

## Report on the geology and mineralogy of the State of Malacca

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### Abstract

In compliance with a request from His Excellency Sir Frederick Weld, previous to his going to England, that I should visit and report on the geology of Malacca and the neighbouring states, I visited Malacca in October, 1884. The following is the result of my brief examination of the Malacca territory.

### Report<sup>1</sup>

The geology of the State of Malacca is of a very simple character. It consists of low hills of palæozoic strata with occasional outcrops of granite and a small amount of overlying beds of alluvial.

The minerals found in these rocks are gold, tin and iron.

I shall briefly consider the above formation in detail, in the order in which they are named.

### Palæozoic Rocks

This formation consists of highly inclined ferruginous slates, schists and gneiss, with occasional veins of quartz. On the surface it weathers into a red honeycombed rock not like [sic] a decomposed volcanic ash. Possibly some of it may be volcanic, but of great antiquity, as, for instance, Bukit China, where the volcanic character seems marked. There are other places where the wearing and weathering of the ferruginous rocks have affected the underlying granite, which now alone remains. The partly decomposed granite then appears as a brown mass with white crystals of felspar scattered through it.

The formation is distinctly stratified, the strata being highly inclined, and occasionally quite perpendicular. There are numerous bands and partings of slate, chert, marly rubble, and green sandstones with mica. The general appearance of the deposit strongly reminds one of the palæozoic or Ordovician rocks of Victoria and New South Wales in Australia, which have proved to be so extensively and richly gold-bearing. I think it highly probable that the beds are of the same age, more especially as from time immemorial these Malacca strata have been worked for gold. There are true quartz veins amongst them and one at the foot of Mount Ophir has been worked quite recently by an English company.

I was never able to examine a section showing the actual junction of the palæozoic rocks with the granite, at least in the Malacca territory. The possibility is that the passage from one rock to another is gradual and manifests metamorphism. I should think that this has taken place after the upheaval of the slates to their present perpendicular position.

Without an accurate survey, it is impossible to say what the thickness of these beds may be. They are doubtless repeated in successive folding, as their present perpendicular position is due to lateral pressure. The formation itself is not very thick, as the granite is, in numerous places, quite close

<sup>1</sup> Reprinted from Appendix 2 in the *Proceedings of the Legislative Council of the Straits Settlements for 1885*, January 1885.

to the surface. In all such localities, tin may be looked for in small quantities.

The palæozoic rock is largely mixed with poor iron ores, and where the surface water charged with carbonaceous matter has come into contact with these ores, they have been oxydised [sic] and converted into a red and reddish-brown limonite called here laterite.

This laterite has been a geological puzzle to most of those who have written on the geology of the Malayan Peninsula. It is remarkable what a variety of guesses have been hazarded as to its origin. Some writers who have pretended to offer an explanation seem purposely to have obscured their meaning from inability to deal with the difficulty. It has been called volcanic, and regarded as a tertiary outpouring of basalt, and so forth. As already stated, the real character of the stone is simply due to the oxydation [sic] of a ferruginous series of rocks. The formation which has mostly supplied the materials for the laterite is the stratified palæozoic slates and the granite in contact with them. It is a decomposed rock. Water and air have been the decomposing agents.

It is a most significant fact that there is no evidence whatever of recent upheaval from the sea, or even marine action. It would be hardly possible for this laterite or limonite with silicates of iron to be in course of formation without entombing some marine remains had they been in contact with them. Malacca is no exception to the general rule throughout the Malayan Peninsula that there is no evidence of recent upheaval in all the great extent of its coastline.

### **Granite**

The granite is of the usual grey colour of the granites which form the main axis of the Malay Peninsula. It seems in every respect to have the same mineral character. There is

every reason to believe that it is an altered stratified rock of the same character as the granite in Perak, and probably possessing similar metals, such as tin, gold and iron.

### **Alluvial**

The alluvial is the result of surface weathering. Water-worn drifts are not common in the Malacca territory. Whatever decomposition has taken place has, for the most part, remained in its original position.

This fact has an important bearing on the way in which a search should be made for the minerals contained in the rocks. An explanation will be given further on.

### **Physical Geography**

If we suppose Mount Ophir to be outside the boundaries of the territory of Malacca, there are no high mountains within its limits. The whole of the State may be said to consist of undulating hills of very moderate elevation and having generally a trend in the direction of the main axis of the peninsula. A few streams of small importance drain into the Straits of Malacca to the westward, as the land is on the western watershed.

