GEOLOGY OF NORTHERN QUEENSLAND.

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Although the geology of Northern Queensland has occupied the attention of many learned and eminent geologists, we know as yet very little about it. This arises from the fact that so much of the country remains unexplored. The first observer in the field appears to have been Dr. Fitton, who, in "The Appendix to King's Voyages," gave a list of the rocks collected during the survey. The list is of no value to us now, and gives very little indication of the nature of the strata met with. Many other observations were made by Stokes, Leichhardt, Mitchell, and others, which are not of much use to refer to. Mr. Jukes, in his essay on the physical structure of Australia, refers but slightly to Northern Queensland. The first systematic attempt known to me to give a geological map and description of Northern Queensland is that by Dr. A. Rattray, R.N. In "The Journal of the Geological Society for 1869," at page 297, there is a paper by that gentleman, entitled "Notes on the Geology of Cape York Peninsula." He gives much valuable and interesting information about the nature of the country between Princess Charlotte's Bay and Cape York. He also gives a sketch map dividing the rocks into igneous and tertiary, the latter being again divided into sandstone and ironstone. As much of the area was not then and is not even now explored, his map may be regarded as ideal only. The paper is an extension of one read before the Royal Society in September, 1865. With many of the conclusions arrived at geologists will not agree—such as the evidence of upheaval which he thought he observed, and with the statement that the whole of the east coast of Australia is slowly uprising. In other respects the paper contains facts of considerable value. I believe he was the first who noted that the culminating point of the Cape York Range is the Bellenden Ker Mountains, which attain an elevation of 5,158 feet, and decrease *pari passu* with the diminishing area of the land, as the peninsula is followed in a northerly direction. I shall show, in the course of this paper, that this generalisation must not be taken too strictly. The depression of the mountain axis is variable until Cape Bedford is passed, after which the decrease in height is very gradual up to Cape York, whose highest point, Cape Bremer, is only 400 feet above the sea.

In 1872 the late Mr. Daintree published his essay on the geology of Queensland in "The Proceedings of the Geological Society," page 271. In this paper the author purposely excluded the Cape York Peninsula—or, at least, all north of the Mitchell River—from his investigations, as the country was so little known. In his map, however, he sets down the south bank of the Mitchell River as occupied by his tertiary desert sandstone, and this is incorrect. The Mitchell flows partly through granite ranges, partly through slates and schists of paleozoic age, and partly at the base of hills which are capped by a sandstone which I regard as the equivalent of the Hawkesbury (Mesozoic?) sandstones of N. S. Wales.

In 1873 Mr. Elphinstone Dalrymple made an expedition along the coast as far as the Endeavour River, and in the same year Mr. Hahn explored the interior of the same territory. Both expeditions resulted in geological observations, but nothing very detailed. Mr. Hahn was accompanied by Mr. Taylor, a professional geologist, but his report has never been published.

I am not aware of any other account of the geology of this part of Australia. Mr. R. L. Jack has been appointed the Geological Surveyor for the Northern Districts since 1877, and from that time has been busily engaged in exploring the northern portions of the peninsula. He has already issued valuable reports on the geology and mineral resources of the district between Charters Towers Gold Field and the coast, besides papers specially devoted to the Bowen Coal Field and Charters Towers Gold Field, and will, no doubt, soon give us valuable information upon the whole geology of the district.

My knowledge of the country I am dealing with extends from Townsville up to Cape Flattery in latitude say 14° south, and inland as far as the Hodgkinson Gold Field and the Normanby River. I shall commence by describing the coast line, and then deal with the formations I have met with in the interior.

In coasting northwards from Rockhampton, an observer has an excellent opportunity of seeing a good deal of the rock formations. The coast is very bold and the number of islands so great, that all day long the steamers are within a cable's length of one or other of them. The islands are very evidently of three kinds:—1. Granite or trappean with a rugged surface and plenty of pine trees. (*Araucaria Cunninghami.*) 2. Flat-topped sandstone islands with apparently little vegetation; of these the Beverly group seem to be notable instances. 3. The trappean, such as Prudhoe Island and Percy Islands, with high peaks and a good deal of open grassy land. It must be remembered that I have not landed on any of these islands, and that my generalization is only made from a distant view. It is very probable also that in the large Percy Islands there may be a development of paleozoic rocks beside the trappean. All the salient points of the main land are granitic, and north of Cape Conway all the islands are granitic or coral islands. Sir James Smith's group appeared to be trappean from their outline, but I was never very close to them.

