A review of all previously published relevant work and much previously unpublished material. Lists all fossils so far known from the area. Comprehensive bibliography and a list of all fossil localities. Tables include a correlation chart of major fossil-bearing formations.

JONES, T.R.

1905 Note on a Triassic *Estheriella* from the Malay Peninsula. *Geol. Mag.* **42**, 50–2, 1 pl.

A new variety of *E. radiata* (Salinas) is described from Pukus Semanggol (Newton 1905). [This is shown to be a species of *Halobia* by Newton 1925].

JONES, W.R.

1913 *Rep. Geol. F.M.S.* [for 1912]. Published as a supplement to F.M.S. Govt. Gazette, May 9, 1913.

Water supply for Kuala Selangor best taken from streams on quartzite in Rantau Panjang area. Rantau Panjang coal a drift deposit. Associated shales contain small amounts of oil. Sequence of coal measures given and considered Tertiary, overlain by boulder beds. Cassiterite-bearing pegmatites recorded from Ulu Serendah and Ulu Kanching. Fractures between Rawang and Serendah trend 100° swinging to 30° at Serendah. Zinc blende recorded in concentrate from Malim Nawar: cinnabar recorded from Jelebu.

1914 On the supposed case of tin *in statu nascenti* in the Malay Peninsula. *Geol. Mag.* **51**, 537–41.

Refutes the case proposed by Meunier (1890). Waters of hot springs at Ayer Panas, Jasin, Malacca; and at Cheras and Dusun Tua, Selangor, are described. Quotes the analyses of Bott (1891) and confirms that no trace of tin is present in these waters. Meunier's specimen was probably weathered cassiterite-bearing quartz.

1915a *Clays of economic importance in the Federated Malay States,* 45p., 9 figs. Kuala Lumpur: Govt. Press.

Describes examples of kaolinization due to superficial weathering and to pneumatolytic activity. The formation of cassiterite from tin fluoride releases HF to attack felspar and kaolinize it. Thus pneumatolytic kaolin is often associated with cassiterite. Methods of working and economic uses of kaolin are discussed. Other clays are mentioned.

1915b Mineralization in Malaya. *Min. Mag., Lond.* **13**, 195–202, 322–30, 19 figs.

Argues the importance of residual (eluvial) tin deposits and lode deposits near the granite contact. Criticises Scrivenor's theories on the geology of Kinta. Discusses the genesis of the cassiterite-bearing topaz rocks of Gunong Bakau. The topaz is formed by the alteration of felspar by F vapours. Describes occurrences of tin-ore *in situ* in sediments, mainly in Kinta, and suggests these are of pneumatolytic origin.

1915c The origin of the tin-ore deposits of the Kinta District, Perak (Federated Malay States). Abstract. *Geol. Mag.* **52**, 381–2.

See Jones, W. R. (1917).

1916a The origin of topaz and cassiterite at Gunong Bakau, Malaya. *Geol. Mag.* **53**, 255–60.

Cites evidence that these minerals were emplaced during the greisenization of the granite and are not primary intrusions as supposed by Scrivenor (1914d). In their occurrence and mineral content they resemble tin-bearing rocks of the Erzgebirge which are of secondary origin.

1916b Preliminary report on tin-mining on the Main Range at Ulu Bakau and neighbourhood. *Geol. Mag.* **53**, 453–6.

Cassiterite-bearing tourmalinized muscovite granite is mined at Hemy's Lode. Topaz greisen is tin-bearing at Bibby's Lode. The area is extensively faulted.

1916c Mineralization in Malaya. *Min. Mag., Lond.* **14**, 213–15.

A letter in answer to Scrivenor (1916a).

1917 The Origin of the secondary stanniferous deposits of the Kinta district, Perak (Federated Malay States). *Q. Jl. geol. Soc. Lond.* **72**, 165–97, 3 pls.

Refutes Scrivenor's (1913a, b) interpretation of a glacial origin and a Gondwana age for the tin-bearing 'clays and boulder clays'. These rocks are clearly shown to be alluvial and eluvial, deformed by collapse on the solution of the underlying limestone. Tin-ore is closely associated with the Mesozoic granite intrusions. Also criticises Scrivenor's (1913a) theories on the formation of the limestone hills, attributing this to stream erosion.

1919 Malayan geology. *Min. Mag., Lond.* **20**, 226–7.

A letter concerning Kinta geology and Scrivenor's relinquishing of his glacial theory for the origin of the boulder beds.

1920 Tin and tungsten-deposits: the economic significance of their relative temperatures of formation. *Bull. Inst. Min. Metall.* 1–27, *Trans. Inst. Min. Metall.* **29**, 320–46, 9 pls. Discussion *ibid*, 347–76, 5 figs.

Mentions the mode of occurrence of cassiterite, wolframite and scheelite in Malaya. High temperature minerals such as tourmaline and topaz are generally associated with cassiterite but not with wolframite or scheelite.

1923 The origin of the alluvial tin-deposits of Kinta and its significance when testing such deposits, particularly for dredging areas. *Times of Malaya*, July 30, 1923.

Not seen.

1925a The tin-deposits of Kinta district. *Min. Mag., Lond.* **32**, 26–31.

Criticises Cameron (1924a). No evidence for two granites of different ages. Cameron's older granite a marginal differentiate. This view supported by examples from elsewhere in Malaya and from SW England.

1925b Tin deposits of Kinta district. *Min. Mag., Lond.* **33**, 83–9.

A reply to the criticisms of Cameron (1925b, c, d) to Jones, W. R. (1925a). Strongly criticises Cameron's succession of schists, older limestone, older granite 'deep leads' with detrital tin, younger limestone, younger (Mesozoic) granite and recent alluvium with detrital tin. Re-affirms sequence as limestone, schists, granite and alluvium with detrital tin. Geological map and horizontal section across the Kinta Valley reproduced from Jones, W. R. (1917a).

1925c *Tin-fields of the world*, 423p. London: Mining publications Ltd.

Includes a bibliography of mining and geology in Malaya 1900–1925. The manner of occurrence of Malayan alluvial and eluvial tin deposits is clearly described (p. 159–213), figs. 45–53): Gives notes on the geology of all mining areas and includes some geological sketch maps.

KIMURA, T. and JONES, C.R.

1966 Geological structures in the northeastern and southern parts of the Langkawi Islands, northwest Malaya. In: Kobayashi, T. and Toriyama, R. (ed.) *Geology and Palaeontology of southeast Asia*, vol. 3, 123–34, 8 figs. Univ. of Tokyo Press.

Thrust faults separate Lower Palaeozoic and Upper Palaeozoic formations. The fold and fault pattern seen in the Lower Palaeozoic rocks can be attributed to a maximum stress directed NW. That of the Upper Palaeozoic was produced by the regional stress, directed E–W, which produced the thrusts.

KLOMPÉ, Th. H.F., KATILI, J., JOHANNAS, and SOEKENDAR

1961 Late Palaeozoic-early Mesozoic volcanic activity in the Sunda Land area. *Proc. 9th. Pacif. Sci. Congr.* **12**, 204–17, 3 figs.

Contains a discussion of the Pahang Volcanic Series based mainly on Richardson (1950). This formed part of a northern arc of acid to intermediate rocks supplied by volcanoes close to an extensive land area or forming islands in the Upper Carboniferous, Permian, and Triassic periods. A southern arc of intermediate to basic volcanics is present in Sumatra. In Malaya serpentine intrusions are considered to represent the initial phase of magmatic activity accompanying the Mesozoic orogeny and hypabyssal rocks are younger intrusions preceding the granite emplacement.

KOBAYASHI, T.

1958 Some Ordovician fossils from the Thailand-Malayan borderland. *Jap. J. Geol. Geogr.* **29**, 223–31, 1 pl., 3 figs.

The gastropod *Malayaspira rugosa* n. gen. and sp., and the nautiloids *Stereoplasmoceras?* sp. indet., *Actinoceras perlisense* n. sp., *A.* sp., and *Armenoceras chediforme* n. sp. are described from Ordovician limestone in Perlis.

1959 On some Ordovician fossils from northern Malaya and her adjacence, *J. Fac. Sci. Tokyo Univ.* **11**, 387–407, 4 pls., 3 figs., 1 tab.

A description of ten species of gastropods (five new) and seven nautiloid species (three new) from the Ordovician limestone of Perlis and the Langkawi Islands. The gastropods from Langkawi are probably of Lower Ordovician (Llandeilian) age. Limestones from Perlis containing *Actinoceras* and *Armenoceras* are probably younger.

1960 Notes on the geologic history of Thailand and adjacent territories. *Jap. J. Geol. Geogr.* **31**, 129–48, 5 figs., 3 tabs.

Gives tentative correlation charts for Malaya, Thailand, Burma and Yunnan. Confuses the Phuket Series with the Cambrian of Langkawi and Pulau Terutau.

1963a On the Triassic *Daonella* beds in central Pahang, Malaya *Jap. J. Geol. Geogr.* **34**, 101–12, 1 pl., 1 fig.

Describes five species (one new) of *Daonella* from Middle Triassic shales northwest of Temerloh and compares these with similar forms from other parts of the Tethyan region. *Posidonia, Arpadites* and *Paraceratites* are also recorded.

1963b *Halobia* and some other fossils from Kedah, northwest Malaya. *Jap. J. Geol. Geogr.* **34**, 113—28, 1 pl., 2 figs.

Describes two species (one new) of *Posidonia;* six species (two new) of *Halobia;* one species of *Daonella* and one new species of *Pecten* from upper Middle and Upper Triassic shale in east Kedah. Also describes crinoid stems, "Rhynchonella", and one *Posidonia* species from localities farther west which are probably Carboniferous. The Triassic fossils are compared to related faunas in Spiti, north Laos, Indonesia and Japan. Mentions a profusion of angular chert fragments in clastics overlying chert beds.

1964 [Studies on the fossils from Malay-Thailand] *Fossils,* **8** 111–17. (In Japanese).

Mainly on recent fossil discoveries in Thailand. Correlations are suggested between the Gagau Series and the upper part of the Khorat Series.

KOBAYASHI, T., BURTON, C.K., TOKUYAMA, A. and YIN, E.H.

1966 The Daonella and Halobia facies of the Thai-Malay peninsula compared with those of Japan. In: Kobayashi, T. and Toriyama, R. (ed.). *Geology and Palaeontology of southeast Asia,* vol. 3, 98–122, 1 pl., 5 figs. Univ. of Tokyo Press.

Two zones of Triassic sediments are distinguished. One runs from Songkhla through Kedah to Taiping. In Kedah this zone is divisible into a lower Chert Belt with *Daonella indica* and probably upper Ladinic, a middle Rhythmic Belt with *Halobia* of Carnic age, and an upper Conglomerate Belt also with *Halobia* and possibly extending into the Norian. The second zone lies in Kelantan, western Pahang and Johore and includes ammonoid-bearing beds and a Myophoria sandstone facies of Anisic-Carnic age as well as Ladinian Daonella beds. In the northern part of this belt the fossils are strongly deformed by slaty cleavage. Descriptions are given of five *Posidonia* species (one new), six *Daonella* species (two new), two *Halobia* species, and a *Serpulites* sp.

KOBAYASHI, T. and HAMADA, T.

1964 On a new species of *Dalmanitina*. *Jap. J. Geol. Geogr.* **35**, 101–113, 1 pl., 3 figs., 2 tabs.

Dalmanitina malayensis from the lower detrital member of the Setul Formation of Pulau Langgun, Langkawi is described. It is of Llandovery age.

1966 A new proetid trilobite from Perlis, Malaysia (Malaya). *Jap. J. Geol. Geogr.* **37**, 87–92, 1 pl., 2 figs.

Cyrtosymbole (*Waribole*) *perlisensis* of uppermost Devonian or lowest Carboniferous age is described from near the base of the Kubang Pasu formation at Hutan Haji, near Kangar.

KOBAYASHI, T., JONES, C.R. and HAMADA, T.

1964 On the Lower Silurian shelly fauna in the Langkawi Islands, northwest Malaya. *Jap. J. Geol. Geogr.* **35**, 73–80, 1 pl., 1 fig.

A partial description and discussion of the fauna of the lower detrital member of the Setul Formation of Pulau Langgun. A plectambonid brachiopod, gastropods, hyolithids, a cystid plate, *Climacograptus* sp., and a pygidium of *Stenopareia?* sp. are figured.

KOBAYASHI, T., KIMURA, T. and IGO, H.

1964 Stratigraphy and geological structure of the Langkawi islands. In: *Report on the stratigraphical and palaeontological reconnaissance in Thailand and Malaysia* 1963–4, section 8, p. 54–67, 4 figs. Overseas Technical Cooperation Agency. Cyclostyled.

Based mainly on the work of C. R. Jones. The distribution and fauna of the Machinchang, Setul, Singa, and Chuping formations are discussed. Fifty-two fossil localities are listed. A major thrust zone separates the Setul formation in the east of the Langkawi islands from the Singa and Chuping formations in the centre. Minor structures are discussed and considered to represent more than one period of deformation (Koopmans 1965).

KON'NO, E.

1966 Some younger Mesozoic plants from Malaya. In: Kobayashi, T. and Toriyama R. (ed.). *Geology and palaeontology in southeast Asia,* vol. 3, 135–64, 3 pls., 5 figs. Univ. of Tokyo Press.

Nine species described from Gunong Gagau, Gunong Panti and Ulu Endau constitute the Gagau flora of early Lower Cretaceous age. One genus and four species are new. The flora is closely allied to that of eastern Asia and is quite distinct from the Upper Gondwana flora.

KOOPMANS, B.N.

1964 Geomorphological and historical data of the lower course of the Perak River (Dindings). *J. Malay. Brch R. Asiat. Soc.* **37**, 175–91, 7 figs.

Five old river channels, visible on aerial photographs, indicate a SE migration of the lower reaches of the Perak river in Recent times. Younger and older sets of beach ridges, 3–6m above mean sea-level, lie inland. The younger set is parallel to the present coast. From a study of historical maps it is shown that the rate of mangrove encroachment on the sea was 1km in the last 80 years. The rise and decline of the Kingdom of Bruas can be attributed to the extension of the Dindings estuary and its later partial silting up when the Perak River changed to a more southerly course.

