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Geological Account of a Series of Animal and Vegetable Remains and of Rocks, collected by J. Crawfurd, Esq. on a Voyage up the Irawadi to Ava, in 1826 and 1827[1]

Reverend William Buckland, D.D. F.G.S. F.R.S. F.L.S.,
Professor of Mineralogy and Geology in the University of Oxford (circa 1827)

For the specimens and notes which form the subject of the present communication, the Society is indebted to the zeal and activity of J. Crawfurd, Esq. one of its Fellows, who having occasion to traverse the Burmese Country, on an embassy to Ava, in the years 1826 and 1827, discovered an extensive deposit of organic remains in that unknown and distant region. He has brought home specimens of these remains, both animal and vegetable, as well as of the strata in which they were found, and has with much judgment and liberality presented them to the Geological Society of London, and to several other scientific Societies. It is on an examination of these specimens, and of the notes contained in Mr. Crawfurd's daily journal, that the observations and descriptions that make up the present memoir arc founded.

Before I proceed to the details of this interesting subject, it may not be amiss to refer to the state of our knowledge, or rather ignorance, of the geology of these regions, antecedently to the discoveries of Mr. Crawfurd; an ignorance which our frequent and extensive intercourse with India has but recently and in a very slight degree tended to dispel; since, with the exception of two

[1] Reprinted from John Crawfurd's *Journal of an Embassy to the Court of Ava.*

Memoirs in the *Geological Transactions* (Vol. I. Part 1. New Series),—the one a paper by Mr. Colebrooke on the North-east border of Bengal, the other a description of a collection of specimens made by Mr. Fraser, on a Journey from Delhi to Bombay; and of two brief notices in the same volume,—no description of the secondary, tertiary, or diluvial formations of central and southern Asia, as compared with the similar formations of Europe, has been given to the public.

In the year 1823, in the following passage of my *Reliquiæ Diluvianæ* (p. 170), I quoted the opinion of Mr. Weaver on the importance of instituting a comparison between the organic remains which might be discovered in the diluvium of tropical countries, and the similar remains found in the diluvium of the temperate and frigid zones of the northern hemisphere:—

> Another interesting branch of enquiry is, whether any fossil remains of elephant, rhinoceros, hippopotamus and hyæna, exist in the diluvium of tropical climates; and if they do, whether they agree with the recent species of these genera, or with those extinct species whose remains are dispersed so largely over the temperate and frigid zones of the northern hemisphere.

It could scarcely have been anticipated, that within so short a period as has elapsed since the date of this publication, the zealous investigations of a single individual should have gone so far as those of Mr. Crawfurd have done, to supply an answer to the questions then proposed.

The evidence which Mr. Crawfurd has imported, is derived from no less than seven large chests full of fossil wood and fossil bones, and of specimens of the strata that are found along the course of the Irawadi, from its mouth near Rangoon up to Ava, being a distance of nearly five hundred miles.

The larger portion of the fossil wood is beautifully silicified, and displays most delicately the structure and fibres of the living plants: in other specimens of it this structure is more obscure, though sufficient to show that the trees in which it exists were dicotyledonous. This obscurity arises from the fact of most of these dicotyledonous plants being impregnated with carbonate of lime, whilst all the monocotyledonous stems are silicified, as are also a

few of the dicotyledonous: in these latter also the vegetable structure is more distinct than in the calcareous fossils, and in some of them it much resembles that of the tamarind wood. These plants were found most abundantly in the same region with the fossil bones, but occur also along nearly the whole course of the Irawadi from Ava to Prome. They were principally collected from a tract of country extending over a square of more than twenty miles on the east bank of the Irawadi, near the town of Wetmasut, about half-way between Ava and Prome, between lat. 20° and 21°. N. The occurrence of bones was most abundant in a small space near the centre of this district, occupying about one-third of the above-named area, the surface of which is composed chiefly of barren sand hills mixed with gravel; beneath these are strata containing shells and lignite, through which they sink wells about two hundred feet to collect petroleum.

