NOTICES OF MEMOIRS.

I.—On the Primæval Rivers of Britain.[1]

By T. Rupert Jones, F.G.S., Professor of Geology, etc., Royal Military College, Sandhurst.

THE geological action and results of rain and rivers may be easily recognized by even casual observers. The muddy waters of a clay country after showers, and the numerous little deltas of rain-washed grit and mud on the slopes of roads and fields where sandy soil abounds, attest the action of the rain in removing earthy material from a higher to a lower level, under ordinary circumstances. The powerful action of torrents suddenly charged with melted snow or with tropical rains, or locally flooded by a bursting water-spout, is well known, and can be likened only to the devastating agency of a broken reservoir, such as those of Huddersfield and Sheffield. In all cases mud, sand, and shingle, together with drifted timber, herbage, leaves, and water-plants, bones and carcases, insects, shells of land and water molluscs, and other organic remnants, are slowly or suddenly moved down-stream,—laid down here, stirred up and pushed forward there,—buried deeply at one place, ceaselessly drifted to and fro at another; and such changes go on until the river-plain, having been made level by marsh-deposits, and excavated repeatedly along the wandering lines of the river's changing course, extends seaward; and the delta pushes out even into the sea, which takes more and more of the mingled detritus for its share, laying it down in the deeps and the shallows with a seemingly capricious irregularity, which is, really, recognizable order, dependent on the gravity of particles and the force and direction of tides and currents.

By its alluvium, or deposits of gravel, sand, and mud, often blackened with peat or charged with shells and bones, the river keeps an imperfect record of its work, as a carrying agent, in removing the ruins of the higher ground, whether reduced by the chipping frost and the grinding glacier, by the soaking mists and sapping springs, by the washing rain and raging torrents, or by all of these, assisted by the slow and sure decomposing power of carbonic acid. As a red river runs from red ground, so does a muddy river come from clay ground, and a hard-water river from limestones. The shingle of slate or quartz-rock, of granite or mica-schist, of sandstone or limestone, bears direct evidence of its local origin; and the sand from old sandstones, from the quartz of granite newly rotted, or from the frost-bitten quartz-rock, still shows traces of its birth-place. Whether in lakes or seas, such detritus tells of its former belongings, and is subject to unchangeable laws of deposition and arrangement. Clay may have been fine mud derived directly from the decomposition and degradation of felspathic rocks, or from the wear and tear of clay-slates, shales, and other argillaceous rocks; but in any case the river carries

[1] Being the substance of a lecture given at Southerndown, July 20th, 1869. Reprinted from the Proceedings of the Cardiff Naturalist's Society.

it in suspension until the current is checked in the still water of a lake, or of a broad reach or bend of the river, or in the sluggish delta-streams where they commingle with the sea. And even here the sweeping tides may drive on the clay-stained waters for many a league, until, transferred to the quiet of a land-locked bay, they drop their sediment, or, borne out to depths where nothing else can reach but drift-wood and floating shells from shore, it slowly sinks among the creatures of the deep.

Where clay has settled near a river's mouth, it is often associated with the decaying marsh-plants, drifted trees, and the water-logged leaves of successive autumns. Where rain-floods and freshets of snow-water have periodically deluged the river's course, the sediment will include the carcases and bones of drowned land animals, and the mud-choked water-creatures that lived at and near its mouth.

What rivers do now they have always done, since the land began to be drained of atmospheric waters along the cracks and crevices of the strata, and the old creeks and arms of the retiring seas. Whether the ground was left by the sea as flats and table-lands, planed horizontally by "marine denudation," or still rugged with the inequalities of crumpled strata crushed upwards by the contracting crust, the air, rain, snow, and frost have had to reduce the elevated and to fill up the hollow surface. And amidst the many changes that this terraqueous globe has suffered (changes due mainly, perhaps, to the reaction of internal heat on a cooling and contracting crust, with its shifting loads of water-borne sediments), such varied deposits as those of everchanging river-systems, rising in the high lands, lifted up in each successive period, and depositing their loads of mud as stratified sediments in the corresponding water-areas, were always being made and often swept away again, but sometimes buried under other strata and kept as part of the stratified series, as we see it now.