1965 Structural evidence for a Palaeozoic orogeny in north-west Malaya. *Geol. Mag.* **102**, 501–20, 6 figs.

"Lower Palaeozoic rocks in the Langkawi Islands have been subject to three generations of deformation. In the slightly dynamo-metamorph slates in the south-east two generations of cleavage folding have been developed with a N.N.W. trend. The first resulted in a recumbent folding with a subhorizontal slaty cleavage, whereas during the second generation the slaty cleavage was deformed in open folds and a crenulation cleavage developed in the steep limbs. The two deformations were probably not formed at exactly the same time, but seem to be related with each other. Boudinage of granite sills was contemporaneous with the development of the slaty cleavage.

In the unmetamorphosed northern part of the area cross-folding is found. Flexure folds with a N.W. trend are superimposed on folds with a N.N.E. trend. In the Upper Palaeozoic sediments such deformations are missing. The Permian and Carboniferous strata show only a slight warping around the granite batholith which was intruded during Jurassic time (Pacific orogeny). A similar warping is found in the large low-angle overthrust, in which Silurian was thrust over Permo-carboniferous. Consequently this thrust plane is dated as pre-granitic and post Permo-Carboniferous. Contact metamorphism by the granite intrusion has resulted in hornfelses in the Permo-Carboniferous sequence and in the development of oriented minerals, mainly clinozoisite, in the Ordovician-Silurian slates. Knick zones and intense jointing parallel with the mineral orientation (third generation structures) are also a result of the granite intrusion.

The first two generations of folding, which are not present in the Upper Palaeozoic beds, are products of an orogenic phase, "the Langkawi folding phase", during late Silurian-Devonian time. The lack of Devonian strata in Thailand and the incompleteness of the Devonian sequence in Malaya (recently a few outcrops of probably Middle-Upper Devonian strata are found along the west coast of Malaya) can be an indication that the Langkawi folding phase is not restricted to the Langkawi Islands." (Author's abstract)

1966 A structural map of north and central Pahang, *J. trop. Geogr.* **22**, 23–9, 3 figs., 1 map 1:250,000.

Mainly an aerial photograph interpretation map. Sedimentary sequence is divided into Gagau Formation, Tembeling rocks and pre-Tembeling strata. The Tembeling rocks form a well-defined laterally constant unit, at least 2700m thick, of resistent felspathic and quartz sandstone interbedded with shale and siltstone, frequently with a primary red coloration. Their base is formed of a poorly sorted polymict terrestrial conglomerate with an arkosic matrix. They lie with probable angular unconformity on shale, limestone and volcanics, partly known to be Permian. The Gagau Formation, 775m thick, lies unconformably on the older strata and is faulted against granite to the NW. Four competent beds alternating with less resistant beds can be interpreted from aerial photographs. The base of the Formation is a polymict conglomerate. The more resistant beds in the Tembeling rocks outline open flexure folds of about 8km wave length. Fold axes trend NNW and show culminations and depressions at about 15km intervals. The Berentai syncline can be traced for 115km. Cross faults and crestal faults are often present. Six horizontal sections trending NE are drawn across the map.

KUMMEL, B.

1960 Anisian ammonoids from Malaya. *Breviora,* **124**, 1–8.

Paraceratites trinodosus (Mojs.), *Sturia sansovinii* Mojs., *Acrochordiceras* sp. indet. and *Ptychites* sp. indet. are described from mudstone from the Budu Estate, SSW of Kuala Lipis, Pahang.

LACROIX, A.

1932 Les tectites de l'Indochine. *Archives du Museum d'Histoire Naturelle,* Paris. (ser. 6) **8**, 139–240, 12 pls., 43 figs.

Refers to (p. 158, 178–9) and illustrates (fig. 20–21) Malayan tektites.

1933 Contribution à la connaissance de la composition chemique et mineralogique de roches éruptives de l'Indochine. *Bull. Serv. geol. Indochine,* **20**, (3), 1–208, 6 pls.

A comparison is given with Malayan rocks (p. 154–161) based on Scrivenor and Willbourn. In Malaya, alkali granites are of infrequent occurrence and porphyritic biotite monzonites are the most common intrusives. Hornblende biotite granites are mentioned from Pulau Ubin and the Kledang range. Monzonitic microgranite with hypersthene and biotite, recorded by Willbourn (1922b) from Kuala Sleh, Selangor, is mentioned. Tin and wolfram deposits are compared to those of Indochina and stanniferous pipes in limestone are compared to those of Yunnan.

LACROIX, A. and SOL

1896 Sur les cristaux de topaz du Royaume de Perak. *C. r. hebd. Seanc. Acad. Sci., Paris,* 123, 135–6.

Not seen.

LAKE, H.

1894a A journey on the Sembrong River from Kuala Indau to Batu Pahat. Part II. Topography and geology. *J. Straits Brch R. Asiat. Soc.* 26, 19–24.

Mentions claystone and sandstone lying horizontally in Sg. Kahang and also outcrops of green felsite. The Batu Pahat hills are of granite.

1894b Johore. *Geographical Journal,* **3**, 281–302, 1 map (not seen).

Includes geological notes on the main lithologies and describes the occurrence of alluvial tin in S. Johore.

LEOW, J.H.

1962 A glimpse of the sedimentary structure of Singapore. *Malay. Nat. J.* **16**, 54–60, 2 pls., 1 fig.

Notes the structure in the Triassic Argillaceous Series and Arenaceous Series of F.E.S. Alexander (1950) at several localities in the southwestern part of Singapore Island and interprets a major anticline plunging NW. Qualitative heavy mineral analyses show no distinction between the Argillaceous and Arenaceous Series. It is suggested that the rocks show a repetitive conglomerate-sandstone-shale sequence. Geological sketch map 1 : 230,000 approx.

1963 Spheroidal weathering in Pulau Langgon, Langkawi. *Malay. Nat. J.* **17**, 170–2, 2 pls., 1 fig.

Well-jointed shale exposed on the foreshore displays the mode of formation of rounded boulders by spheroidal weathering.

LILBURNE, A.S.

1933 Mining and milling at Raub, F.M.S. *Chemical Engineering and Mining Review, Melbourne,* **25**, 83–7, 4 figs.

Gold occurs with quartz, calcite, small quantities of metallic sulphides and scheelite in a N–S striking cross-faulted lode over three miles long.

LOGAN, J.R.

1847a On the local and relative geology of Singapore, including notices of Sumatra, the Malay Peninsula, etc. *J. Asiat. Soc. Bengal,* **16**, 519–557, 667–.

Includes a detailed description of the topography of Singapore Island. A hypothesis of laterization by iron emanations produced by volcanic activity is later modified and high level plutonic action is regarded as the main cause. Describes earthquakes felt in Penang, Malacca and Singapore in Nov. 1833, Aug. 1835, Sept. 1837, and Jan. 1843.

1847b The rocks of Pulo Ubin. *Verh. batav. Genoot. Kunst. Wet.* 22, 3–43. Republished in *Miscellaneous papers relating to Indo-China and the Indian Archipelago,* 2nd ser., **1**, 21–71.

A detailed field description of intimately associated granite, syenite and dolerite, with observations on their structure and weathering. Assumes that all the rock types were formed contemporaneously and considers the variation to be due to assimilation of country rock by granite. Boron, introduced via joints, tourmalinized felspar and mica.

1848a Sketch of the physical geography and geology of the Malay Peninsula. *J. Indian Archipel.* **2**, 83–138.

Notes that the strike parallels the axis of the peninsula and that the structure links with that farther north. Gives the production figures for tin-ore and gold. Cites evidence for Recent sea-level changes.

1848b Notices of the geology of the east coast of Johore. *J. Indian Archipel.* **2**, 625–31.

Describes partly lateritized quartz-mica schists and phyllites and compares them to the schists of Cape Rachado.

1849 Five days in Naning. *J. Ind. Arch.* **3**, 24–41, 278–87, 402–12, 489–93.

Mentions gold as occuring in a quartz vein in quartz-hornblende rock and describes hot springs at Ganong, Malacca.

1851 Notices of the geology of the Straits of Singapore. *Q. Jl. geol. Soc. Lond.* **7**, 310–44, geol. map 1:340,000. Reprinted (1852) in *J. Ind. Arch.* **6**, 179–217.

The steeply dipping sedimentary rocks in the west of Singapore Island strike NW–SE and are composed mainly of violet and chocolate-coloured shale but include some sandstone, conglomerate, and chert. Decomposed hornblende syenite and granite form the central part of Singapore Island. Iron and quartz rocks [secondary residuals] are described but the iron is attributed to a plutonic agency. The alluvium of the east of Singapore Island was probably built up by mangroves and beach ridges.

LOUIS, H.

1899 The production of tin. *Min. J. Lond.* **69**, 18–25.

Not seen.

LOW, J.

1833 Observations on the geological appearances and general features of portions of the Malayan Peninsula, and of the countries lying betwixt it and 18° north latitude. *Asiat. Res.* **18**, 128–62.

Includes general observations on the geomorphology of the coastal parts of Perak, Penang and Kedah.

1847 Notes on geological features of Singapore and some of the islands adjacent *J. Indian Archipel.* **1**, 84–100, 1 fig.

Gives a general geological description of historical interest only.

LOW, V.F.S.

1921 Kelantan and its natural resources. *Min. Mag., Lond.* **24**, 11–20.

Includes brief notes on the geology.

McCALL, T.L.

1922 Description of the coalfield at Batu Arang. *Bull. Can. Inst. Min. Metall.* **123**, 834–. Summary in *Bull. imp. Inst., Lond.* **20**, 531–.

Sub-bituminous coal occurs in a main seam 42 ft thick and containing 37 ft of coal. The Great Seam, confined to one corner of the field is 400 ft thick, contains a coal 30 ft thick, the upper 300 ft consisting of thin coal, shale and sandstone. (From summary in *Bull. imp. Inst.*)

McCLURE, E.

1961 Batu Caves, Kuala Lumpur. *Nature conservation in Western Malaysia*, p. 73–8, 1 pl., 3 figs., Kuala Lumpur: Malayan Nature Society.

Mainly biological but includes a plan of the caves, 1 : 2,500 approx.

MACHADO, A.D.

1900 The hot springs of Ulu Jelai. *J. Straits Brch R. Asiat. Soc.* **33**, 263–4.

Records seven hot springs which according to an aborigine were eruptive geysers ten years previously.

MACKIE, J.B.

1938 Malayan Colleries Ltd., Batu Arang. *Annual Report of the Chief Inspector of Mines, Federated Malay States*, [for 1937], appendix C, 59–74.

Includes brief notes on the geology of the coal field and on the sub-bituminous coal.

MCNAIR, J.A.F.

1878 *Perak and the Malays: "Sarong" and "Kris"*. London: Cassell and Co.

Chapter three treats of mineral productions and includes notes on alluvial gold and tin.

MAIR, F.E.

1911 [A letter on the glacial origin of the Gopeng Beds] *Min. J., Lond.* **76**.

Not seen.

MARLIÈRE, R.

1953 Rectification de nomenclature; *Estheriella multilineata* Jones = *Halobia* cf. *moussoni* Merian. *Annls. Soc. geol. N.* **73**, 208–9.

Not seen.

MARRIOT, G.

1927 *The mining geology and structure of the Kinta Valley.* 17p., 6 figs. Penang.

An attempt to resolve the controversy over Kinta geology. Argues that earlier investigators have assumed an incorrect sequence. Schists underlie limestone and being less resistant to erosion cause undermining of the limestone hills which are thus cliffed, as Gunong Kamuning. Intrusion of granite domes may cause gravity collapse structures in the overlying schists which may then tectonically overlie the limestone.

MEUNIER, M.S.

1890 Examen chimique d'eaux minérales provenant de Malaise. Mineral d'étain de formation actuelle. *C. r. hebd. Acad. Sci. Paris,* **110**, 1085–.

A hydrous form of silica containing 0.5% tin oxide is described from the water of a hot spring. This is assumed to be a sample of tin forming *in statu nascenti.* (Not seen; notes after Jones, W.R. 1914, and Bott 1891).

MORGAN, M.J. de

1886 Note sur la geologie et sur l'industrie minière due Royaume der Perak et des pays voisins (Prequ'ile de Malacca). *Annls. Mines Carbur., Paris.* Also published separately, 79p., 3 pls. Paris.

Includes geological sketch map of Kinta 1 : 200,000 (not seen) and geological sections through Kinta. Describes the occurrence of tin in Kinta and Larut. Azoic gneiss and phyllite are succeeded by Silurian quartzite (adjacent to gneiss on the summit of Gunong Korbu) and three horizons of schists. These are overlain by limestone containing *Platystrophia* in Pahang and Upper Silurian-Devonian in age. Uplift and granite intrusion occurred in the Devonian and the land has been emergent since. Stanniferous alluvium is post Pliocene and underlies Recent alluvium.

MUIR-WOOD, H.M.

1948 *Malayan Lower Carboniferous fossils and their bearing on the Viséan palaeogeography of Asia,* 77p., 12 pls., 2 figs. London: British Museum (N.H.)

The Palaeozoic fossil record of Malaya is reviewed and all fossil localities are shown on a map 1 : 5.7M. Viséan fossils from the Sg. Lembing area of Pahang are listed and 42 species (seven new) of brachiopods are described. The fauna is compared with related faunas in other parts of Asia.

NEWTON, R.B.

1900 On marine Triassic lamellibranchs discovered in the Malay Peninsula. *Proc. malac. Soc. Lond.* **4**, 130–5, 1 pl.

A description of 11 species (four new) from sandstone near Kuala Lipis. The fauna is characterised by several species of *Myophoria* and is thought to be Rhaetic.

1901a Notes on literature bearing upon the geology of the Malay Peninsula; with an account of a neolithic implement from that country. *Geol. Mag.* **38**, 128–34, 1 fig.

Reviews the literature from 1822–1900. Quotes an unpublished letter on the geology of Sg. Tui, NW Pahang which describes steeply dipping slates overlain unconformably by limestone.

1901b Malay Peninsula limestone. *Geol. Mag.* **38**, 189–90.

Records crinoid stems in limestone from Gua Sai, Pahang.

1905 Note on the age and locality of the *Estheriella*-shales from the Malay Peninsula. *Geol. Mag.* **42**, 49 only.

The presence of *Estheriella* (Jones, T.R. 1905) indicates a Triassic age for shales at Putus Semanggol, Perak.