In examining the bones, I have had the advantage of the co-operation of Mr. Clift, to whose anatomical description I beg to refer my readers. And though we are still without proof as to the existence of fossil elephants in Asia; there being no remains of these animals in the collection now before us; we have bones and teeth of the Pachydermata which are usually associated with them in Europe, America, and Siberia; viz. of rhinoceros, hippopotamus, mastodon, tapir, and hog; also several species of Ruminantia, resembling oxen, antelopes or deer; with the addition of the gavial and alligator, and species of the two genera of fresh-water tortoises, viz. Trionyx and Emys.

The occurrence of such reptiles in the same deposits with the Mammalia, has, I believe, not yet been noticed in the diluvium of Europe, America, or Northern Asia; and it deserves remark, that the gavial, and several of the Pachydermata found by Mr. Crawfurd, do not now inhabit the Burmese Country; for the gavial is now limited almost exclusively to the waters of the Ganges and its confluents; the hippopotamus exists no where but in the rivers and lakes of Africa; and the mastodon is utterly extinct. There is, however, no greater anomaly in supposing that all these animals inhabited the Burmese Country at the period preceding the deluge which overwhelmed it, than that at the period preceding the similar catastrophe which befel the North of Europe, the elephant, rhinoceros, hippopotamus and hyæna were co-inhabitants of England,—-a point which in another work (*Reliquiæ Diluvianæ*) I

have endeavoured to establish from the evidence of the bones found at Kirkdale and in other caverns.

Judging from the number and proportion of bones in the collection, made by Mr. Crawfurd, the most abundant fossil animal in the valley of the Irawadi is the mastodon, then the crocodile and tortoise, and lastly the rhinoceros and deer. Of the hippopotamus, parts only of two jaws have been yet identified; and of the tapir and hog, one fragment only of a lower jaw. It is not however possible to deduce any certain conclusions as to the relative abundance of these animals, from the proportion of bones in any single collection.

The following maybe given as a rude approximation to the numerical proportion of bones and fragments of bones we have now before us.

	No. of bones.
Mastadon	150
Rhinoceros	10
Hippopotamus	2
Tapir	1
Hog	1
Ox, Deer, and Antelope	20
Gavial and Alligator	50
Emys	20
Trionyx	10

At the head of this list stand the remains of the genus Mastodon, not only because they so much exceed in numbers the aggregate of all the rest, but because they establish the fact, that at least two species of these gigantic animals were among the antediluvian inhabitants of the southern parts of Asia, and because they add, to the six species of this extinct genus already ascertained by Cuvier, two new and strongly characterized species, one of which, from its approximation to the elephant in the structure of the teeth, Mr. Clift proposes to designate by the name of *Mastodon elephantoides:* to the other he has given the name of *Mastodon latidens.*

In the collection before us, there must be fragments of at least a dozen skeletons of mastodons, many of them equal in size to the bones of the largest modern elephant, and some exceeding them; the fragments of femur and tibia, equal those of the largest fossil elephant, whilst in another specimen we have the milk-tooth of a sucking mastodon. In other specimens of the teeth we observe various stages of advancement from youth to extreme age.

Of the ivory tusks of this animal, there are many small but decided fragments, of one of which a section is given showing the intersecting curved lines, like the engine-turning, on a watch, by which the ivory of the elephant's tusk also is characterized.

Of Ruminantia we have evidence to establish at least three species; viz. three different sized condyles of the femur of three full-grown animals; also teeth of at least two species of ox or deer or antelope; and fragments of the solid bony base or core of three horns of antelopes; and two different tibiæ, with two different scapulæ of full-grown Ruminantia.

The bones of gavial in this collection afford, like the hippopotamus, another example of the occurrence of fossil animals in a different locality from their recent analogues. Mr. Clift considers this species to resemble the existing gavials of the Ganges, but the frequent discoveries of fossil gavials in tertiary strata, and even in secondary strata, down to the lias, show, that in an earlier and different state of our planet, this genus also has been dispersed abundantly and widely over its surface.

