded by Mahomed Pysen Soomra, the first of that tribe, who reigned in Lower Scinde (14th or early part of the 15th century), when the present dry watercourse was the bed of the Indus. The next Chief named is Umeer Soomra, by which title the large mound of ruins mentioned also goes, as this is stated to be the remains of his palace. This Chief left two sons, Chumeesa and Doda. Doda, the younger, usurped the throne, and Chumeesa having laid a complaint before the then reigning Emperor at Delhi, Allahodeen, the latter sent a force back with him to recover his property, which Doda met at a place called Keree, 10 miles from Mehmetpoor. Here a battle ensued, in which both the brothers were slain and the Soomra army defeated; after which the Delhi force plundered Mehmetpoor, and set it on fire.—*16th June* 1853.

The letter from Dr. Bowring, dated Athenæum, 1st ultimo, intimates the desire of the Governor General of Nertherlands India, that the Bombay Asiatic Society should interchange publications with the Batavian Society of Arts and Sciences in Java. Dr. Bowring also adds, that on any subject within the field of Chinese inquiry he will greatly rejoice in an opportunity of being useful to the Society.

It was resolved that a copy of the Society's Journal should be forwarded for the acceptance of the Batavian Society by the earliest opportunity.

The letter from A. Grote, Esq., dated 5th instant, intimates that the Council of the Asiatic Society of Bengal had cancelled all pecuniary obligations under which the Bombay Society laboured for this publication, intending henceforth to present them in exchange for those which they at present receive from the Society of Bombay.

The *Secretary* was directed to acknowledge the receipt of this letter with best thanks of the Society.—*18th August* 1853.

With reference to the Government letter No. 2718, dated 17th ultimo, forwarding printed copies of a despatch No. 30, dated 24th May last, together with other correspondence, from the Honorable the Court of Directors, respecting an Universal Exhibition of Agricultural and Industrial Products to be held by the Emperor of the French at Paris in May 1855, and requesting the Society to give the greatest possible publicity to this announcement, the Secretary was directed to

adopt the best measures in the Society's power for carrying the Government request into effect.

The Rev. Dr. Stevenson's paper contained a translation, with notes, of a Buddhist inscription published in "*Fortune's Tea Districts of India and China*" page 324, in which he showed that the foreign characters there given are Tibetan letters; that the inscription contains three Buddhist sacred formularies, the middle one the famous *Om Mani Padme Humh*. Dr. Stevenson gave reasons for believing that these formulæ had been borrowed from India; that they were originally Tantrical, and afterwards adopted to Buddhism; and that they were respectively invocations to the Deity as first the Creator, now the Preserver, and finally about to be the Destroyer of the Universe.

With reference to the copies of the Haj-i-Abad inscription mentioned, (p. 374,) the author, Dhunjibhoy Framji, Esq., states that after having carefully re-examined them, he thinks that the copy which appears in Professor Westergaard's edition of the Bundhesh has been most carefully taken from the original, and that it is only inaccurate in a few characters; that the Sassanian lapidary Pehlivi inscription in Sir Ker Porter's Travels is also in some respects incorrect, and the Parthian or most ancient Pehlivi inscription appears to be still more so, which may have arisen from the difficulty with which it was obtained, for Sir Ker Porter states—"I copied them with all the accuracy in my power, being much impeded by the height and darkness of their position. One portion of the three upper lines I could not make out in the least." Between Sir Ker Porter's and Professor Westergaard's Pehlivi inscription, the author had discovered about thirty characters which differed from each other in their respective words; but as amongst these there were a few homogeneous ones, the difference in the decipherings was of no great consequence.

When Mr. Dhunjibhoy Framji first deciphered and translated this inscription from Sir Ker Porter's copy, he entertained doubts respecting the accuracy of the translation, and therefore, as far as lay in his power, supplied a list of *errata*, deduced from the analogy, etymology, and comparative philology of the words contained in them; he now begged leave to lay before the Society a translation of the inscription from Professor Westergaard's copy, which, when compared with his first deciphering, would be found to differ only in a few words, the explanations of which differences were in the notes appended to his translation.

In conclusion, the author states, that as yet he does not feel quite competent to place before orientalists a satisfactory translation of this

inscription, because he is still doubtful of the orthographical and interchangeable value of some of the characters, which he will be better able to explain in the preface to his Zend Dictionary, where he hopes to publish the Pehlivi alphabets, with observations on their lapidary, cursive, and numismatic forms, to facilitate future investigations in the deciphering of this character.