1906 Notice on some fossils from Singapore discovered by John B. Scrivenor F.G.S., Geologist to the Federated Malay States. *Geol. Mag.* **43**, 487–96, 1 pl.

Thirteen species (seven new) of lamellibranchs, and two plant species are described from silty clay at Mount Guthrie, Singapore. The fossils suggest an estuarine environment of deposition and the presence of *Podozamites* and *Goniomya* suggest a middle Jurassic age. (Later revised to Upper Triassic—Scrivenor 1931a)

1907 Geology of the Federated Malay States. *Geol. Mag.* **44**, 565–7.

A review of Scrivenor (1907). Reproduces Scrivenor's correlation table, comparing the Malayan sequence with that of India and the Malay Archipelago.

1913a Geology of the Federated Malay States. *Geol. Mag.* **50**, 223–4.

A review of Scrivenor (1913a).

1923 On marine Triassic shells from Singapore. *Ann. Mag. nat. Hist.* (ser. 9), **12**, 300–21, 1 pl.

A description of 17 species (one new) of lamellibranchs, one gastropod; and ammonoid and brachiopod fragments of Upper Triassic age.

1925 On marine Triassic fossils from Kedah and Perak. *Geol. Mag.* **62**, 76–85, 1 pl.

A description of two indeterminable ammonoids, two species (one new) of the lamellibranch *Halobia*, and crinoid stems all of Middle Triassic age from Kuala Nerang and Kg. Kuala. *Estheriella radiata* var. *multilineata* described by Jones, T.R. (1905) from Putus Semanggol, Perak, is shown to be a species of *Halobia*.

1926 On Fusulina and other organisms in a partially calcareous quartzite from the Malayan-Siamese frontier. *Ann. Mag. nat. Hist.* (ser. 9), **17**, 49–64, 2 pls.

Describes two species of fusulines, one stromatoporoid, three corals, one crinoid, one polyzoan and two lamellibranchs from north Perlis and considers these late Carboniferous or Permian. [It is probable that they were collected from immediately below the base of the Chuping Limestone and are Lower Permian.]

NIGHTINGALE, E.

1908 Tin mining in Ulu Selangor, Federated Malay States. *Trans. Inst. Min. Metall., Lond.* **17**, 159–63.

Red clay with granite boulders covers the higher ground and is rich in tin-ore. The alluvial ore is probably derived from these clays.

NOONE, R.O.

1940 Caves, and some cave formations. *Malay. Nat. J.* **1**, 5–8.

Mentions and illustrates some drip-stone deposits in Kedah and Perak caves.

NOSSIN, J.J.

1961a Relief and coastal development in north-eastern Johore (Malaya). *J. trop. Geogr.* **15**, 27–39, 6 figs.

The solid geology of the Mersing-Endau area comprises a Quartzite-Shale Series and rhyolites. Quaternary alluvium increases in thickness seawards, exceeding 40 ft. The main physiographic units are an 'old land', inland beach ridges, freshwater swamps, and the present coast. Over the Quartzite-Shale Series of the 'old land', two zones of weathering are described, mass movement being restricted to the upper zone. The 'old land' is characterized by uniform slopes, mass movement and a fine drainage texture. The coastal geomorphology shows a combination of accretion and cliff recession producing a straight coastline. Eustatic lowering of sea-level has left inland beach ridges up to 25 ft above present sea-level.

1961b Occurrence and origin of clay pebbles on the east coast of Johore, Malaya. *J. sedim. Petrol.* **31**, 437–47, 10 figs., 2 tabs.

Clay pebbles, derived from clay sheets alternating with sand layers in tidal flat deposits, are recorded from 10km of shore east of Kuala Endau. The clay exposed at low tide dries and cracks. Wave action at the next high tide loosens the flakes and rolls them up to the high tide mark, where they sink rapidly into the underlying wet sand or have sand blown over them.

1962 Coastal sedimentation in northeastern Johore (Malaya). *Z. Geomorph.* (n.s.) **6**, 296–317, 9 figs., 3 tabs., 2 maps.

Holocene sediments overlying a thick Pleistocene sequence consist of well-sorted sandy marine deposits and clayey fluviatile deposits. Their origin and sedimentation is discussed. A high sea-level, evidenced by beach ridges about 6m above the present level, may be correlated with the Daly sea-level of 3000–2000 B.C. Since this time the land of the Endau estuary has advanced at least 6km seawards.

1964a Beach ridges on the east coast of Malaya. *J. trop. Georgr.* **18**, 111–17, 7 figs.

Beach ridges in NE Johore and NE Pahang parallel the coast and increase in height from 10–15 ft at the present coast to a maximum of 35 ft inland. They consist of well-sorted fine to very coarse sand, devoid of clay, and derived locally. They can be accounted for by a gradual fall in sea-level of about 6m during the Holocene, unaccompanied by land movements. The 50 ft deposits near Kuantan aerodrome (Fitch 1949b) are poorly sorted and resemble granite wash.

1964b Geomorphology of the surroundings of Kuantan. *Geologie Mijnb.* **43**, 157–82, 24 figs.

Biotite granite and olivine basalt form the main rock types. The granite weathers into an unsorted mass of sand and clay which is subjected to strong mass movements in spite of the dense vegetation. During colluviation, silt is washed out leaving the colluvium as a bimodal deposit. The granite landscape exhibits lateral plantation from the base, resulting in comparatively flat piedmonts surrounding steep hills. Granitic colluvium occurs on the piedmonts and also occupies large parts of the surrounding sedimentary flats.

The basalt weathers into a heavy homogenous clay which undergoes little or no mass displacement and produces a low landscape dissected by a dense dendritic network of insequent streams with steep valley sides and heads. The coast is lined by a series of Holocene beach ridges, separated from the higher land by extensive flats and filled with alluvial and swamp deposits, including thick peat layers, after the closure of the bars. The drainage on these flats is impeded by the beach ridges which cause rivers to converge upon common outlets. The fluvial deposits have a high silt content derived from the granite colluvium. Seasonal changes in river competency cause bimodal grain size distribution. There was a eustatic fall in sea-level during the Holocene. Ancient maps evidence that the southern part of the area was converted to land only after 1800 A.D.

1965a The geomorphic history of the northern Pahang delta. *J. trop. Geogr.* **20**, 54–64, 5 figs., 1 tab.

Within the last 1500 years the coastline south of Kuantan has extended eastwards up to 15 miles, forming a succession of beach ridges backed by freshwater swamps.

1965b Analysis of younger beach ridge deposits in eastern Malaya. *Z. Geomorph.* (n.s.) **9**, 186–208, 12 figs., 4 tabs.

Beach ridges between K. Trengganu and K. Pahang decrease in height seaward from 30 ft above sea-level and are ascribed to a Holocene eustatic lowering of sea-level. The younger beach sands are well-sorted and almost all grains fall within the range 125–1000μ in diameter. They were derived from the marine erosion of coastal cliffs and transported by the sea. The heavy mineral fraction is characterised by andalusite. The older beach ridges barred bays and straightened the coastline causing convergent and rectangular drainage patterns along the coast.

NOYES, H.H.

1906 Tin deep leads in Selangor. *Mining Journal, Railway and Commercial Gazette, London,* **79**, 690–, Reprinted in

Engng Min. J. **82**, 1–.

Not seen.

OAKLEY, K.P.

1940 The organic content of Recent rhyolitic ashes in Malaya. *Geol. Mag.* **77**, 289–94, 3 figs.

Ashes from Perak and Pahang re-examined and found to contain diatoms of freshwater type only and problematical opaline rods and spicule-like bodies, some of which might possibly be casts of plant structures, others inorganic (*cf.* Scrivenor 1930b.)

1948 Lower Carboniferous fossils from Malaya: Bryozoa, Mollusca, and Crinoidea. Appendix to Muir Wood, H.M. *Malayan Lower Carboniferous fossils and their bearing on the Viséan paleogeography of Asia*, p. 82–92, 2 pls., 1 fig. London: British Museum (N.H.).

Describes six species of lamellibranchs, one gastropod, one scaphopod, six species of polyzoa and crinoid stems from the Viséan of Sg. Lembing, Pahang.

OLDHAM, T.

1871 On the supposed occurrence of native antimony in the Straits Settlements. *Rec. geol. Surv. India*, **4**, 48 only.

A specimen of native antimony, reputedly found on Pulau Ubin, Singapore, was probably artificially introduced.

PANTON, W.P.

1956 Types of Malayan laterite and factors affecting their distribution. *6th. Int. Congr. Soil Sci.* **E**, 419–23.

'Laterite' includes any hardened iron-rich mass occurring in the soil profile. It is ubiquitous in Malaya. The stage of lateritization indicates the maturity of the soil profile. Laterite bands are best developed in mature soils derived from iron-rich parent material, on dry land, and over gently to moderately undulating country.

1965 Topography, geology and soils. In: Environmental factors and tree properties. *Malay. Forest Rec.* **23**, pt. 2, chapt. 2, 20p., 4 figs., 2 tabs.

Mentions the main rock types occurring in Malaya and their ages and describes the main sedentary and alluvial soils developed from these rock types.

PARK, M.

1914 Mining in the Malay States. *Min. Mag., Lond.* **10**, 205–16, 4 figs.

Includes a general review of the geology of Malaya.

PATON, J.R.

1957 The pre-Tertiary rocks of Malaya. (Abstract). *Australian and New Zealand Assoc. Adv. Sci.*, sect C, Dunedin Meeting 1957, C18.

Mentions that recent fossil discoveries denote the presence of Lower Palaeozoic rocks in Malaya.

1959 Jurassic/Cretaceous sediments in Malaya. *Nature, Lond.* **183**, 231 only

Gently dipping sediments of the Gunong Gagau plateau rest unconformably on Palaeozoic sediments and on granite. They consist of a basal conglomerate succeeded by a pebbly quartzite with occasional thin red mudstone beds containing Upper Jurassic or Lower Cretaceous plants.

1961 A brief account of the geology of the limestone hills of Malaya. *Bull. Raffles Mus.* **26**, 66–75, 3 figs.

Ordovician-Silurian, Lower Carboniferous, Permian, and Upper Triassic limestones are found in Malaya. All these except the last form prominent cliffed hills, residuals left by stream erosion and, in Kinta and NW Malaya, by marine erosion. The isolation of the hills is due to differences in age; to original deposition in lenses (*e.g.* the Viséan limestone near Kuantan); to orogenic movements; and to recent alluvial deposits (*e.g.* in Kinta). One map, 1 : 1.8M, shows the distribution of the limestone hills and a second map, 1 : 190,000, shows limestone outcrops in N Pahang and S Kelantan.

1964 The origin of the limestone hills of Malaya. *J. trop. Geogr.* **19**, 134–47, 4 pls., 5 figs.

Earlier theories are reviewed (Scrivenor 1913a, Jones, W.R. 1917, Cameron 1925a, Rastall 1927a). There is no field evidence for a structural origin of the hills. More recent unpublished theories are that the hills are diapirs or due to aeolian erosion. Some of the undercuts around the bases of the hills are due to marine erosion (Walker 1956) but most features can be accounted for by sub-aerial erosion, the chemical nature of the limestone being the most important factor controlling its erosion.

1966 Geology—Federation of Malaya. In: Agocs, W.B. *Report on airborne magnetometer and scintillation counter survey of Kedah, Perak, Selangor, Trengganu, Pahang, and Johore, Federation of Malaya.* Chapt. 2, p. 33–97. Malaysian Govt.

A concise general account of the topography, geology and economic geology of Malaya. Brief notes on the more detailed geology of areas selected for aerial survey.

PENROSE, R.A.F.

1903 The tin deposits of the Malay Peninsula with special reference to those of the Kinta district. *J. Geol.* **11**, 135–54, 4 pls., 9 figs.

A clear and accurate account of the occurrence of alluvial and lode tin-ore in the Kinta Valley. Lode tin-ore in granite and limestone was deposited from aqueous solution and possibly derived from a primary dissemination in granite.

PENZER, N.M.

1921 *The tin-resources of the British Empire,* x + 358p., illustr. London: W. Rider and Son Ltd.

Includes a geological sketch of Malaya and two geological sections drawn by Scrivenor. Reviews all the tin-mining areas. Useful bibliography.

PHILIPS, J.A. and LOUIS, H.

1896 The Malay Peninsula. In: *A treatise on ore deposits* p. 597–607. London: MacMillan and Co.

Malayan alluvial tin results from the disintegration of stanniferous greisen or granite forming the outer margins of granite masses. Notes the occurrence of tin, gold and lead.

PICHAMUTHU, C.S.

1959 Malaya. In: *Enciclopedia del Petrolio edei Gas Naturali.* Rome.

Not seen.

1960 [Geology and mineral resources of the Federation of Malaya]. *Tamil Oli.* (In Tamil)

Not seen.

PRIOR, G.T.

1927 Tektites, *Nat. Hist. Mag.* **1**, 8–13, 1 fig.

Mentions two large tektites from Malaya, each 75mm in diameter and weighing 464 and 316 gms respectively, presented to the British Museum by J.B. Scrivenor.

PROCTER, W.D. and JONES, C.R.

1967 Wrench faulting in Malaya: a discussion. *J. Geol.* **75**, 127–8.

Refers to Burton (1965) and suggests that his postulated north and south extension of the Kedah Bok Bak Fault is not supported by field evidence, including mapping on a scale of 1 : 63,360.

RASTALL, R.H.

1918 The genesis of tungsten-ores. *Geol. Mag.* **55**, 193–203 241–6, 293–6, 367–70.

Refers to wolframite occurring with cassiterite (p. 199) and to scheelite (p. 296) in Malaya.

1923 Tin in the Malay Peninsula. In: *The geology of the metalliferous deposits,* p. 275–7, Cambridge University Press.

Mentions that some of the so-called alluvial deposits are eluvial ones. A few sentences on the stratigraphy are misleading.

1927a The geology of the Kinta Valley. *Min. Mag., Lond.* **36**, 329–38, 7 figs.