The characteristic sign of fluviatile and lacustrine strata have been indicated above, and the kinds of shells, such as *Paludina*, *Limnæus*, *Planorbis*, *Cyrena*, *Cyclas*, *Unio*, *Anodon*, etc., are well known. So also *Cypris* and *Estheria* among the low crustacea have left their carapace-valves in the silts of fresh or brackish waters. Fishes are not good witnesses; for many genera and even species of fish inhabit both rivers and sea, and may be imbedded in the mud of either. Accumulations of vegetable matter (especially land plants) are more likely to occur in lakes and rivers than in the sea; and the skeletons of land animals get dissipated as separate bones in most instances before they reach the sea. In Shells, Corals, and Encrinites we have the best criteria for judging of the origin of strata. There are fossil beds of shells, such as *Paludina*, that are never known to live in the sea; and there are others, as *Ostrea*, that flourish only in salt water, though some individuals may have a struggling existence in brackish estuaries. Others, as *Venus* and *Turritella*, are sea-shells. Of Entomostraca, *Cythere*, *Bairdia*, *Leperditia*, and others are habitually marine. Of Corals there are none that live in rivers or lakes; and all fresh waters, too, are destitute of Echinoderms, whether Starfishes, Encrinites, or other forms, as well as of Foraminifera, the microzoa so abundant in

the fossil state. Take limestones (a various group, comprising chalk, oolite, common limestone, and marble), with the exception of a few that have originated from the chemical arrangement of carbonate of lime, as travertine, all have been made up of organic remains, namely, the calcareous shell or crust, or other support of some of the creatures above mentioned—mostly Shells, Corals, Encrinites, and Foraminifera; and only occasional bands of limestone made of fresh-water shells (*Paludina*, *Cyrena*, etc.) are found. They tell, however, plainly of their local origin, and are associated with equally powerful and distinct witnesses of the extent and influence of rivers and lakes deltas and lagoons, at many, if not all, periods of the earth's history.

The chief examples of such evidences as are retained among the known strata, in different parts of the world, will now be noticed in a brief review of the several great groups of geological formations.

The oldest known strata are the Laurentian, formerly involved in the little understood mass of old schists, slates, and gneiss lying below the Cambrian rocks, but of late years disentangled by Logan and others, and recognized as crumpled beds of masked and altered sandstones, shales, and limestone, such as constitute any of the later formations. They contain also some thin bands of graphite; and if this be altered coal, that was accumulated (like the later coal) in salt marshes and lagoons, the existence of land and its concomitant conditions is indicated thereby. In other respects the Laurentian strata appear to be of truly marine origin, with shingle and sand-banks of the coasts, and calcareous formations of the deep water.

The Cambrian rocks have not yet presented evidence of the existence of rivers or lakes. Land, however, there was; for sand-banks under tidal influence were rippled and sand-cracked, drilled and furrowed by shore-worms and small crustaceans, and pitted by rain-drops. They imbedded here and there the sea-weeds, and, if some decide truly, land plants also (*Eophyton*). The Silurian strata are also wholly of marine origin as far as is known; but in the uppermost formation (the Passage-beds or Ledbury Shales) land plants were brought into the shallows or estuaries, possibly by streams, and remain for us to examine as twigs, branches, spore-cases of Lycopodiaceous plants (*Lycopodites*, *Pachytheca sphærica*). These Passage-beds lead us into the Old Red Sandstones of Herefordshire and Scotland; and for these Mr. Godwin-Austen has strongly argued a freshwater origin. That freshwater conditions did predominate when a part at least of the Old Red of Caithness was formed, the multitudes of *Estheria membranacea* attest; and *Anodon Jukesii* in the Upper Old Red of Ireland speaks of similar conditions. Wide regions were certainly occupied then as forest-land and by jungle-growth, with Conifers and Cryptogams, whence originated the plant-beds of New Brunswick and the coal of Gaspé. Coniferous trees, too, were not wanting in the Scottish area; and in either case were probably washed down by rivers to the salt-marshes, with the sand, mud, and vegetable débris that form the associated sandstones and shaly layers.

