Bulletin No. 2

Geological Society of Malaysia

Bibliography and Index of the Geology of West Malaysia and Singapore

compiled and annotated
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KESATUAN KAJIBUMI MALAYSIA
Kuala Lumpur, 1968

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Introduction

This bibliography was started a few years ago as a corollary of local geological studies and of teaching the stratigraphy of the Malay Peninsula. I then thought that, if annotated and published, it could become a useful tool for students and research workers in the country. Papers on the geology of West Malaysia and Singapore are again on the increase after a lull during the period 1940–1960. Most of these are scattered among the numerous scientific journals now published. The older literature is confined to fewer periodicals but is in many cases not readily available. Interest in mining, oil exploration, and civil engineering in West Malaysia is now greater than ever before and visiting experts in these activities will find the existing geological literature unsummarized by a general book since Scrivenor's *Geology of Malaya* published in 1931.

During subsequent preparation of the bibliography I have had the practical aspect constantly in mind and have not considered it merely as an academic exercise. I have included most aspects of geology but excluded mining technology and mineral dressing, pedology, hydrology, and other subjects at the fringe of the geological sciences. General works which briefly mention the geology of the Malay Peninsula have also been excluded.

In preparing the bibliography I have relied very largely on libraries in West Malaysia, notably that of the Geological Survey Department in which much of the older literature survived the Japanese occupation. Items not available locally were obtained as xerox copies, mainly from England, and these copies are now deposited in the Klompé Reading Room, Department of Geology, University of Malaya.

The main part of the bibliography is an annotated list of works published between 1822 and 1967. These are referred to in a subject index by the author's surname (including initials only when two authors share the same surname) and the year of publication. Small letters are used to distinguish the works of a single author all published in the same year. The style of the references follows the Harvard system. Abbreviations for the titles of periodicals are taken from the *World list of scientific periodicals* (1963–1965, 4th ed. London: Butterworths). The volume number is shown in bold type, the fascicle (only given when each fascicle has its own pagination) in parentheses, and the first and last page numbers in ordinary type. Text figures are referred to as 'figs'.

The annotations attempt to point out, as concisely as possible, original facts and ideas which may be of use to the student. They are inevitably coloured, but I hope not dominated, by my own interests. Author's abstracts have rarely been used because the majority of items have no abstract and where abstracts are given they are frequently not of the informative type. The subject index was prepared at the same time as the annotations and the items in it are based on the entire publication, not only its annotation. On general questions of procedure *Bibliographical procedures and style* (1954, Washington: Library of Congress) has been valuable.

Many important and practically useful studies have been written down without being intended for publication. Thus a large number of reports have been prepared by various members of the Geological Survey Department, West

Malaysia, from 1903 onwards, and, in recent years under the directorship of Dr. J. B. Alexander, that Department cyclostyled a number of 'Professional Papers' including annual reports, for limited distribution. Some of these were published elsewhere but the remainder cannot be considered as published. The Department of Geology, University of Malaya, has a steadily increasing number of students' theses and also some unpublished reports by staff members.

The inability of the Geological Survey Department, West Malaysia, to publish the results of its regional mapping surveys has created a formidable pile of manuscripts awaiting publication. The task of revising and editing these is now an enormous one but is being tackled by an editor seconded to the Department from Canada under the Colombo Plan. Appendix I is a list, albeit incomplete, of manuscripts including those awaiting publication. The works it lists contain a large amount of information including much detailed fact which will not become out of date. It would have been very misleading to have left these out of the bibliography but, since they are unpublished, I cannot annotate them.

A number of geological maps have been published by the Geological Survey Department and issued independently as well as together with regional memoirs. These are listed in Appendix II together with a larger number of manuscript maps, privately circulated.

The preparation of this bibliography was possible only with the help and co-operation of a number of people. In particular I am indebted to W. D. Procter and S. K. Chung, successive Directors of the Geological Survey Department, West Malaysia, for placing their Department's library at my disposal and to them and their staff for answering many detailed and boring questions about dates of publication and page numbers. I also wish to thank the staff of the University of Malaya library who have kindly allowed me to consult their catalogues of periodicals and of the Library of Congress, have obtained for me works from Singapore and Australia, and supplied xerox copies and microfilm. I thank the Director of the Arquib Negara who has allowed me to consult Government Gazettes and other publications within his custody.