The map illustrative of Dr. Livingstone's and Mr. Oswell's travels in Southern Africa mentioned (p. 373) is a copy of one received by Mr. Reeves from the Cape of Good Hope, and forwarded by him with copy of a letter to the Chief Secretary to Government, calling the attention of the latter to the existence of an extensive slave trade discovered by these gentlemen in the countries to the east of Lake Ngamee. In this letter Mr. Reeves states as follows:—

"You will observe in the upper left hand corner of the map, a notice of a tribe called 'Membari,' to the following effect:—

"'The Membari came to Sebitoane in 1850, bringing a large quantity of English clothing, viz. printed cottons, coloured, and bartered for about 200 slaves. By their suggestion the Makololo went on a foray against the Bashukulompo—the Makololo to receive all the cattle, the Membari all the captives, in consideration of the use of their guns in the attack.'

"Sebitoane, as will be found explained in the right hand upper corner of the map, is the chief who rules over the well-watered country shown in the centre. The Makololo are a tribe under his rule. The Membari most probably communicate between the sea coast and the great lake by means of the 'Zambezi' river, a magnificent stream, which, after receiving the waters of many rivers in the neighbourhood of the lake, flows across an unexplored tract of country, and it is conjectured falls into the Mozambique a little to the north of Sofala.

"It appears probable that Major Hamerton, Political Agent at Zanzibar, may, through His Highness the Imam of Muscat, be able to procure much valuable information connected with the proceedings of the slave dealers, Portuguese, or whoever they may be, and to ascertain whether the Membari are Europeans or Natives employed by them; and the result of his inquiries, communicated to the British Admiral commanding at the Cape of Good Hope, will enable that officer to check their nefarious traffic. Perhaps, too, the Imam may have it in his power to interfere actively for the prevention of the slave trade himself.

"Subsidiary to the above object, accurate information is required in reference to the means of communication between the coast and the

great lake. The river 'Zambezi' especially is an object of the greatest interest. It is a branch of the 'Zambezi' set down in our maps between the 15th and 20th parallels of south latitude. If Major Hamerton could determine this, and lay down with any accuracy the point of junction of the branch with the main stream, or procure any information on the means afforded by these streams for navigation, and the nature and distance of the country traversed by the branch from the sea to the great lake, he will add a most interesting and useful supply to our geographical knowledge, for so late as this morning I read an account in the *New Quarterly Review* of a journey accomplished by Mr. Francis Galton from the Western Coast of Africa to the Ngamee lake, without much difficulty; so that the supply of the above information regarding the 'Zambezi' is now all that is requisite to complete the chain of discovery across the continent of Africa from sea to sea."

Through the kindness of Lieutenant Close, of the Engineers, a beautiful copy of the Koran, written on a scroll 10 feet long, and 3 inches broad, making in all a roll 3 inches long and $\frac{3}{4}$ inch in diameter, was laid before the Members, and much admired.—*15th September* 1853.

With reference to the Government Circular No. 3419, dated 10th instant, forwarding printed copies of a further despatch from the Honorable the Court of Directors, respecting the Universal Exhibition of Agricultural and Industrial Products about to be held by the Emperor of the French at Paris in 1855, and requesting that the greatest publicity might be given to the same, the *Secretary* was directed to have recourse to the best measures in the Society's power for carrying the request of Government into effect.

Dr. Stevenson stated, in defence of his position, that the Tithyas of the Buddhists and the Gymnosophists of the Greeks were Digambar Jains, that the work called the Kalpa Satra, the most sacred book of the Jains, gives us a regular succession of Hind teachers, with probable dates and terms of life back to B. C. 569, and places the previous great teacher Parsoonath only 250 years earlier, assigning to him a life of 100 years; whereas the Buddhists carry us back with probable dates only to 543, but throw the predecessors of Buddha back to an almost illimitable distance, and therefore that this book has more internal probability in reference to those times than those of the Buddhists.

That the Tithyas agreed with the Gymnosophists in rejecting all articles of dress, that the usage is commended in the Jain books, while

in all the Hindu books of authority it is reprobated, and therefore, that as Jains then existed, and in their system alone does such a usage as that intimated exist, the conclusion must follow that they belonged to that sect.

The following observations are appended by Mr. Pestonji Behramji to the re-examination of his translation of the Pehlivi inscription at Haj-i-Abad :—

" Modern Zoroastrians, and especially those of the sacerdotal order, to which I have the honour to belong, have often been accused of ignorance, not only of the ancient literature of Persia, but also of the language in which their sacred and religious works are written, as well as the characters which are inscribed on the rocks near the relics of antiquity abounding in different parts of Persia. With a view to remove this reproach, I have attempted to decipher the Pehlivi inscription at Haj-i-Abad, near Nuksh-i-Rustam, in Persia.

