of Cromarty:—Accompanied by Mr. Stables, Mr. Joass, and Major H. Drummond, of the Bengal Engineers, I spent the whole of one day on and around the Nigg, or North Sutor of Cromarty. We examined it minutely in reference to the sketch sent to Sir R. I. Murchison by Miss C. Allardyce. This sketch represents the Oolites lying conformably to the Old Red Sandstone, and as if they occurred on the *west or inner side* of that Sutor, namely the northern one*.

We examined all the bits of rock or strata that were to be seen cropping out along the Cromarty Firth shore of the North Sutor, and found in them nothing but Old Red Sandstone.

We then proceeded down the Moray Firth as far as Shandwick, landing at different points, and walking along almost the whole shore, spending a considerable time at Gaan Righ. Here, so far as we could see, the Oolites *first* appear. Covered at high water, and lying at the base of a cliff about 250 feet high, these Gaan-Righ Oolites are evidently an extension of the well-known deposit of the same series at Shandwick. The tide was low, and most favourable for our work over this part of the coast.

The complete *unconformity* of the Shandwick Oolitic beds to the Old Red Sandstone is acknowledged on all hands; and the seeming conformity of the Oolitic beds at Gaan Righ to the Old Red arises from the accidental change of dip (caused by a fault, or rather by a slip or slide) in a large mass of the rock (Old Red) in the overhanging cliff. The strata of this mass, if projected on their present plane, would most probably *overlie* the Oolites! The persistent northern dip of the Old Red Sandstone, in this line of coast all the way down to Shandwick, comes out distinctly, when seen, as on our return to Cromarty, from the boat when sailing in the offing.

Faults and slips there are in many places, but they do not present any difficulty. I am, therefore, convinced that the great question at issue—the age of our Reptiliferous beds—is not in the least affected by any appearance presented by the Oolites at Gaan Righ—the locality, I am persuaded, alluded to by Miss Allardyce in her note to Sir R. I. Murchison.—[G. G.]

2. *On some TERTIARY SHELLS from JAMAICA.* By J. CARRICK MOORE, Esq., M.A., F.R.S., F.G.S. *With a Note on the CORALS; by P. MARTIN DUNCAN, M.B., F.G.S.: and a Note on some NUMMULINÆ and ORBITOIDES; by Professor T. RUPERT JONES, F.G.S.*

THE late Mr. Barrett formed a collection of Tertiary fossils in Jamaica from some beds which were referred to in the 'Geologist' for 1862, p. 373. The collection was forwarded to Mr. Woodward, who, seeing their relation to the San-Domingan fossils, asked me to examine the Mollusca, while the Corals were submitted to Dr. Duncan. In comparing the Shells with fossil and recent forms, I

* The examination of the North Sutor was made on May 14, 1863. The sketch referred to is one by the late Hugh Miller, in the possession of Miss C. Allardyce, Cromarty.

have been kindly assisted by Mr. Woodward, Dr. Baird, Mr. Hamilton, and Mr. Lovell Reeve, and now lay the results before the Society.

Excluding such shells as are too small or too imperfect for determination, the collection contains 71 species, referable to the following genera:—

	SP.		SP.		SP.
Cassis	2	Turbinella	1	Solarium	1
Cassidaria	1	Fusus	1	Cyclostrema	1
Strombus	2	Marginella	1	Dentalium	1
Malea	1	Columbella	2	Vermetus	1
Conus	7	Cancellaria	2	Venus	7
Murex	1	Pleurotoma	7	Lucina	2
Triton	1	Terebra	1	Cardita	1
Ranella	1	Phos	2	Cardium	3
Oliva	1	Cerithium	1	Corbula	1
Ancillaria	1	Natica	4	Pectunculus	3
Mitra	2	Turbo	1	Arca	3
Fasciolaria	1	Trochus	1	Chama	2

71

Of these, the following 19 are found in the San Domingo beds, and are not known in a recent state:—

<i>Conus validus</i> , Sow.	<i>Natica subclausa</i> , Sow.
— <i>planiliratus</i> , Sow.	—, spec. unnamed.
<i>Murex Domingensis</i> , Sow.	—, spec. unnamed.
<i>Triton similis</i> , Sow.	<i>Solarium quadriseriatum</i> , Sow.
<i>Mitra Henekeni</i> , Sow.	<i>Turbo</i> , spec. unnamed.
—, spec. unnamed.	<i>Cardita</i> , spec. unnamed.
<i>Fasciolaria semistriata</i> , Sow.	<i>Venus</i> , spec. unnamed.
<i>Terebra bipartita</i> , Sow.	<i>Cardium Haitense</i> , Sow.
<i>Phos</i> , spec. unnamed.	<i>Corbula</i> , spec. unnamed.
	<i>Arca consobrina</i> , Sow.