The hills are, no doubt, outliers of the main range. Their character will be better understood if it be borne in mind that the main range, which forms the backbone of the Malayan Peninsula, gradually declines after reaching its culminating point in the high mountains of Perak and Pahang. About the latitude of Malacca, not only does the range decline, but loses its continuity. To the south and east of Malacca, there are places where the watershed of the peninsula is, with difficulty, determinable. The range becomes broken up into isolated groups of mountains. Of this, Mount Ophir is one. It does not belong properly to the territory, nor is the country affected to any extent by its proximity, so that

I do not include it in its physical features. It is the highest mountain in this part of the peninsula but very much below the mountains of Perak and Pahang. It is isolated and not accompanied by any great elevation of the main range in its neighbourhood. Thus there is not extensive drainage passing through the Malacca territory, and consequently no large deposit of alluvial matter on the surface.

Now, bearing in mind these features, it is easy to arrive at the general conclusions as to the mineral resources of the Settlement, and what are the probabilities of any extensive development of the mining industry.

Observations in other parts of the peninsula have shown me that the stream tin deposits are alluvial and that they are found in the greatest quantity in the junction of the granite with the palæozoic schists, slates, and gneissose rock already referred to. The absolute amount of tin at this junction is probably not great, but when it accumulates under the influence of alluvial washing from the weathering of the rocks, it becomes considerable. Thus, if the laterite or red rock were washed at its junction, or near to its junction, with the granite, it would not yield tin enough to pay for the labour. Some tin will be found, but not enough to pay for the mining. It requires the operation of nature's laboratory, or mechanical terrestrial forces, to produce the deposits of sufficient extent to remunerate regular working as a mine. What is needed is the weathering influences of streams acting upon large surfaces of rock and acting upon them during long periods of time. By these means, the matrix is worn down and reduced to the finest sub-division. The lighter particles are carried away by the streams, whose waters are then rendered turbid. They are deposited as sediment on the coasts: on mud flats which accumulate to such a considerable

extent on the shores of the Straits of Malacca. This tin, by its weight, remains behind, being sifted and mingled with coarse gravel.

It can be easily perceived that the higher the mountains, the more extensive the drainage and consequent weathering. This action is also more rapid. Thus all the most valuable of the tin mines in the neighbourhood of the Straits Settlements are found in those parts of the peninsula which are very mountainous, and where the mountains are both high and steep. While, therefore, I think that probably there is as much of the tin-bearing rocks on the territory of Malacca as in any part of the peninsula, I must add that, owing to the moderate elevation of its mountain system, at present, there are no surface indications of sufficient alluvial deposit to give prospects of rich accumulations of stream tin. Deeper deposits there may be, as I shall explain further on.

The preceding conclusions will show where the ore deposits are to be looked for. These are:- on the slopes of mountains, by the sides of streams, or in their ancient beds and especially where the granite crops out at the junction of the palæozoic rock.

### **Mines in the Territory of Malacca**

Besides the many localities where the sand is washed by a few Chinese for the small quantity of tin which it contains, there are two or three places only where more extended mining operations are carried on.

#### **Linggi Sands**

As an instance of the small operations of Chinese sand-washing, I may mention that of Linggi. A little to the south of the river of that name, at a distance of a mile or so, a few Chinese gain a precarious subsistence on the sea-shore, by washing the sand for tin at low tide. The quantity obtained is small, and in

the form of coarse, rounded grains of cassiterite. The ore has this peculiarity that the grains are not of a generally uniform size, but of a mingled character, large and small together. I attribute this to the fact that the grains have not been sorted by alluvial washing, but are found in this position, just washed out by the sea from the junction of the granite and palæozoic rock. Now, at Thaipeng and other alluvial tin mines in Perak, where the sands have been subject to much silting by alluvial action, the tin ore is generally found to be sorted. Near the mountains and in the steep gullies, the tin ore is coarse, and the farther it is traced from the hills the finer it becomes. A slight experience enables one to tell at a glance what is the nature of the locality from which ore has been derived – whether near mountains or from plains, or from the sea-shore.

### **Panchor**

At a place called Panchor, seven miles south of Linggi, there is another small area where the sand is washed for tin by two or three Chinese. The beach is lined with vesicular red rock or palæozoic slates, which have been much affected by sea water. Granite crops out close by. The amount obtained here is very small, and only to be got at low tide, the men employed scarcely make the moderate wages which will maintain a Chinese coolie.

