is necessary to calculate the time taken to cut the cliff sections. To be as brief as possible I have selected three sections on the Werribee between Bacchus Marsh and Ballan.

			Thickness.				Time required for cutting.
(1)	Glacial	...	195 feet	...	...	...	234,000 years.
	Silurian	...	415 "	...	...	...	830,000 "
	Total	...	610 "	...	...	...	1,064,000 "
(2)	Basalt	...	235 "	...	...	...	705,000 "
	Glacial	...	60 "	...	...	...	72,000 "
	Granite	...	176 "	...	...	...	264,000 "
	Total	...	471 "	...	...	...	1,041,000 "
(3)	Basalt	...	240 "	...	...	...	720,000 "
	Glacial	...	98 "	...	...	...	117,600 "
	Silurian	...	122 "	...	...	...	244,000 "
	Total	...	460 "	...	...	...	1,081,600 "

In compiling these notes I have assumed that the rainfall has not been greater in past ages, say since the flow of newer basalt, than it is on the average at the present time.

VIII.—ON THE NAPARIMA ROCKS, TRINIDAD.

By R. J. LECHMERE GUPPY, Esq.

I HAVE received a copy of the paper by Messrs. Harrison and Jukes-Browne on the Oceanic Deposits of Trinidad, and wish to place on record a few remarks on it.

In the first place I must compliment these gentlemen upon the manner, at the same time courteous and impartial, in which they have dealt with my work.

Our authors state that my writings leave both the nomenclature and the succession of the Trinidad Tertiaries in a very uncertain state. I am afraid that there is much of truth in this statement; and I should feel satisfaction could I clear up the uncertainty either by producing evidence of a nature distinctly confirming or distinctly refuting Professor Harrison's opinion that the Nariva Series is older than the other Naparima beds, and that the Sanfernando beds are closely connected with and are probably an upward continuation of the Nariva Series. I have not been able to satisfy myself with positive certainty either one way or the other. Our authors admit themselves that no sections were seen showing the junction of the two formations, but they consider that there is abundant evidence that the two series occupy the relative positions assigned to them by the geological surveyors. I am not so wedded to my own opinion that I would not welcome theirs if I could be satisfied about this evidence. But so far as I know, no evidence of a conclusive nature is forthcoming, as in no place is the junction of the two series seen. A similar doubt formerly prevailed respecting the junction of radiolarian and foraminiferal beds; but this has been dispelled,

and we are now aware that these two series pass gradually and conformably one into the other. A similar result may hereafter happen in regard to the Naparima marls and the Nariva Series. In the meantime my opinion is based mainly upon conjecture, though one point weighs a good deal with me, that is, the strong resemblance of the Nariva beds to the strata now being deposited in the gulf derived from the degradation of the Naparima beds; and if this inference is correct the Nariva Series must be later in date than the foraminiferal marls. The resemblance I refer to is one not only of mineral composition and mechanical aggregation, but of organic contents, inasmuch as some of the deposits now being laid down and (notably those off the mouth of the Sipero river) contain foraminifera of the same character and in similar condition and of similar frequency of occurrence as the Nariva beds. To take an example, *Globigerina* is a very abundant organism, both in the mud-deposits off Sanfernando and in the Nariva beds, but in both these deposits it is relatively much less abundant than in the foraminiferal marls; and the relative infrequency of occurrence is due to the destruction of the fossils in the course of the denudation and redeposition of the marls. No such foraminifera now exist or can exist in a living state in the gulf, though in my very first dredgings off Sanfernando I recorded *Globigerina* at every haul in shallow water near the shore. That was before I had recognized *Globigerina* in the rocks of Naparima, and, as I have already stated, the foraminifera so dredged by me were fossils derived from the Naparima marls. Also, I consider that the abundance of gypsum in the Nariva Series is due to the breaking down and redeposition of the foraminiferal marls, in course of which the carbonate of lime existing in the latter was partly changed into sulphate.

Respecting the nature and origin of the Argiline of Naparima Hill, I somewhat timidly expressed my opinion in former papers. As I find that Messrs. Harrison and Jukes-Browne are substantially of the same opinion as myself on the subject, I may take the opportunity of restating it. The nature and origin of the Argiline are similar to those of the Naparima foraminiferal and radiolarian marls, and it contained similar Radiolaria and Foraminifera. But the Argiline has undergone a change consequent upon an alteration in the form of its silica; a change analogous to that which has taken place in part of the so-called 'cement' of the White Hills of Bendigo, Australia, described by me in the Proceedings of the Geologists' Association of London, 1864, p. 409, and which consists in an induration by probably a partial solution and redeposition of the siliceous constituents. The whole mass of Naparima Hill is thus affected; but a similar change has partially and locally affected other portions of the Naparima rocks.

To my description of the Argiline of Naparima Hill published in the Geological Society's Journal, November, 1892, p. 526, should be added the remarks contained in my paper in the Trinidad Field Naturalists' Journal, 1893, p. 7, as follows: "Beds of different texture occur in the Argiline, some being more sandy in composition.