Twelve others have been identified with recent species† inhabiting West Indian seas:—

<i>Strombus fragilis</i> .	* <i>Natica mamillaris</i> .
<i>Ranella crassa</i> .	* <i>Venus Paphia</i> .
* <i>Turbinella infundibulum</i> .	* <i>Lucina Pennsylvanica</i> .
* <i>Oliva reticularis</i> .	* <i>Pectunculus pennaceus</i> .
* <i>Marginella coniformis</i> .	* <i>Arca Noë</i> .
* <i>Natica sulcata</i> .	* <i>Chama arcinella</i> .

It thus appears that, of the whole 71 Jamaica shells, 12 are still living, and 28 are common to Jamaican and San Domingo.

Dr. Duncan, in his Memoir lately read before the Society‡, finds the same relations between the Jamaican and San-Domingan beds from a comparison of the Corals,—three of the seven Jamaican Corals being common to both formations, whilst the number of extinct forms justifies the age formerly attributed to the San-Domingan Tertiaries. It will be remembered that the Miocene date was assigned to the latter from the great proportion of extinct species of Mollusca, and also from the presence of four species of Fish, all known in the Miocene beds of Europe and America, and in no newer formation. Here the proportion of extinct Mollusca and Corals is about the same as in the San-Domingan beds; and the number of fossils common to

Those marked with an asterisk are also found in San Domingo. † See p. 406.

both is sufficient to prove their synchronism. But we are able still further to extend the limits of this Miocene Sea. In the cutting for the Panama Railway, shelly beds were passed through near Navy Port, at a height of 15 feet above the sea, from which Mr. Saunders collected some fossils which he presented to this Society. Most of them are too imperfect for determination; but out of less than a dozen, which are tolerably distinguishable, five are certainly identical with San Domingan Shells: they are, *Conus Domingensis*, a *Malaea*, a *Natica*, a *Venus*, and a *Cardium* *.

In my Reports on the San-Domingan Shells†, I mentioned that one or two seemed identical with Shells now living in the Pacific, and that the nearest analogues of several others were to be found in the Pacific, and not in the Atlantic Ocean: several striking instances of these resemblances were mentioned. The collection now before us also presents the same feature; for although all the specimens I have identified with recent Shells are now living in the West Indian seas, yet the affinities of several others are decidedly with Shells of the Pacific Ocean. I may mention a *Venus* belonging to a group confined to Australia; a *Corbula* scarcely distinguishable from *C. modesta*, Philippine Islands; a *Pleurotoma* very near, if not identical with, *P. nigerrima*, Panama; and another very close to *P. gibbosa*, Cumana; besides which, some of the San-Domingan Shells which presented this character in a marked degree also occur in Jamaica. Observing this in the San-Domingan collection, I formerly threw out the conjecture that the separation between these seas may not have been so complete in early Tertiary times as at present. Dr. Duncan's Memoir, just quoted, throws great light on this question. It results from his studies, that the relation between these fossil Corals and those now living in the Pacific or China seas is even more intimate than that indicated by the Mollusca. Some of these species are actually now living in the Pacific, and others belong to genera of which all the living species are confined to that ocean.

M. d'Orbigny, in his great work, 'L'Amérique Méridionale,' shows that five of the Cretaceous fossils from the western side of South America are identical with five in the Paris Chalk, while of all the Tertiary fossils on the two flanks of the Cordilleras not a single one is common to both formations; and he thence infers that a communication must have subsisted between those two oceans during the Cretaceous period, and that at its close the upheaving of the Cordilleras effected that separation which has subsisted to this day. But it is to be observed that the Tertiary fossils collected by M. d'Orbigny were all found south of latitude 30° S., whereas those from Jamaica and San Domingo are in latitude 18° N. Even if some connexion had existed between the two oceans in the district of Panama, as is now supposed, the Mollusca living on the two flanks of South America, 40° to the south of that opening, might be expected to be distinct, just as those at present living on the

* See Quart. Journ. Geol. Soc. vol. ix. p. 132.