" When I first attempted this in January last, I had access to only one copy, as published in Sir R. K. Porter's Travels, which appears to be imperfect and erroneous in many places ; but through the kindness of Mr. Dhunjibhoy Framji, a much better and more correct copy, as recently taken down, apparently with great care and attention, by Professor Westergaard, and published last year at the end of his lithograph edition of the Bundehesh was placed at my disposal in June last. This has cleared up several ambiguities, and has enabled me to make several modifications and corrections in my original decipherment and translation.

" I have not spared any pains to render my decipherment and version faithful and accurate. I therefore have no hesitation in submitting the result to the criticism of the European public, if whose discerning judgment be in my favour it will go far to establish the genuineness and antiquity of several of the Pehlivi works now in the possession of the Parsees of Western India."

This translation does not differ essentially from that presented by Mr. Dhunjibhoy Framji at the last meeting of the Society. They will both, with the inscription in original and in Gujarathi transcript, be published in the next number of the Society's Journal.

With reference to the presents for the museum mentioned, (p. 369,) the *Secretary* stated that collections 1 to 3 inclusive were from the tertiary formations of the Persian Gulf and Arabian Sea, well described and illustrated in Colonel Grant's Geology of Cutch.

The fossil oyster bed in the limestone at Minora Point, Kurachee, in Cutch, and on the Arabian Coast, seems equally to characterise the

tertiary formation on the coast of Kattyawar; for among the fossils of the 2nd collection are specimens apparently identical with the oysters and the limestone of these parts in which they are imbedded, which came from the summits of low hills (50 to 150 feet high) on the western coast of Kattyawar.

The small, but extremely interesting collection of fossil shells presented by Major General Cullen, also belongs to this tertiary formation. Several are identical with those figured and described by Sowerby in the work just mentioned. They are in an exquisite state of preservation, not having yet become connected with the material in which they are imbedded, and never having been worn by the action of the waves. The fact of their underlying the lateritic cliffs and beds of lignite, mineral copal, &c. of Quilon and the neighbouring coast, proves that the latter are not so old, geologically considered, as the tertiary formation.

Captain Nicolls' beautiful collection of cut and polished woods, as well as shell-deposits of the eocene lacustrine formation, seems to indicate that there are fossils not only of the latter, but also of the Oolitic (?) sandstone of India about Saugor; at all events the cast in limestone, apparently of a large *turbo*, among the collection, show that this at least is of marine origin. The section of the elephant's tusk imbedded in the Nerbudda calcareous conglomerate probably came from the same species as that presented to the Society by Dr. Bradley, which he obtained from the banks of the Godavery. Both are $7\frac{1}{2}$ inches in diameter, and solid; the hollow portion at the base of the Godavery one gives an arc of a circle about $11\frac{1}{2}$ inches in diameter. Baron Hugel mentions one from the island of Perim, opposite the mouth of the Nerbudda, which was $10\frac{1}{2}$ inches in diameter; and Mr. Dean saw one from the bed of the Jumna which he imagined to be at least eight inches in diameter. The latter appears to have been in a friable state, like those of the Nerbudda and Godavery, for the sepoys were making use of it for pipe clay. These seem to be the largest tusks on record.

The minerals collected from the Rewa Kanta by the late Major Fulljames are of great interest in an economical point of view. Iron ores of the richest kind evidently abound there, in the same forms as in Malwa and in the Southern Mahratta Country, at the opposite or southern boundary of the great basaltic region of Western India. Limestone, too, appears to be a part of the same formation; so that with this flux on the spot, all that appears wanting is the proximity of coal to make these ores highly available—a *desideratum* well known to Major Fulljames, who, led on by the rich mineral specimens afforded by this interesting district of which he was Political Agent, probably

contracted that fever, in his great zeal for their full development, which has so suddenly cut short his useful career. By his death the Society has lost an original observer and a valuable contributor; and the Government an officer whose love for geological and mineralogical research would have soon tested the economical resources of the Rewa Kanta in this respect to their utmost.—*20th October* 1853.

As the letter from Professor E. B. Eastwick applied for a copy of the Society's Journal in virtue of his membership, it was resolved that at the Anniversary Meeting a proposition should be brought forward to entitle any Member out of India to that claim on payment of the annual subscription of non-resident Members, viz. Rs. 15.

The copies of the Society's Journal applied for by Professor Eastwick for the public Library at Berlin, the Library of the East India College, and for himself, had been forwarded by the last mail.

Of the sepulchral urns presented by Mr. Barker, he states that they were found in a mound called *Tel Balari*, in the vicinity of Bagdad, which was excavated under his direction. After having dug a large tunnel of 60 feet long, and about 20 feet below the surface, he came upon a wall composed of kiln-burnt bricks, of the same size as those found at Babylon, but, with the exception of one or two, having no inscription on them; and on breaking through this wall, he found it to be the side of a sepulchral vault, containing about 150 urns, piled upon one another about ten feet deep, in a semi-circular form. Some of these contained calcined bones and ashes, also pieces of vitrified earth, glass, and beads; others were filled with fine powder, and some were empty. All were lined with bitumen. The mound had not been previously opened.—*17th November* 1853.

ANNIVERSARY MEETING.

MONDAY, 28TH NOV. 1853.

Report of the Committee of Management.

The proceedings of the past year indicate a favourable advancement in every department of the Society.

Sixteen resident, seven non-resident Members, and two Subscribers, have been elected, that is four non-resident Members and two Subscribers more than last year, with an equal number of resident Members.

Eighty-two pamphlets and books have been presented, twenty original communications, and sixty donations to the museum, among which are upwards of 1,000 mineralogical and geological specimens.

To the library 138 works, comprising 227 volumes, have been added by purchase, and these have not been so exclusively confined to two or three classes, as in former years, although the general reader can still claim by far the greater share. The number of literary and scientific periodicals is the same, viz. 40, and the newspapers have been increased by 8, making in all 21.

The chief improvement that has taken place in the library during the past year is the number of works that have been bound and repaired; this amounts to 512, or 1,289 volumes, many of which have been folios and quartos, among which, again, may be included some of the largest books in the library.

The frame-work for the newspaper room sanctioned by the Society at the last Anniversary Meeting has been erected, and, with the exception of a few files, the whole of the newspapers are now stitch-bound, lettered, and conveniently arranged. The alphabetical catalogue, which it was hoped would have been completed by July last, has, until lately, been very slow in its progress, but now that the plan in which the books should be arranged has been laid down, four cases have been numbered and lettered in accordance with it, and the rest may be expected to speedily follow.

The museum is steadily advancing towards an instructive state, and the additions which it has received during the past year have been both numerous and very valuable. Central India, Scinde, the Rewa Kanta, the Southern Mahratta Country, and the Salt Range of the Punjab, have all afforded rich illustrations of their mineralogy and geological formations, through the kindness of the gentlemen whose names are mentioned after respective presents in the list of donations to the museum, where the latter will be found more particularly detailed.

The report of the Cave-Temple Commission informs us that several accounts of Buddhist Cave-Temples and remains have been received, among which the most interesting are those of Lower Scinde, discovered by W. Cole, Esq., and communicated through H. B. E. Frere, Esq., Commissioner in Scinde; of Koolvee in Malwa, by Dr. Impey; and of Baitalbaree and Dowlatabad, in H. H. the Nizam's territories, by Dr. Bradley. All the impressions of the cave-temple inscriptions taken by Lieutenant Brett have been reduced and lithographed under the superintendence of the *President*, the Rev. Dr. Stevenson, who has added translation and remarks on a part of them, which have been

published in No. XVIII. of the Society's Journal, and the other part is now being printed in the forthcoming one. There are still several inscriptions, however, in different parts of the Presidency of Bombay, which have not been taken, but the Cave-Temple Committee is not without hope, that by the kind assistance of Government, impressions of these also will shortly be obtained. Mr. Fallon, the artist, has completed the illustrations of the caves of Elephanta, and is now far advanced with those of Karlee.

The Society has published the usual number of its Journal for 1852, viz. No. XVII., also another No. viz. XVIII., in July last, and the number for the present year, which is now in the press, will appear in January next. It is a source of much gratification to your Committee to be able to state, that the increasing demand for the Society's Journal both in India and Europe promises favourably for its increasing usefulness.

The balance in favour of the Society exceeds that of last year.

This Report was received, and the best thanks of the Society voted to the Committee of Management for their valuable services during the past year.

Election of Vice President.

His Excellency Lieutenant General the Right Honorable Lord Frederick Fitzclarence, G.C.H., *Vice-Patron* of the Society, was also elected *Vice-President*.

The following gentlemen were elected for the Committee of Management, Museum Committee, and Auditors for the ensuing year :—

Committee of Management.

William Howard, Esq.	Capt. J. G. Forbes.
Lieut. Col. J. Holland.	Thos. L. Jenkins, Esq.
A. H. Leith, Esq.	John Ritchie, Esq.
Rev. P. Anderson, A.M.	M. Stovell, Esq.
John Harkness, Esq., A. M.	C. J. Erskine, Esq.

Museum Committee.

A. H. Leith, Esq.	George Buist, Esq., LL.D.
H. Conybeare, Esq.	R. S. Sinclair, Esq., A.M.
J. Harkness, Esq., A.M.	H. J. Carter, Esq.

Auditors.

Captain G. J. Forbes.	H. B. Gilmore, Esq.

The following proposition was carried :—

"Members on leaving India shall, by a deposit of Rs. 50, be entitled to a copy of all subsequent publications of the Society."