An investigation of the controversy on Kinta geology (Cameron's, W. R. Jones' and Scrivenor's papers on Kinta 1924–6). There is no evidence for an older sheared granite. The limestone beneath the alluvial valley floor passes into and is the same as the limestone forming the hills. The 'deep leads' of Cameron are non-existant and the schists overlie the limestone. The Tekka clays are interpreted as schist metamorphosed by the granite, decomposed by weathering, faulted and brecciated and collapsed over dissolving limestone. The Western Boulder Clays contain tourmalinized boulders and are thus probably younger than the granite. The Gopeng Beds belong to a high-level alluvium. The siting of the limestone hills is due to three asymmetrical anticlines, striking N–S and with steep eastern limbs. The form of the hills has been modified by faulting and erosion.

1927b The limestone of the Kinta Valley, Federated Malay States. *Geol. Mag.* **64**, 410–32, 6 figs.

Some of the arguments and conclusions of Rastall (1927a) are repeated. The pinnacled form of the limestone beneath the alluvium is due to subterranean solution, the tops of the pinnacles being concordant in height and representing an erosion surface. The limestone outcrop is bounded to the west against the Kledang granite by a fault zone which contains thick tin-bearing alluvium. The granite probably lies at some considerable depth below the valley floor.

1928 Report on the geology of the Kinta Valley, Federated Malay States. *Proc. Federal Council F.M.S.* [for 1927], paper 26, C354–60.

The same content as Rastall (1927a).

1931 The metamorphic rocks of Gunong Terendum, Kinta Valley, Federated Malay States. *Geol. Mag.* **68**, 193–206, 1 fig.

At Gunong Terendum a vertical limestone-schist contact is penetrated by veins of topaz-bearing alkali granite. The metasediments include crushed quartz-biotite-tourmaline schist, quartz-pyroxene schist, and felspar-garnet-pyroxene-idocrase-carbonate rock. Metasediments from Changkat Papan, Kinta, are described as sheared arkose, tourmaline schist and amphibolite, all mineralized with cassiterite and sulphides.

RASTALL, R.H. and WILCOCKSON, W.H.

1920 Tungsten-ores. *Monogr. Miner. Resour.* 23–.

Not seen.

REED, F.R.C.

1949 The Straits Settlements and Protected Malay States. In: *The geology of the British Empire,* p. 526–32, London: Ed. Arnold and Co.

A review based on previously published work.

REID, J.A.

1961 Conservation and the quartz ridges. In: *Nature Conservation in Western Malaysia,* p. 66–7, 2 pls. Kuala Lumpur: Malayan Nature Society.

Includes photographs of the Klang Gates quartz ridge near Kuala Lumpur.

RENWICK, A. and RISHWORTH, D.E.H.

1966 *Fuel resources (coal, lignite, and petroleum) in Malaya*, 123p., 2 tabs., 7 maps., Ipoh: Geol. Surv. Dep. W. Malaysia.

Part 1 gives an outline of Malayan stratigraphy as known about 1960. Part II gives a comprehensive review of the known occurrences of coal and lignite. Small seams and veins of lignite recorded from Quaternary rocks cannot be exploited commercially. Information on the geology and exploitation of all Tertiary coal-bearing basins is compiled from published and unpublished sources. Known reserves and potential lignite-bearing strata are very limited. The investigations started in 1941 and 1958 at Bukit Arang, Perlis, should be continued Part III discusses petroleum and concludes that no commercial deposits are likely to be discovered in Malaya. Minor occurrences of oil shales are recorded from Tertiary basins at Batu Arang in Selangor; Enggor in Perak; and Durian Chondong in Johore. Useful bibliographies include unpublished reports.

RICHARDSON, J.A.

1938 Progress report of the geological survey of that part of the gold belt in Pahang which lies north of Raub. *Rep. geol. Surv. Dep. F.M.S.* [for 1937], 27–46.

Rhyolitic and andesitic volcanics are interbedded with shales of the Raub Series. An arenaceous formation is regarded as Triassic: it is regionally metamorphosed near the Main Range granite. Amphibolite and serpentine bodies are thought to be regionally metamorphosed dolerites and basic plutons respectively. In the Raub Gold Mines auriferous quartz veins are localized in fault zones in shale with minor felsite intrusions: the faults are analysed into four systems.

1939a Progress report of the geological survey of northwest Pahang. *Rep. geol. Surv. Dep. F.M.S.* [for 1938], 15–32.

Additional observations to Richardson (1938). The order of events during the Mesozoic orogeny was (i) deformation and metamorphism, (ii) granite intrusion and differentiation, (iii) aplite, pegmatite and microgranite intrusion, (iv) cassiterite mineralization, (v) gold mineralization, (vi) shear faulting. Includes further notes on the gold mines. Small quantities of nickel and chromium were found in the serpentine and amphibolite. Alluvial cinnabar is recorded.

1939b The geology and mineral resources of the neighbourhood of Raub, Pahang, Federated Malay States, with an account of the geology of the Raub Australian Gold

Mine. *Mem. geol. Surv. Dep. Fed. Malaya,* **3**, 166p., 16 pls., 35 figs., geol. map 1:63,360.

Shale, dolomitic limestone, amphibole schist (probably metamorphosed calcareous sediments) and rare chert are thought to be Permo-Carboniferous. An arenaceous formation including conglomerate, quartzite, phyllite and chert is referred to the Triassic. Rhyolitic tuffs occur sparingly in both formations. A serpentine belt lies along the Main Range foothills. The main biotite granite intrusion was accompanied by smaller bodies of granite porphyry and quartz porphyry. The Gunong Benom granite was intruded into basic and ultrabasic rocks and with them formed a hybrid suite, the mineralogy of which is described. Between the Main Range and the Benom granite, a N–S sedimentary belt is isoclinally folded with dips generally towards the east. Hydrothermal tin and gold were migrant from the granite magma. Auriferous quartz veins occupying N–trending fissures adjacent to the axial planes of isoclinal folds in shale, are worked at the Raub Australian Gold Mine. River alluvium contains detrital gold and cassiterite. Recent rhyolite ash occurs locally. The main tin mining areas are described.

1940a Report of progress of the geological survey of that part of northwest Pahang covered by topo sheets 2N/12, 2N/11, and 2N/8. *Rep. geol. Surv. Dep. F.M.S.* [for 1939], 16–21.

A summary of the geology of the Chegar Perah sheet (2N/12). An arenaceous formation on the eastern flank of the Main Range is probably unconformable to a calcareous formation. Shales in the latter are interbedded with rhyolite and andesite tuffs and a few lavas of the Pahang Volcanic Series. Intrusives rocks include syenite, quartz porphyry, and biotite granite. Placer gold is associated with these intrusions. The Selinsing Gold Mine lies in gently folded phyllite and subordinate quartzite, conglomerate, and limestone. Fault movements are less that at the Raub Mines. The auriferous quartz veins and stringers are of small size and low productivity.

1940b The geology of the Batu Bersawah gold mine. *Rep. geol. Surv. Dep. F.M.S.* [for 1939], 44–6.

Steeply dipping shales are intruded by a dolerite sill. Auriferous quartz occurs in fault fissures. Compression faults, tension faults and two sets of oblique faults are developed as at the Raub Mines.

1940c The relationship between structure and ore-deposition at the Raub Australian Gold Mine, Pahang, F.M.S. *Yb. Chamb. Mines F.M.S.* [for 1939], 167–70, 2 figs.

(RICHARDSON, J.A.)

Mineralization has taken place in a zone of compressional faulting, within which lie two parallel major lode channels separated by about 800 ft of country rock. Fault planes have a veneer of polished and striated graphite and most of the auriferous quartz is laminated with graphite seams. Tensional faults lie at right angles to the compressional faults and are mineralized at Raub Hole.

1941 The coal veins of British Malaya. *Geol. Mag.* **78**, 451–62, 2 pls., 6 figs., 3 tabs.

Near vertical veins of coal (mostly vitrain), a few inches wide, cut the alluvium and decomposed bedrock at several localities in Perak. The composition of the coal is similar to that mined at Batu Arang, Selangor. The author agrees with Fermor (1939a) that these veins were formed from organic matter which was derived from wood in the alluvium and deposited as a gel in vertical fissures.

1946 The stratigraphy and structure of the Arenaceous Formation of the Main Range foothills, F.M.S. *Geol. Mag.* **83**, 217–29, 2 figs.

Fine to coarse-grained unfossiliferous clastics form the Foothills Formation, striking N–S east of the main range from which it is separated by a trough formed of phyllites and schists. It dips steeply east beneath Permo-Carboniferous rocks [now known to be mainly if not entirely M.–U. Triassic.] The Foothills Formation resembles Triassic formations known elsewhere in Malaya. Evidence from the Selinsing Gold Mine and the Sg. Telom suggests that the Permo-Carboniferous rocks are folded into the Foothills Formation. There is a 10–20° divergence in strike however which may be due to an unconformity or to tectonic moulding of the Permo-Carboniferous against the buttress of the Foothills Formation. Two sections are given, one assuming the Foothills Formation to be Triassic and thus overfolded; the other assuming it to be older than the Permo-Carboniferous. The author favours the second interpretation.

1947a Bauxite formed *in situ* in alluvium, and laterization of alluvium and limestone in the Mae Khlaung and Khwae Noi valleys, Siam. *Bull. Inst. Min. Metall., Lond.* 490, 13–17, 1 fig. Reprinted (1951) in *Trans. Inst. Min. Metall., Lond.* **57**, [for 1947–8], 103–7 (discussion 118–23).

Mentions bauxite at Penggerang in Johore formed from phyllites and tuffs; and laterization of residual clay and silt formed by the solution of impure limestone in Pahang.

1947b Alluvial cinnabar in northwest Pahang, Malaya. *Bull. Inst. Min. Metall., Lond.* **490**, 19–22, 1 fig. Reprinted

(1951) in *Trans. Inst. Min. Metall., Lond.* **57**, [for 1947–8], 109–12 (discussion 118–23).

Cinnabar occurs as rounded grains about 2mm in diameter in the valleys draining granitic areas. It is accompanied by cassiterite, zircon, tourmaline, gold, and iron oxides. The cinnabar probably originated, along with quartz and gold in low-temperature veins effluent from the granite.

1947c Economic importance of jointing in the limestone bedrock of two alluvial gold mines, Pahang, Malaya. *Bull. Inst. Min. Metall. Lond.* **490**, 23–8, 1 fig. Reprinted (1951) in *Trans. Inst. Min. Metall. Lond.*, **57** [for 1947–8], 113–18, (discussion 118–23).

At the Foo Brothers Gold Mine, Sg. Timah, rectangular jointing has controlled solution of the limestone bedrock and gold-bearing alluvium is concentrated in the solution furrows. In the Tui Gold Mine, Padang Tengku, auriferous quartz veins cut the limestone and are found as residual deposits concentrated in similar solution furrows. The overlying gold-bearing alluvium includes two carbonized plant layers on seat-earths.

1947d An outline of the geomorphological evolution of British Malaya. *Geol. Mag.* **84**, 129–44, 5 figs.

The present mountain ridges form eight coulisses gently arcuate towards the west. A major watershed lies along the Thai border in Perlis, Kedah, and Perak and separates Kelantan and Trengganu from the rest of Malaya. The present river system was probably initiated in the Cretaceous and was controlled by the geological structure of the country, large N–S subsequent streams being later captured by fast-flowing E–W rivers, *e.g.* the present course of the Pahang River. A finer dissection of the main N–S trending ridges was performed by tributaries of the E–W dip rivers. Later, local radial and rectilinear drainage patterns evolved (examples are taken from N. Pahang). Erosion in limestone was joint controlled. During the drowning of the Sunda Shelf in the Quaternary, rivers aggraded the lower parts of their courses. River terraces up to 5,000 ft and nick points between 5,000 ft and 500 ft are widespread in NW Pahang.

1947e The origin of the Amphibole-Schist Series of Pahang, Malaya. *Geol. Mag.* **84**, 241–9, 1 fig., 1 tab.

Actinolite schist associated with serpentine occurs in the Arenaceous Formation of the Main Range foothills. This rock is not known elsewhere in Malaya and may have resulted from a type of metamorphism or polymetamorphism restricted to NW Pahang near the Main Range axis, in which calcareous sediments were contaminated by ultrabasic magma.

1947f Facies change and lithological variation in the Permo-Carboniferous formation of north-west Pahang and south-west Kelantan, Malaya. *Geol. Mag.* **84**, 281–8, 2 figs., 1 tab.

A coastline lay to the N and NE and neritic sediments accumulated throughout the Permo-Carboniferous. Explosive volcanic centres lay in SW and central Kelantan and NW Pahang near the coast. They produced rhyolitic ashes in the early Permo-Carboniferous but later became more basic and andesitic and basaltic pyroclastics were formed. The volcanic material decreases southwards into a shale province. Limestone was formed mainly in the S in the lower Permo-Carboniferous but this facies later moved N where its maximum thickness was attained in the middle and upper Permo-Carboniferous. Thin beds of fine-grained quartzite and carbonaceous chert are found interbedded with the limestone and shale.

1947g Report of progress of the geological survey of that portion of northwest Pahang covered by topo. sheets 2N/6, 2N/7, 2N/8, 2N/10, 2N/11 and 2N/12. *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 26–30.

The geology of the Merapoh sheet (2N/8) is a northerly continuation of that of the Chegar Perah area (Richardson 1940a). To the W of these sheets is the Main Range granite with roof pendents of metasediments, some calcareous, in the Cameron Highlands area. Pelitic metasediments along the eastern margin of the granite are provisionally included in the arenaceous formation (Richardson 1940a). This formation also includes amphibole schist previously (Richardson 1938) thought to have been derived from dolerite but now considered possibly as altered calcareous sediments or hydrothermally altered serpentine. A brief report is given on work by rock collectors in S Kelantan.

1950 The geology and mineral resources of the neighbourhood of Chegar Perah and Merapoh, Pahang, Malaya. *Mem. geol. Surv. Dep. Fed. Malaya,* **4**, 162p., 3 pls., 20 figs., 2 geol maps 1:63,360.

The calcareous series are neritic sediments of Carboniferous and ? Permian age divided into limestone, shale and mixed facies. Mainly rhyolitic tuffs, agglomerates and subordinate lavas are interbedded with these. The arenaceous series of conglomerate, quartzite, shale and phyllite, and, locally, quartz- and mica-schist are referred provisionally to the Trias but is probably older than Carboniferous and may lie unconformably below it. The calcareous series is intruded by three main bodies of biotite granite, one of granite porphyry and one of syenite. Dolerite dykes outcrop locally. The regional strike is N–S and the sediments are tightly folded. The area forms the northern end of the

Pahang gold belt and placer gold is worked. Two lode gold mines have been abandoned. The gold originated from granitic and syenitic rocks. Longitudinal river profiles show evidence of rejuvenation.