On a still larger scale the succeeding period witnessed the action of rain and rivers. These nourished a rich vegetation and swept it

away, to be buried beneath like material again and again, jungle on jungle, time after time, as the lagoon became a marsh, the marsh a forest, the forest a ruin of trees, silted up with river mud, and buried beneath sea sand, but succeeded again by marsh, and soil, and trees. The streams played their part in this old land. It was rich with trees and ferns, and the great congeners of our small club-mosses and horsetails, and furnished with land-snails, myriapods, arachnids, and insects in abundance; reptiles too, great and various, were there, and possibly birds and mammals. The stream cutting through the older beds of peat and the coal brought down the tribute of the higher ground, flooded the forests and gradually filled the sunken areas. Basins also, barred off from the sea by shingle banks, were thus made into brackish lagoons, full of marsh-plants, and alive with reptile, fish, crustacean and mollusc, that made the foul water and black mud their home.

In the "Rothliegende" of the Permian Series we again find *Estheria* and Dreissena-like Molluscs that indicate brackish habitats. The Permian breccia of Worcestershire has been referred to a glacier for its origin; and so also some of the conglomerates of the Old Red series, and even of the Cambrian, have been thought to have originated in such an ice-river of the ancient lands.

In the New Red Sandstone series of Germany the shaly coal, called "Lettenkohle," is of fresh-water origin; and the same *Estheria minuta* that abounds therein occur also in the "Keuper" or Upper New Red of Worcestershire, with fragmentary plant-remains. In the succeeding Rhætic strata the influence of occasional rivers and lakes is seen in the drifted land plants and insects, and the interpolated Estherian beds of Gloucestershire, Somersetshire, and elsewhere. The Lias of the Banat (Austria) has abundance of terrestrial plants, forming a coal; but here in the west the fossil trees and leaves of the Lias are but waifs and strays, and were washed to sea with the bones of the great *Scelidosaurus*; and the sudden river floods must have killed by the million successive generations of fishes, Ammonites, and Belemnites, and buried them in thick new mud, together with the unhurt carcases of the associated Ichthyosaur and Plesiosaur. These last have their skin and bowels intact; the molluscs were imbedded with the animal in the shell, and the cuttles retain even their inkbags unemptied, for death was quicker than their fear. Melting snow produces such sudden floods in temperate climates, and the monsoons on the eastern coast of India supply such abundance of fresh water, as to kill the sea-fish in myriads.

During the time that the Oolitic formations were being laid down, some rivers ran into the sea from the west (the direction that all the older rivers also had in this region probably, as the old land lay where the North Atlantic and parts of North America are now), and we find traces of their influence in the Brora coal and the Moorland coal of Yorkshire, and further south in the plant-bearing sandy shales of Collyweston, and in somewhat similar laminated oolite at Stonesfield. In the last-named beds, which supply a roofing-stone, bones of land animals have long been known to occur, especially the

lower jaw-bones, such as fall off from floating carcases in rivers, as Dr. Buckland pointed out to be the case with dead dogs washed down towards the mouth of the Thames. The *Megalosaurus* then lived upon the land, as we know by his bones having been washed into the neighbouring sea.

When we examine the Purbeck strata, lying on the Portland Oolite, we find thick beds of limestone formed of shells that lived in lake and estuary; and in one particular bed, mis-named a "dirt-bed," but really an old lake-deposit, hundreds of bones have been found by Messrs. Beckles and Brodie, that belonged to the land mammals and reptiles of small size and various kinds, herbivores, carnivores, and insectivores. The river-system that gave rise to the Purbeck beds came from the west, as did the older rivers from the old land; and it continued in a modified form, and made the delta-beds, mud-banks, sand-shoals, and lagoon-deposits, sometimes full of vegetable matter, that are known as the Wealden formation. The Megalosaur lived on, with the Iguanodon, Hylæosaur, and other monster reptiles of the times; and they not only left their drowned carcases as evidences of their existence, but their foot-tracks remain on the marshy banks now converted into sand and clay; and these are often full of *Paludina, Cyclas, Unio,* and other such-like shells, with ferns and cycads, and other spoils of land and river. Similar deltas and lagoons existed in Europe and America, with the allied or analogous inhabitants of the different regions. The sea again asserted its dominion over these areas, and deposited the various Cretaceous strata, until, by the silting up of the hollows, and by local elevations, land was again formed, with its marshes, lakes, and rivers. Of these the lignites and wonderfully-mammaliferous strata of Nebraska and the adjacent regions bear full witness; and the South of France is said to have similar passage-beds between the Cretaceous and the Tertiary systems. Since then, that is, during the Tertiary period, and until now, continental areas, the nuclei of the present continents, have existed, with varying outlines and elevations, and with glaciers and river-systems, which have left numerous fresh-water formations. The Woolwich beds are the oldest of these. The London clay, lying on the last-mentioned, was the mud of a great gulf, receiving, perhaps, the same river, with others, draining a land rich with a sub-tropical flora of conifers, palm, spice-trees, etc., and stocked with crocodiles, serpents, birds, and mammals. A modification of the same drainage system afterwards washed the Palæothere and many other land animals into the seas and lakes of the subsequent period, as we see in the Barton Cliffs, in the Isle of Wight, and in the Paris district; for the Nummulitic sea came and went, and oscillations of the land changed the levels, and fresh water alternated with salt on many coasts. The middle Tertiary times had a still more chequered scene of sea and land; for bays, straits, archipelagos, rivers, lakes, and glaciers abounded. The Dinothere, Mastodon, and other land animals, great and small, and a characteristic flora, have been preserved here and there in lake-deposits of that time, often in beds of great extent and thickness.