### **Chin-Chin**

These mines are situated near the southern boundary of the territory of Malacca, about ten miles from Mount Ophir. They are the largest tin mines in the territory, but I should think that all the country right to the foot of Mount Ophir, may reasonably be expected to produce tin. The land and the character of the mine have considerable resemblance to the Kamunting mines in Perak. The ground is very undulating. The workings

are at present between the low hills. On the surface the ground is strewn with angular fragments of quartz, slate, jasper, and gneiss. The sinking is through two to three feet of black carbonaceous mould, then two or three feet of yellow, or red gravel, then 40 to 50 feet of white pipe-clay and sand, then the wash dirt or tin sand.

The surface has evidently been a swampy jungle, and there are signs of workings having been carried on for a considerable period. About 100 coolies were employed at the time of my visit.

The tin seemed of good quality in finely divided grains. From this, I should infer that it has travelled some distance. Probably other beds of coarser tin will be found nearer to the mountainous spurs of Mount Ophir. On the whole, I consider that the mineral resources of the district are decidedly promising.

At Chin-Chin itself, the great thickness of the overlying alluvial, which is 50 feet at least, must be a great drawback, but it is probable that other and shallower deposits will be found towards the mountains.

There is one consideration connected with this mine which ought not to be lost sight of. When we find 50 feet of alluvial drift in one place, and under what is now a level swamp, it shows that there are immense accumulations of detritus hidden under a level surface. It shows also that there have been long periods of weathering action in the geological history of the country. This we might conclude from the enormous mud deposits along the shallow coasts and banks of the Straits of Malacca. The ore has, during past ages, largely encroached upon the land. In the alluvial action, some mountains must have been worn down, and the detritus undoubtedly must be rich in tin. This leads me to the conclusion that boring operations in some of

the level marshy flats where rice is now grown may be attended with successful results, and rich deposits of tin found where hitherto it has never been looked for. It may yet be worth the while of the Government to test this question. It may be that these marshy flats represent the ancient drainage of the country, and from what little I have been able to observe, I strongly suspect that it is so.

Former historians of Malacca speak of a stream on the south side of the city<sup>2</sup>. This stream has disappeared, as no doubt many others have done. The tendency is of mountain drainage to become obliterated as the sources are lowered by weathering and the estuaries fill up from the sluggishness of the waters.

If my suggestions are correct not only tin may be looked for, but also alluvial gold, in the drift under the marshes.

### Gading

A small mine is worked by a few Chinese on the road between Allor Gadja and Ayer Panas. The washings are exactly on the junction of some decomposed palæozoic rock with the granite at a few feet below the surface. The tin is fine, with much iron intermixed. None but the most economical methods would enable even the Chinese to work such a deposit with profit. Only about half-a-dozen men are employed.

### Conclusion

The peculiarity of the geology of the territory of Malacca renders it probable that small

quantities of tin are spread throughout the whole extent of the country. I am further of the opinion, that my suggestion that the marshy lands represent the former drainage of the country, must lead to an important development of the mining interests of the Colony. They are so extensively spread, and occupy so large a portion of the territory, that even if tin or gold be found in a third of them, the result must be great. I should strongly recommend that a small sum should be annually set apart for boring operations so that the ground may be thoroughly tested.

*Gold:* I entertain no doubt that the quartz veins of the palæozoic formation are all more or less auriferous. In ancient times we may be pretty certain that the alluvial deposits contained gold. In the more populous parts of the country this has long ago been extracted, but I think it very likely that a careful search might reveal washing stuff which would yield small quantities of gold. Like most of the gold found in connection with granite, it will probably be scaly, or else in the form of gold dust.

If prospecting be undertaken, it should be in alluvial gravels, and first of all in the upper waters and banks of small streams; as already stated, the lower portions of the streams have been well worked formerly.

For any other metals excepts gold and tin, the geological indications in Malacca are not favourable. If near a coal mine, the red rock might be valuable for iron. If the trade of the port were larger, it might even pay to export it as ballast. The iron from such ores is usually of excellent quality.

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<sup>2</sup>D. F. A. Hervey, "Valentyn's description of Malacca," *Journal of the Straits Branch of the Royal Asiatic Society*, No. 13 (June, 1884), pp. 49-74B, 260