RIDLEY, H.N.

1891 Diamonds in the Malay Peninsula. *J. Straits Brch R. Asiat. Soc.* **24**, 166–7.

Quotes Garcia da Orta on the occurrence of "heavy diamonds" at the Strait of Tanjam.

1894 Earthquake in the Malay Peninsula. *J. Straits Brch R. Asiat. Soc.* **25**, 169–71.

Describes an earth tremor which occurred on May 17, 1892 and was felt in Singapore, the southern part of Malaya, and more strongly in Sumatra. Also mentions a similar tremor reputedly felt in Singapore in 1861.

1899 Caves in the Malay Peninsula. Appendix, *Rep. Br. Ass. Advmt Sci.* [for 1898], 572–82, 2 figs.

A description of Batu Caves, Selangor.

1916 The natural history of Kedah Peak. *J. fed. Malay St. Mus.* **7**, 37–58.

On floral evidence Kedah Peak and Mount Ophir were recently islands.

ROBINSON, H.C. and KLOSS, C.B.

1916 The natural history of Kedah Peak. *J. fed. Malay St. Mus.* **6**, 219–44.

The vertebrate fauna suggests that the hill was an island at some time in the Recent.

ROE, F.W.

1938 Progress report on geological work in Selangor. *Rep. geol. Surv. Dep. F.M.S.* [for 1937], 46–56.

Outlines the geology of N Selangor. Limestone and graphitic schist are overlain by quartzite and schist. Regional metamorphism is associated with Mesozoic granite intrusion. Two N–S zones of coarse porphyritic biotite granite border a medium-grained granite with subordinate micro-granite and granite porphyry. The granite is schistose locally. Supports Scrivenor's

(ROE, F.W.)

(1923a) theory that the granite was intruded into a parallel series of anticlines. Describes the occurrence of primary cassiterite in greisens and in quartz-topaz rock cutting the granite.

1939 Progress report on geological work in Selangor. *Rep. geol. Surv. Dep. F.M.S.* [for 1938], 32–50.

Refers to N Selangor and contains some additional notes to Roe (1938). Regional metamorphism is widespread yet contact metamorphism around the granite is negligible. Pre-granite epidiorite outcrops in the Ulu Bernam valley. The sequence of events during the Mesozoic orogeny was; 1) earth movements folding sediments; 2) intrusion of the Main Range granite and its differentiation; 3) faulting and shearing of the granite; 4) cassiterite pneumatolysis; 5) quartz intrusions; 6) local zeolitization; 7) minor faulting. During (3) granite-gneiss, mylonite gneiss, and quartz-sericite (epidote-chlorite) schist were formed. Notes the geology of tin mines in the area. Torbernite is recorded. Description and analysis of water from hot springs near Kuala Kubu Bharu and Kerling. Three Neolithic stone axes recorded.

1940 Progress report on geological work in Selangor. *Rep. geol. Surv. Dep. F.M.S.* [for 1939], 34–44.

Refers to N Selangor. Notes the weathering of rocks of the arenaceous formation. Heavy mineral studies of the metamorphosed sediments show quartzite to contain mainly zircon, with subordinate rutile, anatase, garnet, ilmenite and tourmaline. The metamorphic aureole of the granite is well-exposed around Rasa. Along its western border and also in the NW of topo. sheet 3B/7 this granite is of uniform type and is not cassiterite-bearing. In its centre, the granite mass is often sheared and in some places carries tourmaline. It contains numerous intrusions of fine-grained granite with tourmaline and cassiterite and roof pendents of metasediments. Poorly-jointed epidote granite outcrops in the northern part of the area. The different types of granite were found to contain different heavy mineral suites. Notes lode-tin prospecting in Ulu Selangor. Montmorillonite is recorded from mile 47 on the Gap road, and stilbite from near Kalumpang. Wolframite is mined in small quantities in the Kuala Lumpur area. Tin-bearing quartz veinlets occur in sediments at Bt. Ginting Prah, Kuala Selangor.

1941 The coal field at Batu Arang, Selangor. *Yb. Chamb. Mines F.M.S.* [for 1940], 142–4.

A general review for the non-geologist. Mentions coal seams cut by river channels.

1947 Progress report on geological work in Selangor. *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 20–6.

Mainly concerned with topo. sheets 3B/10, 3B/11, and 3B/12. The calcareous formation is composed of psammitic schist, pyroxene- and amphibole-schist, marble, and phyllite. Roof pendents of this occur in the granite in the SE of the area. The arenaceous formation comprises quartzite and quartz conglomerate, in some places schistose, and phyllite. In the Main Range, coarse porphyritic biotite granite is dominant. Two small hills at Kuala Selangor are of fine-grained granite with tourmaline patches and quartz sulphide veins. NW of Serendah dolerite cuts the arenaceous formation and weathers to bauxite. Similar dolerite NE of Tanjong Malim is metamorphosed by the granite. Wolframite-cassiterite-quartz veins occur in or near the granite at Ulu Yam Bharu and, together with scheelite, at Kanching and Batu Caves. Magnetic cassiterite is recorded in concentrates from Kalumpang.

1948 Progress report on geological work in north Selangor and Ulu Selangor. *Rep. geol. Surv. Dep. Malay. Un.* [for 1947], 21–3.

Re-mapping after the destruction of records during the Japanese occupation has shown surface exposures of limestone near Tanjong Malim.

1949 Progress report on geological work in Selangor. *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1948], 24–37.

Summarises the geology of topo sheets 3B/7 and the Selangor part of 3B/8. Ore bodies in the granite are richest in tin near the surface and much tin-ore was formerly obtained by lampaning. The Tertiary basin at Batu Arang contains shale, sandstone, coal and conglomerate, tilted SSW, overlain by boulder beds, and underlain by quartzite. A bore hole proved 1,164 ft of boulder beds and 298 ft of coal measures. The coastal alluvium has buried an earlier landscape; old valley bottoms are now over 100 ft below the present surface. Gravel and sand forms the base of the alluvium, followed by sandy clay and clay and finally swamp deposits and peat. Investigations of dam sites on the Sg. Gombak and at Klang Gates, near Kuala Lumpur, are reported. The quartz reef at Klang Gates is almost pure SiO_2 and was emplaced along a line of weakness after the granite it cuts was consolidated. Drilling on the site of a proposed power station at Klang encountered friable sandstone and stiff clay underlain by quartzite.

1951 The geology and mineral resources of the Fraser's Hill area, Selangor, Perak and Pahang, Federation of Malaya, with an account of the mineral resources. *Mem. geol. Surv. Dep. Fed. Malaya.* **5**, 138p., 5 pls., 10 figs., 15 tabs., geol. map 1 : 63,360.

Unfossiliferous pelite with subordinate marble form the Calcareous Series and are overlain by less metamorphosed quartzite and shale of the Arenaceous Series, believed to be Triassic. A few small outcrops of amphibole schist are found in both Series. The Main Range granite is mineralized in many areas. Cassiterite occurs in zones of thin parallel stringers and in stockworks, being commonly associated with fluorite and topaz in fine-grained tourmaline granite. Four alkaline hot springs carry relatively large amounts of dissolved silica. The principle mines and mining areas are described.

1953 The geology and mineral resources of the neighbourhood of Kuala Selangor and Rasa, Selangor, Federation of Malaya, with an account of the geology of the Batu Arang coalfield. *Mem. geol. Surv. Dep. Fed. Malaya*, **7**, 163p., 5 pls., 9 figs., 24 tabs., 2 geol. maps 1 : 63,360.

Closely-folded dolomitic limestone, phyllite and schist of the Calcareous Series are overlain, probably unconformably, by less intensely folded quartzite, quartz schist, and hornstone of the Arenaceous Series. Small outcrops of dolerite and amphibole schist occur locally associated with the Calcareous Series. Lode tin deposits, generally of low grade, occur in the Main Range granite. Quartz intrusions with wolframite and cassiterite are found in the Liam Valley and the Kanching area. Alluvial tin deposits are extensively worked in river valleys adjacent to the Main Range and have also been proved in buried river valleys along the coast. Tertiary shale, sandstone, and conglomerate, with two thick coal seams form a small basin at Batu Arang.

ROMANG, M.

1922 Petrographische Untersuchung zinnersfuhrender Gesteine aus Kinta (Malakka). *Eclog. geol. Helv.* **17**, 178–251, 8 pls., 4 figs.

Describes Kinta granite, pegmatite, greisen, hybrid rocks, hornfels and metamorphic limestone specimens in the collection of Pannekoek von Rheden in the Natural History Museum at Basel. Primary tin-ore originates from the granite and occurs in greisen and hybrid rocks. The inner part of the contact aureole of the granite is formed of clastic sediments, now tourmaline and corundum-bearing hornfels. The outer part of the aureole is of limestone. Wherever limestone lies against the granite the contact is faulted.

ROUX-BRAHIS, J.

1910 *Étude du district stannifère de Tekkah.* Bordeaux: Gounouilhou.

Not seen.

RUMBOLD, W.

1903 Kinta (given an ideal section). *Trans. Am. Inst. Min. Engrs.*

Not seen.

1906 The tin-deposits of the Kinta valley, Federated Malay States. *Bull. Am. Inst. Min. Engrs,* **11**, 755–65.

Not seen.

1907 The tin-deposits of the Kinta valley. *Trans. Am. Inst. Min. Engrs,* **20**, 879–89. Reprinted in *Min. J., Lond.* [for 1906], 460–.

Not seen.

SAKAGAMI, S.

1963 Bryozoa from Pulau Jong, the Langkawi Islands, northwest Malaya. *Jap. J. Geol. Geogr.* **34**, 205–9, 1 pl.

A description of a new species of *Cyclotrypa,* a species of *Fistulipora* and two species of *Polypora* of Middle Permian age.

1966 [Upper Palaeozoic bryozoa of Malaya and Thailand] *Fossils,* **12**, 40–6. (In Japanese)

Mentions the fauna from Pulau Jong (Sakagami 1963).

SANTOKH SINGH, D. and BEAN, J.H.

1967 *Some general aspects of tin minerals in Malaya.* International Tin Council, Technical Conference on Tin. London, March 1967, 22p., 10 figs.

Describes the occurrence and properties of stannite, varlamoffite and magnetic forms of cassiterite. Stannite is found in cassiterite-sulphide veins. Under hypogene conditions it alters to 'needle-tin' and chalcopyrite. Cassiterite can crystallize at various temperatures but under low temperature and pressure it forms acicular and collomorphic aggregates.

SATO, T.

1963 Ammonites du Trias de la Malaisie. *Jap. J. Geol. Geogr.* **34**, 93–9, 1 pl.

A description of three Carnian species from Yong Peng, Johore, and three Anisian species and two Ladinian species from near Temerloh, Pahang.

SAVAGE, H.E.F.

1925 A preliminary account of the geology of Kelantan. *J. Malay. Brch R. Asiat. Soc.* **3** (1), 61–73.

Granite of the Main Range and the Kelantan-Trengganu boundary resembles that found elsewhere in Malaya. On Bt. Kemahang and Bt. Roh it shows gneissic banding; on Gunong Setong it is capped by metamorphic limestone. The Raub Series is represented by N–S striking phyllite, schist and limestone. The Chert Series, associated with volcanics, is recorded from Ulu Sg. Lebir. Rhyolite and andesite of the Pahang Volcanic Series are extensively interbedded with the Quartzite and Shale Series. Hypabyssal intrusives possibly of Tertiary age and old tin and gold workings are mentioned.

1928 The metalliferous deposits of Trengganu. *Rep. geol. Surv. Dep. F.M.S.* [for 1927], appendix. Published in a supplement to F.M.S. Govt. Gazette, May 11, p. 5–14.

Alluvial and lode tin-ore occurs, the latter in sediments affected by contact metamorphism and/or pneumatolysis. In the Besut area, hornblende granite is tin-bearing. Wolframite occurs at Chendrong, Ulu Kemaman, iron-ore and manganese at Machang Satahun, and a magnetite-haematite deposite at Sg. Dungun.

1937 The geology of the neighbourhood of Sungei Siput, Perak, Federated Malay State, with an account of the mineral deposits. *Mem. geol. Surv. Dep. Fed. Malaya,* **1**, 46p., 5 pls., 1 fig., geol. map 1:63,360.

Strongly folded limestone, more or less marmorized, is interbedded with phyllite, mica schist, amphibole schist and calc-silicate rock. Overlying these supposed Carboniferous beds, are strongly deformed quartzite and schist believed to be Triassic. Quartz porphyry with a cryptocrystalline groundmass and often sheared, preceeded the intrusion of biotite granite, which covers about half of the mapped area. The geology of alluvial and lode tin mines and the occurrence of economic rocks and minerals is noted.

1947 Report. *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 19–20. Addendum to Ingham (1947b).

Quartz porphyry and a vein of ? chalcedony is recorded from Ulu Klang, Selangor.

1948 Progress report on geological work in south Selangor. *Rep. geol. Surv. Dep. Malay. Un.* [for 1947], 12–13.

Notes on the Kuala Lumpur-Ampang area. The margin of the granite and, in places, the schist is tourmalinized. Cassiterite-rich

quartz veins are present in granite near Salak. Sedimentary roof pendants mapped in the granite of Ulu Langat.

1949 Progress report on geological work in west central Pahang. *Rep. geol. Surv. Dep. Fed. Malaya* [for 1948], 13–17.

Coarse to fine pyroclastics and subordinate lava of rhyolitic to basaltic composition outcrop along the Benta-Jerantut road. Triassic fossils are recorded (Savage 1950b). The open-cast gold mine at Penjom works alluvium and eluvium over intermediate volcanics.

1950a Progress report on geological work in Pahang. *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1949], 19–25.

Galena lodes reported from the Sg. Luit in E Pahang. Stibnite-bearing quartz veins with negligible gold and galena are found in vertical phyllites at the disused Buffalo Reef Gold Mine at Bt. Ribu, 22 miles WNW of Kuala Lipis. Haematite and magnetite boulders recorded from near 47¼ milestone on the Kuala Lipis--Jerantut road.