In later Tertiary times the world had much the same continental contours as at present; but with vacillations, letting in the Glacial and Pluvial periods, when ice and water exerted their utmost power in modelling the northern hemisphere at least, and produced the great banks of gravel, and coatings of boulders and clay, that mask so much of its rocky surface. To the existing deltas, marshes, turbaries, lakes, glaciers, and river-systems, with their often subterranean streams, we need only refer as examples of the natural machinery by which fresh water acts in modifying the surface now, and has acted in times past, as shown by this brief sketch of the primæval rivers of Britain.

II.—On *PALÆOCORYNE* a genus of Tubularine Hydrozoa from the Carboniferous Formation.

By P. M. Duncan, F.R.S., Sec. Geol. Soc., and H. M. Jenkins, F.G.S., Sec. Royal Agric. Soc.

(Phil. Trans. for 1869, pp. 693-699, pl. lxvi.)

THE remarkable little organism which forms the subject of this paper, was obtained from the lower shales of the Carboniferous limestone series of Ayrshire and Lanarkshire, so rich in fossil Brachiopoda, Polyzoa, Crinoidea, and Madreporaria; and was found attached to the margins of the polyzoarium of *Fenestellæ*, and also in a detached and more or less fragmentary condition amongst the small pieces of broken Polyzoa, and Crinoid stems which compose the fossiliferous layers of the shales.

The base of *Palæocoryne* was expanded, giving rise to a short robust and cylindrical stem fluted and punctated on its surface, and surmounted by the body of the polypite from the upper margin of which radiate a single whorl of long and slender tentacles. On the upper surface of the body, a crateriform process with an opening on its apex, indicates the position of the mouth.

Its external investment appears to have been calcareous, covering the whole of the hydrozoon, except at the opening for the mouth and the terminations of the tentacles which had probably ciliated ends projecting beyond the periderm or polypary.

This is an almost solitary instance of a Hydrozoon having a hard periderm, save the recent genus *Bimeria*, discovered on the West coast of Ireland by Dr. T. Strethill Wright.

The Zoological position of the fossil is amongst the Hydrozoa in the order Tubularidæ, and near the Eudendridæ. Two species are described and figured by the authors *Palæocoryne Scoticum* and *P. radiatum*.

III.—The American Journal of Science and Arts, Vols. xlviii. and xlix. Contains the following communications from Prof. O. C. Marsh, of Yale College.

I. *Notice of some new Mosasauroid Reptiles from the Greensand of New Jersey.*—A striking difference between the reptilian fauna of the Cretaceous of Europe and America, is the prevalence in the

former of remains of *Ichthyosaurus* and *Plesiosaurus*, which in the latter appear to be entirely wanting; while the Mosasauroids, a group comparatively rare in the Old World, replace them in the New, being represented by several genera and numerous species. Recent explorations in the Cretaceous deposits of the Atlantic border, and in the region west of the Mississippi, have resulted in the discovery of many new forms of this peculiar type of reptilian life. Five forms are described by the author, namely:—

(1). *Mosasaurus princeps*, Marsh, sp. nov., perhaps the largest hitherto found, and when entire probably represented an animal not less than 75 feet in length. The remains are in excellent preservation, and include the greater portion of the skull with the maxillary teeth; one quadrate bone, one mandible, and about 26 vertebræ, besides several bones of the extremities.