The specimens of alligators' bones also are scarcely sufficient to allow Mr. Clift to pronounce decisively as to their identity with existing species. From the magnitude of the fragments, their size must occasionally have been very great.

The fossil emys and trionyx of Ava we can scarcely identify, from our imperfect fragments, either with species that now inhabit the rivers of that country, or with the fossil tortoises which extend through nearly all tertiary and secondary strata; occurring in the tertiary sand-rock of Brussels, and in our London and plastic clay, in our Hastings-sand and Purbeck lime-stone, as well as in the Kimmeridge clay and Stonesfield oolite, in the lias of Glostershire, and transition slate of Glarus, In the modern rivers of India, there are tortoises which attain a considerable size, and are cherished and fed by the natives.

It cannot but occur to us in this stage of our enquiry as remarkable, that not one fragment is found in all this collection, either of the elephant, tiger, or hyæna, which now abound so much in India; whilst the mastodon, whose living analogue exists not upon earth, must probably at one time have swarmed in the districts bordering on the Irawadi. The same analogy which emboldened me, in my first paper on the Cave of Kirkdale, to anticipate the discovery which was speedily made of hyaenas' bones in the diluvium of England, arguing on the fact of their existence in the diluvium of the European continent, at the present moment encourages me also to anticipate the future discovery of the elephant, tiger, and hyæna in the diluvium of Asia. I would also argue, on the same grounds, that it is highly probable we shall hereafter find the mastodon in our own diluvium and most recent tertiary strata.

The state of preservation of all these bones from Ava is remarkably perfect, from the circumstance of their being almost entirely penetrated with hydrate of iron, to a degree that has converted many of them to a rich mass of iron ore, and has given them a hardness which caused them, at first, to be considered as silicified; and they have been erroneously so described in some printed notices on this subject in the *Calcutta Gazette*, March 21st, 1827, and in other publications. Such, however, is not the case with any specimen I have seen in the whole collection; the cancelli of the bones are filled either with hydrate of iron or carbonate of lime, and their weight and strength-thereby increased, but no other kind of change or injury to their external form has been produced.

It is, in fact, to the strength and indestructibility resulting from the mineral impregnation above-mentioned, that we owe the discovery of these remains on the shores of the Irawadi. An accident that delayed for some days the steam-boat in which Mr. Crawfurd was descending this river, allowed him to land, accompanied by Dr. Wallich, and to investigate the structure of the country for some miles on the north-east of Wetmasut. The accident arose from the shallowness of the water, when the steam-boat was descending, which, fortunately for geology, caused it to run aground near the wells of petroleum, where the left bonk of the river presents a cliff of several miles in length, generally perpendicular, and not exceeding eighty feet in height. At the

bottom of this cliff the strand was dry, and on it were found specimens of petrified wood and bones, that had probably fallen from the cliff in the course of its decay; but no bone was discovered in the cliff itself by Mr. Crawfurd and Dr. Wallich; nor were they more fortunate in several places where they dug in search of bones in the adjacent district. This district is composed of sand-hills that are very sterile, and is intersected by deep ravines: among the sand are beds of gravel, often cemented to a breccia by Iron or carbonate of lime; and scattered over its surface at distant and irregular intervals, were found many fragments of bone and mineralized wood, in some instances lying entirely loose upon the sand, in other cases half buried in it, with their upper portions projecting, naked, and exposed to the air: they appeared to have been left in this condition, in consequence of the matrix of sand and gravel that once covered them undergoing daily removal by the agency of winds and rains, and they would speedily have fallen to pieces under this exposure to atmospheric action, had they not been protected by the mineralization they have undergone.