Individuals, too numerous to mention here, have aided and abetted my efforts, but for errors and omissions of the resulting work I must bear the full responsibility. However, I hope that in spite of these, it will prove to be a handy bibliography for Malayan geology.

D. J. GOBBETT.

Kuala Lumpur
11 Jan 68

Some abbreviations used in the annotations

Malay geographic terms

Bt.	=	Bukit (*hill*)
Kg.	=	Kampong (*village*)
P.	=	Pulau (*island*)
Sg.	=	Sungei (*river*)
Tg.	=	Tanjong (*point; cape*)
K.	=	Kuala (*mouth of river*)

Gunong (*mountain*) is not abbreviated.

Compass directions are indicated by capital letters: N, S, NE, etc.

Chemical symbols for elements are used where no confusion results from such use: Sn, Fe, Ca, etc.

Published Works 1822 — 1967

ADAMS, F.D.

1928 Tin mining in Malaya. *Trans. Can. Inst. Min. Metall.* **8**, 1–32, 19 figs.

Adams spent one month in Malaya. Descriptions of the occurrence of tin ore in Kinta are taken from Scrivenor, W.R. Jones, and Willbourn. Dredging near Batu Gajah has shown that tin ore is not concentrated at the base of the alluvium but is more or less evenly distributed in profile.

AGOCS, W.B.

1959–65 Airborne magnetometer and scintillation counter survey. *Econ. Bull. geol. Surv. Dep. W. Malaysia* **1**, pts. 1–6.

Preprint of Agocs 1966. Parts 1, 2, 5, and 6 contain interpretive summaries by J. B. Alexander.

1966 *Report on airborne magnetometer and scintillation counter survey of Kedah, Perak, Selangor, Trengganu, Pahang and Johore, Federation of Malaya.* Malaysian Govt. 340p., 100 figs.

Shallow igneous bodies cause sharp magnetic anomalies in all areas surveyed. The more intense anomalies found in central S. Pahang and E. Johore may indicate intermediate or basic igneous rocks but high radioactivity is also found in these areas. In S. Trengganu two magnetic anomalies compare with that of the Bukit Besi iron mine. S. Pahang and Johore gave 25 magnetic anomalies with high susceptibility contrast values. High radioactivity in S. Perak is probably due to clay concentration.

ALEXANDER, F.E.S.

1950 *Report on the availability of granite on Singapore and the surrounding islands.* Singapore Govt. Press. 24p., 5pl., 5 figs., geol. map 1:63,360, 2 sk. maps. 1:25,300.

Igneous rock available for construction and road works totals 2×10^8 cubic yards. The depth of weathering is related to slope and closeness of jointing. Details of overburden and granite resources are given for quarried and suitable but unquarried sites in central Singapore and Pulau Ubin.

Appendix I outlines the general geology. Mica schist is overlain unconformably by an argillaceous series with minor tuff, spilite and chert. This is followed by an arenaceous series with plant remains and conglomerates containing mica schist pebbles. Faults trend NW and NNE. Central Singapore consists of granite, diorite, norite and hybrid rocks, cut by pegmatites, and granite prophyry and quartz dolerite dykes. The igneous complex of Changi and Pulau Ubin is of metamorphosed hornblende granite and more basic rocks cut by pegmatite and lamprophyre dykes. The gravels, sands, and subordinate clays comprising the older alluvium in the east of Singapore Island are thought to be estuarine or deltaic and are overlain by recent alluvium. Appendix II notes the occurrence of economic sand and gravel, brick clays, bauxite, ground water and building foundations.

1958 Observations on tropical weathering: a study of the movement of iron, aluminium and silicon in weathering rocks at Singapore. *Proc. geol. Soc. Lond.* **1560**, 83–6, 117.

