

ORDINARY MEETING, MAY 3RD, 1872.

JAMES THORNE, Esq., F.S.A., Vice-President, in the Chair.

The following Donations were announced :—

“ On the Relative Ages of the Stone Implement Periods in England,” by J. W. Flower, F.G.S., from the Author.

“ Abstracts of the Proceedings of the Geological Society,” from that Society.

“ Miners’ Association of Cornwall and Devonshire—Annual Report for 1871,” from that Association.

The following were elected Members of the Association :—

Arthur Angell, Esq.; H. George Fordham, Esq.; William Henry Hennah, Esq.; Henry Hobden, Esq.; John Studdy Leigh, Esq., F.G.S.; Reginald John Gilbert Leigh, Esq.; Arthur S. Lovelock, Esq.; A. R. Montalba, Esq.; and William Taylor, Esq.

The following Papers were read :—

1. ON A VISIT TO THE DIAMOND FIELDS OF SOUTH AFRICA, WITH NOTICES OF GEOLOGICAL PHENOMENA BY THE WAYSIDE.

By JOHN PATERSON, Esq., M.A.

(*Abridged.*)

Though the paper I have undertaken to read this evening may be less of a scientific character than those to which you are accustomed, yet, as a contribution to the information concerning Diamond Land, it may not be unacceptable to this Association.

You wish to know something more of that country—to hear something more of the wonderful discovery of diamond-fields there—to look in upon its scenes through the eyes of a visitor, if I may so say, without encountering all the heat, dust, and other discomforts of a personal visit, and happy should I be could I this evening meet your desires; but I scarcely know how I should best help each one, for himself and for herself, to realize that wonderful scene of diamond-land in South Africa. Should I describe to you its already explored extent—over 10,000 square miles—within which at many different points diamonds in great numbers have

already been unearthed ; or should I tell you of the richness of the finds in certain favoured and congenial spots where, as at New Rush, from an area of less than half a mile square, diamonds to the value of over one million sterling have already been extracted ; or should I paint to you something of the living moving scene there, where in each little space of 30 feet square—called a claim—there are 10, 20, 30, or even more, busy diggers at work in search of the precious gems ; or should I speak to you for a little of the delightful climate of that bright land, whose deep blue heavens are studded with so many starry brilliants—brilliants of stars which, seen through the clear atmosphere of South Africa, seem like innumerable gems of glory fresh cut and fresh polished from the hands of the Great Artificer himself ; or, returning again to this nether world, should I picture to you something of the wooded plains around that scene, and the terribly impressive solitudes, and the simple primitive pastoral life of the few early indwellers there ; or, descending still deeper down among nature's crypts, so to speak, where she has laid the sure foundations of this grand old temple of God's praise named Earth, interrogate there the molten rocks and silent shales in your hearing that they might be moved to tell us, in the signs and hieroglyphics of some strange remains in them, something of their long bygone history,—all these things and much more should I have to do before I succeeded in making you realize in full, that wonderful magic scene, as I may term it, which Diamond-land in South Africa now presents.

We first enter that country at a small town called Fauresmith, 350 miles due north of Port Elizabeth. I ask you to join me there, and to look abroad with me upon the surrounding scene. The country for many miles around is one extended plain, or great table-land, some 4,000 to 5,000 feet above the level of the sea. It is reached by one almost continuous ascent from Port Elizabeth, through a country much more broken in surface, and known among geologists as the great lacustrine country of South Africa. This region is supposed once to have been the bed of a great inland lake, the waters of which had, under some great convulsions, burst their way by several channels through the enclosing mountain ranges, and fled to lower levels in the existing seas. The country at least is marked and scarred in every direction by deep traces of some violent agency, but these traces almost entirely disappear as you enter Diamond-land. You see no more the gashed and torn

mountain sides, the bare and blasted peaks and headlands, the deeply worn and furrowed plains, the great upheaved and twisted quartzite ranges leaning on mighty axes of porphyritic rock, by which they have been upborne, but a country in oppressive repose and sameness, if one may so say, in which the wide extended plains after plains, or "flats" as they are termed, seem never to have been subjected to any more violent action than is expressed by ever-recurring ridges, sometimes only a few feet high, sometimes a few hundred feet high of the prevailing trap-dykes of this region. These trap-dykes are a very marked feature of diamond-land, and the FIRST feature to which I desire to call your special attention.

