The Geology and Mining Industries of Kedah and Perlis.

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With a geological sketch map.

INTRODUCTION.

This report describes the results of field work from January 1922 until January 1924. Most of it was completed by the end of May 1923. A considerable amount of information was collected by Mr. J. B. Scrivenor, Geologist, Federated Malay States, in previous years, and this has been incorporated.

An account, written by Mr. J. B. Scrivenor and the present writer, of the geology of the Langkawi Islands, and the prospects of mineral development, was published in October, 1923, in Volume I of the Malayan Branch, Royal Asiatic Society, with a coloured geological sketch-map, so this portion of Kedah territory has not been dealt with in the present report.

During 1925, Major W. A. D. Edwardes, M.C., Assistant Superintendent, Trigonometrical Surveys, who takes a keen interest in the geology of the country, gave great assistance in furnishing a more accurate idea of the geology of the Baling District.

It was hoped to publish a large scale geological map, printed in colours, but as this would have entailed considerable expense, the attached sketch-map must serve. The map used when doing the field work was the 1920, 3 miles to 1 inch production, but later a coloured geological sketch-map has been prepared, using the 1925 2 miles to 1 inch map as a basis, and the later information obtained by Major Edwardes and the Malay Collectors has been used to amplify and correct the original. This latest large scale coloured map can be examined at the Geologist’s Office, Batu Gajah.

PREVIOUS LITERATURE.

The following list comprises the most important publications dealing with the geology and mining of Kedah and Perlis.


In this paper the late Mr. Newton describes fossils found at Kuala Nerang, and Kampong Kuala, in Kedah, and identifies them as marine organisms and similar to shell-remains previously found at Putus Semanggol, in Perak. He states that the late Professor T. R. Jones was wrong in describing the Perak fossils as *Estheriella*, a Crustacean which lived in estuarine or lacustrine conditions. The fossils from Perak and Kedah are marine Pelecypods and include species of *Halobia*. Their age is Middle Trias. Extracts from the paper are given in Chapter VI.


The late Mr. Newton describes fossils found near boundary stones 9 and 10 in the north of Perlis, occurring in beds of hard quartzite with calcareous cement, interstratified with shales. The most abundant organism belongs to the foraminiferous genus, *Fusulina*, whilst others include remains of corals (*Stenopora*), crinoidal stem fragments, polyzoa (*Fenestellidae*), and imperfect casts of pelecypod valves. The presence of true *Fusulina* is of chief importance, however, for stratigraphical results, because that genus is characteristic of the youngest Carboniferous deposits (Uralian) as well as of beds of Permian age, thus forming a definite Palaeozoic horizon which is often referred to as Uralian-Permian, or Permo = Carboniferous.


Mr. Ridley suggests on botanical evidence, that at no great distance of time the flat land of Kedah was under the sea, in which Gunong Jerai and Gunong Perak stood out as islands as Penang does at the present day, and that the present flora of Province Wellesley and Gunong Jerai came up from the south while the flora of the country from Bangtaphan to Alor Star came from Burmah southwards.

On page 43 Mr. Ridley mentions "sea bird Guano" in a large cave at Chuping. He is evidently referring to the deposits of phosphate which are described later in the chapter on limestone. It is certainly not guano now; it may have been formed by the interaction of guano with limestone.


Mr. Ridley says: "The flora of Kedah Peak bears a considerable resemblance to that of Mt. Ophir. . . . . . . . . . . . There can be little doubt that Mt. Ophir was at one time an island detached
from the mainland as Penang is to this day, and it seems highly probable that Kedah Peak may have been similarly isolated.”


The introduction describes Kedah Peak:—It is quite isolated, standing on a base that does not exceed 50 square miles, and is separated by low land not exceeding 50 feet in elevation from all other hills. Its slopes to the north and west are much steeper than those to the south and east, and vertical rock faces, many hundreds of feet in height, exist. Geologically the mountain appears to consist of sandstones and quartzites of varying degrees of hardness, traversed by veins of quartz, while in one or two places deposits of haematite are found. It is well watered, being cut into by three great valleys which have been utilised for a water supply to the neighbouring districts, and the cliffs are ornamented in several places by cascades which are very conspicuous after wet weather of any duration.”