The passage between Whitsunday Island and the main land is rather narrow but the water is deep, and the land rises on each side in high granite jagged ridges of the most picturesque character. Cape Gloucester is a granite island which rises abruptly from the water into sharp pinnacles and ridges about 2,000 feet high. In the background is the heavy-looking dark mass of Mount Dryander, which is partly metamorphic and partly granitic and trappean, and over 3,000 feet high. All around Port Denison the view is diversified by many granitic peaks and mountains, whose summits are so stony and rugged that the bare granite rock is quite conspicuous, and but for the climate might be mistaken for a capping of snow. Cape Upstart on the north side of Port Denison is just such another abrupt mountain mass as Cape Gloucester, rising almost as a precipitous ridge out of the sea to about the same height, having a very sharp, rugged outline. Beyond this the granitic axis recedes from the coast, and the low-lying land is formed of alluvial flats, through which the Houghton and the Burdekin drain into the sea. Cape Bowling Green is almost level with the water's edge, and the water shoals so gradually that there can be no doubt that the alluvial deposits of the river must extend a long distance out to sea. The Burdekin drains an immense area. One of its main tributaries comes from the Bellenden Ker ranges, and another from the south as far as Peak Downs, Mitchell's Belyando River being its main channel. It is a stream with an immense bed. In the dry seasons there are three distinct channels, but in the rainy season the body of water which comes down it is enormous. The sea is quite muddy as far as the Barrier Reef, and sometimes little more than brackish. The current is also very strong from the river, and it is more than probable that it was by this current that the unfortunate Gothenburg steamer was in 1874 carried out of her course on to the Barrier Reef.

Beyond this low-lying land the granite ranges reappear in Cape Cleveland, which is a bold headland similar to all the other granitic capes. Cleveland Bay succeeds this with a high granite island lying outside it, named Magnetic Island. Mount Cudtheringa is a high granite peak in the midst of Cleveland Bay, but with the exception of some granite outliers, the country around it is flat, and rises very slowly towards the main divide. North of Cleveland Bay the same series of level country and granite outliers continue to Rockingham Bay, at the southern part of which the alluvial flats of the Herbert River are found. Above the mouth of the Herbert is Hinchinbrook Island, which is a narrow range of granitic and trappean mountains, some of which rise to over 3,000 feet above the sea. These mountains are so steep and rocky that they present only bare and precipitous faces of stone. It is only in the gullies that a dense tropical vegetation is seen, and this is of the richest description, with palm-trees predominating. Nothing can exceed the picturesque appearance of the sharp outlines of the mountains which form the islands; their bare slopes of rock and their proximity to

the sea making them look less elevated than they really are. Some of the slopes of rock are quite black, exposing an immense surface of bare stone, without a trace of vegetation. These, I suppose, are trappean. Others, by their texture and colour, can be seen to be clearly granitic. Hinchinbrook channel, though wide, is very shallow, and there are long mangrove flats upon the main land. I looked very carefully for any signs of upheaval, but could see none. The channel may be filling up by the denudation from the mountains on each side. At Cardwell, which is situate on the north end of the channel, the beach and the shore are made up entirely of granitic debris. The waters of the sea are so muddy as to resemble a river rather than the ocean. The main range rises like an abrupt wall at a couple of miles distance from Cardwell, so that the creeks from the dividing range have only a very short course.

From Cardwell to Cairns, a distance of 70 miles, I had no good opportunity of seeing the coast. We know, however, that the range dividing reaches its greatest elevation in this interval in the Bellenden Ker Mountains. At a part of the coast called Morilyan Harbour, the Johnston River finds its outlet to the sea. My opportunities for observation on this place were very brief. A few granite hills of moderate elevation flanked the harbour, and the Main Range was approached by extensive river flats. All the islands of any elevation are granitic with a few coral islets interspersed.

Between Cairns and Port Douglas the land abuts upon the sea in lofty ranges which are densely clothed with forest. Here it is that the Dividing Range breasts the ocean, and it continues so with little interruption as far as the Endeavour River, a distance of nearly 100 miles. In this interval there are a few sandy beaches of moderate extent, but the great proportion of the coast is rocky and precipitous with forests of the most dense tropical vegetation crowning every ridge. The greater part of the mountains are over 3,000 ft. high, and for nearly all the year are clothed with cloud so that their outline can rarely be seen. Two peculiarities on the coast range are very conspicuous and picturesque. One is, that the Dividing Range is so precipitous and rocky near the sea that a large number of cascades can be seen falling over the cliffs. Another is a number of yellow strips of grassy land which seem to run to the top of the ridges. These are clothed with very luxuriant grass. I saw this from the facility with which they blazed up when lit by the natives as signal fires. I should imagine they must be due to some peculiarity of the soil, or perhaps they are too steep or rocky for trees to grow upon them. The line of gigantic forest timber on each side is as sharp as if it were cut with a knife.