1950b Triassic fossils from near Kuala Lipis, Pahang. *Colon. Geol. Miner. Resour.* **1**, 76–7.

The Middle Triassic ammonoid genera *Paraceratites, Sturia, Ptychites,* and *Acrochordiceras* were identified by L. F. Spath from mudstones exposed in the Sg. Tua, Budu Estate, 10½ miles SSW of Kuala Lipis. The Upper Triassic lammellibranch genera *Myophoria, Gervillea, Mytilus* (or *Myalina*), *Anodontophora,* and *Megalodon* were identified by L. R. Cox from siltstones exposed behind the Geological Survey Office at Kuala Lipis.

1956a A note on oil and gas in Malaya. *Int. geol. Congr. 20th Petroleo y Gas Symposium,* **2**, 159–60.

Economic deposits absent in Malaya.

1956b A note on manganese in Malaya. *Int. geol. Congr. 20th, Symposium sobre yacimentos de manganeso,* **4**, 221–2.

Manganese was formerly mined in Trengganu and Kelantan. Psilomelane and pyrolusite at Gual Periak, Kelantan occurs in secondary lateroid deposits capping low shale hills.

SAVAGE, H.E.F. and WILSHAW, R.G.H.

1932 An examination of the geology and soils of an area in the state of Perak, Federated Malay States. *Scient. Ser. Dep. Agric. Straits Settl. F.M.S.* **10**, 1–15, 4 pls., 3 tabs., 1 geol map 1 : 4000.

An area of 154 acres of the Talong Tinggi Estate is hilly and exposes granite, schist and limestone. Soil profiles are described from each of these rock types.

SCRIVENOR, J.B.

1904a A preliminary report on the geology of the neighbourhood of Taiping, Perak. *F.M.S. Govt. Gazette,* Jan. 8, 1–14.

Recognises granite, limestone and a sandstone-shale series.

1904b *Rep. Geol. F.M.S.* [for 1903].

The granite of Jugra Hill, Selangor, is cut by a N–S fault. Earlier records of basalt in Kinta (Tenison-Woods 1885) are incorrect. The rock is a tourmaline schist. Andalusite and idocrase are recorded from Chenderiang, Perak.

1904c A preliminary report on the gold mines of the Federated Malay States. *F.M.S. Govt. Gazette,* June 24, 4, 1–12.

Not seen.

1904d In Belfield, H.C. (ed.). *Handbook of the Federated Malay States* (2nd. ed.) London: Ed. Stanford.

A general popular account of the geology of each of the States.

1905a *Rep. Geol. F.M.S.* [for 1904]. Published as a supplement to the *Perak Govt. Gazette,* July 14, 7p.

Triassic fossils reported from Putus Semanggol, Perak (Jones, T.R. 1905): Carboniferous fossils from Pahang identified by G.C. Crick (Jones C.R. *et al* 1966, p. 322); and *Semionotus* recorded from the Myophoria sandstone at Kuala Lipis. Serpentine from Pahang and Kuala Pilah, Negri Sembilan, was assayed unsuccessfully for platinum. This serpentine and some limestone and granite might be economic as ornamental stone. Tin ore from weathered pegmatite is disseminated in minute amounts in the unweathered rock at Sudu, Seremban. Primary tin-ore in limestone at Siak, Batu Gajah, occurs with sulphides but tourmaline is absent. At Lahat, Kinta, a vertical cylindrical pipe 25 ft in diameter cuts limestone and is filled with detrital tin-ore and iron-ore cemented with calcite. At Jehoshaphat, Kinta, detrital tin-ore lies in a vertical cleft and at Tronoh it lies in a deep trough between clastics bordering the granite and limestone. The Sg. Lembing mines are compared to those of Cornwall. Alluvial tin originates from the prolonged erosion of pegmatites, lodes and stockworks rather than from the bulk of the granite. China clay suitable for pottery is available in Malaya.

1905b Coal in the new territory, Perak. *Perak Govt. Gazette, Supplement,* May 19, 2p.

Records a single piece of coal from alluvium at Ayer Jeddak.

1905c Alluvial and lode tin in Malaya. *Min. J., Lond.* **78**, 273–.

Not seen.

1906 *Rep. Geol. F.M.S.* [for 1905], 2p.

Mentions fossils from Mount Guthrie, Singapore. Cassiterite, molybdenite and tourmaline form a small body in granite near Bt. Panjang, Singapore. Wollastonite schist is extensive in Upper Perak. Lode tin and gold are very limited in Ulu Pahang. Mentions basalt around Kuantan. Tin mines at Siah and Ayer Dansang in Kinta expose bodies of cassiterite, fluorite and metallic sulphides in limestone.

1907 *Geologist's report of progress, Federated Malay States, September 1903 to January 1907,* ix + 44p. Kuala Lumpur: Govt. Press.

The geology of Malaya and especially of Pahang is compared to that of India and the Malay Archipelago. Four 'Series' are designated. Chert Series is of carbonaceous shales, and cherts with radiolaria, developed in West Pahang. Raub Series comprises limestone and shale of Carboniferous and Permian age. Tembeling Series containing conglomerate with chert pebbles from the Chert Series, sandstone and shale, is typically coloured red or yellow and is Triassic. Pahang Volcanic Series is mainly of pyroclastics, andesitic to trachytic in composition, interbedded with the Raub Series and also associated with the Tembeling Series. Sheared diabases and greenstones in W Pahang are probably older than the granite. The granite comprises porphyritic and non-porphyritic varieties; hornblende granite and augite syenites occur in the Benom area, Pahang. Several metamorphic and skarn rocks are described, including tourmaline-corundum rock from Kinta. Dolerite dykes cut granite in east Pahang. The mountain ranges are composed of either granite, Tembeling Series, or limestone. Obsidianites are recorded from near Kuantan. The economic part of the report reviews gold and tin mining in Malaya. The prospects of much economic gold are gloomy. Prismatic cassiterite in decomposed pegmatite and iron-stone is described from the Bundi Mine, at Kemaman, Trengganu. Notes are given on the Machi tin field of SW Pahang, mines in the Main Range and in Malacca, the Bruseh Mine, some Selangor mines, and Kinta lode mines, including the Lahat Pipe; also on alluvial mines at Tronoh, Perak and Sg. Besi, Selangor. Cassiterite--topaz-quartz rock recorded from near Bentong. 'Amang' consists mainly of ilmenite but locally contains a considerable amount of monazite.

(SCRIVENOR, J.B.)

1908a The geology of the Tahan Range. *J. Fed. Malay. St. Mus.* **3**, 73–4.

The Tahan Range is formed of estuarine shale, sandstone, grit and conglomerate folded into a series of anticlines and synclines and named the Tembeling Series. The conglomerate contains pebbles of chert and carbonaceous shale with radiolaria and foraminifera, probably derived from W Pahang.

1908b Note on the sedimentary rocks of Singapore. *Geol. Mag.* **45**, 289–91.

Fine sandstones and red and grey shales with subordinate pebbly sandstones and conglomerates containing chert and, in one locality, decomposed lava, resemble the rocks of the Tembeling Series of Pahang. The latter are known to be Triassic but there is some doubt on the age of the Singapore rocks. Map of Malaya 1 : 1,267,200 shows the main outcrop of the Tembeling Series.

1909a Note on the igneous rocks of Singapore, with special reference to the granites and associated rocks carrying rhombic pyroxene. *Geol. Mag.* **46**, 17–22.

Boulders of trachyte and andesite tuff are similar to those of the Pahang Volcanic Series. Quartz porphyry of obscure relations occurs at Pulau Pergam. Diabase boulders may represent dolerite dykes or basic lava. The granite is medium grained, non-porphyritic, with biotite and sometimes hornblende. Granite with rhombic pyroxene occurs in the northern part of Pulau Ubin and a dyke-like mass of enstatite-vogesite is associated with it. It is compared with quartz-hornblende norites from Sarawak which are probably late Eocene.

1909b *Rep. Geol. F.M.S.* [for 1908]. 7p.

Notes on water supply, lignite, a quartz-tourmaline-scheelite lode at Salak North, Perak and on other lode tin deposits in Kinta. Mentions the collapse of 'karang' and alluvium into depressions in limestone bedrock. The Lahat pipe is an original lode with the calcite matrix leached, and the cassiterite and sulphides re-oriented and concentrated as a residual deposit.

1909c The Lahat 'pipe': a description of a tin-ore deposit in Perak (Federated Malay States). *Q. Jl. geol. Soc. Lond.* **65**, 382–9, 4 figs.

A vertical pipe with irregular outline lies in limestone. It has been worked to a depth of 314 ft and contains irregularly distributed angular cassiterite in a deep red matrix of calcite and iron-oxide. No cassiterite was found in the walls of the upper part of this pipe but at 120 ft small veins containing cassiterite,

yellow tourmaline, pyrite, and mica intrude the surrounding limestone. No tourmaline is present in the main ore-body. The pipe was originally a primary lode. The cassiterite was re-deposited in it after the solution of some of the calcite and oxidation of the sulphides.

1909d Archean or Lower Palaeozoic rocks in the Malay Peninsula. *Geol. Mag.* **46**, 330–2.

A letter in response to a mention by Verbeek of "ancient schists" in the Malay Peninsula. No evidence of rocks older than Carboniferous.

1909e Obsidianites in the Malay Peninsula. *Geol. Mag.* **46**, 411–13.

Typical obsidianites are recorded from the Blat and Gambang valleys near Kuantan, Pahang and from Sudu Seremban in Negri Sembilan. Partial analysis of a Kuantan specimen gave 72% SiO_2, 26% $Al_2O_3 + Fe_2O_3$ and 4% CaO.

1909f The use of the word 'laterite'. *Geol. Mag.* **46**, 431–2.

Laterite should not be too strictly defined. In the Malay Peninsula engineers use this term for masses of iron oxide replacing weathered rock and filling fissures, and it is an engineer's rather than a geologist's term.

1909g The use of the term 'laterite'. *Geol. Mag.* **46**, 574–5.

A letter recording the occurrence in Malacca of a rock agreeing with Buchanan's original definition of laterite. It can be cut when fresh but hardens on exposure to air and is used for building. There is no alternating wet and dry season in Malacca and thus this is not necessary for the formation of laterite *sensu stricto*.

1909h *The origin of tin deposits*, 11p. Kuala Lumpur: Govt. Press.

Fluorine, boron and lithium are often associated with tin. These elements were derived from an acid granite body and invaded its margin and the country rock, as a gas or in pegmatite veins, at a late stage in the cooling of the magma. Pre-existing minerals were altered to topaz, tourmaline, and lithium mica and cassiterite was formed. Fluorine is an important reagent in the formation of cassiterite. At Chendai and Menglembu, Perak, cassiterite and tourmaline are primary in fresh granite; at Gapis and Sempang, Pahang, quartz-tourmaline-cassiterite bodies may have originally segregated in molten pegmatite; at Chinchong on the Selangor-Pahang border a topaz cassiterite rock probably represents granite altered by gases rich in Sn and F. Tourmaline is rare in tin

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deposits in limestone as, in Malaya, such limestone is usually poor in alumina, but the presence of F is shown by the occurrence of fluorite. Exceptionally, as at Bundi, Trengganu, cassiterite is found in granite without tourmaline.

1910a *Rep. Geol. F.M.S.* [for 1909]. Published as a supplement to the F.M.S Govt. Gazette, Aug. 19, 4p.

Alluvial tin-ore in Kinta is at least partly derived from ore bodies in schist. Beach sand from the Dindings contains cassiterite. Notes discoveries of lode tin-ore and analyses of lignite from Rantau Panjang, Selangor.

1910b On an occurrence of native copper with tin-ore in the Federated Malay States. *Mineralog. Mag.* **15**, 299–301.

Native copper is recorded from the fine grade of a tin-ore concentrate derived from decomposed schists at Rotan Dahan, Kinta. One sample contained minute but unworn crystals of copper; these were probably formed by the reduction *in situ* of a copper salt.

1910c The term 'laterite'. *Geol. Mag.* **47**, 335–6.

Malayan laterite, including that from Malacca, contains free aluminium hydroxides and in this respect resembles the Indian laterite (Crook 1909).

1910d Laterite and bauxite. *Geol. Mag.* **47**, 382–4.

Weathered Malayan granite contains aluminium hydroxides but does not have the properties of laterite. Bauxite is not proved to have a constant chemical composition and is better used as a rock term, the term 'laterite' being left to engineers.

1910e The rocks of Pulau Ubin and Pulau Nanas (Singapore), *Q. Jl. geol. Soc. Lond.* **66**, 420–34, 3 figs.

Hornblende granite on Pulau Ubin is veined by quartz norite and enstatite spessartite and carries irregular masses of quartz-biotite gabbro. It is suggested that the granite magma carried up parts of a previously irrupted gabbro but that later intrusions of the gabbro magma veined the cooled granite. Pulau Nanas is composed of dacite and dacite tuff of the Pahang Volcanic Series. The tuffs contain altered fragments of a Pre-Carboniferous biotite granite which is tentatively correlated with a Palaeozoic granite known on Amboyna in the Banda Sea.

1910f The tourmaline corundum rocks of Kinta (Federated Malay States). *Q. Jl. geol. Soc. Lond.* **66**, 435–49, 2 pls., 1 fig.

Outlines the geology of the Kinta valley. The tourmaline-corundum rocks contain accessory carbon, white mica, and spinel, have an oolitic structure, and contain oval cavities. They are associated with schist and carbonaceous chert and possibly represent metasomatised oolitic limestones.

1911a Sketch of the geological structure of the Malay Peninsula. *J. Straits Brch R. Asiat. Soc.* **59**, 1–13.

A popular account summarising contemporary knowledge.

1911b *Rep. Geol. F.M.S.* [for 1910]. Published as a supplement to the F.M.S. Govt. Gazette, May 12, 3p.

The Gopeng Beds of Kinta are considered older than the granite and to be Permo-Carboniferous glacial beds containing an older tin-ore. Mentions small quantities of oil present in mangrove mud. Columbite recorded from a concentrate. Cassiterite containing iron recorded from Kinta.

1911c *The geology and mining industries of Ulu Pahang,* 61p., 13 pls., geol. sk. map 1 : 506,880. Kuala Lumpur: Govt. Press.