The SECOND striking geological characteristic of the region is the vast breadth of shale formations reaching out in every direction, now the yellow ochreous shale, then a bluish slaty shale, and again a dull, black carboniferous shale. These extend in undisturbed horizontal position for miles and miles, unless where they are ever and anon seamed and riven, and occasionally slightly tipped from their horizontal position by the protruding dykes of trap to which I have just referred.

A THIRD feature in the scene to which I would just desire to draw your attention is the "sacked" or sunken appearance, as one may term it, which each vast plain or flat presents, as if towards its centre it had settled down from the level of the trap-ridges which traverse them from N.E. and S.W. How this appearance has been imparted to the scene, perhaps, it would not be very easy to say, but where such uniformity of effect has been produced, it may be assumed to have been the result of some single uniform commensurate force within. Can it be that these wide-spread shales have in some by-gone age been swayed and rocked upon a molten liquid mass or portion of themselves beneath, which by the earth's motion on its axis, or kindred cause, has ever and anon rent the unmolten crust above, and projected through the numerous seams or lines of division so caused in it waves of molten trap or greenstone from the liquid mass below? The strange depressed flats of Griqualand suggest such an idea, and the injected traps of greenstone seem in their elements of composition none other than the molten shales of the country.

A FOURTH feature which I would desire to notice here before descending to more minute and detailed examination of our subject is the peculiar resemblance of the shale formations of Diamond-

land to a section of the deposits of modern lagoons, as if the Diamond-land had been once a great lagoon like Lake Nganii, in which reeds and grass and matted weeds of every description grow up in greatest rankness, and with every succeeding flooding of rivers or streams pouring into it, are buried in endless layers of slime and clay until they constitute a body of shale like that which is cut through at so many points by the Vaal. The carboniferous shales especially are clearly the product of reeds and grasses such as grew in a lagoon, and were laid down from time to time in the mud and sediment of inflowing waters.

Bearing these points or general features in mind, let us now visit in company together the first diamond diggings of Griqualand. They are situated at a place called Jagers Fonteyn, about an hour on horseback from the little town of Fauresmith. The road to these diggings is across a country of dull grey shale, and the diggings themselves lie in a hollow enclosed on every side by dykes of trap. Let me now detail to you the appearances which struck myself most forcibly when lately I visited these diggings, and here I call your attention—

First to the *stuff* which the diggers were excavating from the pits. It consisted of a kind of marl, or mixture of lime and clay—whitish by the presence of lime in it, when first dug out, but soon under exposure changing into a greenish tinge approaching that of olivine in some trap rocks. The same marl I found at all the diggings, and soon had forced upon me the conviction that it was the matrix soil of the diamond.

The second thing that struck me at these diggings was the peculiar character of the trap rocks by which they were enclosed—a trap of greenish tinge when fresh broken, but soon, under exposure to the winds and rains, rusting or wasting away into a red unctuous dust.

A third singular and remarkable appearance which struck me as I explored these diggings was the amorphous condition of the marl-stuff which was being excavated from the claims or pits. It showed no regular formation, but was ballasty, so to speak, in appearance, and seemed such a mass of nodular lime and clay as is produced where with hot water a mortar of lime and clay is made, and thrown up in a heap and there allowed to dry.

A fourth, and I may add, last feature of the diggings here which struck me, was their situation. Surrounded on every side by a

ridge of trap rising to some considerable height above the surrounding country, the marl there enclosed could never have been lifted into that situation by water agency. It was stuff *in situ*—at least ever since the trap-dykes had been raised around it.

A few smaller points of observation I also noted down carefully here, such as that the nodules of marl were very friable to the touch, that subjected to a running stream of water they readily dissolved, and so could never have been a vehicle for the bringing of diamonds from a distance by any torrent or stream; and finally that from this marly stuff many crystals and siliceous nodules were being sifted. I noticed nothing further in any way peculiar or deserving of particular attention here, and so left Jagers Fonteyn, bearing carefully with me in memory the appearances and facts I have just detailed. The next diggings to be visited are the Koffy Fonteyn diggings. Here too you meet at the edge of the diggings the greenstone trap, exactly in texture and colour, as well as ingredients, the same as the traps around Jagers Fonteyn, and related in the same way to the enclosed diggings.