In some of the recent maps of Queensland the Main Range is represented as lying a long way from the coast, and giving rise to important rivers with a direct east and west course. None of these facts are correct. The rivers, if they

are important, flow nearly north and south along the valleys between outliers of the Main Range. Mount Thomas is a very important mountain of granite near Port Douglas; and Mount Peter Botte, 3,500 ft., is another granitic peak about 40 miles inland from Cape Tribulation which separates Trinity from Weary Bay. Mount Cook (1,400 ft.), at the mouth of the Endeavour, is another granite peak with many hills of the same kind of rock and lower elevation in the neighbourhood. Here and there cliffs of stratified rock may be noticed on the coast, and as far as I could discern at a distance the formation was closely similar to the paleozoic rocks of Victoria and New South Wales, the strata being inclined at high angles. At Island Point, Trinity Bay, the rock formation exposed was a paleozoic metamorphic rock, the strata still traceable and very highly inclined. Here and there a dark substance very like dolerite can be seen in the mass, but not confined to any particular stratum. It would be hard to give it a name from its external appearance, but I attributed it to partial metamorphism. There was no granite in the immediate neighbourhood.

About ten miles further north the Daintree River finds an outlet to the sea. I ascended this river as far as it is navigable, but was not able to find any rock sections except in one or two places. These were clay slates almost vertical. At a cascade about 20 miles from the mouth of the river the water falls over a rock like diabase.

In making a journey inland from Island Point as far as the Hodgkinson River, I found the rock formation to be highly inclined slates, schists, and sandstones, with quartz veins, until a granitic axis is reached, at about thirty-five miles from the sea. After this range has been passed over, lower paleozoic rocks succeed, with quartz veins and trap-dykes, in which the Hodgkinson River Diggings occur. I have dealt separately with the geology of the Hodgkinson Gold Field,* and shall return again to the consideration of the geology of the interior.

After passing Mount Cook at the mouth of the Endeavour River a notable change takes place in the geology of the coast-line. The Endeavour River basin itself is an immense amphitheatre formed by the recession of the coast range in a large semi-circular curve inland. The range returns to the coast at a point called Indian Head,† of which an outline sketch is here given (see outline sketch No. 1). The granite has now disappeared, and instead we have paleozoic rocks highly inclined, curved, and folded in a series of anticlinal and synclinal folds, on the top of which rest strata of almost horizontal ferruginous sandstone, in appearance very like the Hawkesbury sandstones of Port Jackson. The hills on the coast range and in all the country back towards the head of the Endeavour River are of unequal height, showing in every part long-continued subaerial

* See *Transactions of Royal Society of Victoria for* 1880.

† A name badly selected, as there is already a point named Indian Head on Frazer's Island, near Brisbane.

denudation. Wherever they rise above a certain elevation they are always capped by this horizontal sandstone, which itself has been very much denuded. Sometimes they lie in thick beds, as at the gap of the Endeavour River (see outline sketch No. 2) or at the Dalrymple Range. Again they occur as mere outliers at the top of a hill, as at Mount Platform (outline sketch No. 3), and Connor's Nob (sketch No. 4). The whole of the country is so modified by these sandstones as to give it a marked character; and as this formation must not only be extensive, but also bear a permanent geological character, I shall refer to it subsequently as the Dalrymple sandstones, after the range in which they are so well developed, and the explorer who first mapped so much of this region. They are found in certain places to contain fossils, I believe, of plant remains only, and these of a fragmentary character. What little could be made out concerning them is that they are similar in form, like the stone in which they are embedded, to the plant remains in the Hawkesbury sandstones. I do not pretend to settle the question at once of the identity of the two formations, though the similarity is very great; and for this reason I keep the names for the present distinct. Though the Dalrymple sandstones appear horizontal, yet when the formation is traced over large areas a gradual dip to the north-east may be observed. This observation was made to me first by Mr. Robert Jack, the Government Geologist, and it was confirmed by all that I saw. Mr. Jack has traced the formation as far north as near Princess Charlotte's Bay. It extends inland for a very considerable distance, but appearing only at intervals in small patches as outliers, or unconformably upon the upturned paleozoic slates, schists, and quartz reefs, with conglomerates between.

At Indian Head, the junction of the paleozoic rocks and Dalrymple sandstones is very plainly visible. They are quite unconformable to one another. The paleozoic rocks are curved and twisted; there is a thin seam of conglomerate at the junction, and then the sandstones ensue in horizontal strata. A little beyond Indian Head, there is a point of rock at the level of the sea of a most interesting character. It is the core of one of the folds of the paleozoic strata. Near its junction with the land the strata are almost vertical, but, as they are followed towards the sea, they gradually curve more and more until they become horizontal, as shown in the accompanying sketch, No. 5. Beyond this point the northern side of Indian Head shows the folds of the paleozoic strata very clearly.

The next point beyond Indian Head is Cape Bedford. It consists of a peninsula formed of two hills, one round topped, and the outer one flat on the summit. Both are capped with outliers of the Dalrymple sandstones lying upon the usual paleozoic strata.