The supposed abundance of gold and numerous earlier gold workings are attributed to forced labour and possibly surface enrichment due to weathering. Most gold areas are not workable commercially. At Silensing abandoned gold workings are in conglomerate. At Tui auriferous quartz and calcite vein limestone. At Kechau gold occurs in a fault breccia. In the Raub mines auriferous quartz bodies saddle sharp fold apices and are associated with faults: stibnite and scheelite also occur. Tin-ore is limited to the Main Range and the Machi area. The sedimentary rocks are divided into the Carboniferous Raub Series of limestones and calcareous shales, in places metamorphosed; the chert Series of carbonaceous and radioclarian chert; and the Gondwana rocks of conglomerate with chert pebbles, sandstones, and subordinate shales. The Pahang Volcanic Series is mainly associated with the Raub Series. Andesites, dacites, pyroclastics, dolerite and porphyries are described. The Gondwana Series is thought to have been littoral to the Gondwana continent, deeper water sediments having formed in Borneo. The Chert and Raub Series both lie unconformably beneath the Gondwanas. Hornblende granite and syenite of Gunong Benom differ markedly from the granite of the Main Range. Dolerite dykes cut the granite and are assumed to be Tertiary.

1911d *Notes on prospecting for tin-ore in the Federated Malay States,* 24p., 3 figs. Kuala Lumpur: Govt. Press.

In the granite hills detrital tin-ore, frequently with tourmaline, is concentrated in stream beds where the water flow is obstructed.

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Tourmaline-quartz-muscovite veins and kaolin suggest the presence of tin. Non-detrital tin-ore in the granite hills is found in fine-grained granite, and in quartz-tourmaline-cassiterite-topaz veins, frequently in a soft, highly weathered state. At the granite margin tin-ore is concentrated locally in association with tourmaline, muscovite, and topaz; and with fluorite and metallic sulphides in limestone. The whole surface of the granite at present exposed may be marginal, the sedimentary cover having been only recently removed. In prospecting alluvial deposits, weathered granite bedrock can be distinguished from granitic alluvium by the presence of quartz veins. The limestone hills of Kinta are fault blocks and their sides carry grooves cut by former streams. Thus limestone hills in tin-bearing regions should be searched for alluvial deposits within them. In Kinta tin-ore is distributed irregularly in clays and boulder beds older than the granite and directly overlying limestone. Solution of the limestone has caused the overlying beds to collapse and to vary greatly in thickness, leading to spurious prospecting results. Practical notes are given on prospecting veins and pipes and on the valuation of prospected samples.

1911e Notes on cassiterite in the Malay Peninsula. *Min. Mag.*, Lond. **16**, 118–20.

Magnetic cassiterite from Gopeng, Perak is described. Finely divided and intermixed cassiterite and tourmaline pseudomorphs a large quartz crystal from Pusing, Perak. A 30gm mass of minute granules and prisms of cassiterite from Siputeh, Perak, is recorded.

1911f *Memorandum on the possibility of obtaining supplies of artesian water in the Federated Malay States*, 5p. Kuala Lumpur: Govt. Press.

The geological conditions necessary for artesian water are outlined and it is pointed out that such conditions are not present in Malaya, except possibly in coastal alluvium.

1911g Report on the Rantau Panjang coal measures. *F.M.S. Federal Council Paper* 4, 4p., 1 map 1:63,360.

Four analyses of coal show high moisture and low fixed carbon but low ash content. The coal measures are younger than the Mesozoic granite and contain plant remains of modern type. They form a small erosional remnant lying on a watershed. The soil over them differs from that of the surrounding clay slate and quartzite hills.

1912a *Rep. Geol. F.M.S.* [for 1911]. Published as a supplement to F.M.S. Govt. Gazette, March 29, 4p.

Quartz-topaz rock forms a 4,700 ft peak in Ulu Bakau, Selangor. Gold has been re-discovered at Bt. Mas, near Tapah. An old sea beach of comminuted shell acts as an aquifer at Telok Anson. Fossil plants from the Rantau Panjang coal measures are listed. Struverite is recorded from Salak North, Perak. Partial analyses are given of concentrates from Pahang and Kedah.

1912b Gunong Tahan and Gunong Riam. *J. Straits Brch R. Asiat. Soc.* **62**, 8–21, 4 pls.

A general account of journeys to these mountains including observations on their geomorphology. Plates include sketches of gently dipping sandstones forming cliffs in the valley of the Sg. Teku.

1912c The Gopeng beds of Kinta. *Q. Jl. geol. Soc. Lond.* **68**, 140–63, 5 figs., geol. sk. map 1 : 110,880.

The Gopeng Beds are thought to be younger than the limestone but older than the phyllites and quartzites and the Mesozoic granite. They resemble tillite, containing boulders of a variety of rocks, and also tin-ore, and are traversed by kaolinite veins. They are thought to have been deposited by Gondwanaland ice which had eroded tin-bearing rocks and to have been further enriched in tin by the Mesozoic granite. The limestone hills on the east side of the Kinta valley are mainly fault bounded and the granite junction is, in many places, also a fault.

1912d Radiolaria-bearing rocks in the East Indies. *Geol. Mag.* **49**, 241–8.

A Chert Series consisting of carbonaceous radiolarian chert associated with carbonaceous shales and pyroclastics occurs in Ulu Pahang and Kedah. Pebbles of the chert are found in younger conglomerates. These rocks are compared with similar rocks in the Malay Archipelago. Malayan radiolarian cherts are not of deep sea origin, but large quantities of silica in solution, supplied by tropical weathering of siliceous rocks, may have promoted the growth of radiolaria in offshore seas.

1912e Note on the occurrence of struverite in Perak. *Min. Mag., Lond.* **16**, 302–3.

Struverite described by Crook and Johnstone (1912) from Salak North, Perak, probably originated in a kaolin vein cutting indurated shale near the granite margin.

1912f In: Belfield, H.C. (ed.). *Handbook of the Federated Malay States.*

Not seen.

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1913a *The geology and mining industry of the Kinta district, Perak, Federated Malay States, with a geological sketch Map*, 90p., 20 pls., 11 figs., geol. sk. map 1 : 94,040. Kuala Lumpur: Govt. Press.

The first comprehensive account of Kinta geology, now mainly of historical interest, and a useful review of previous literature. Limestone is overlain by Gondwana clays and boulder beds and these by younger Gondwana phyllites and quartzites. Detrital tin-ore is present in the Gondwana beds. Recent alluvium contains more rounded detrital tin-ore. The limestone hills are fault bounded. Tourmaline-corundum rocks are described and their origin discussed. Brief notes on some Kinta minerals are included.

1913b The geological history of the Malay Peninsula. *Q. Jl. geol. Soc. Lond.* **69**, 343–71, 1 pl., 2 figs.

A contemporary summary of the geology of Malaya. The beds above the limestone in Kinta are interpreted as glacial. A sketch map 1 : 3M shows the chief structural features of Malaya.

1913c *On the prospect of mineral oil being found in payable quantities in the Federated Malay States and other parts of the Malay Peninsula,* 11p. Kuala Lumpur: Govt. Press.

Outlines the conditions required for oil deposits and concludes that these do not occur in Malaya except possibly in the alluvium of the west coast and the small Tertiary basins.

1913d *Report on a visit to Perlis.*

Tin-ore in limestone caves is of fine grade and contains magnetite as the chief impurity. Analysis of coal from Bt. Arang is given: oil shale may occur in these Tertiary beds.

1914a *Rep. Geol. F.M.S.* [for 1913]. Published as a supplement to F.M.S. Govt. Gazette, March 27.

Contains a brief report of W. R. Jones's work in N Selangor. Limestone and schist N of Rawang are bordered to the W by quartzites and phyllites. An old coast line extending from Rantau Panjang to Sg. Bernam is clearly seen from the top of Bt. Tunggal. The tin-bearing deposits of Ulu Selangor are more sandy and have more rounded pebbles than those of Kinta. Cassiterite is disseminated in quartz-topaz veins and more rarely in topaz aplite cutting porphyritic granite of Gunong Bakau.

1914b The deposits of tin-ore in the limestone of the Kinta valley, F.M.S. *Min. J., Lond.* **106**, 823–5, 830–2, 858–9. Also published separately at Ipoh: Times of Malaya Press.

Tin-bearing pipes and lodes in limestone are characterised by abundant pyrite and arsenopyrite, with fluorite and tremolite but lacking tourmaline. They are a pneumatolytic replacement of limestone and may be continuous with ore bodies in the granite below. The absence of boron minerals in limestone suggests that boron bypassed it. A contact metamorphic aureole in limestone at Lenggong, Perak, is a narrow zone 10 ft wide and has a different mineralogy from that of the Kinta pipes.

1914c The junction of the Malayan Gondwana clays with the Mesozoic granite of the Malay Peninsula. *Geol. Mag.* **51**, 309–11, 2 pls.

Near Gopeng, Kinta, the clays show coloured streaks and in places a foliation parallel to the granite margin. They are enriched in tourmaline near the granite and carry thin veins of muscovite, fluorite, and corundum. This is offered as evidence for the clays being older than the granite, their present soft condition being due to tropical weathering.

1914d The topaz-bearing rocks of Gunong Bakau (Federated Malay States). *Q. Jl. geol. Soc. Lond.* **70**, 363–81, 2 pls., 3 figs.

Porphyritic granite was intruded first by quartz-topaz veins, in some places carrying cassiterite, iron-rich zinnwaldite and tourmaline, and later by masses of topaz aplite with some cassiterite. A 'reaction border' either of schorl rock or greisen is found bordering the quartz topaz veins. Cassiterite-bearing schorl rock and greisen formed by pneumatolytic alteration of the granite were formerly mined. They were probably formed at the margin of the granite mass whereas the quartz-topaz rock was formed deep in the magma chamber before invading the consolidated granite above.

1914e In: Howe, J.A. *A handbook to the collection of kaolin, china-clay and china-stone in the Museum of Practical Geology,* p. 102–3. London: H.M.S.O.

Includes a note on Malayan kaolinite. A vein of kaolinite at Kramat Pulai, Kinta, is figured. (Not seen).

1915 *Rep. Geol. F.M.S.* [for 1914]

Contains notes on the geology of upper Perak granite ranges, quartzite hills, limestone, quartz porphyry, and basic volcanics.

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Monazite is present *in situ* at pegmatite-limestone contact near Lenggong, Perak. Tin-ore is mined at Klian Intan from veins in sedimentary rock. Gold mining in upper Perak has ceased although the gold present in the alluvium is economical for small scale working. At Gunong Tahan quartzite and shale are folded asymmetrically and possibly overfolded to the ENE.

1916a Mineralization in Malaya. *Min. Mag., Lond.* **14**, 94–5.

A letter answering criticisms levelled by W. R. Jones (1915b) on tin mineralization.

1916b Note on a collection of rock specimens from Pulau Pisang, west coast of Johore. *J. fed. Malay St. Mus.* **7**, 31–4.

Two specimens collected *in situ* appear to be tuffaceous and siliceous argillite. Similar rocks and also volcanic ash, syenite porphyry, granite and black chert are recorded as beach pebbles. These rocks are thought to be from the Chert Series near granite. Chert, often radiolarian, occurs with volcanics in other parts of Malaya. The argillite is compared with pebbles in Kinta associated with tourmaline-corundum rock.

1916c Two large obsidianites from the Raffles Museum, Singapore, and now in the Geological Department, F.M.S. *Geol. Mag.* **53**, 145–6, 1 pl.

These are believed to have come from Kelantan. An analysis is given and it is compared with those of other obsidianites.

1917a Tungsten-ores in the Malay Peninsula. *F.M.S. Chamber of Mines Magazine,* **4**. Summary in *Min. Mag., Lond.* **14**, 347–8.

Outlines the distribution of wolframite and scheelite. Wolframite occurs, often with cassiterite, in quartz veins in granite or neighbouring schists. Scheelite is found with fluorite near granite/limestone junctions. (Original not seen)

1917b Report on the Enggor coalfield. *F.M.S. Govt. Gazette, Supplement,* Feb. 2, 3p., 1 fig.

A sequence of shale and sandstone with evidence of two 4 ft coals outcrop over a limited area.

1918a The kaolin veins. *Geol. Mag.* **55**, 79–82.

Kaolin veins occur in clay above limestone with granitic veins in Kinta. They contain traces of mica, quartz, and tourmaline and sometimes cassiterite. Their origin is discussed.

1918b The origin of the clays and boulder clays. Federated Malay States. *Geol. Mag.* **55**, 157–68.

Argues, against W. R. Jones (1917), for the original unbedded nature of the clays with associated tourmaline-corundum and other boulders. Discusses the evidence against a glacial origin for the rocks but concludes that the glacial theory best fits all the facts.

1918c Malayan geology. *Min. Mag., Lond.* **19**, 254–7.

A letter answering W. R. Jones (1917) concerning the geology of the Kinta valley.

1919 Topaz as a rock constituent. *Geol. Mag.* **56**, 190–1.

A letter concerning W. R. Jones (1916a), and arguing that topaz in topaz-rich rocks cannot all be accounted for by secondary topazization.

1920 *Rep. Geol. F.M.S.* [for 1919]. Published as a supplement to F.M.S. Govt. Gazette, Oct. 22.

A bore-hole through 81 ft of coal measures on the Perlis-Thai border passed through two seams of 6 inches and one of 12 inches. Kedah Peak is composed of quartzite intruded by granite. Alluvial tin-ore lies around the base of the mountain and magnetite occurs in the quartzite. Gives a geological sketch of the Langkawi Islands. Radiolarian rocks overlie limestone around Sg. Siput and Salak North, Perak. Viséan corals from the Kuantan area are identified by Dr. S. Smith. Lignite is recorded from the Gopeng Beds and euxenite (*s.l.*) from Negri Sembilan.

1921a *Rep. Geol. F.M.S.* [for 1920]. Published as a supplement to F.M.S. Govt. Gazette, May 20, 2p.

Details two bore-holes through the Perlis coal measures.

1921b The physical geography of the southern part of the Malay Peninsula. *Geogr. Rev.* **11**, 351–71, 9 figs.

The main coulisses are described. Granite, quartzite, and limestone hills are distinguished. Marine denudation, at a time of higher sea-level, is considered responsible for the geomorphology of the lower areas. Raised beaches evidence former sea-level changes.