Nor did the points of similarity end here. If the marl into which the diggers were working at Jagers Fonteyn were an amorphous mass, as if all texture in them had previously been destroyed by fire or by water, or by both, so was the stuff here. If at Jagers Fonteyn you looked in vain for traces of fluvial deposit, or of deposit by some mighty torrents, so, too, you looked in vain here. If at Jagers Fonteyn you could discover no higher source for the diamonds found there in any proximate mountain chain, so here too the theory of such an origin broke yet more fatally down, for no mountain range whose detritus could have been strewed there was within a hundred and fifty miles of the spot where now we stood. And finally if even such a distant origin could be supposed, the question rose, in very insoluble form to my mind, by what doctrine of chances is it to be explained, that the diamonds brought from afar across these plains should, like living things of instinct, here, as well as at Jagers Fonteyn, seek the identically same marl stuff as cover, or their hiding place, so to speak. The affinity between the marl and the diamond was not to be disputed; but was it an affinity of some magnetic attraction, by which they sought each other from afar? I leave you to take with you this question, while we now proceed on our journey to the greater diggings of Du Toit's Pan, of Bultfonteyn, of Colesberg Kopje, and Old De Beer's.

These diggings are distant from Koffy Fonteyn about sixty miles, and the road lies across the ever self-repeating flats, as they are termed, of Griqualand West. In crossing these great flats one or two geological points struck my attention. I have already observed to you how these flats "sacked" in builders' phrase, or were slightly sunk towards the centre from the higher level of the crossing dykes of trap, which in such numbers traverse the extended plains, and seem to act there like great joists thrown in by nature to support the vast floor of shales across which we drive. This sacking was clearly an inclination to the trap dykes, and indicated beyond dispute that the traps were rocks of more recent origin than the shales, and by their intrusion had disturbed the older stratifications. The shales were there seen to be disturbed by them, and if in the traps there are found unfused substances common to them with the shales, such as garnets and spikes of olivine, these substances it may be assumed, I think, the traps have received from the shales in their upward eruptions through them, and not that the shales received these substances from the rusting away and waste of the intruded traps.

Another point of geological interest which struck me forcibly as I crossed these plains, was the constant recurrence, in patchy deposits of no great thickness, of an effloresced tufa or limestone. These patches had a very peculiar appearance, and looked like a lighter scum of limey impurity boiled up from beneath upon the surface, as the scum of dross is boiled up upon and out of the molten metal. It was observable too that these patches ever lay near a crossing dyke of trap, and seemed to have in their origin some relationship to it.

A last point which distressingly impresses itself upon the traveller across these flats is the frequent occurrence of great drifts of that reddish sand, as they call it, or rather dross of iron-clay, which makes the roads through it so heavy to the horses. This red powder is undoubtedly derived from the rusting away of the ridges of greenstone-trap under exposure to the weather, and goes on in very rapid decay. A fresh broken piece of greenstone-trap, green when so broken to the deepest tint of olivine, will, if blown upon by the winds and rains, within a month begin to cover itself with its own reddish rust, and I think it important to take note of this here, for I am not sure that to the composition, the peculiar composition of the traps of Griqualand, in

which iron and olivine are so richly present, something of their metamorphic power upon the surrounding shales may not be due.

But it is perhaps time that we should cross the intervening flats, follow the busy crowd to the scene of their labours, and observe the operation of diamond-finding, say at Colesberg Kopje or New Rush, as it is called.

The New Rush diggings are all going forward in an oval space enclosed around by the trap-dyke, and of which the larger diameter is about 1,000ft., while the shorter is not more than 700 feet in length. Here all the claims of 30 feet square each are marked out with roadways of about twelve feet in width occurring every sixty feet. Upon these roadways, by the side of a short pole fixed into the roadway, sits the owner of the claim with watchful eye upon the Kafir diggers below, who fill and hoist by means of a pulley fixed to the pole above, bucketful after bucketful of the picked marl stuff, in which the diamonds are found.