1959 Ibid. *Q. Jl. geol. Soc. Lond.* **115**, 123–44, 2 pls., 5 figs., 3 tabs.

The composition of the weathering rock determines that of the solution from which precipitates are deposited but the type of precipitate depends largely on the rock texture. Pure iron oxide concretions are found only in weathered igneous rocks and shales; seams of secondary quartz crystals are found in weathering quartzites; and composite seams of crystalline quartz enclosed in iron oxide layers are found in mixed argillaceous-arenaceous rocks. This separation of iron and silica may be due to dialysis, the colloidal iron deposited on the walls of an intermittently drying crack forming a semi-permeable membrane which allows crystalloid silica to pass through into the crack. Gibbsitic concretions are associated with shales, the form of these being controlled by the structure of the weathering rock. Weathering processes are controlled by the density of the surface vegetation, the decomposition of which may account for the low pH values found in some rocks. In others the sulphide content is sufficient to account for the very low pH values of the weathering zone. (Author's abstract, slightly modified)

ALEXANDER, J.B.

1940 Progress report on geological work in that part of southwest Pahang covered by topographical sheets 3B/8, 3B/12 and 3C/9. *Rep. geol. Surv. Dep. F.M.S.* [for 1939], 30–4.

The "calcareous formation" is mainly argillaceous with some limestone and tuff. It outcrops in the eastern part of the area.

The "arenaceous formation" outcrops along the eastern foothills of the granite Main Range. Quartz-tourmaline-cassiterite lodes and stockworks, and cassiterite-bearing greisen occur in the granite and its metamorphic aureole. Small quantities of wolframite are mined near Manchis.

1941 An outline of prospecting and mining activities near Bentong. *Yb. Cham. Mines F.M.S.* [for 1940], 130–4.

The main zones of mineralization trend SE or SSE and consist of several parallel cassiterite-bearing quartz-tourmaline stringers separated by barren granite. Local enrichments are sometimes found where two sets of stringers intersect. At Bukit Ulu Bakau a cassiterite-bearing quartz-topaz sill has been mined for 30 years. At Murai cassiterite occurs in stockwork veinlets in tourmalinized quartz-mica schists near the granite contact. Mentions wolframite N of the Manchis area and alluvial gold. Sketch map 1: 500,000 shows mining localities.

1947a Progress report on geological work in south-west Pahang. *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 34–44.

The "arenaceous formation" of the Main Range foothills is considered older than the "calcareous and argillaceous series" which is succeeded by a younger "arenaceous series". The oldest post-Triassic intrusives were basic and were altered to serpentine before the main earth movements and granite intrusion. Cassiterite pneumatolysis followed and also hydrothermal activity. Hot springs remain active today. Notes are given on the tin mines in the area.

1947b Report on special investigation of coal-bearing formation at Bukit Arang in the state of Perlis during 1941. *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 44–6.

A 600 ft borehole passed through eight major horizons of brown and grey clays and six horizons with coal traces. Some of the clays are probably worth working for pottery. The Japanese invasion prevented further work.

1948 Notes on some geological aspects of the area near Bentong, south-west Pahang. *Rep. geol. Surv. Dep. Malay. Un.* [for 1947], 14–21.

Three hot springs in granite have temperatures of 97–125°F. The dissolved solids (about 0.02%) are SiO_2, $CaCO_3$, and $NaHCO_3$. The water supply of Bentong is discussed and dam sites suggested for hydro-electric power. Possible future ground sluicing of eluvial tin deposits might cause rapid silting of impounded water. Gold and wolframite occurrences are summarized.

1949 Progress report on geological work in south-west Pahang and in part of north-west Selangor. *Rep. geol. Surv. Dep. Fed. Malaya* [for 1948], 19–24.

A summary of the occurrence of tin-ore in the area and recommendations for future prospecting. No extensive alluvial areas are suitable for dredges. Large scale ground sluicing on the Main Range granite and associated metasediments is suggested. Tin ore is generally widely dispersed in thin veins in the granite. Larger lodes can only be proved after the cover of decomposed rock is removed.

1950 Progress report on geological work in south-west Pahang and in Selangor. *Rep. geol. Surv. Dep. Fed. Malaya* [for 1949], 28–34.

Heavy mineral analyses show "Younger Arenaceous Series" quartzites to resemble known Triassic quartzites both having zircon more abundant than tourmaline. "Older Arenaceous Series" quartzites have tourmaline more abundant than zircon, a higher proportion of blue-green tourmaline and a higher degree of grain roundness. Notes on the Klang Gates dam site near Kuala Lumpur and on granite quarry sites in Malacca are included.

1956 *Lexique stratigraphique international,* vol. 3, fasc. 6b, 7c, *Malaya.* Paris: Inter. geol. Congr. 31p.

Lists 58 rock and time-rock units. Notes their original and subsequent meanings and gives a general description of each but includes no formal definitions.

1959 Pre-Tertiary stratigraphic succession in Malaya. *Nature, Lond.* **183**, 230–1.

New fossil discoveries necessitate a revision of the succession. Formal names are given as follows: Machinchang Formation for the "older arenaceous series" in Langkawi, now known to be Cambrian; Setul Formation of Ordovician and Silurian age in Langkawi and Perlis; Kuantan Group—Lower Carboniferous; Bentong Group—Carboniferous [subsequently known to be Lower Palaeozoic, see Jones *et al.* 1966]; Raub Group, equivalent to the previously named "calcareous series" and "Raub Series"—Upper Carboniferous and Permian; Lipis Group for the "younger arenaceous series"—Triassic; Gagau Formation—late Jurassic or early Cretaceous.This sequence is correlated with the succession in Thailand.

(ALEXANDER, J.B., ed.)

1961 Geological appreciation summary regarding prospects of iron-ore deposits in the Mukim of Bera, District of

Temerloh, Pahang. *Prof. Pap. geol. Surv. Dep. Malaya,* **E61.1P,** 21p., 29 figs.

Four magnetic anomalies interpreted from an aeromagnetic survey (Agocs 1966) were investigated by ground magnetic and geological surveys. One anomaly south of Tasek Bera, Pahang, proved to be caused by a magnetic body covering about 100 acres. The other anomalies were caused by magnetite disseminated in volcanic, dyke or sedimentary rocks and are of no economic importance.

(ALEXANDER, J.B.)

1962a A brief summary of the geology of Malaya. *Malay. Nat. J.* **16**, 30–5, 1 tab., 2 maps 1 : 5.5M.

Mentions the discovery of Lower Palaeozoic rocks in Kedah and pre-Carboniferous schists in Kelantan. Includes geological and tectonic maps of the Malay Peninsula and the stratigraphic succession in tabular form.

1962b A short outline of the geology of Malaya with special reference to the Mesozoic orogeny. *Crust of the Pacific basin. Monogr. Am. geophys. Un.* **6**, 81–6, 2 tabs., 2 maps 1 : 5.5M.

"The general regional geology and structure of Malaya is succinctly described, illustrated by two coloured maps (scale 1 : 5,500,000). Details of the stratigraphic succession and igneous history are summarized in table form and several isotope age determinations are quoted as indicating the age of the major granite emplacement." (Author's abstract)

Records Lower Palaeozoic rocks from Kedah, Perak and Selangor and schist of ? Lower Palaeozoic age from Kelantan. Isotope age determinations of the granites are Triassic and Jurassic.

1963 Review of progress in geological work since 1920 in the Federation of Malaya. In: *Geology and solid earth geophysics of the Pacific Basin. Rep. 10th Pacif. Sci. Congr.* 1961. Standing Committee geology and geophysics, p. 89–96.

Gives an historical summary of the Geological Survey of Malaya and notes recent advances in knowledge of the stratigraphy and in geophysical, geohydrological, and geochemical surveying.

ALEXANDER, J.B. and FLINTER, B.H.

1965 A note on varlamoffite and associated minerals from the Batang Padang district, Perak, Malaya, Malaysia. *Miner. Mag.* **35**, 622–7.

Malayan varlamoffite is found encrusting cassiterite crystals and appears to be a hydrated microcrystalline form of cassiterite. It shows an X ray powder diffraction pattern very similar to that of cassiterite and in this agrees with varlamoffite from Cornwall and the Congo which was derived from stannite. A new floures-cent calcium-tin silicate, malayaite; and a mica composed of Al, Si, Mg, Li, and Na are also recorded associated with varlamoffite.

ALEXANDER, J.B., HARRAL, G.M. and FLINTER, B.H.

1964 Chemical analyses of Malayan rocks, commercial ores, alluvial mineral concentrates 1903–1963. *Prof. Pap. geol. Surv. Dep. W. Malaysia,* **E64.1C,** 295p.

Analyses of 120 igneous, 216 sedimentary and 46 metamorphic rocks and a selection of 792 assays of commercial ores and alluvial mineral concentrates.

ALEXANDER, J.B., MACDONALD, S. and SLATER, D.

1961 The basement rocks of Malaya and their paleogeographic significance in South-East Asia.—A discussion. *Am. J. Sci.* **259,** 801–6.

Objects to Hutchison (1961a) and criticises the basis for his observations.

ALEXANDER, J.B. and MÜLLER, K.J.

1963 Devonian conodonts in stratigraphic succession of Malaya. *Nature, Lond.* **197,** 681 only.

Three Upper Devonian conodont species are recorded from the limestone of Gunong Kanthan, Chemor, Perak.

ALEXANDER, J.B. and PROCTOR, W.D.

1955 Investigations upon a proposed dam site at Klang Gates, Federation of Malaya. *Colon. Geol. Miner. Resour.* **5,** 409–15, 4 pls., 1 fig.

The northern end of the Klang Gates gorge was selected as a dam site to create a 4,000 million gallon reservoir for Kuala Lumpur. The dam foundation is a 500 ft. wide quartz reef which is well jointed, the major, NE, joints being open. Ground and air stereoscopic photograph pairs are included in the illustrations.

ALLEN, B.M.

1961 Limestone hills near Ipoh. In: *Nature Conservation in Western Malaysia,* p.68–72, 2 pls., 1 fig. Kuala Lumpur:

Malayan Nature Society.

Mainly a biological account but includes a clear map of the hills 1 : 190,000.

AMIES, A.C.

1949 Progress report on geological work in southern Trengganu. *Rep. geol. Surv. Dep. Fed. Malaya* [for 1948], 42–6.

Clastic sediments with rhyolite and rhyolite tuff strike N–S near Chukai. Carbonaceous shales at Tg. Mat Amin and near K. Kemaman have yielded plant fossils. At Bundi are hornfels, banded shale, limestone and chert intruded by biotite granite and with quartz-cassiterite-sulphide lodes near the contact. In the Besut area in north Trengganu the granite is cut by small dolerite dykes and gabbro is recorded. Notes on tin, graphite, wolfram, iron and manganese mines.

ANDREWS, C.W.

1905 Fossil tooth of *Elephas namadicus* from Perak. *J. fed. Malay St. Mus.* **1**, 81–2.

Describes a molar fragment of *Palaeoloxodon namadicus* found 12 feet below the surface in tin-bearing alluvium at Salak North. (From Hooijer 1963, original not seen)

ANNANDALE, N., COGGIN-BROWN, J. and GRAVELY, F.H.

1913 The limestone caves of Burma and the Malay peninsula. *J. Asiat. Soc. Beng.* (n.s.) **9**, 391–423.

Mentions Batu Caves. Quotes Scrivenor on the limestone in Pahang and its fossils.

ANONYMOUS

1889 Tin in the Malay Peninsula. *Engng Min. J.* **47**, 48–.

Not seen.

1904 The Tambun Tin Mine, Perak. *Min. J., Lond.* **76**, 626–.

Not seen.

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

A review of Scrivenor (1913a).

1919 Tin deposits of Kedah, F.M.S. *Min. J., Lond.* **125**, 315–.

Not seen.

1935 Geology and minerals. In: German, R.L. (ed.) *Handbook to British Malaya,* p.38–41, 3 pls., 1 geol. map 1:1M. London: Malay States Information Agency.

A brief account of the economic geology of Malaya.

1952 Federation of Malaya and Singapore. In: Coal and iron resources of Asia and the Far East. *Miner. Resour. Devel. Ser.* **1**, 113–20, geol. map. 1:1.6M, locality map 1:2.5M. Bangkok: U.N.E.C.A.F.E.

A description of the Batu Arang coalfield is based on Roe (1953). At Ulu Rompin, Pahang, veins of haematite and magnetite were introduced into a quartz porphyry by a later granite and occupy a series of N–S trending lenses. At Bukit Besi, Trengganu, iron ore occurs near the granite-shale contact. A massive primary ore has abundant martite. It is partly limonitized. Limonite is mined at Temangan, Kelantan, and haematite and magnetite boulder ore at Pelepah Kanan, Johore. Other deposits are mentioned.

1966 Age determination unit. Summary of results from Malaysia. *Ann. Rep. Inst. geol. Sciences* [for 1965], *pt.2. Overseas geol. Surveys.* 50 only, table 8.

Fourteen age determinations are given for Malayan granites. All the now available granite dates appear to fall into five groups, Permian, early Trias, late Trias, Jurassic-Cretaceous boundary, and Cretaceous-Tertiary boundary. Some of the later dates may represent metamorphism of pre-existing granites.

AW, P.C.

1967 Ignimbrite in central Kelantan, Malaya. *Geol. Mag.* **104**, 13–17, 1 pl., 1 fig.

An ignimbrite dyke, running N–S for 15 miles south of Temangan, plugs an old feeding fissure. It is intermediate in composition between rhyolite tuff and rhyolite lava and is interpreted as a tuff flow.

BALFOUR, J.F.

1907 In: *J. Soc. Arts, Lond.* **55**, 505–7.

A general account of the occurrence of tin in Malaya. Mentions tin "in a matrix of hard crystalline limestone" at Lahat and the presence of more than one level of "pay gravel" in some alluvial deposits.

BALL, H.W.

1967 Palaeontological investigations, Malaysia. *Ann. Rep. Inst. geol. Sciences* [for 1966], 149 only.

The Permian brachiopod *Costiferina* is recorded from N Kelantan; and Silurian corals, *Favosites* and *Heliolites*, from Chemor, Perak.

BARNES, W.D.

1903 Notes on a trip to Gunong Benom. *J. Straits Brch R. Asiat. Soc.* **39**, 1–18.

Mentions the granite of Gunong Benom, coarse conglomerates of Gunong Raka and Jeram Kapur below Bentong, and limestone hills of Serdam and Chintamani.

BEARD, E.H.

1950 Thorotungstite—a misnomer. *Colon. Geol. Miner. Resour.* **1**, 50–1.

Thorotungstite from Kramat Pulai, Perak (Scrivenor and Shenton 1927) re-analysed and found to be a tungstate of rare earths, mainly yttrium, and to contain no thorium. The mineral should be called yttrotungstite.

1961 The geology and mineral resources of the Kinta Valley, Perak, Federation of Malaya. *Overseas Geol. Miner. Resour.* **8**, 313–4.

A summary of Ingham and Bradford (1960).

BECHER, H.M.

1893 The gold-quartz deposits of Pahang (Malay Peninsula). *Q. Jl. geol. Soc. Lond.* **49**, 84–8.

Steeply dipping slate, sandstone and impure limestone contain auriferous quartz as lodes and irregular formations. Many lodes are intimately associated with trachyte-porphyry dkyes. Rich ore is very localized. Weathering sometimes concentrates the gold in superficial detritus.

BEMMELEN, R.W. van

1940 On the origin of some granites from Singapore. *Ing. Ned.-Indie*, sect. 4, **7**, 23–35.

Granites from Bukit Timah and Mandai show phenocrysts younger than the groundmass and it is argued that they are porphyroblasts.

Thin sections of known migmatitic granites resemble those of the Singapore granites.

1949 The Malay Peninsula. In: *The geology of Indonesia,* vol. 1A, 360–4, 1 fig., 1 tab.

Based mainly on the published work of Scrivenor, Willbourn and Richardson. Submits an hypothesis that there was a first orogenic phase at the end of the Palaeozoic causing uplift in the east and the deposition of Triassic flysch. A second phase of mountain building, possibly at the end of the Triassic, caused isoclinal folding and thrusting to the west, followed, perhaps in the Jurassic, by the emplacement of tin-bearing granites of the Main Range. A Malayan double orogene is envisaged, with an inner volcanic arc and an outer non-volcanic arc. The post-Mesozoic history of Malaya is summarized.

BEYSCHLAG, F., VOGT, J.H.L. and KRUSCH, P.

1914 The Straits Settlements including Banka, Billiton, etc. In: *The deposits of the useful minerals and rocks,* vol. 1, p.437–44, 5 figs. London: MacMillan and Co. (Translated by S.J. Truscott).

Includes a map of Malaya showing mining areas.

BOTT, W.

1891a The thermal springs of Selangor and Malacca. *J. Straits Brch. R. Asiat. Soc.* **24**, 43–62.

The springs lie in decomposed granite which is coated with siliceous sinter. The water is 95–185°F and contains 250–400 ppm dissolved solids, mainly silica. Bott destroys Meunier's theory of tin *in statu nascenti* in hot springs (Meunier 1890).

1891b The alleged discovery of mercury in Malacca. *J. Straits Brch. R. Asiat. Soc.* **24**, 79–82.

Metallic mercury in lateritic soil on St. Paul's Hill possibly originated from a store of mercury in the old Portuguese Government buildings.

BOUCOT, A.J., JOHNSON, J.G. and JONES, C.R.

1966 Silurian brachiopods from Malaya. *J. Paleont.* **40**, 1027–31 1 pl., 1 fig.

One species each of the genera *Capelliniella, 'Conchidium' Cymbidium,* and *Atrypella* of Ludlow age are described from the Kuala Lumpur Limestone at Kuala Lumpur.

BRADFORD, E.F.

1961 The occurrence of tin and tungsten in Malaya. *Proc. 9th Pacif. Sci. Congr.* **12**, 378–98.

Mineralogical notes on Malayan cassiterite, stannite, varlamoffite, wolframite, scheelite, ferberite, stolzite, yttrotungstite and tungstite. These minerals are genetically related to Mesozoic granites and in general are of hypothermal origin. Four analyses of Kinta granites give 0.0025–0.0076% SnO_2. The main primary associations of workable ores are a) pegmatites with cassiterite and tourmaline; b) sulphide veins with cassiterite; c) quartz veins with cassiterite and wolframite; d) quartz veins with gold and scheelite; e) iron-manganese oxides with cassiterite. A comprehensive survey of the geological and geographical occurrence of tin and tungsten deposits form the bulk of the paper. Production statistics are given to 1956.

BRELICH, H.

1914 Mining in Trengganu. In: *Mining in Malaya.* F.M.S. Information agency. Reprinted *Malay. Tin Rubb. J.* **3**, (18), 15–19; and *Min. Mag., Lond.* **13**, 263–66 (1915).

Describes the occurrence of wolfram at Bukit Runtoh. The working of tin-bearing gravels in Ulu Dungun and the presence of silver, lead, and gold are mentioned.

BROWN, G.E.

1913 Cassiterite in soil. *Min. Mag., Lond.* **8**, 359–63.

Its concentration is inferior to that of alluvial cassiterite. It is localised near its origin *in situ*, especially where veins strike at 90° to the slope. Unidentified mines are described.

BURTON. C.K.

1964 The Older Alluvium of Johore and Singapore. *J. trop. Geogr.* **18**, 30–42, 2 figs.

Clay, sand and gravel, mainly of marine origin, lie from 150 ft below present sea level to at least 230 ft above it. Detailed observations on the lithology, structure, weathering, geomorphology and distribution of this alluvium are recorded. It concurs in height with older alluvial deposits known from elsewhere in Malaya and is probably related to a 250 ft sea level of Lower Pleistocene age.

1965 Wrench faulting in Malaya. *J. Geol.* **73**, 781–98. 1 pl., 5 figs.

In the Baling area, Kedah, faults comprise two complementary sets disposed in a typical wrench fault pattern. A N–S maximum stress initiated the faults but a later E–W stress caused the direction of strike slip along the faults to be reversed. The largest, Bok Bak, fault has been mapped for 51 miles and is postulated for a further 52 miles in NW Malaya. It shows sinistral displacement of 32–36 miles. The line of the fault when traced southeastwards to NE Johore coincides with several geological and morphological discontinuities which can be largely resolved by restoring the indicated offset along the Bok Bak fault. The main sinistral movement probably occurred in the Jurassic or Cretaceous.

1966a Discussion *in* Friend, P.F., Clay fractions and colours of some Catskill (Devonian) Red Beds. *Proc. geol. Soc. Lond.* **1632**, 79 only.

Secondary precipitation of iron during weathering has reddened black shales of the Mahang Formation in NW Malaya.

1966b Palaeozoic orogeny in north-west Malaya. *Geol. Mag.* **103**, 364–5.

A letter discussing Koopmans (1965). Doubts the existence of a late Silurian to early Devonian folding phase because of the lack of evidence for this in the basin deposits (Mahang and Pokok Sena formations) in Kedah. Suggests a Middle-Upper Carboniferous folding.

1967a Graptolite and tentaculite correlations and palaeogeography of the Silurian and Devonian in the Yunnan-Malaya Geosyncline. *Trans. Proc. pal. Soc. Japan.* (n.s.) **65**, 27–46, 1 fig., 2 tabs.

The Setul, Mahang and Baling formations of NW Malaya contain Lower to Middle Silurian graptolites and Lower to Middle Devonian tentaculites. At some localities the latter occur with poorly preserved monograptids of Llandovery type. A period of non-deposition is postulated during at least the Upper Silurian and the sequence is correlated with supposedly similar sequences in west Thailand, the Shan States, and west Yunnan. This zone of the geosyncline formed a euxenic trough in which black shales slowly accumulated. Lower Silurian graptolites were later reworked by earth movements in the Lower Devonian and admixed with tentaculites.

1967b Dacryoconarid tentaculites in the Mid-Paleozoic euxinic facies of the Malayan Geosyncline. *J. Paleont.* **41**, 449–54, 3 figs.

The Devonian tentaculitid genera *Nowakia* and *? Metastyliolina* are common in the Mahang and Baling formations, associated with trilobites and graptolites of supposed Ordovician and Lower Silurian age. This anomaly is explained by the emergence of a geanticlinal barrier in the Silurian which was removed in the Devonian when earth movements disinterred the earlier fauna allowing it to become mixed with Devonian tentaculites.

1967c The Mahang Formation: a mid-Palaeozoic euxinic facies from Malaya—with notes on its conditions of deposition and palaegeography. *Geologie Mijnb.* **46**, 167–87, 3 pls., 3 figs., 4 tabs.

The Ordovician to Devonian Mahang Formation of Kedah is formally defined. It is characterised by highly siliceous and carbonaceous mudstone and chert. It contains a fauna exclusively planktonic and is interpreted as a deep water deposit within a basin barred to the E by a geanticlinal ridge. The excess of silica may be associated with volcanic activity known in the Lower Palaeozoic of the Grik area, Perak.

1967d Wrench faulting in Malaya: a reply. *J. Geol.* **75**, 128–9.

A reply to Proctor and Jones (1967). Argues for the complex nature of the fault zone and mentions many other major wrench faults in various parts of Malaya. Postulates thrust tectonics within the Foothills Formation, E of the Main Range, which obscures the wrench faulting.

1967e Ignimbrite in Malaya. *Geol. Mag.* **104**, 397–8.

A letter referring to Aw (1967). Mentions welded tuffs from Johore and points out that the 'quartz porphyry' shown by the geological map (1965M)[1] is in many places an acid volcanic rock. Suggests that the linear feature continuing the line of the Temangan ignimbrite for about 100 miles to the SSE may be a wrench fault.

CAMERON, W.E.

1924a The deep leads of Kinta Valley. *Min. