

FEDERATED MALAY STATES.

GEOLOGIST'S ANNUAL REPORT FOR THE YEAR 1923.

STAFF.

1. The Geologist, Mr. J. B. Scrivenor, was on leave in England at the beginning of the year. He returned to duty on July 21st.
2. The Assistant Geologist, Mr. E. S. Willbourn, acted for the Geologist during the latter's absence on leave, and also continued his work in Kedah.
3. The Chemist, Mr. J. Shelton, was transferred in January to the Institute of Medical Research, and Mr. J. C. Shenton, Temporary Assistant Chemist, carried on the chemical work alone.
4. Mr. H. E. Savage's work in Kelantan was interrupted by a serious attack of malaria in April but he was able to resume his duties in May.
5. Mr. G. R. Fulton continued his survey of Johore, but his health broke down towards the end of the year, incapacitating him for further work in 1923.

CHEMICAL LABORATORY.

6. Mr. J. C. Shenton reports that the greater part of the work in the Chemical Laboratory consisted of assays for miners, experimental work on the separation of scheelite from tin-ore, and on the settlement of arsenical fumes from roasting furnaces.

7. Assays were as under :

Tin assays	...	...	...	...	...	...	...	524
Gold assays	...	...	...	...	...	...	...	12
Miscellaneous assays and analyses	...	...	...	...	...	...	...	213

A total of 749; 75 more than in 1922.

8. Numerous samples of slimes in water from tin-mines were reported on for the Mines Department.

The estimated revenue for the year from assays was \$3,200. The actual revenue was \$4,405. The excess is in part due to special work on scheelite-cassiterite concentrates, and on arsenical tin-ore.

9. It was decided to raise the scale of assay fees to correspond more closely with those charged by the Government Analyst, Straits Settlements, the change to date from January 1st, 1924.

10. Mr. J. B. Scrivenor was invited to join a committee to report on the advisability of establishing a Central Laboratory for all departments.

11. Mr. J. C. Shenton was invited to join a committee to discuss and draw up rules under the Dangerous Trades Enactment for the better control of the fumes from arsenical and sulphurous roasting furnaces.

12. Mr. J. B. Scrivenor served on the Executive Committee for Malaya of the British Empire Exhibition. He also prepared for the exhibition a collection of typical rocks and a collection of minerals. Two maps have also been prepared as exhibits, one a geological sketch-map of British Malaya up-to-date, the other a map showing the distribution of tin, tungsten, and gold in British Malaya.

PUBLICATIONS.

13. The stock of departmental publications with the Superintendent of the Government Printing Department was transferred to the office in Batu Gajah. Stocks remain with Messrs. Kelly & Walsh and the Federal Rubber Stamp Company. Sales have increased since these firms undertook to sell the department's publications, but it is regretted that even now enquiries are received locally which show that in some quarters the existence of these publications is unknown.

14. Mr. J. B. Scrivenor contributed chapters to Dr. R. O. Winstedt's "Malaya"; contributed a paper on the "Structural Geology of British Malaya" to the *Journal of Geology*, Chicago University Press; contributed a paper in conjunction with Mr. E. S. Willbourn on the "Geology of the Langkawi Islands" to the *Journal of the Malayan Branch of the Royal Asiatic Society*; and for the same Journal prepared a paper on the "Geology of Singapore Island," which will be published in 1924. Coloured geological maps for the papers on the Langkawi Islands and Singapore were printed in the Surveyor-General's office.

15. Mr. E. S. Willbourn prepared a map of the Kinta district showing all occurrences that could be traced of primary tin-ore, i.e., tin-ore in its original matrix whether as veins, pipes, or irregular bodies, and wrote descriptive notes. This work awaits publication.

16. Mr. Willbourn has also completed for publication his paper on minerals found in British Malaya.

17. Acknowledgments are due to Captain C. F. S. Jameson for a report on tin-lodes in the neighbourhood of Peretak, Ulu Selangor; and to Dr. W. R. Jones for a paper read to the Federated Malay States Chamber of Mines on prospecting alluvial tin-deposits in Kinta.

FIELD-WORK.

18. After returning from leave the Geologist was chiefly engaged with office-work, but some field-work was done in Kinta, Upper Perak, Kelantan and Johore.

19. Mr. E. S. Willbourn did further field-work in Kedah and Perlis, visiting the mines at Ulu Badak and Sintok. Mr. Willbourn reports that:

"The Bukit Kachi Mine was particularly interesting. It has been cited in a widely read article on tin and tungsten ores (W. R. Jones. Tin and tungsten deposits. The economic significance of their relative temperatures of formation. Transactions. Inst. Mining and Metallurgy. Vol. xxix, 1920, p. 345) as an example of a mine, rich in wolfram near the surface, yielding increasingly high values of cassiterite in depth. About sixty shafts of varying depths were being worked in May, 1923, on the different quartz-veins, the deepest being about 140 feet at that time. The stone that was being brought up from the deeper shafts was rich in wolframite, and certainly was not richer in cassiterite than that from the more recent workings. Enquiry drew forth from the Chinese tributer that, on the contrary, the amount of cassiterite relatively to that of wolframite grew smaller as the shafts were sunk lower, and the owners of the mine, Messrs. J. A. Russell & Company, confirmed this."

20. Mr. Savage reports as follows on his field-work in Kelantan:

"The results of field-work carried out during 1923 show that the geological formation of Kelantan is a northern continuation of that of Ulu Pahang.

"The western (Perak-Kelantan) boundary is formed by the Main Range granite. Raub Series rocks (carboniferous) run in a direction roughly north and south through the centre of the State. Between these and the Main Range granite there is a strip of the Triassic quartzite and shale formation believed to be a continuation of the quartzite hills found in West Pahang.

"East of the Raub Series rocks there are quartzites and shales which, commencing at Tanah Merah in the north of Kelantan, extend up the Sungei Kelantan to Kuala Lebir, continuing up the Sungei Lebir almost to Gunong Tahan. There can be little doubt that these form the continuation of the Tahan Range quartzite and shale. Interbedded with, and intrusive into these rocks are abundant ashes, lavas and other rocks of the Pahang Volcanic Series, and other small outcrops of volcanic rocks occur in the Raub Series and in the quartzite and shale between the Raub Series and the Main Range granite.

"At the junction of the Raub Series and the Sungei Lebir quartzites and shales, there are narrow beds of cherts, shales, and ashes, which form the chert series.

"The eastern (Kelantan-Trengganu) boundary is formed by a range of granite hills, many of which are from 3,000 to 4,000 feet in height. The granites of Ulu Sungei Tembeling, Gunong Irong, and the Kuantan district are probably connected with this range.

"An outcrop of diorite occurs near Kuala Lebir, at Bukit Kedah, and an outcrop of granite-porphry, believed to be of Pahang Volcanic Series age, occurs about six miles from Manik Urai, along the railway construction line to Kuala Gris.

"About eight miles along this line, there are slab-like boulders of black micaceous haematite. Their average measurements are 2' x 3' x 18", and they occur embedded in weathered chlorite-epidote schists (altered Raub shales). They have apparently been brought down by soil creep from an adjacent hill.

"Some handsome figured marble—red, pink, blue and white—was found in the Sungei Aring, a tributary of the S. Lebir, on its left bank. Coarse white marble also occurs there. The floors of some limestone caves at Gua Gelak, near Manik Urai, are covered with a chocolate coloured deposit which probably contains a certain amount of phosphates."

21. The continuation of the rocks found in Ulu Pahang into Kelantan was expected, and Kelantan also forms a northerly continuation of the Pahang gold-bearing country. It further resembles Pahang in having given so far equally poor results in gold-mining.

22. Transport difficulties make the examination of the remoter parts of Kelantan, such as the S. Betis and Ulu Nenggiri, expensive and arduous.

23. Mr. G. R. Fulton continued his field-work in Johore and the adjacent islands. Mr. Fulton reported that Pulau Tinggi, a large island off the east coast, is formed of rhyolite and tuff. He said:

"I went right round the island, finding an almost uninterrupted outcrop of rhyolite and hard, well-consolidated tuff all along the shore, forming high cliffs at the north-west end, where the main jointing of the rhyolite over a considerable area dips 60° to the north-west. . . . I walked up the spur from Tanjong Balang to the summit of the island, the last two or three hundred feet of the

ascent being very steep, in places quite vertical. From the shore to the top outcrops of rhyolite and tuff are frequent. The steep cone-shaped apex of the island is composed of rhyolite, quartz-veined in one place. I saw where there was a vertical face of rock 30-40 feet high. . . . I walked to the top of all the foot-hills around the main hill. . . . Everywhere I found the same kind of volcanic rock and nowhere a single granite outcrop."

24. Mr. Fulton found that Pulau Lima, Sibul Tengah, and Sibul are also composed of rhyolite.

25. Mr. Fulton also examined the country between Kuala Endau and Bekok Railway Station, obtaining very interesting information. The following are extracts from his report :

"From the fourth mile, Jalan Bekok, I followed a stream nearly to the top of Gunung Bekok, all the way along it finding boulders and falls and rapids of hornblende-granite. . . . From the top of Gunung Bekok it was observed that Bekok is connected to a huge mountain mass on the Pahang border, including Pukin and Gunung Besar, the northern end of the ridge running north and south and the southern end south-east and north-west. The whole has an outline like granite. Farther east are two similar parallel ridges, Kaleman and Ramut, not granite. Ramut runs into a mass of high ground, about half its height above the surrounding plain, at its south-east extremity, and this forms the hills around Ulu Mas. A low divide runs west-north-west and east-south-east (approximately), connecting Ramut, Kaleman, and Bekok, and forming the source of the Kamedak, Selai, Endau, Layal, and Jasin rivers. I followed up the Selai river to about five miles from Pingan in a straight line. . . . From about one to two miles above Pingan there is a series of rapids and falls made of rhyolite and well-consolidated tuff, culminating in a fall made of a cliff of rhyolite 80 feet high. . . . The main joints are all the way horizontal. I climbed to the top of Ramut, everywhere finding boulders of tuff and rhyolite.

"The Kamedak River, above where the Pingan Bekok path crosses it practically follows the junction between the hornblende-granite and the volcanic rocks."

Mr. Fulton goes on to give evidence which he thinks points to the volcanic rocks (rhyolite and tuff) being younger than the granite, but there is no conclusive proof as yet.

26. Rhyolite is evidently an abundant rock in the eastern part of Johore and the islands off the east coast, but no satisfactory information has been obtained yet about its age relative to the granite. At Kuantan a dike of a similar rock, quartz-porphry, obviously younger than the granite was once seen in a quarry; and in one of the islands hexagonal columns of rhyolite have been found which show no sign of the earth-movements that led to the intrusion of the granite. It seems probable that this rhyolite is an extension of the widespread acid lava-flows of Tertiary age found in Sumatra (where they are called "liparites"), but definite proof is wanting, and can only be expected where a junction between these rocks and the granite is exposed.

PALAEONTOLOGY.

27. Mr. R. B. Newton, I.S.O., F.G.S., described fossils found in Singapore by the Geologist and also fossils found in Kedah by Mr. Willbourn.

28. The Singapore fossils are the subject of a paper published in the Annals and Magazine of Natural History (Vol. xii, 1923, pp. 300-321, one plate). Mr. Newton reconsiders his earlier remarks on the fossils found at Mount Guthrie (Geol. Mag. 1906, pp. 487-496), and concludes that we may consider the Singapore sedimentary strata to be Upper Trias or Rhaetic "until better preserved and more varied material is available to facilitate a greater accuracy of statement as to their true position in the Triassic Series."

He also says :

"Lithologically the same throughout, it is certain that the Singapore deposits must be of one geological horizon, and forming, as it seems possible, a continuation of the Myophorian sandstone of Pahang, developed some 200 miles north of Singapore, which has been regarded as of Rhaetic age, although, like the Singapore material, containing both St. Cassian and Muschelkalk species."

The Myophorian sandstone referred to by Mr. Newton was first found near Kuala Lipis and has been identified since in two other localities farther south in Pahang.

29. The Kedah fossils were found by Mr. Willbourn in black shale, interbedded with black quartzite, at Kuala Nerang, and Kampong Kuala, 13 miles east of Kuala Nerang. They resemble the *Estheriella radiata* found at Putus Semanggol, Larut, and described by the late T. Rupert Jones (Geol. Mag. 1905, pp. 49-52) but are associated with ammonite remains, these indicating a purely marine origin for the shales rather than a freshwater origin which would be expected if the fossils are really *Estheriella*. Mr. Newton thinks a re-examination of the Putus Semanggol fossils necessary, and says that the Kedah fossils are mollusca referable to either *Daonella* or *Halobia*, both characteristic of the later Triassic formation in countries spreading from Europe to Eastern regions such as India and China. It follows that even if the Putus Semanggol fossils prove to be *Daonella* or *Halobia* instead of *Estheriella*, no revision of the age of the beds containing them will be necessary.

GENERAL.

30. Prospecting by the United Plantations Limited for oil on the Erik and Westenholz Estates, S. Bernam, ended during 1923 with negative results.

31. A report of oil on Bukit Kajang Estate, Malacca, was investigated by Mr. Willbourn with negative results at the end of the year.

32. Mr. Willbourn reported to the Kedah Government on a zinc-copper-bismuth deposit at the junction of limestone and granite in the Langkawi Islands, and also on marbles of the same islands.

33. Mr. Willbourn also reported on new sites for lime-burners in Kuala Lumpur at the request of the Town Planner, Federated Malay States. This work involved a long enquiry and many analyses of limestone to find the most suitable rock. Incidentally interesting information was obtained about the chemical composition of the limestone.

34. The Geologist reported on the advisability of diverting roads in Kinta where they are adjacent to limestone-hills.

35. The Geologist reported on tin-ore on the old mining-land at Bruseh and on the occurrence of a vein of tin-ore in limestone at Selebin, near Ipoh. The oxidized cap of this lode was very rich and created considerable interest in the mining community. Mineralogically it does not differ markedly from other primary deposits in the Kinta limestone. As usual arsenopyrite is very abundant.

36. The Geologist reported again to the Singapore Municipality on the site for a dam on Gunong Pulai in connection with the proposed new Singapore water-supply.

BATU GAJAH,

4th February, 1924.

J. B. SCRIVENOR,

Geologist, Federated Malay States.