Many of the claims are already sunk to a depth of 100 feet, and still, as plentifully as ever, the diamonds continue to be found. From the roadway above, the marl is carted away to the sorting tables outside the range of the diggings among mounds of marl stuff which seem like little hills. Here amidst such whirls of dust as are nowhere else seen, the marl stuff is pounded, sifted of the finest powder of lime and clay, and from the residue put on the sorting tables, the diggers, with a piece of zinc 9 inches long by 4 inches in breadth, search out, in the successive layers taken from the heap, the precious gems. I need not tell you that the search is by no means very perfect, or that perhaps as many diamonds escape the digger's eye as are discovered and taken out by him, but you will perhaps confess with me that their aptness in picking out the diamonds is by no means to be despised when I tell you that in one six months from the date of opening New Rush diggings little short of a million sterling in diamonds has been extracted from them. At close of day the diggers take daily stock of their finds, and between five and six o'clock in the afternoon are to be seen hundreds and hundreds moving through the main street of New Rush in visits to the tents of the buyers, seated behind their little green baize tables with scales all ready, and bags of gold and silver, and piles of bank notes to buy the little gems.

Whilst I was at Du Toit's Pan diggings, the spectacle of the diggers working through the fragments of unchanged shale at some

points only a few inches in thickness, at some points from 3 to 4 feet in thickness, sufficiently impressed me to make me revolve the point, while I made my next visit to New Rush, scarcely two miles distant.

Here I had scarcely arrived, when a feature yet more striking than the fossil shale of Du Toit's Pan presented itself to me in a black heap of true carboniferous shale being dug up by some well-sinkers in the very midst of the mounds of greenish marl around the New Rush claims. These well-sinkers were excavating a pit in search of water just outside the "reef," as it is called, of greenstone trap, which encloses New Rush diggings, and from this pit down to a depth of 60 feet, were bringing up bucketful after bucketful of black carboniferous shale in strata of the thickness of coarser roofing slate, while at a distance of less than fifty feet from them, inside the greenstone reef, or trap-dyke, the diggers were bringing up as steadily bucketful after bucketful of the greenish marl. Nor was it from one solitary well-pit that the well-sinkers were bringing up this shale. I crossed the diggings from the first pit I had seen to the opposite side, and there found the well-sinkers bringing up exactly the same black carboniferous shales from 60 to 70 feet.

To all enquiries put to these well-sinkers as to whether they had ever found any diamonds in the shales, the universal answer was the invariable "No;" but I found at the depths where these carboniferous shales commenced in the well-pits, to wit from 5 to 7 feet below the surface, the true marls within the reef also commenced: at exactly the same depths for the first time did the diggers look for any number of diamonds in their claims. So much for the first correspondence traceable between the carboniferous shales of the well-pits outside the trap-reef of the New Rush diggings, and the amorphous mass of diamond-bearing stuff within the reef-coil: but, struck by this first correspondence, I subjected the shale formations to further investigation, to see whether in other correspondences I could trace common origin for the carboniferous shales of the country and the diamond stuffs, and I found as follows:—

1st. That deep as some of these marls reached within the reef, the black shales reached without the reef at least to 70ft., the lowest depth to which the well-diggers could sink, because of the water which generally, about that depth, came in to the pit in force and stopped further sinking.

2nd. That as the shales without the reef commenced to shew in colour and texture at a depth below the surface varying little from 6 to 7ft., so at like depth from the surface, the green marls within the reef began to show in all their distinctiveness from surface deposits.

3rd. I found, upon a close investigation, that taking this black shale and subjecting it to the action of fire it yielded up, after a time, the element of blackness in it—an element undoubtedly of vegetable origin—and showed an ashy residue behind, not by any means, when made into a mortar with water, unlike the marl stuff of the diggings.

I found also, by accident, one other very interesting fact in connection with these shales, or rather with the water drawn from the wells sunk in them. This water a friend found in his bath every morning covered with an oily scum of clearly vegetable origin: and, if the water found rising in wells sunken among the shales could be so impregnated with a species of paraffin, or oily substance so rich in carbon, who will say that in these carboniferous shales of the country, a source of carbon, abundantly sufficient, may not have been found for the origin of all the diamonds now being unearthed at Colesberg Kopje. Beyond this striking feature of the diamond-fields just brought to my notice by the well-sinkers at Colesberg Kopje, I noted one or two other points there, not altogether wanting in interest.