To the north of Indian Head, and between it and Cape Bedford, there is a stretch of about eight or nine miles of sand hummocks. They are white and red, but the white sand predo-

minates. The appearance at a distance is very like houses. There is no rock showing out, and the vegetation seems scanty and poor, with but few trees.

North of Cape Bedford is the inconspicuous opening of the McIvor River. This runs through open alluvial plains of the richest agricultural character. From the description I have heard of the country around the McIvor, I should imagine that the soil is derived from the decomposition of volcanic rocks, but I have not seen more of the locality than the mouth of the river, and that only at a distance. The sandy soil and sand hills continue, with some interruption, as far as Cape Flattery, where granite reappears. The Lizard Islands which lie off the same cape are entirely granitic. Beyond this, I know nothing of the peninsula from actual observation, but I am informed that the coast is very uninteresting. The Main Range continues to diminish in height as far as Cape York, where, as already stated, it is scarcely 300 feet high. I have been dealing thus far with the coast region only, and I now proceed to relate what little I know of the interior. Of the journey from Island Point to the Hodgkinson, I have already spoken. The gold diggings are situated on a branch of the Mitchell River, and the auriferous district extends at intervals from the Slate Range close to the Mitchell on the east to the Walsh River, which is one of the principal tributaries of the Mitchell. It may perhaps be necessary to state that the river last named is one of the main channels of drainage from the western side of the Dividing Range into the Gulf of Carpentaria. Its sources are not more than ten miles from the Pacific, which will show how very near to the sea the main divide is in the Cape York Peninsula. The river has a very large number of tributaries, the principal of which are Rifle Creek, the East and West Hodgkinson, the Walsh, and the Palmer. It has a very long course to the Gulf, probably more than 500 miles, and its sources may be said to be the main granitic axis of the divide and the slaty auriferous hills which are found by the side of the granitic axis, and often exceeding it in height. From the fact that some of the longest and best tributaries come from the east, we may conclude that the main sources of the river are amongst the heights behind Trinity Bay, from Mount Harris to the Endeavour River. The Lynd is another of its tributaries, and by far the most important of all. This has its sources in the Bellenden Ker Ranges, whose highest summits are, as I have already stated, to the north of Cardwell. The great mass of mountains are granitic, but to the westward the slopes are occupied by a mass of ranges which are Silurian probably, or at least upturned slates of palæozoic rock with quartz veins and trap dykes. The dykes are numerous and trappean. They have been so altered by metamorphism that it would be difficult to give them a name from their external character alone. They are now porphyritic, and enclose large crystals of what seems like hornblende, but of such large size that the stone might easily be mistaken for a conglomerate. On the

eastern side of the table land, the upturned edges of the slate seemed like a dolerite, and I should think newer than Silurian, because of its resemblance to upper paleozoic rocks in other parts of the colony. But my conclusions on this subject were formed from a very slight observation.

In connection with the slates, dykes, and quartz veins of the Hodgkinson Gold Field there was a considerable outcrop of black limestone, besides very thick veins of quartz which include no gold. Some of the hills also were of strata consisting largely of jasper and chalcedony; the strike of all the quartz veins is east and west, but the strike of the slates is a point east and west of north-east and south-west, so that the slates abut diagonally on the faces of the reefs. The dykes correspond in strike with the strata, and as they are more recent they continually cut off the veins and fault them. The course of the ranges about the diggings is the same as the strata, and this is very nearly diagonally to the main divide. From the direction of the streams we can gather that this is generally the course of the spurs which flank the granitic axis.

There can be no doubt that the granite is the transmuted lower paleozoic strata. This can be seen as the road crosses the axis. Slates gradually pass into schists and so on into gneiss and finally granite. In saying that these rocks are Silurian, I only do so from the fact that they are very similar in character to the lower Silurian auriferous rocks in Victoria, which are known to be so from the included fossils. Those of the Hodgkinson may be either older or younger.

We can conclude nothing as to the extent of the beds transmuted into granite from the thickness of the granitic axis, because it is most probable that these upturned strata represent a series of folds whose curves have been denuded away. Sometimes in the midst of the granite little patches of unaltered, or very slightly altered, slate may be seen. They have generally the same dip and inclination as the other parts, as well as the gneiss and schist, from which we may conclude that the slates were upturned to their present angle, or, rather, that the folding of the strata was effected before the metamorphism into granite.

In the midst of these ranges we find an isolated patch of the Dalrymple sandstone, lying unconformably upon the summit of the slates just as before described at the mouth of the Endeavour River. This is Mount Mulligan, an isolated range of about twelve miles in length and very conspicuous amongst the neighbouring hills for its flat-topped summit and precipitous outline. The lower part of the mountain, as it consists of slates and quartz reefs, is worked for gold, and there are mines on several different portions of it. There cannot be much doubt that all the ranges hereabouts were at one time covered by this deposit, which probably stretched over the whole peninsula; but it has all been denuded away, leaving only a few outliers on the summits of the ranges. The section of

Dalrymple sandstones on Mount Mulligan is a more extensive one than on any other mountain in the north of Queensland. The appearance is exactly that of the sandstone on the Blue Mountains or at Port Jackson. It is a fine-grained freestone, with many ferruginous concretions and red bands. It is full of strata of the nature known as false bedding. I am not aware that fossils have been found in it, but I am assured that the quartz veins never penetrate it, nor is it known to have any volcanic dykes.