† *Ibid.* vol. vi. p. 40, and vol. ix. p. 129.

opposite coasts of Chili and of Patagonia are distinct, though there is free communication by Cape Horn. No negative evidence can counterbalance positive facts; and when it is recollected that the summit of the Panama Railway is but 250 feet above the sea,—that that inconsiderable height must have been less when the shelly beds of Navy Port (contemporaneous with those of Jamaica and San Domingo) were formed,—that some few of these Mollusca and Corals are now living in the Pacific,—and that the nearest allied forms of several more are to be found on the western side of America, it will be admitted to be most probable that the complete separation of these oceans did not take place until after the commencement of the Tertiary period.

P.S.—Dr. Duncan has kindly supplied me with the following facts, which he has ascertained since the reading of his Memoir on the Corals:—"The Foraminifer so common in the European Miocene and in the San-Domingan beds, *Amphistegina Haueri*, is found in abundance in the Jamaican Corals; also the Coral sent over by Mr. Barrett, and known as *Montlivaltia ponderosa*, is amongst a collection from Travancore, with *Trochocyathus cornucopia*, a San-Domingan and common Viennese Miocene species. The occurrence in Jamaica of *Astrocenia decaphylla*, a Gosau fossil, is very remarkable; but the same kind of thing occurs in San Domingo, where *Phyllocenia sculpta* and a *Barysmilia* very little differing from *B. tuberosa*, Reuss, both Gosau fossils, are noticed."

Note on the FOSSIL CORALS accompanying the TESTACEA from JAMAICA.
By P. MARTIN DUNCAN, M.B., F.G.S., &c.

The majority of the Corals have been described in my communication, referred to by Mr. Moore, and published in this Number of the Society's Journal, on the Fossil Corals of the West Indian Islands.

1. *MONTLIVALTIA PONDEROSA*, Edwards & Haime.

Two specimens of this great simple Coral, which is found both in the Miocene of Guadaloupe as well as in that of San Domingo, are amongst the collection; the San-Domingan specimen is in the British Museum.

2. *PLACOCYATHUS BARRETTII*, nobis. "Fossil Corals of the West Indies," p. 437. Pl. XVI. fig. 1.

From San Domingo and Jamaica.

3. *PLACOTROCHUS ALVEOLUS*, nobis. "Fossil Corals of the West Indies," p. 438. Pl. XVI. fig. 2.

4. *ASTROCCENIA DECAPHYLLA*, Michelin, sp.

The specimen can only be considered as a very slight variety of the well-known *Astræa decaphylla*, Michelin, of Gosau. The *Astrocenia ornata* of Turin and Antigua is only distantly allied. *Astrocenia decaphylla* is a very marked species, and its occurrence in the

Jamaican Tertiaries is very remarkable: like *Phyllocenia sculpta* in San Domingo, and the Isastreans in Antigua, it belongs to a Coral-fauna which died out in the Miocene period.

5. *THYSANUS EXCENTRICUS*, nobis. "Fossil Corals of the West Indies," p. 439. Pl. XVI. fig. 3.

These beautiful Corals are allied to the *Thysani* of San Domingo. From Jamaica and San Domingo.

The other Fossil Corals from Jamaica, in this collection, and which I have described already, are *Alveopora Dædalæa*, Dana, and *Siderastræa grandis*, nobis.—[P. M. D.]

Note on some NUMMULINÆ and ORBITOIDES from JAMAICA.

By Professor T. RUFERT JONES, F.G.S.

In connexion with Mr. J. C. Moore's researches on the Tertiary Molluscs of Jamaica, the following remarks on some specimens of Nummulites * and Orbitoides from the same island will be of interest.