On examining many of the ravines that intersect this part of the country, and which were at this time dry, the same silicified wood was found projecting from the sand-banks, and ready to drop into the streams; from the bottoms of which the travellers took many fragments, that had so fallen during the gradual wearing of the bank, and lay rolled and exposed to friction by the passing waters. Some of these stems were from fifteen to twenty feet in length, and five feet in circumference. These circumstances show, that the ordinary effect of existing rains and torrents is not only to expose and lay bare these organic remains, but wash them out from the matrix to which some other and more powerful agency must have introduced them.

Of the total number of bones in this collection, about one-third have suffered from friction; and of the remainder, nearly all appear to have been broken, more or less, before they were lodged in the places where Mr. Crawfurd found them irregularly dispersed. Many fragments also of the ivory have been rolled considerably; but no one specimen of that substance, or indeed of any bone in this collection, has been reduced to the state of a perfect pebble: from this circumstance we may infer, that the waters which

produced the rolling they have undergone, were not in violent action during any very protracted period of time.

Many of the larger bones, and some of the small ones, have masses of stone adhering to them, which afford specimens of the matrix in which they were imbedded; these are composed of small round grains and pebbles of white quartz, and various quartzose and jasper pebbles, strongly united together by a cement of carbonate lime, and sometimes by hydrate of iron: where this iron is very abundant, it affords concentric ocherous concretions, resembling aetites, dispersed irregularly through the breccia. The masses of calcareo-silicious conglomerate that adhere thus to the bones, do not appear to have been separated by violence from any mass or stratum, of solid stone, but to be merely small local concretions attached, to these bones. There are other calcareous concretions that contain no kind of organic nucleus, but are composed of precisely the same materials as those which are formed around the bones, and present many of the irregular shapes of the tuberous roots of vegetables; some of them also have the elongated conical form of slender stalactites, or clustered icicles, a form not unfrequently produced in beds of loose calcareous sand by the constant descent of water along the same small cavity, or crevice, to which a root or worm-hole may have given the first beginning: some of these appeared in the cliffs just mentioned, near Wetmasut. I have seen similar elongated and pseudostalactitic concretions disposed at right angles to the beds of sand, and descending vertically by the side of each other, like the roots of carrots and parsnips, to a depth of nearly two feet, displayed in the section of the cliff near Finale, between Genoa and Nice; and I have also a collection of the same kind from the calcareous sand-beds of Bermuda: their form and position in the sand caused them to be sent home, under an idea that they were petrified roots.[2] Neither the insulated concretions from Ava, nor those adhering to the bones, contain traces of any kind of shell;

[2] Original footnote: Dr. Fitton, in his excellent account of some geological specimens from the coasts of Australia, (London, 1826,) describes many similar examples of stalactite-shaped and other irregular calcareous concretions, in the sandy strata that occur on many parts of those coasts. He also gives references to authors who have described similar cases in other countries; viz. to Dr. M'Culloch, who has described them as existing in Perthshire, Dr. Paris in Cornwall, Captain Lyon in Africa, and other writers.

they also differ mineralogically from all the specimens of tertiary and fresh-water strata in this collection.

Among the most remarkable of these strata is a fresh-water deposit of blue and marly clay, containing abundantly shells that belong exclusively to a large and thick species of Cyrena; a dark-coloured slaty limestone, containing shells, which Mr. Sowerby has identified with some of those that occur in our London clay. There is also, from the lulls opposite Prome, granular yellow sandy limestone, containing fragments of marine shells, and much resembling the calcaire grossier of the environs of Paris; and from the same neighbourhood, and other places higher up the Irawadi, are several specimens of soft and greenish sand-stones resembling those of our plastic clay formation. From all these, it appears highly probable, that some of the most important component members of our tertiary strata occur along a great part of the course of the Irawadi, between Ava and Prome, near which latter place the alluvial delta begins, which extends from thence, by Rangoon, to the Gulf of Martaban.