I return now to the Endeavour River, from the mouth of which I made an excursion inland. The line followed by me is about 100 miles north of Mount Mulligan. The town of Cooktown is built entirely on the grey and pink granite of Grassy Hill, except the small portion already mentioned, which is occupied by a doleritic dyke. About two miles out of the town the granite ceases, and there are many outcrops of vertical slates and schists with quartz veins. As well as I could ascertain, this formation continues for a considerable distance inland, say 14 or 15 miles, but of this I can hardly be sure. The ground is level and extensively covered with an alluvial deposit. There are very many creeks or small rivers, but though they have not deep channels I saw nothing but alluvial deposits on the banks. The first mountain range crossed was about 1,000 feet above the sea. The rock was somewhat similar to the slates on the lower ground, but belongs to a different formation. It is a highly-inclined quartzose sandstone, the beds dipping at various angles, sometimes quite vertical, and sometimes curved and contorted. I have been informed by Mr. Jack that plant impressions are found on these rocks, and that they are quite similar to the coal-bearing deposits to be mentioned presently.

After passing this range—called, I believe, the Annie Laurie—another range is crossed at about 1,400 feet, evidently of the same character. This is, I believe, known as the Grecian Bend. The hills after this become extremely steep, and the country of a very broken character. The ground becomes covered with a peculiar gravel of rounded quartz ranging in size from a mere pebble to that of a man's head. I turned northwards from the road into the ranges for the purpose of examining a prospecting shaft which was being sunk in the neighbourhood for coal. Our course was along a creek, the banks of which were formed of the pebbles already mentioned, together with a conglomerate of other rocks, waterworn, and so much changed by the action of aqueous decomposition that it would be hard to say what was the original character of the strata from which they were derived. The creek soon became too much hemmed in by the hills for riding or driving, so we crossed a very steep slippery range on foot. I cannot describe the way in which the hill was thickly strewn with rounded pebbles of quartz. It was literally white with them. We reached the creek at another portion of its course,

and found its bank lined with a series of low ridges of ferruginous shale or sandstone dipping away at about an angle of 35°. There were outcrops of a kind of coal on the banks, and on one of these a shaft was sunk to a depth of about 20 feet. There was a seam of anthracite exposed about 20 inches thick. In appearance, colour, lustre, &c., it was as good coal as any from Newcastle. It was, however, of a quality that would not burn unless a great heat were employed, and then only with a dull slow kind of combustion, leaving a thick white ash behind, or sometimes scarcely changing by the application of heat. It seemed to me very like the coal in the neighbourhood of Port Denison, where the seams are known to be "coked" by sheets of lava which overlie them. I could not see any evidence of igneous rocks in this neighbourhood. Yet, considering the broken character of the country and the inclination of the beds, I think that there must be considerable disturbance of a volcanic character, evidence of which will be forthcoming when a more detailed survey of the ground is made.

I made a further excursion to the north from this place next day towards two hills called The Brothers, on the spurs of which I was informed there were considerable outcrops of coal. I found the ridges of a very steep character, and outcrops of rock showing the nature of the formation clearly. The strata were composed of a coarse conglomerate of waterworn quartz pebbles of almost every size, cemented together by a hard, dark-brown, ferruginous paste, or concreted by a siliceous infiltration. Those who have visited the Upper Hunter River will not require to have it described. It is precisely similar in character to the rocks which form such conspicuous escarpments around Murrurundi and at the base of the Liverpool Ranges. These thick beds of pebbly conglomerate form the base of the coal measures. They are entirely composed of waterworn quartz pebbles or fragments of different kinds of trap rocks. Their actual thickness is not known, but the beds of the conglomerate retain their character in cliffs of several hundred feet. The relations of this formation at the Hunter River are not very well known—that is to say, whether it rests conformably or not upon any older formation, or what that formation may be. There, however, we may believe that it rests on older—much older—paleozoic rocks. The pebbles may have been derived from the denudation of these strata, or some of the missing links between them and the carboniferous and the quartz pebbles from the quartz reefs. This is only conjecture, but the strata at the Normanby River and those at the Hunter may be considered as belonging to the same formation. It is a remarkable circumstance that such peculiar features as this conglomerate presents should be the same at places 1,500 miles apart. One would think that such an accumulation of pebbles was dependent upon circumstances purely local, and it is not easy to understand how such deep and apparently such wide-spread deposits could be formed.