From an examination of the mammal fauna and the birds the authors infer “That Kedah Peak has never been connected either with the Trang mountains or those of the Main Range in such a manner as to permit the passage of the fauna of these two districts to it.”


An investigation was made of a reported occurrence of coal near Kulim. It had been stated that the coal was found on, or near, Victoria Estate, but, on cleaning out the well, not a trace of coal was found in it. Pieces of coal with tin-slag were found in a heap of debris near by, so it is possible that secret smelting operations had been carried on, but it was not discovered where the coal had been brought from.

8. “Memorandum on the possibility of obtaining supplies of artesian water in the F.M.S.” Kuala Lumpur 1911.

A bore for artesian water was put down near Alor Star. After 60 feet it passed from alluvium into quartzite and continued in that rock to 130 feet until the bore was stopped. No good supply of water was tapped. It is interesting to have the record of the shallowness of alluvium at Alor Star, but it is probable that the bore struck the top of an eminence arising from the floor under the Recent deposits. Probably the average depth of alluvium is much more than 60 feet.

Mr. Scrivenor corrects the error which had found its way into Suess’s book “Das Antlitz Der Erde,” that the Lakawn Range enters the Peninsula from Siam to form the main granite range.


The Kedah Singgora Range was said to be composed of quartzite and shale, and it was thought that none of its summits reached 1000 feet above sea level. Surveys made since 1913 show that some of the hills are higher than this, and a granite mass occupies the highest ground, in the middle of the quartzite and shale country.

A well preserved beach at the foot of Gunong Keriang, near Alor Star, is cited as evidence that the flat land, west of the Kedah Singgora Range, was not long ago under the sea.

12. “Geologist’s Annual Report for the year 1913,” Kuala Lumpur. In this report Mr. Scrivenor mentions his unpublished report on the Economic Geology of Perlis. Material from this is incorporated in the present work.


14. “Geologist’s Annual Report for the year 1919,” Kuala Lumpur. A description is given of prospecting work done near the coal-bearing rocks on the Perlis-Siam boundary. An account of this is given in the present work.

The geology and minerals of Kedah Peak and the Langkawi Islands are described.

15. “Geologist’s Annual Report for the year 1920,” Kuala Lumpur. Details are given of the two bores sunk to 81 feet and 68 feet on the coal-bearing beds in Perlis.

16. “Geologist’s Annual Report for the year 1921,” Kuala Lumpur. Details of the 205 feet bore in the Perlis coal measures are given.

Mr. Scrivenor suggested that the phosphate of Perlis may be present as amorphous aluminium phosphate. Analyses made since then indicate that the phosphate is present as hydrated calcium phosphate.

This subject is dealt with in the chapter on limestone.


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The geology of the Langkawi Islands is not dealt with in the present paper as the above account dealt with it completely enough.


The author mentions a factory in "Quedah" with an Under-factor and a Settlement to barter tin, gold, and elephants for the Hon'ble Company, but owing to trouble the factory had to be closed down in 1656.

19. **Willbourn, E. S.** "Geologist's Annual report for the year 1922." This gives a *resume* of results of the survey to the end of 1922, which are now given *in extenso*.

**PHYSICAL FEATURES AND GENERAL GEOLOGICAL SKETCH.**

The most accessible part of Kedah is the strip of flat ground which is crossed from south to north by the road and railway, and as the larger part of the State is not traversed by any important line of communication, a visitor passing through the country receives the impression that Kedah is very flat. He would quickly change his mind if he were to go on a journey of exploration in the little-known eastern half of the State. With the exception of the roads from Padang Serai to Baling, Weng, and Kroh, and from Alor Star to Kuala Nerang, he would have to rely on rivers and jungle paths. The country formed of sedimentary rocks is hilly, and where the quartzites and shales have been metamorphosed, and hardened, by igneous masses, their resistance to denudation has left high peaks, such as Gunong Jerai, and the hills south of Sintok. The most mountainous part, however, is in the granite country on the eastern side of Central Kedah which extends over the boundary into Siam.

**Sungei Muda.** The largest river in Kedah is Sungei Muda. It flows along the northern fringe of these mountains, fed by a number of tributaries which rise in the highlands between Gunong Kubang Badak and Bukit Bubus, and in the shale and quartzite country as far west as the Bukit Pakir Terbang Range. Near Jeneri the Muda Valley passes between Bukit Perak, a long high granite ridge, and the high granite hills on the east bank. Granite outcrops can be seen in the river over a short distance only, and from here to the sea the river pursues an even course along a gentle gradient, with very few rock exposures.

**Ulu Ketil.** The eastern central granite mass is, on the surface, almost divided into two by a tongue of sediments which starts north of Weng and runs in a southerly direction to Baling. This furrow in the surface of the granite has determined the position of the valley of Sungei Ulu Ketil. A road has recently been made from Baling to Weng, and it would be an easy matter to prolong it to beyond Tanjong Pari. The construction of a
further extension over the granite mountains to Sok would be more difficult. The granite country between Weng and Sik and to the north of this line is very rugged, but to the south, near Baling, the granite ridges are lower. The path from Charok Pelandok to Kuala Kupang follows approximately the line of contact of the granite with sediments.

**Limestone hill in Ulu Muda.** On the map a limestone hill, Gunong Labuh, is marked in the headwaters of Sungei Muda, near the Siamese boundary, but its position is not accurately known.

**Baling Hill.** Baling limestone hill is usually viewed from the Baling road, from which it seems to be a solid mass of limestone several miles across. From the north, or better still, from the summit of the hill itself, it is seen to be a natural amphitheatre like the *wangs* of Perlis, horse-shoe shaped, with an opening 2 miles across at its northern side. There is another much smaller opening at the south-west corner, near Pulai, which is known as *pintu wang*. The limestone cliffs are very imposing on the inner walls of the amphitheatre, and, in comparison, the low rolling ground inside appears to be quite flat. Actually there are hills up to about fifty feet in height, and it is interesting to note that they are built of sandstone and shale.

**View from Baling Hill.** The top of Baling Hill is a good spot for viewing the whole of the southern part of Kedah; Gunong Jerai (Kedah Peak), Bukit Mertajam, and Penang Island can all be easily picked out, as well as a number of less conspicuous hills. The rising ground to the east of Baling is the beginning of a broad expanse of plateau land which extends into Upper Perak and Siam.

**Limestone ridge near Perak border, south-east of Baling.** The presence of this hill was reported by Major W.A.D. Edwards, and Malay Collectors were sent to visit it in December, 1925. They found a high limestone ridge, built up, at any rate in part, of coarsely crystalline marble. The country on its east side is granite.

**Bintang.** The granite range, which starts from the Dindings and passes to the north through Perak, ends abruptly after entering Kedah territory. Gunong Bintang, 6103 feet, on the Kedah Perak boundary is much higher than any other peak in Kedah. Gunong Kangar, 4760 feet, is a granite peak not far from Bintang. The country in Ulu S. Kuang, near the boundary, has not been visited, but a view from a hillock of sandstone about five miles upstream from Kuala Kupang showed that the boundary lies on an expanse of flat land, in all probability an area of sediments separating the Bintang granite from the southern prolongation of the Baling granite.
Near Mahang. The granite which occupies the Kulim District, extending to Gunong Bongsu, is separated on the surface from the Bintang granite by a north and south belt of sediments, forming an area of flat or rolling country between the two mountain ranges. There are small deserted mines in the flat country to the north of Mahang, but, with the exception of a lampan near Karangan, the only miners in the district in 1923 were tin-stealers.

The Kulim granite mass. Parts of the northern margin of the Kulim, Bongsu, Relau, Panchor granite are mineralised, but mining operations here are on a very small scale. There were mines near Kulim, now abandoned, and a mine is being worked a few miles from Karangan. There are also deserted lampans in the same district. On the whole it is an easy matter to map the boundary of this granite, because, as a rule, the sediments do not form such bold hill ranges as does the granite.

Sediments in South Kedah. In the quadrangle between the Kulim granite the Bintang granite, the Baling granite, Gunong Jerai, and the coastal plain of alluvium, there is an expanse of hilly land built up of quartzite, sandstone, shale and chert. The sediments have a general north and south strike, and, in the case of more thinly bedded rocks, such as the chert, the dips are nearly vertical owing to a succession of sharp folds. The north and south strike is typical of all the sediments in Kedah, and local exceptions can be explained by the presence of granite intrusions. On the west of this quadrangle, and south of Gunong Jerai, are shales with no sandy beds; all exposures show a massively bedded red shale. The red colour is due to weathering, and the unaltered beds are black in colour. The best exposures are on Bukit Sungei Pasir, and on the isolated hills near Kuala Merbok. It would seem that the four islands Bidan, Telor, Tukun Terendak, and Songsong, are built up of the same series, with the difference that some limestone is found in Bidan, and there is calcareous grit in Tukun Terendak.

Red Shale. Volcanic Tuff. Although there are good exposures of the red shale in the hills near Kuala Merbok, yet no fossils have yet been found in them, and it is not possible to say definitely whether the beds are younger or older than the quartzite of Kedah Peak and the chert, shale, and quartzite, of the Baling road, but the presence of limestone on Pulau Bidan makes it probable that the red shales are passage beds between the limestone series, developed in Baling, and the overlying arenaceous beds. The eastern boundary of the area occupied by the red shales is indicated by a dotted line on the geological sketch map. There is a shortage of good road metal up to the 36th mile on the Baling road, because of the absence of unweathered quartzite, and at present the only supplies are drawn from 1926] Royal Asiatic Society.
quarries of weathered chert. At the 36th mile there is an exposure of hard volcanic tuff which gives a satisfactory road metal.

**Gunong Jerai.** Gunong Jerai, 3987 feet, is a most imposing pile, seen from many points of view from land and sea. It is built up of quartzite which has been made highly resistant to weathering by the hardening metamorphic action of granite intrusions. Probably the core of the mountain is a mass of granite, for some of the foot-hills on the south and south-west side are granite or pegmatite, and intrusions of sheared granite-porphyry are exposed on the mountain, some quite near the summit. There are very precipitous cliffs, one, on the south side near the top, being particularly conspicuous. It is characteristic of quartzite hills that they have steeper slopes than hills of granite, and the fact can be used sometimes to map the granite contact in difficult country. For instance, Bukit Kepala Gajah, which is one of the hills attendant on Jerai, can fairly surely be mapped as quartzite on account of its steep contours. The granite intrusion near Gunong Jerai is tin-bearing, and tin-mining has been carried on near Semiling for some time. Coarse-grained pegmatites were recently worked for mica near Tanjong Jaga. There are reports that gold was found in the mountain, but no confirmation of this has been obtained.

**Bandar Bahru.** The sedimentary rocks lying between the Kulim and the Bintang granite, exposed on the Bandar Bahru and Selama roads, are arenaceous, and similar lithologically to the Gunong Jerai quartzite and to the quartzite and shale exposed in the country to the east and north-east of Gunong Jerai. Although Pulau Kera is outside Kedah territory, yet it may be mentioned as belonging to the same series. It lies between the granite of Penang Island and the Kulim granite.

**Plains.** There is a small alluvial plain to the south of Gunong Jerai, from which various hills of red shale stand out like islands from the sea, and there is a much larger plain on the north side of the mountain. It extends into Perlis to within a few miles of the Siam border, and east of Alor Star a narrow deep bay of alluvium penetrates inland as far as Kampong Pinang. It is possible to draw a line from the sea eastwards through Alor Star, on perfectly flat country for more than half the breadth of the State at its widest part. A good deal has already been done towards irrigating the plain by means of canals, and there are very large areas still remaining to be developed.

**Sedimentary rocks in North Kedah.** Apart from this alluvial plain, a series of quartzites and shales occupies the greater part of northern Kedah, and as in South Kedah, the rocks are associated with radiolarian chert. They form part of the series, younger than the limestone, that is extensively developed throughout the Malay Peninsula and fortunately there is deci-
sive evidence to give the age of one horizon in Kedah. Fossils found in black shales interbedded with quartzites at Kuala Nerang, and near the Bukit Pakir Terbang conglomerate range, are similar to those found many years ago near Taiping in Perak, and they were stated by the late Mr. R. Bullen Newton, of the British Museum of Natural History, to be of Middle Triassic age. Conglomerates are commonly developed east of Kuala Nerang, as in the neighbourhood of the fossils found near Taiping, and the Bukit Pakir Terbang Range, which forms the State boundary to the east of Kampong Kuala, is built up solely of them. Parts of the range, on its western (Kedah) side, have vertical cliffs hundreds of feet in height, and it would be quite a feat of climbing to ascend to the Trigonometrical Survey beacon from this side. The slopes are much gentler in Siam. In 1922 a view from the summit of Bukit Perak, many miles away, showed that the three-peaked hill, Batu Tajam, marked as 1896 feet in height, to the south of Bukit Pakir Terbang, was once probably part of the same range, because its bold contours suggest that it too is made up of conglomerate. This was confirmed later by Major Edwardes, who went along the ridge including Batu Tajam and Bukit Sayong. The pebbles in the rock at Gintang Kerinai and Bukit Pakir Terbang are commonly two inches across, and boulders with a diameter of one foot are not uncommon.

Metamorphosed Sedimentary in North Kedah. The quartzite and shale in the neighbourhood of Padang Pelandok and the Alor Star Catchment Area seem to be underlain at no great depth by granite, indicating that the granite intrusion exposed at Pintu Wang and on the boundary at Kao Mai has a much greater lateral extent a short distance underground than on the surface. This is seen by the wide-spread metamorphosis of the shales and quartzites in the two districts above-mentioned. There is a very beautiful gorge in the Catchment Area in which the metamorphosed shale and quartzite are well displayed.

In the north-east corner of the State, to the east of Kao Mai, the boundary is quite low, and there are no striking features. Ginting Pahat, at boundary stone 34, is a V-shaped pass between two hills. It is about fifty yards long and fifty feet deep, and at the bottom of it is only two or three feet wide. It has been formed as a result of the natural erosive action of two streams which have worked backwards to meet at their headwaters, one the S. Tempat, flowing westwards into Kedah, the other, the S. Langetap, flowing into Siam. The walls of the valley are of red earth in which are embedded fragments of fine grained schist, which looks like metamorphosed sandstone. No granite is known to outcrop near here, but it probably underlies the sediments at a shallow depth.

1926] Royal Asiatic Society.
Kao Mai. The watershed to the west of Ginting Pahat, which forms the boundary between Siam and Kedah, is all low, less than 1000 feet above sea level, until the granite slopes of Kao Mai, 2486 feet, are reached, near Kampong Seraya, and here the country is more mountainous. No tin deposits are known, though there are mines working on the same intrusion, near Padang Pelandok, in Ulu Badak, and at Pintu Wang, a few miles from Ban Sebapen. This is the intrusion that has caused the widespread metamorphism south of Padang Pelandok, and the effect on the topography has been to leave hills of altered sediments, over 2000 feet high, that have resisted denudation as stubbornly as granite.

Prominent hills in the coastal plain. Between these schists and the coastal plain, less strongly metamorphosed sedimentary rocks form an area of rolling country, bounded on the west by a number of rather prominent quartzite hills, whose slopes disappear under alluvium. These hills, Bukit Talipong, 1271 feet, Bukit Tunjang, 987 feet, and further south, Bukit Tinggi, 438 feet, and Bukit Hijau, 484 feet, were in Recent times a natural barrier against the eastward creeping sea. The sea bottom was being covered by mud, sand, and silt, brought down by rivers from the hills, so that, when uplift took place, the new land that emerged was a flat plain. A number of islands and irregularities on the sea floor that had not been silted over are seen at the present day as isolated hills in the alluvial flat, and certain areas of low undulating country, such as that between Sungei Patani and Gurun, and in the north and east of Perlis, were swept by the sea, and probably denuded, to some extent, by the action of the waves.

East boundary of Perlis. There are no natural features forming the boundary between Kedah and Perlis. The watershed at the east boundary of Perlis and Siam is nowhere very high, Bukit Tinggi, 378 feet, being the highest point. Tertiary beds with interbedded coal seams are known to occur near Bukit Tinggi, but neither their lateral extent nor their thickness has yet been proved. They are known not to reach so far as Padang Besar in the north, and an outcrop of ancient quartzites and shales was noted by Mr. Scrivenor in the west, but it is quite possible that they extend to the south-east across the Changlun Singgora road. One weathered road-cutting gave the only evidence, and it was not possible to decide from this whether the rocks were of Tertiary age or more ancient. Owing to the gently undulating nature of the country along this watershed there are very few exposures of rock, and recourse must be had to boring before definite information can be obtained. Prospecting work carried out by the Railway Department, Federated Malay States, is described in a later chapter.