1922 *Rep. Geol. F.M.S.* [for 1921]. Published as a supplement to F.M.S. Govt. Gazette, June 2, 5p.

Notes on upper Perak geology include mention of granite gneiss. Dolerite dykes cut the granite in the Kuantan district: columnar rhyolite occurs on the islands off the E Pahang coast. A bore-

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hole is recorded to 205 ft through the Perlis coal measures. A haematite lode on Bt. Menia, Johore, and a haematite deposit on Gunong Panjang, Kinta are noted. Includes an analysis of a tungsten mineral from Kramat Pulai, Kinta, and a report by Professor Seward on conifer remains in chert pebbles from Sg. Tembeling, Pahang. An indeterminate fusulinid is recorded in chert from near Bt. Chuping, Perlis.

1923a The structural geology of British Malaya. *J. Geol.* **31**, 556–70, 2 figs.

The geological sequence is summarized. A series of coulisses, mainly of granite, run en echelon parallel to the axis of the Peninsula. Between the coulisses sedimentary rocks are strongly folded. Large faults are associated with the magmatic stoping of limestone blocks.

1923b In: Winstedt, R.O. (ed.) *Malaya.* Chapters 3–4. London: Constable and Co.

Summarises the geology and mineralogy.

1924a *Rep. Geol. F.M.S.* [for 1923]. Published as a supplement to F.M.S. Govt. Gazette, May 2, 4p.

Wolframite is richer than cassiterite at depth in Bt. Kachi Mine, Kedah (W. R. Jones 1920). The geology of Kelantan is a continuation of that of Ulu Pahang and the same rock 'Series' are recognised. Pulau Tinggi and other islands off the Johore E coast are of rhyolite and tuff. Gunong Bekok, Johore, is formed of hornblende granite; Ulu Selai of rhyolite and tuff. A zinc-copper-bismuth deposit at the limestone-granite contact in Langkawi is noted.

1924b The geology of Singapore Island. *J. Malay Brch R. Asiat. Soc.* **2**, 1–8, geol map 1:84,480.

A summary of work mainly previously published. Upper Triassic shales and sandstones including pebbles of chert and volcanics are well exposed in the S, dipping steeply SW. Tourmaline, cassiterite and molybdenite have been recorded from the granite of Bt. Timah. Hornblende granite is found at Seletar, Pulau Ubin, and Changi. The alluvium forming low hills 50–100 ft above sea-level in the E of Singapore contains staurolite and a high percentage of felspar. It may represent former terraces of the Johore river.

1924c The Government Geologist's report on "Cameron's Highlands" *Proc. Federal Council F.M.S.* [for 1923], paper 6, C 47–9.

Mainly a discussion of the topography.

1925a Geology of the Kinta valley. *Min. Mag., Lond.* **33**, 156–7.

A letter referring to Cameron (1925c). A bore put down on the spot postulated by Cameron to be underlain by schist only, traversed limestone underlying the schist. This limestone is the same as Cameron's 'older limestone'.

1925b Summary of the geological history of British Malaya and British Borneo. *Gedenboek Verbeek. Verh. Geol.-mijnb. Genoot. Ned. Kol.* (geol. ser.) **8**, 441–6.

A stratigraphic summary with no original content.

1926a The geology of the Kinta district. *Min. Mag., Lond.* **35**, 53–5. Also published in: *Rep. Geol. F.M.S.* [for 1925], appendix 2.

A statement of established facts prompted by the controversy between W. R. Jones (1925a,b) and Cameron (1925a,b,c.d, 1926). The limestone of Kinta is compared with Carboniferous limestone known elsewhere in Malaya; and the clastic metasediments to the Triassic clastics of the Taiping area. There is no evidence for two distinct limestone formations in Kinta. The origin of the boulder clays is doubtful. The tin-ore they carry may possibly be derived from an older (Palaeozoic) granite, but there is no evidence for such a granite *in situ* in Kinta. Detrital tin-ore cannot be present below the limestone but primary tin-ore may be found at the granite contact beneath the valley.

1926b *Rep. Geol. F.M.S.* [for 1925]. Published as a supplement to the F.M.S. Govt. Gazette, April 30, 3 p.

Gold is recorded from quartz veins at Batang Padang, Perak. The vein quartz of the Klang Gates dyke, Selangor, contains only 0.02% impurity of pyrrhotite, scheelite, and ? cassiterite. Sulphide mineralization of limestone away from the granite contact in Kinta suggests that the valley is underlain by granite. Native copper and cobaltite is recorded in tin concentrates from Kinta.

1926c The palaeontology of British Malaya. *J. Malay. Brch R. Asiat. Soc.* **4**, 173–84.

A summary of palaeontological knowledge mainly published previously. Fossiliferous strata of Viséan, Upper Carboniferous, Permian, Triassic, and Tertiary age are recognised.

1927a *Rep. Geol. F.M.S.* [for 1926]. Published as a supplement to the F.M.S. Govt. Gazette, April 14, 5p.

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Three analyses for cassiterite in porphyritic granite gave 0.00034% to 0.000087%. Chemical analysis is given of a hydrated borate of magnesium, probably a new mineral, from the Beatrice Mine, Kinta.

1927b The geology of Malacca, with a geological map and special reference to laterite. *J. Malay Brch R. Asiat Soc.* **5**, 278–87, 2 pls., 1 geol map 1 : 253,440.

The oldest rocks are phyllites, locally associated with calc-silicate rocks. Quartzite and shale are believed to form a younger series. Granite younger than these sediments occupies much of the eastern part of the state. Hot springs occur within the granite. Old gold workings are present in the NE and around Kesan and Jasin, stanniferous veins are worked in the phyllite. Alluvial tin is worked on the coast, where natural beach concentrates contain up to 8 katis of cassiterite per cubic yard, a chemical analysis of laterite is given: it is formed over phyllite and granite in Malacca and is used as a building stone.

1927c Geological map of British Malaya, issued as folio II of the general geological map of the Netherlands East Indies. *Jaarb. Mijnw. Ned-Oost-Indie,* [for 1925]. (Reprint only seen, 16p.)

Explanation of a coloured map 1 : 1M. The sedimentary rocks are grouped into Carboniferous, Triassic, Neogene, and Recent alluvium. Limestone, the Pahang Volcanic Series, dolerite, radiolarian chert, and fossil localities are indicated. Hornblende granite, biotite granite, syenite, and diorite are distinguished. Fossils are listed.

1928 *The geology of Malayan ore-deposits,* xv + 216p., frontispiece, 3 pls., 47 figs. London: MacMillan and Co.

A comprehensive review of the occurrence and nature of gold, cassiterite, tungsten and other metallic ores. A discussion of all mining areas in the western and eastern tin belts comprises half the book. A bibliography and index, a geological map of Kinta (1 : 126,720), and a map of Malaya showing the occurrence of tin and gold (1 : 1.3M) are included.

1929a *Rep. geol. Surv. Dep. F.M.S.* [for 1928]. Published as a supplement to the F.M.S. Govt. Gazette, March 15, 10p.

Notes on Kelantan include mention of gold in Ulu Pergau. A cassiterite-arsenopyrite-chalcopyrite deposit in a 'pipe' in limestone at the Beatrice Mine, Kinta, is now worked to a depth of 320 ft. Chemical analyses given of magnetic and non-magnetic cassiterite. Current bedded and oolitic tourmaline-corundum rock found *in situ* in Kinta. Analysis suggests that the mica it contains

is margarite. A vitric tuff, 'vitrite', containing siliceous organic bodies is recorded near Kuala Plus, Perak.

1929b Cubic magnetite and haematite. *Min. Mag., Lond.* **40**, 30 only.

Magnetite and haematite pseudomorphing pyrite is recorded from alluvial concentrates at Serendah, Selangor.

1929c The progress of the Geological Survey of Malaya. *Proc. 4th. Pacif. Sci. Congr.* **2a**, 449–66, map of fossil localities 1:2.2M.

A general review of Malayan geology with fossil lists. The Chert Series including shales and bedded cherts, is thought to lie between the Carboniferous Raub Series and the Trias. High level alluvium is recognised in Johore and Singapore and Pleistocene volcanic ash of the Perak river valley is described. Granite clasts in rocks older than the Mesozoic granite evidence a Palaeozoic granite. This is recognised *in situ* in Mergui, Lower Burma. Petrology of granitic and associated rocks of Singapore and of tourmaline-corundum rocks of Kinta is briefly discussed.

1929d Laterite. *Malay. agric. J.* **17**, 454–9.

A discussion of the definition of laterite. That of Malacca fits Buchanan's description of the original Indian laterite. A chemical analysis of Malacca laterite formed on acidic rocks, indicates that most of the alumina is in the form of an hydrated silicate.

1929e The production and occurrence of gold in Malaya. *15th. Int. geol. Congr. The gold resources of the world*, 227–31, 1 map.

The main occurrence of gold is within a N–S strip running from Kelantan through Pahang, and narrowing in Negri Sembilan and Johore. Gold is associated with intermediate plutonics and acid to intermediate volcanics. It is also obtained as a by-product of tin mining, especially around Tapah and Bidor, Perak, where it originates in small veins in schists independent of the tin-ore. In the Raub gold mines the ore is found in quartz lenticles inter-bedded with or cutting across calcareous shale. It is unlikely that Malayan gold deposits were richer in past historical time. Map showing gold-bearing areas 1 : 3.5M.

1929f Radiolaria-bearing rocks in the Malay Peninsula. *De Mijningenieur* **11**, 238–9.

Radiolarian chert and shale, believed to be Triassic occurs usually in association with quartzite and sometimes with volcanics. Details the occurrences of these rocks in E Selangor and SE Pahang.

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Chert pebbles are present in Triassic conglomerates. The chert is usually in beds 1–2 inches thick and contains carbon and finely divided pyrite. Radiolarian genera are listed from Singapore chert.

1930a *Rep. geol. Surv. Dep. F.M.S.* [for 1929]. Published as a supplement to the F.M.S. Govt. Gazette, Feb. 28, 7p.

Contains a short review of coal occurrences in Johore: coal is exposed in a railway cutting near Kuang. The 'pipe' in the Beatrice Mine, Kinta, after being worked for 400 ft has reached an aplite mass (Scrivenor 1931b). Gold derived from quartz stringers occurs in a tin mine near Tapah, Perak. *Daonella* sp. identified from Sg. Kelubi, Kelantan.

1930b A Recent rhyolite-ash with sponge-spicules and diatoms in Malaya. *Geol. Mag.* **67**, 385–93, 3 pls., 1 fig.

This rock, from central Perak, consists of fine-grained pumice, fresh albite, quartz, biotite and other rock-forming minerals, and siliceous organic bodies. The latter are sponge spicules and spherasters, considered marine by Mr. M. Burton of the British Museum and diatoms similar to freshwater forms from Lake Chini, Pahang. The ash now lies at 150 ft above sea-level but could have been a Pleistocene marine deposit. The inorganic content of the ash was probably derived from the Lake Toba volcano in Sumatra. The freshwater diatoms may have been wind transported.

1930c Laterite. *Geol. Mag.* **67**, 382–4.

In Malaya the main product of the weathering of acid igneous rock is a hydrated silicate of alumina, probably kaolin. Aluminium hydrate is formed by weathering of basic rocks. The original laterite from India was of the former type.

1931a *The geology of Malaya,* xx + 217p., 33 figs., geol. map 1 : 760,320. London: MacMillan and Co.

The only general text on Malayan geology, giving a comprehensive survey of knowledge up to 1930. Separate chapters deal with physical geography; intrusive rocks (the granite is thought to be late Mesozoic); Carboniferous limestone and shale; Triassic clastics; shallow water radiolarian chert and shale; the 'Pahang Volcanic Series'; structure of the pre-granitic rocks; the small late Tertiary coal-bearing basins; Pleistocene history, alluvium (including the Gopeng Beds of Kinta) and hot springs; weathering and laterite; metamorphism and the tourmaline-corundum rocks; notes on minerals and tektites; and economic rocks and minerals other than ores. The historical introduction includes a good summary of the controversy over Kinta geology. The names 'Tembeling Series' and 'Raub Series' are discarded. Full bibliography and index. Map of fossil localities 1 : 5.7M.

1931b *Rep. geol. Surv. Dep. F.M.S.* [for 1930]. Published as a supplement to the F.M.S. Govt. Gazette, April 10, 14p.

Notes bore-holes through coal deposits near Kluang, Johore, which are compared with Tertiary coal beds in Mergui, Burma. The Beatrice Mine aplite (Scrivenor 1930a) now seen to be the main granite body. Notes on mineralized shales and quartz bodies in limestone in Kinta. Evidence that folding controlled the distribution of some of the Kinta limestone hills. Tourmaline-corundum rock may result from selective metamorphism of shale near limestone. Post-Triassic boulder beds described from Batu Arang. Aurichalcite, allophane, gibbsite, jamesonite, beryl and scorudite are recorded from Kinta.

1931c Report on the economic geology of Kelantan and Trengganu. *Rep. geol. Surv. dep. F.M.S.* [for 1930], appendix.

Tin deposits in Ulu Menggiri are difficult of access. In central Kelantan, gold is present in small amounts, generally uneconomic. A quantitative report is given on gold in the Sokor and Galas rivers. Metallic sulphides are present in Ulu Sokor. In Trengganu tin-ore is sometimes associated with hornblende granite and syenite. Large deposits of wolframite occur in Ulu Kamaman and Ulu Dungun.

1934 Note on the correlation of the geology of Burma and Malaya. Appendix A in: Chhibber, H.L. *The geology of Burma* p. 519–24. London: MacMillan and Co.

The Moulmein limestone of Burma is correlated with the Raub Series and the Mergui Series of Burma is compared with the Carboniferous rocks underlying the limestone of Langkawi, Perlis and Kedah. The Rhaetic Napeng Beds of Burma appear to be unconformable on the Moulmein limestone and an unconformity may also be present between Permian and Triassic sediments in Malaya. Small coal-bearing late Tertiary basin deposits are known both in Burma and Malaya. The early Palaeozoic and late Cretaceous to early Eocene intrusives of Burma probably had counterparts in Malaya.

1935 In: Burkill, I.H. *A dictionary of the economic products of the Malay Peninsula.* London: Crown Agents.

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