I followed up the course of these strata to the summit of

a very steep ridge, along which the carboniferous conglomerates crop out at every few yards. Descending into a narrow gully or watercourse, a very good section of the beds was obtained. They dipped away at a high angle underneath the neighbouring hill. As I ascended the creek, many outcrops of dark carbonaceous shale were exposed in seams of about one foot to twenty inches thick. The shale was not near so promising in appearance as that on the creek visited the previous day, which was about three miles distant. I should think, however, that the locality should be well tested for coal seams. The lower coal measures of the Hunter River are known to have rich seams, and they are highly inclined like the strata near Cooktown, which, for convenience, I shall distinguish as the Normanby shales.

The ranges of hills in the neighbourhood were capped by the horizontal Dalrymple sandstones. I could not say what the underlying rock is, but Mr. Jack is of opinion that there is in this neighbourhood a line of fault. I am quoting from memory, but I believe he considered that the fault was at the foot of the ranges, and that the Normanby shales abut on the Dalrymple sandstones.

The creek on which the outcrop of carboniferous shales is seen forms a series of cascades and rock basins. This place being in the centre of a fierce and numerous tribe of natives, and our position on the rock basins being so very assailable, we were not able to give them a lengthened examination, especially as we were obliged to leave our horses tied to trees at the edge of the gully. It seemed to me, however, as if the rocks were not so full of conglomerate near the shales.

The Maytown or Palmer River diggings are about 80 miles from this locality. I had not an opportunity of visiting them, but I received a geological map of the district from Mr. Selheim, the Mining Warden, who is a geologist and a very intelligent observer. In this map he lays down areas of vertical slates, carboniferous sandstones and shales, with outcrops of granite and trap. As the outlines are only approximate, it would be of little service to give them. He says in his letter to me, "I have no data to fix the extent of the slates to the northward, as they dip under the plains of the Laura, and I have not met with any sections. However, there can be little doubt that they are succeeded by the carboniferous sandstones and slates found by Mr. Jack at Deep Creek. There are no granites between the Normanby and the Palmer. Those we have on the latter field are evidently part of the series traversed by you on your journey to the Hodgkinson. They are certainly metamorphic, but there is no visible transition from slate to granite. Their boundaries are defined with great precision, as, for instance, at Granite Creek, where the east bank is granitic and the west bank slate. Hence the creek is mined for both gold and tin. These granites are conspicuous for large crystals of orthoclase felspar some two inches long. I forward here-

with also a sketch of Mount Mulligan, as I saw it on my way through the bush from the Palmer. I examined it on the line of the dip, and had a good opportunity of studying the bedding. I had no clinometer with me at the time—in fact, I was too hungry to lose much time; but I am sure that the conglomerates rest unconformably on the almost vertical slates. The chocolate coloured sandstones of the upper bed in their turn lie unconformably on the conglomerates. Mr. Jack is at present engaged in a geological survey of the Hodgkinson, and will doubtless bear me out should he view the mountain from the northward. The metamorphic schists of the Lower Palmer belong evidently to the same horizon as the slates and merge into one another. Referring to your question more particularly as to the axis of the Dividing Range, I have to say that, as far as I have seen, it consists of highly contorted slates and is unconformably overlaid by horizontal sandstones, on which no fossils have been found hitherto, but which doubtless are tertiary. The same series can be traced both by outliers and large ranges from the Palmer by the Gilbert and the Cloncurry to Port Darwin."

These sandstones here referred to are probably the same as the Dalrymple sandstones. They are in that case not tertiary but mesozoic. Any one who would examine the extent and structure of the stone, as well as the way in which it has been denuded, would scarcely fail to see that it is a much older formation than tertiary. The plant remains found in them resemble those of the Hawkesbury sandstones, as I was informed by Mr. Jack, though I have since heard, indirectly, that fossils of a cretaceous aspect have been discovered in them by the same geologist.

General Conclusions.—Though the foregoing observations are limited, from the scattered nature and the absence of any details, yet they are quite sufficient to enable us to make a summary of the geology of Cape York Peninsula. We have fortunately for our guidance in this matter the observations of Mr. Daintree on the rest of the colony, and it will be seen that there is a great similarity between all the localities. In fact we may say that on the eastern Dividing Range, from north to south, there is little or no variation in the geology. This may be summarized as a granitic or metamorphic axis with paleozoic formations on each side, ranging from Silurian to carboniferous, the whole capped by a horizontal sandstone or intrusive beds derived from ancient dykes, or tertiary basalts. There are no tertiary marine formations of any kind known on the whole extent of the range. This is true of every portion hitherto described, and I have now to add that the Cape York Peninsula forms no exception to this. For the sake of comparison, I shall now give Mr. Daintree's observations. He divides the whole of North Queensland, as far as Townsville, into a few distinct formations, thus :—Aqueous, including recent alluvial, containing extinct faunas; desert sandstone, which he calls cainozoic; mesozoic, including cretaceous, oolitic, and carbonaceous; paleozoic, including Car-