Some time since, Mr. S. P. Woodward, F.G.S., submitted to my examination a water-worn piece of Orbitoidal limestone from Healthful Hill, St. Thomas-in-the-East, collected by the Hon. Edw. Chitty. Among the *Orbitoides* constituting the mass of this hand-specimen (6 inches $\times$ $2\frac{1}{2}$ $\times$ 2), three or four *Nummulinæ* are visible on the surface, and their internal structure has been sufficiently well exposed by weathering. The *Orbitoides* are similar to those found fossil in the Upper Chalk of Southern France and the Pyrenees, and in the Nummulitic beds of Scinde (*O. media*, *O. dispansa*, &c.). The *Nummulinæ*, differing only in size one from another, belong to the sinuo-radiate group †, and are near to the forms known as *Nummulina perforata* and *N. Rouaulti*. The largest is about $\frac{1}{4}$ inch in diameter and $\frac{1}{12}$ inch in thickness.

Orbitoides are not confined to this nodular limestone in Jamaica, but are there found as low down as the Cretaceous Limestone, with *Nerinea* and *Barrettia* ‡; and here the thick variety (*O. Fortisii*) and the thin (*O. papyracea*) are both abundant.

When Mr. Barrett, the late Director of the Geological Survey of the British West Indian Isles, was in England last year, he showed me, by the following diagram, the position of this Orbitoidal Limestone in the geological series of Jamaica. He stated that it occurred as nodules in clay just underneath the great "White Limestone," which, with overlying shaly and sandy beds, I understood him to refer to

* De la Beche has recorded the occurrence of "Nummulites" in Jamaica (Geol. Trans. 2nd ser. vol. ii. p. 170); but it is doubtful whether the fossils he alludes to may not have been *Orbitoides*, which are common in that island.

† See Ann. Nat. Hist. 3rd ser. vol. viii. p. 233, and Carpenter's Introd. Foram. p. 275.

‡ See Mr. Woodward's paper on "*Barrettia* and other Hippurites," in the 'Geologist,' vol. v. p. 373. De la Beche seems to have regarded some of the *Orbitoides* as "Encrinal remains" (Geol. Trans. 2nd ser. vol. ii. p. 158), as Mr. Woodward has remarked.

the Pliocene*. The nodular limestone he regarded as forming, with some underlying beds, the Middle Tertiary series†; whilst the Plant-bearing shales, still lower down, are of Eocene age, and overlie the

Section of the Tertiary and Cretaceous Rocks of Jamaica.

Cretaceous Hippurite-limestone, containing *Nerinea*, *Actæonella*, *Radiolites*, *Barrettia*, *Inoceramus*, *Ventriculites*, and *Orbitoides*. The last-mentioned limestone, with its flint-nodules and intercalated shales, as well as the underlying porphyries and conglomerates, were described by Mr. Barrett in the Quart. Journ. Geol. Soc. vol. xvi. p. 324 ‡.

It may be remarked as a point of interest, that the *Nummulina* and *Orbitoides* above alluded to are such as are found in the South of Europe and in India; whilst in the neighbouring continent of America *Nummulina* are, it seems, wanting; and the *Orbitoides* (in Alabama §) is *O. Mantelli*, which occurs also in Scinde, but is not dominant there.—[T. R. J.]

3. Notes on the MINERALOGY and GEOLOGY of BORNEO and the ADJACENT ISLANDS. By Mijneer CORN. DE GROOT, Chief of the Mining Department in the Dutch East Indies.

(Extracted from a letter to Sir R. I. Murchison, K.C.B., F.G.S.)

THE steam-coal formation of Borneo underlies the Nummulitic Limestone, and, so far as I am at present able to judge, belongs to the "Étage Suessonien" of D'Orbigny. From the Nummulitic Limestone the following fossils have been obtained, namely, *Nummulina depressa*, *N. lenticularis*, *N. mamilla*, and *N. polygyrata*; also *Eupatangus ornatus* and *Phaculina Faujasii*. The last-named fossil is,

* In Mr. Woodward's paper above referred to, this limestone is termed "Miocene."

† In the Western Hemisphere, *Orbitoides* and *Nummulina* are very rare in beds above the Eocene group.

‡ The woodcut at p. 325 incorrectly represents the shales and limestone-bands as unconformable.

§ See Lyell on the so-called Nummulitic formation of Alabama, Quart. Journ. Geol. Soc. vol. ii. p. 409, and vol. iv. p. 11; and Manual Elem. Geol. 5th edit. p. 233.