In these I have found very evident organic remains, though I cannot yet say exactly what they are. In another stratum of the same rock, I found two or three identifiable Foraminifera, namely, *Pullenia* and *Sphaeroidina*, both deep-water forms." J. W. Gregory found indeterminable fragments of Radiolaria in this rock, and I can confirm this observation, such remains being abundant.

It is singular that no attempt was ever made to ascertain whether water could be obtained from beneath the Naparima Rocks. Previous to my arrival in the island (1859), the Government offered a reward of £2,000 for the discovery of water by means of an artesian well in Naparima. One would have thought that that would have been sufficient encouragement for such an attempt. A close examination of the physical features and geology of the country might afford to an observant eye and a sanguine mind further encouragement for a prosecution of the search for subterranean water. In my paper on the water-bearing capacities of Trinidad Rocks (published in the Trinidad Agricultural Record, 1891), also in my paper in the Journal of the Geological Society already quoted, I gave a description of the marls of Naparima, showing that these rocks do not yield springs, nor do they contain water except in union with the rock. It is true the rock (marl) is capable of union with any quantity of water, but it will not give up this water except by the process of evaporation. I had not mentioned the fact, however, that in one or two places in Naparima there are at the bottom of ravines or gullies springs of water which, though too small to give rise to any stream, being rapidly absorbed by the soil or dissipated by evaporation, serve to a very limited extent for drinking and washing purposes. Their existence is usually obvious to the wayfarer, for they assail his senses by the view of linen spread on bush and grass, the smell of foul water, and the noise of banging and beating of clothes characteristic of the Creole way of washing. Now it has occurred to me that these springs arise from the rock vertically underlying the marls, and that they only occur where the depth of the marl above the underlying rock is not great. This underlying or hypogene rock I suppose to be an extension of the hypogene or granitoid rocks of South America.

I am satisfied now that the Naparima deposits are not a continuous series of formations of several thousands of feet in thickness, but that the rocks as shown in section are several repetitions of the same beds or series of beds. As these beds are now almost vertical, it is evident that the movements which have brought about the alteration in position have been very extensive, and the intermediate and connecting portions of the strata have been removed by denudation.

In my paper on the Gulf of Paria, printed in the Proceedings of the Victoria Institute of Trinidad, 1894, p. 106, I touched cursorily on the remarkable depression between Trinidad and Venezuela passing through the Bocas. I reproduce here what I there wrote:—

"The Bocas are narrow channels connecting the Gulf of Paria with the Caribbean Sea. These channels have had their origin

as subærial valleys, now submerged. (See papers in Proceedings Scientific Association, 1877, p. 103, and Agricultural Record, 1891, p. 79.) The first Boca (Boca de Monos) is barely half a mile wide, the second (Boca Huevos) a little wider. The third (Boca Navios, so called, I suppose, because ships do not use it), about the same. The Grand Boca is about six miles wide. These widths may be taken to be the clear widths in the narrowest parts. The rapid currents through these channels have kept them scoured out, and the depth reaches 120 fathoms. No mud or sand of any kind is deposited in these Bocas. The bottom is one of rocky inequalities whose existence is evidenced in the violent eddies and ripples of the so-called 'remu,' a phenomenon which occurs when the water outside the Bocas is at its lowest and consequently the water surface gradient from the middle parts of the Gulf the greatest. Outside the Gulf the Caribbean Sea varies in depth from 20 to 60 fathoms except in the line of the great downthrow passing along the axis of the Grand Boca. Here the depth attains 120 fathoms, and is probably not less than 90 in any part. This line of depression seems to be a terrestrial feature of some magnitude. Its extension north-eastward from the Boca Grande, between the islands of Grenada and Tobago, is indicated by deep water marking the boundary between the volcanic region of the Antilles and the non-volcanic region to the south and east thereof."

It is strange now to myself that in writing my paper on the Microzoic Deposits of Trinidad I should have given so little weight to the bearing the existence of this depression must have on any theory of the movements of the earth's crust in this region. I am unable now to go further into this subject, but I cannot forbear pointing out that this great depression of a portion of the earth's surface, which evidence clearly shows to have been formerly a continuous land surface, had most probably an intimate connection with, or rather was part of, those movements, which among other events broke up and elevated the Naparima Rocks and tilted them on edge.

IX.—TWO NEW SPECIES OF OSTRACODA OF TITHONIAN AGE FROM NESSELSDORF, AUSTRIA.

By FREDERICK CHAPMAN, A.L.S., F.R.M.S.

THE following descriptions of Ostracoda from the Tithonian of Austria relate to specimens kindly forwarded to me by Dr. M. Remeš. They were obtained, together with numerous other fossils, including Foraminifera, from the Red Limestone of Nesselsdorf.

The Ostracoda seem to be very rare in these beds, for the two specimens now described were the only forms obtained by Dr. Remeš, whilst other microzoa were fairly numerous.

BYTHOCYPRIS, G. S. Brady [1880].

Bythocypris (?) *Jurassica*, sp. nov. (Figs. 1a-c.)

Carapace somewhat compressed; from the side subreniform, the greatest height a little in front of the middle, anterior extremity broad and rounded, posterior rounded but narrower. Edge view,