boniferous, Devonian, and Silurian, and Metamorphic. Of the alluvial, he says (see Proceedings or Quarterly Journal of Geological Society for 1872, p. 278) :—Fluviatile or freshwater deposits skirt all the present watercourses, but the accumulations are insignificant on the eastern watershed, except near the embouchures of large rivers, such as the Burdekin, Fitzroy, &c. On the shores of Carpentaria, however, and in the *south-western* portions of the colony, where the watercourses have scarcely any fall, and where in seasons of excessive rain the country is nearly all inundated, fluviatile deposits are very extensive. Although the sediments redeposited as alluvia between the Main Dividing Range and the *east* coast are as stated comparatively insignificant, they represent the denudation of no insignificant amount of varied rock material, since the present physical contour of the eastern portion of the colony is probably due to the influence of meteoric action, such as rain, &c. Though the dense lavas of the Upper Burdekin (volcanic outbursts of a late tertiary epoch) are traversed by valleys of erosion, in some cases 200 feet deep and five miles broad, yet very narrow and shallow alluvial deposits skirt the immediate margin of the watercourses draining such valleys. The same conditions are met with in all the more elevated table-lands or ridges, which give a character to the present physical outline of the eastern Main Range. It is only near the mouths of the larger rivers that any extent of alluvium has been deposited, and even these areas are at the present time in seasons of excessive rain liable to inundation, showing that little upheaval of this portion of Australia has taken place since the last volcanic disturbances terminated."

Mr. Daintree goes on to say that meteoric conditions were the same as the present time with regard to the distribution of the rain in the seasons ; but this, I think, is an assertion which we are hardly in a position to prove, though there is no evidence to the contrary.

As far as my observations have gone, the low-lying flats north of Townsville are of recent alluvial formation and are of freshwater origin. If they had been marine, we should expect to see signs of upheaval on these and other portions of the coast. There are, however, no such signs. This, I am aware, is a direct contradiction to the opinion of Dr. Rattray, already cited. But that gentleman cites no evidence of upheaval, such as raised beaches and marine fossils. He also appears to have been imperfectly acquainted with the coast geology of New South Wales, for he refers to that region as also affording evidences of upheaval, whereas such things are quite unknown. In fact, there could not be a stronger contrast than is presented by the whole of the north-eastern or eastern coast to the southern, where upheaval is either now going on or has been going on until recently. There the appearances are unmistakeable. From the mouth of the Murray River to Cape Bridgewater we have raised beaches and thick beds of fossiliferous rocks full of marine remains. The most of these are extinct,

but above them for sixteen or twenty miles inland there is underneath the surface soil a thick deposit of marine shells. They are of recent appearance, some preserving their colouring matter. I have examined many of these beds and thousands of the shells from them, and I have found them all similar to the shells at present existing on the coast and not one extinct species amongst them. All scientific men will appreciate this when I mention the names of the commonest forms. They are *Venus aphrodina* or *scalarina*, *Bulla australis*, *Cerithium granarium*, *Turbo undulatus*, *Phasianella tritonis*, *Nerita atrata*, *Trochocochlea constricta*, *T. australis*, *Carinidea aurea*, *Clanculus undatus*, *C. nodoliratus*, *Euchelus badius*, *Thalotia conica*, *Bankivia varians*, *Patella tramaserica*, *Haliotis nævosa*, *Mactra rufescens*, *Anapa triquetrum*, *Tellina deltoidiales*, *Tellina albinella*, *Mesodesma erycina*, *Rupellaria crenata*, *Mytilus latus*, *Ampularina fragilis*, etc., etc., etc. All these are the common littoral shells of South Australia. If there be any difference it is in this, that the fossils are of larger size than those common on the coast. From this I concluded, at one time, that the climate of the later pliocene period was warmer. On the west coast of Australia there is a recent upheaval of land. Recent shells of the pliocene period were sent to me from a limestone quarry at Freemantle. These fossils included many which, as far as I know, are only found living in the tropics.

Besides the occurrence of recent shells in large beds at a considerable distance from the sea and at heights very much above the present sea level, the general aspect of the land is such as to suggest recent upheaval of a slow kind. The shore is low-lying and flat. Outliers of eolian rocks are found with traces of marine action upon them. There are immense sandy beaches and sand dunes along the coast, with large salt lagoons and marshes extending to some considerable distance within the land. These salt lakes are surrounded with beds of marine shells, and it is quite evident that some of the mollusca lived and died there long after the lagoon was separated from the sea, though there are none living in them now.