Throughout this district also we seem justified, by the notes of Mr. Crawfurd, in establishing the existence of the same distinctions between diluvial and alluvial deposits that are found in the valleys of all our European rivers. To the alluvial belong not only the immense deltas just mentioned as occurring from Prome downwards to the sea, but also a number of islands, that are continually forming and shifting at various places along the whole extent of the actual bed of the Irawadi, more particularly at Rabakyoaktan, and also between the latitudes of 20° and 21° N. about half way from Prome to Ava, between the towns of Wetmasut and Salè, in the neighbourhood of the fossil bones, to the diluvial deposits we may probably refer the sand and gravel beds containing the mineralized bones, which, as Mr. Crawfurd has observed, it is impossible to attribute to the waters of the Irawadi, because they occur in a district where the stream is pent up within steep banks which it never overflows, and within which it never rises above twenty feet, while the average elevation of the ossiferous sand and gravel beds is at least sixty feet above the highest floods of this river. He further observes, that whilst the bones and wood of these comparatively elevated plains are mineralized, and converted the one to iron and the other to flint, the remains of modern trees and modern animals that are

stranded on the alluvial islands of the existing river, (particularly on an island near Rabakyoaktan,) undergo no such change, but are seen daily falling to decay and crumbling to dust: and he also mentions, for the purpose of disproving its correctness, that it is a popular notion among the natives, who have long observed the existence of this fossil wood, that it had been turned to stone by the waters of the Irawadi: such opinions are very natural on the shores of rivers and lakes where fresh pieces of fossil wood become continually exposed by the wearing away of the banks in which they were imbedded and received their mineral impregnation; the waters of Lough Neagh in the county of Antrim are in the same way believed by the Irish peasants to possess the property of converting wood to stone.[3]

The facts in such cases are, that a succession of fresh pieces of silicified wood is found after storms exposed along the shores, being washed out of the banks that are continually wasting by the waves. The evidence before us then is such, that I believe no practical geologist will be disposed to assign the origin either of the wood or bones under consideration, to the comparatively impotent exertions of existing causes. The question reserved for him is, whether some of these remains may not also occur in the most recent tertiary strata, as well as in the diluvium of Asia:—the analogy of Europe would lead him to expect the same Mammalia in both; we have however in the specimens before us not one shell of any kind adhering to the bonus, or in the agglutinated sand and gravel attached to them; and in Mr. Crawfurd's notes, there is no evidence to show that any bones were found, except in the deposits of sand and gravel near Wetmasut, and these differ materially from every specimen in his collection which we recognise as identical with the tertiary strata of our own country.

It is of course impossible for any person who has not been on the spot, to decide with ertainty on a question which requires so much minute local investigation by a very experienced observer. I shall therefore conclude with recapitulating the only three

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[3] [Original footnote] The idea is probably alluded to in the cry, which is said to have been at one time common in Dublin.

"Lough Neagh! buy my
hones,
Once were wood, and now
are stones."

speculations that I conceive can be proposed, to explain with probability the date and origin of the bones before us.

I. Either they were lodged in the most recent marine sediments of the tertiary formation, like the elephant in the crag of Norfolk, the rhinoceros of Placenza, and the mastodon of Dax and Asti;

II. Or in antediluvian fresh-water deposits, analagous to those which contain the rhinoceros, elephant, hippopotamus, and mastodon in the Val' d'Arno;

III. Or in diluvial accumulations more recent than either of these formations, and spread irregularly, like a-mantle, over them both.

Now, as we find on careful examination of the matrix adhering to these bones, that it contains neither fresh-water nor marine shells, and is wholly different in character from all the specimens which contain such shells, and which thereby enable us to refer them respectively to, fresh-water or marine origin; the most probable conclusion we can arrive at is, that the bones belong to neither of these formations, and that their matrix is of the, same diluvial character with that in which the greater part of the fossil bones of Mammalia have been discovered in Europe.