Among these I would repeat to you here the following:—1st. I found wherever the diamond was obtained perfect in form, and smooth to finest smoothness of surface, without depression, hump, or twist of any kind, such diamonds were ever found in their own little moulds of finest limey stuff, as if such mould of lime had been a necessity to its perfect formation. 2nd. And farther I found, that where the splinters of diamonds, or borty stuff, were chiefly met by the diggers, there was much less presence of limey matter in the claim at the section of it where such broken or fragmentary diamonds were found, and that chiefly from among what the diggers termed “clay-ballast” or “burnt brick,” were unearthed the bits, or undeveloped crystals, so plentiful at New Rush.

I know not that there was anything further particularly noteworthy at New Rush diggings, the greatest of all diggings yet discovered;—but the river diggings had still to be visited. These are situated on the Vaal, and in its bed, about 20 miles from New Rush; and it was re-

ported to me by many diggers and others from the river, that there the diamonds were found, not in the greenish marl, but in the red soil of the country, among the great trap-boulders of the greenstone dykes. These reports seemed terribly to conflict with the theory of the diamonds which all I had yet seen seemed to force upon me, and I hastened to Pniel, the first of the river diggings, to examine for myself. There I found the diggers certainly sinking through the red soils of the country, and among the trap-boulders of the adjoining greenstone dykes; but not until they had passed through the red ferruginous soil, and reached a bed of the familiar well-known marl, like a great mortar layer in which were bedded round greenstone boulders, did the diggers find any of the sought-for diamonds. And here, indeed, I was struck in watching the operations of some diggers, as I heard them one day shout out as they reached a patch of the marl stuff, "Ah, here is the true stuff at last."

To the question whether, under the present rich findings in South Africa, the fields there may not be soon worked out or exhausted, I think I may give an emphatic negative, and for the reasons I have already advanced, and to be very briefly recapitulated here.

I have told you of the immense area of Diamond-land—over 10,000 square miles, through the whole of which centres of diamond deposit of more or less richness have been discovered. I have detailed to you the richness of some of these centres, as New Rush, from which in six months a million sterling of diamonds under very imperfect search have been extracted. I have named to you the mounds of excavated stuff around New Rush, from which, under second search, I confidently believe as many diamonds as have already been extracted will again be found. I have mentioned to you the depths of these diggings, already in many claims 100 feet and more, and told you that in the revealed sections of the country at the river diggings of Gon Gong and Delpport, evidence is given that for 300 feet the diggers may go down in these claims and yet not touch the bottom of the diamond marls. I have called your attention to the frequent occurrence of great diamond centres in the country, when a section of only 8 miles of it, laid open by the river, has revealed the presence of two such centres within that limited space. Finally, I have advanced the suggestion that the matrix soil of the diamonds is none other than the

great carboniferous shales of the country, and as these seem to extend there not only over a wide area but also to a very great depth, the product to my mind of a great growth of weed, and reed, and grass, in the shallow waters of a widely extended lagoon which had once covered diamond land; imagination itself fails almost to conceive the wealth of diamond production from such body or world of shales. Diamond-searching is no passing or fleeting enterprize there, but an abiding, continuing industry, not for years only, but for ages.

2. ON COLUMNAR BASALTS.

BY JOHN CURRY, ESQ.

(*Abstract.*)

In the introduction the modern views by which heat is regarded as a vibratory motion were referred to. In accordance with these views cold must be considered as only a lower degree of heat, or a lesser intensity of vibratory motion. Such being the only distinction between heat and cold, it necessarily follows that a diminution of the former is equivalent to an increase of the latter, and *vice versa*.

The process of the formation of columnar mud was briefly described. The analogy between this process and that of the formation of columnar basalt being such that the same diagrams served for illustration in both cases, though in the former case heat penetrates the fine clayey sediments, and produces columns of dried mud; in the latter cold advances into the molten lava, and changes it into solid rock, which frequently has a rude, but sometimes a perfect columnar structure. In reference to the production of such columnar structures the chief and most notable conditions are two diverse temperatures, closely situated at the contact surfaces of dissimilarly constituted bodies. The higher temperature the author designates heat, and the lower one cold. In the above instances the dissimilar bodies in surface contact are, first, the at-