All these appearances differ in every way from what is observed upon the north-east coast. The land abuts on the sea for the most part abruptly. There is not the faintest sign of any upheaval in the form of raised beaches or any marine remains within the margin of the present known beach. Wherever the land is low-lying and flat it is covered with alluvial deposits either derived from the rivers or from ordinary weathering. A very large part of the coast line is, as I have already said, abrupt, and does not even offer a narrow beach of sand between the ocean and the steep acclivities of the ranges which rise above the waves. Besides this, the whole contour of the coast line is such as to suggest subsidence instead of upheaval. If we were suddenly to plunge any part of the Dividing Range some 500 feet below the present level, what would be the result? Why, the Main Range would rise abruptly out of the

sea, while many of the spurs, ridges, and isolated peaks would appear as chains of islands, and very abrupt islands separated from the main by narrow and deep channels. The peaks and higher mountains would be small precipitous islands, and there would be groups of them where a cluster of hills formerly existed. Now, this, in brief, is a precise description of the north-eastern coast. The islands are just as described—ridges and spurs from the Main Range, which were formerly its precipitous peaks and crests, the deep valleys now represented by ocean channels of bold water.

If we examine the nature of the rocks we shall find the evidence still stronger. The rocks are those of the Main Range in every particular. Granite is the most abundant, as it is more common in the northern islands than in the south. The nearer the islands are to the shore the more granitic they are, while the outliers are often composed of highly-inclined metamorphic schists and slates. There are exceptions to this, however; just as we find on the Main Range the granitic or metamorphic portions as much exposed on the coast as in the centre of the axis. Finally, if we take a glance at the whole aspect of the north-eastern coast line we shall be forcibly struck by its resemblance to a range of mountains round which the sea has arisen. Any one who has witnessed the effect of a high tide on a very rocky coast, especially in places where the rise and fall is considerable (Jersey, for instance) will be struck by the resemblance it presents to the island coast line of north-east Australia.

From this, therefore, we may conclude that the coast range of Northern Australia, or the northern portion at least of the great divide, was formerly much higher than it is now. What the amount of subsidence has been, there is not knowledge enough of its character to form an opinion. There is no part of the channel between the main land and the Barrier Reef which is over 200 feet deep. An upheaval to this extent would lay bare dry land between all the islands and the main, as far as the Barrier. To raise all the reef itself, an elevation of 2,000 feet would at least be required, and probably even more. On the other hand, a subsidence of 3,000 feet or more would be required to submerge all the islands. Mount Stafforth and other mountains on Hinchinbrook Island are over 3,000 feet high, Cape Gloucester, 2,000, &c. Such a subsidence would submerge the whole of the Dividing Range, with the exception of a few mountains, such as the Bellenden Ker Range, Mount Peter Botte, and a few others. If the subsidence has been equal, and the depth of the Barrier Reef be any indication of its extent, then the Dividing Range must have been over 7,000 feet high in some places, and we might expect to find in extremely high portions of the range some evidence of glacier action. The river channels may also be expected to furnish evidence of their greater elevation. The large proportion of Asiatic species of plants in the flora of the northern divide certainly points to some more intimate con-

nection with the Asiatic continent than that which exists now. It is useless to speculate on the connection that would ensue between Australia and Asia by an upheaval of three or four thousand feet, because we cannot be sure it would be general and extensive.

The question now meets us as to whether the subsidence of the north-east coast was sudden or gradual. The evidence of the coral reefs, if Mr. Darwin's theory be true, is that it has been very gradual, and this is to some extent confirmed by the extent of the alluvium on the plains. The accumulations are extensive and must have taken some long time to form. They are sometimes found to include extinct animal remains, such as bones of Diprotodon. But the country is too little known and explored to conclude much more with certainty than that there has been extensive denudation, so I must leave this part of the subject to future enquiries.

In conclusion, I must ask my readers to bear in mind that I claim no more correctness for these cursory observations than what a hurried journey through a new country would enable me to effect. A very different kind of survey must be made ere the geology of North Queensland can be thoroughly known. Any conscientiously recorded facts must be of value, and this is why I have lost no time in recording what I saw in the preceding pages.

NOTE.—Quite recently an impression has been current that the coast of Queensland is rising. A good deal has been written on the subject, but not one well-recorded observation has been brought forward. On several occasions I have gone to what were described as raised beaches, but they had no resemblance to anything of the kind. A Mr. Chas. Devis stated publicly that sea shells of existing species had been found on the Barcoo, but in answer to my questions as to where they were found and who identified them I have received no information. By the marine surveyors I have been informed that there has been no change of level in the last thirty years. I have found some evidence of outpouring of lava at Cleveland during recent times on the sea bottom, and fossils of existing species are found under the lava mud. This, however, must form the subject of a separate paper. I have no doubt that there has been some very circumscribed local upheavals in connection with these volcanic outpourings, but we have no evidence so far that it has affected or is affecting the whole Queensland coast.

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