Having proceeded thus far in our consideration of the nature of the bones before us, the time when the animals lived to which they belong, and the most probable causes that brought them to their actual place and condition,—we may now consider the evidence on which it has been asserted in the preceding pages, that the strata subjacent to the Burmese diluvium, along nearly three hundred miles of the course of the Irawadi, from Prome to Ava, present a repetition of the geological structure of Europe.

From the examination of the specimens, compared with the notes in Mr. Crawfurd's journal, the following formations may be recognised with a greater or less degree of certainty.

1. Alluvium,
2. Diluvium.
3. Fresh-water Marl.
4. London Clay and Calcaire Grossier.
5. Plastic Clay, with its sands and gravel.
6. Transition Limestone.
7. Grauwacke.

8. Primitive Rocks, Marble, Mica Slate.

There are also, indications (but less certain) of new red-sandstone and magnesian limestone.

The Alluvium and Diluvium (Nos. 1. and 2.) have been already spoken of.

3. The Fresh-water formation (No. 3.) occurs a little north of the Petroleum Wells, and of the district in which the bones were found near Wetmasut, and is at an elevation of 150 feet above the Irawadi. The specimens of it consist exclusively of marly blue clay, containing fresh-water shells of the genus Cyrena: the shells are very thick and heavy, nearly three inches in diameter, and judging from the great quantity imported, must be extremely abundant; and, though accompanied by no other organic remains of any kind, are sufficient to establish an analogy, in the strata containing them, to the fresh-water formations that occur associated with the tertiary strata of Europe. There is, however, no evidence to show any connexion between these fresh-water deposits and the fossil bones or wood: from the portions of iron and gravel adhering to many of the remains of tortoise, crocodile, and hippopotamus, it should seem that they had no connexion with the fresh-water deposit: still the abundance and size of such animals, show that there must have been large rivers or lakes at the time and place in which they lived; though it would not justify our assigning them, without further examination, to the period in which these fresh-water strata were formed that contain the shells of Cyrena.

4. We have from the hills near Prome a coarse-grained yellow shelly and sandy limestone, scarcely distinguishable from the calcaire grossier of Paris; and from several places higher up the Irawadi, particularly at Pugan, we have a dark bituminous slaty limestone, in which Mr. Sowerby has recognised the following fossils as identical with those of the London clay.

Ancillaria } Lamarck, Environs de Paris. Only found in London clay and calcaire grossier.
Murex }
Cerithium } London clay
Olivia }
Astarte rugata. (Min. Conch.) London clay and calcaire grossier.
Nucula rugosa. London clay and calcaire grossier.
Erycina.
Tellina. London clay :—shell figured by Brocchi.
Teredo. In blocks of calcareous wood: the same as in the London clay.
Teeth of Shark. London clay.
Scales of fishes. London clay.
Pebbles of rolled black bone.
Unknown radiating fossil, resembling coral.

This recognition of a stratum so nearly resembling the London clay in respect of its peculiar shells and other fossils, in so distant a part of Asia, receives still further Interest when viewed in conjunction with the information that has been afforded to us by Mr. Colebrooke, as to the existence of a similar formation at Cooch-Behar in the N.E. border of Bengal, where the Brahniputra emerges into the plain. Here Mr. Scott discovered strata of yellow and green sand alternating with clay, that lie horizontally at the height of about 150 feet above the level of the sea, and contain organic remains resembling those of the blue clay of the London and Hampshire basin. Mr. Scott has also discovered at Robagiri, in this same district, a stratum of white lime-stone containing nummulites and vertebrae offish, surmounted by beds of clay which contain the same nummulites, and also bones of fish, with shells of Ostrea and Pecten. Near Silhet the Laour Hills, composed of white limestone loaded with nummulites, form another example of tertiary formations in the eastern extremity of this province. And the section near Madras, given by Mr. Babington, shows the same tertiary formations to exist also on the western shores of the Bay of Bengal.