(2). *Mosasaurus Copeanus*, Marsh, sp. nov. represented by portions of a skull, with some of the maxillary teeth, and part of the corresponding lower jaws, including the anterior extremity of the left ramus, etc. They indicate one of the smallest Mosasauroids yet discovered, and one very distinct from any hitherto known. These remains, Prof. Marsh considers, may indicate an animal about 25 feet in length.

(3). *Mosasaurus Meirsii*, Marsh, sp. nov. Indicated by the crown of a single tooth.

(4). *Baptosaurus* (*Halisaurus*) *platyspondylus*, Marsh. Founded on a posterior cervical and an anterior dorsal vertebra; the right splenial bone, and a small portion of the base of the skull, etc.; indicating an animal about 30 feet in length.

(5) *Halisaurus fraternus*, Marsh, sp. nov., established on an anterior and two posterior dorsal vertebræ. The vertebræ are more depressed than are those of *Macrosaurus lævis*, Owen, or *M. validus*, Cope, and indicate a smaller animal than either of these species, probably 25 or 30 feet in length.

Prof. Marsh next describes a new and gigantic fossil serpent (*Dinophis grandis*), from the Tertiary of New Jersey.

This species is founded upon a single dorsal vertebra, somewhat injured but having the neural arch well preserved. Two other fossil Ophidians have already been described by Prof. Cope, under the genus *Palæophis*, namely. *P. littoralis* and *P. halidanus*; these Prof. Marsh suggests should be included in the genus *Dinophis*, being very distinct from Prof. Owen's genus *Palæophis*.

II. *Notice of some Fossil Birds, from the Cretaceous and Tertiary Formations of the United States.* By Prof. O. C. Marsh, of Yale College.—The remains of Birds described from European rocks are at present limited in the Mesozoic to the famous *Archæopteryx* of the Jurassic, and a single species only from the Cretaceous: but in the Tertiary period, and especially in the Miocene and Pliocene, this class was very fully represented by many of the modern types, and numerous species have already been described by European Palæon-

tologists. In America, however, since the discovery that the three-toed footprints in the Connecticut river sandstone were probably all made by Dinosaurian reptiles, no species of birds have been included in the extinct fauna, none having heretofore been described from any American rock. Recent explorations, however, have shown that remains of this class are not wanting in the later formations of the United States, and that the Cretaceous and Tertiary, especially, contain representatives of many interesting forms.

Remains of Cretaceous Birds.—Among the fossils under consideration are specimens indicating five species of Cretaceous birds, the remains of which were found in the Greensand of New Jersey, and, with a single exception, in the middle marl bed. The specimens are all mineralized, and in the same state of preservation as the bones of the extinct reptiles which occur with them in these deposits.

The remains described are as follows:—

(1). *Laornis Edvardsianus*, Marsh, gen. et sp. nov. Shaft and distal extremity of a left tibia, indicating a species apparently of a swimming-bird, nearly as large as the common wild swan.

(2). *Palæotringa littoralis*, Marsh, gen. et sp. nov.

(3). *Palæotringa vetus*, Marsh, sp. nov. Remains apparently of two wading birds; the former about the size of the European Curlew, the latter about as large as the Hudsonian Godwit.

(4). *Telmatornis priscus*, Marsh, gen. et sp. nov.

(5). *Telmatornis affinis*, Marsh, sp. nov. The remains of the former indicate a bird about the size of the King Rail, those of the latter of a bird considerably smaller.

Remains of Tertiary Birds.—The few remains of birds hitherto discovered in the Tertiary deposits of the United States, naturally show a much closer resemblance to recent species than those from the Cretaceous formation.

(1). *Puffinus Conradi*, Marsh, sp. nov. Discovered in the Miocene of Maryland, by T. A. Conrad, Esq.

(2). *Catarractes antiquus*, Marsh, sp. nov. Closely resembling the thick-billed Guillemot: found in Post-tertiary Clays, near Bangor, Maine.

(3). *Grus Haydeni*, Marsh, sp. nov. From the later Tertiary beds of the Niobrara river, indicates unmistakeably a large species of the genus *Grus* or Crane.

(4). *Graculus Idahensis*, Marsh, sp. nov. The species represented by this fossil appears to have been related to the Cormorants, and has been placed provisionally in the genus *Graculus*. This bird-bone was obtained from a freshwater Tertiary deposit, probably of Pliocene age, on Castle Creek, Idaho Territory, west of the Rocky Mountains.

In conclusion, Prof. Marsh mentions that he has just received from Prof. F. V. Hayden the distal portion of a feather with the shaft and vane, preserved from a freshwater Tertiary deposit of the Green River group, Wyoming Territory.

IV.—Records of the Geological Survey of India.

Vol. III. Part 1. February, 1870.—(*Continued from p.* 341.)

THIS Part of the Records contains—in addition to Dr. Oldham's Annual Report noticed in our last number—p. 339,

2. *Notes on the Geology of the Neighbourhood of Madras.* By R. Bruce Foote, Esq.

The district under consideration lies to the north of the river Palar, and south of the Pulicat lake. The topographical features are simple: the ground rises from the coast westward in a gradually inclined plane, varied only by the shallow valleys of the Narnaveram, Cortelliar and Palar rivers, and in the south-eastern corner by a number of low hills. Roughly speaking, the northern, central, and south-western parts of this area are occupied by stratified rocks, the southern and south-eastern by metamorphic rocks. The following is a table of the rocks noticed in the neighbourhood:

Recent and Quaternary.	Blown sands.
	Alluvium, marine, and fluviatile.
	Laterite and Conjeveram gravels.
Tertiary.	Gritty sandstones. (? Cuddalore sandstones.)
Secondary.	(Cretaceous, not yet known in the area).
	Jurassic, Rajmahal plant-beds.
Sub-metamorphic.	Cuddapah group. (Quartzite rocks).
Metamorphic.	Gneissic series.

The *Laterite* deposits comprise clayey conglomerates, gravels, and sands, which graduate one into the other. They rarely attain a thickness of 12 feet. They are scattered over the higher grounds between the river valleys, and have evidently been separated by denudation into patches, some of small size, others attaining one and two hundred square miles in extent. The laterite gravels contain pebbles of quartzite and gneiss, mixed with pisiform ferruginous pellets.

The *Conjeveram gravels* occupy similar positions to the lateritic deposits, but they differ from these in the absence of ferruginous matter. Both appear to contain implements of human manufacture, in the shape of axes and spear-heads made of chipped quartzite pebbles, and of the same types as those which occur in the gravels of Western Europe.

The *Rajmahal beds* consist of conglomerates, sandstones, gritty clays, and shales. Numerous plant remains have been found in some of the clay beds, and particularly in a white shale. These remains include *Palæozamia*, *Dictyopteris*, *Taxodites* (?), *Pterophyllum*, *Tæniopteris* (?), *Stangerites*, *Pecopteris*, *Lycopodium* (?), and *Poacites*. Several genera of Mollusca have likewise been obtained from these beds; they include—besides several small Ammonites—*Leda*, *Yoldia*, *Tellina*, *Psammobia Lima*, *Pecten*, etc.

3. *On the Alluvial Deposits of the Irawádi, more particularly as contrasted with those of the Ganges.* By W. Theobald, Jun., Esq.

In every large river basin two distinct alluvial deposits will

generally be met with. The older of these may be either marine (estuary) or fluviatile (lacustrine), or of a mixed and alternating character, but the newer group is essentially fluvio-lacustrine, and directly produced by the existing river. Whilst no very great thickness of the newer deposit can anywhere have been deposited without a corresponding subsidence of the area, a very large accumulation of the older or estuarine deposit may have taken place during an elevation of the area covered by it.

Every river that discharges its waters into the sea, does so under a condition either of subsidence, of quiescence, or of elevation, and to what extent this condition influences the character of the deposits as well as the physical peculiarities of the delta, Mr. Theobald endeavours to illustrate by the Irawádí, and the contrast which its delta presents to that of the Ganges.

These two—the Ganges and Irawádí—present examples of rivers subjected to, respectively, the first and last-named conditions. At Fort William boring operations for an artesian well showed 70 feet of the newer (Gangetic) alluvium, resting on the denuded surface of the kunker clay, which is indicated by the rolled kunker pebbles found at the junction. The author regards the kunker clay as an estuarine deposit (the older alluvium) accumulated during an upward movement of the land. It is a stiff clay, of a homogeneous character, and of a mottled yellow or pale buff colour, reddening by exposure. The kunker is disseminated through the clay, sometimes in well-defined nodules, more often in irregular stringy courses.

The newer alluvium comprises a very varied series of beds directly deposited by the waters of the Ganges or its tributaries. They consist of sand sometimes dark brown, at others a dazzling white, with several beds of peat. It is at once an extensive and important group deposited within the trough excavated by the Ganges in the older clay, or filling up such low-lying tracts as receive the flood-waters of the Ganges during its annual inundations. Mr. Theobald is of opinion that the area is undergoing depression at a rate which is adequately counterbalanced by the accession of Gangetic sediment on the surface.

Mr. Theobald then compares the alluvial deposits of the Ganges valley with those of the Irawádí, prefacing the subject with a few remarks on the physical character of the country, which presents some peculiar features.

The alluvium of the Irawádí belongs almost entirely to the older group, and the cause of this is attributed to the fact that the delta of this river is at the present time in precisely the same condition as was the delta of the Ganges when the first layers of its alluvium, 70 feet below the present surface at Calcutta, were being deposited. At this period the older marine group had become sufficiently raised to admit the deposition of beds stamped with a fluviatile and terrestrial character, and even the accumulation of such matters as peat; since then a steady downwater movement of the Gangetic delta has permitted the enormous accumulations of newer alluvium, which covers so large an area in Bengal. No such movement has hitherto

taken place in the Irawádí area, and the proofs of a general elevation are sufficiently clear and undeniable. To a consideration of these Mr. Theobald devotes some space.

In conclusion, he points out the economic value of the two groups. It is on the newer alluvium that the finest indigo is grown, and indigo and silk (mulberry) may be said to be the two main staples of the Zillahs in Bengal. The newer alluvium will, moreover, he adds, produce any crop required of it, either rice, sugar, opium, oil seeds, etc., and hence the fertility for which Bengal is noted. In the Irawádí valley, in place of this fertile deposit, is the older alluvial clay, which though in some places it is capable of producing valuable crops of various descriptions, is generally fit to sustain nothing so well as rice crops; and hence the inability of the delta of the Irawádí to compare in richness with that of the Ganges.

REVIEWS.

I.—The Explorer's Test-Case; with the Key to Fortune in New Lands. S. W. Silver and Co., 66, and 67 Cornhill, E.C.

ONE of the great hindrances to the successful development of the natural productions of new countries, lies undoubtedly in the fact of the want of knowledge of the more simple means of recognizing the common, and therefore often the more important of the metals and minerals used so abundantly in the arts and manufactures. The settler's first thought is naturally to provide for his immediate necessities, and the cultivation of the soil becomes his first consideration. From day to day and year to year this work is carried on, and the mineral products around him, whether in the soil or the beds of neighbouring streams, or contiguous rocks, are unheeded; and even gold, a metal which it seems almost incredible should not be recognized at first sight, was overlooked for many years, both in California and Australia.

Writing on the "Gold-fields of Victoria" Mr. Brough Smyth says:—"Reefs of White Quartz, standing 20 feet above the surrounding surface, every foot of which contained gold, visible to the naked eye, excited neither curiosity nor inquiry; and the careless shepherd, whose earnings amounted to no more than 10*s.* or 15*s.* a week, every day drew water from the creek beneath whose bed lay nuggets and grains of gold, far exceeding in value the fee-simple of the run on which he was a labourer." (p. 4).

Not alone does this ignorance retard the search for minerals, but it also leads to ruinous blunders, which, whether perpetrated by individuals or by governments are equally to be regretted. Who will forget the unfortunate possessor of a beautiful stone said to be a diamond, who made a voyage to England from Australia for the purpose of disposing of it to better advantage—he having had already a considerable sum offered for it—only to find upon his arrival that it was a quartz crystal, value a few shillings. Or the story of the