All these circumstances taken together, leave not a doubt of the important fact that the tertiary strata, which a few years since had been noticed only in the basins of Paris and London, are most

extensively distributed over the surface of the globe. Their existence is now familiar to us in almost every state in Europe, particularly in the sub-Apennine formations, where they have been so ably described by Brocchi, and are now receiving further illustration from the able hand of Professor Guidotti of Parma. Again, we trace them round the shores and in the islands of the Mediterranean, at Montpellier and Nice, at Savona, Volterra, and Rome,—in the fish-beds of Mount Lebanon,—and the nummulite limestone that forms the foundation of the Pyramids of Egypt. We recognise them also along the northern shores of Africa, and in Malta, Sicily, and Sardinia. Mr. Strangways has traced them largely in the Steppes of southern Russia, and on the shores of the Black Sea and the Caspian (see his Map of European Russia, Geol. Trans. 2nd Series, vol. i. plate II). The Russians in their expedition to Bokaria have found them on the borders of Lake Aral; and now, on the authority of Mr, Crawfurd's discoveries, we establish them in a considerable district of the Burmese empire beyond the Ganges.

5. In many of the specimens from near Prome, we find a soft green and yellow sandstone resembling that of our plastic clay formation. Mr. Crawfurd describes these as associated with reddish clay intermixed with sand and pebbles, in words that are almost equally applicable to our English plastic clay-pits at Reading or Lewisham. He found them in many places where he landed along the shores of the Irawadi; and near Pugan (On the west shore of the Irawadi, opposite to Pugan, springs of petroleum ooze from the hills composed of immense masses of blue clay; and if wells were dug, it might be collected as at Wetmasut.--*Mr. Crawfurd's Notes*.) and Wetmasut they were associated with brown coal and petroleum, precisely as we find them containing brown coal all over Europe, and connected with wells of petroleum near Parma, and also in Sicily, and near Baku on the west coast of the Caspian. Near the petroleum wells of Wetmasut, Mr. Crawfurd also found large selenites resembling those that occur at Newhaven in our plastic clay. In Ava, as in Europe, they seem to be co-extensive with the clay-beds of the tertiary formation.

6. The transition limestone appears, from the few specimens we possess, to be of the same character with that of Europe, but in these specimens there are no organic remains. At a small hill four hundred feet high, called Manlan Hill, near Wetmasut and the petroleum wells, it is associated with grauwacke. There are also specimens of grauwacke much charged with carbonate of lime from so many distant points along the Irawadi, that, in the absence of better information, we may conjecture the fundamental strata of this region to belong to the transition series, and that they are covered more or less by the tertiary strata and diluvium which we have been considering.

7. From the mountains of the Sakaing Chain, a little above Ava, we have much pure mica slate and statuary marble in its usual connexion with mica slate and hornblende rock; this marble is of the finest quality, and extensively employed by the natives in making images of Buddha.

The specimens afford no decided example of secondary rocks in this district (Near Pukangyi); but a reddish sandstone, which is used for architecture in the construction of thrones to receive the images of Buddha, and a limestone which resembles the magnesian limestone of England, may, I think, with more probability be referred to the new red sandstone than to any other formation.

The extent and relative position of all these strata it was impossible to ascertain from the few opportunities afforded to Mr. Crawfurd of landing from the steam-boat in which he made his voyage; these may become the subject of future investigations. The grand point is, however, established, of the occurrence of formations in the south-east of India, analogous to the tertiary and diluvial formations of Europe, and containing respectively the remains of animals the same which the formations of Europe contain, or very similar to them: these animals must therefore at some time or other, and most probably at the same time, have existed in regions whose climate and inhabitants now differ so widely as those of India and Europe. It must be confessed, in concluding, that the result of these discoveries, though intensely interesting, and a splendid example of what may be done by the skill and activity of one zealous individual, is rather to stimulate

than fully gratify our curiosity; and to excite our hopes for more detailed and more extensive information from the future investigations of the most intelligent among our countrymen, whose professional duties call them to the eastern world.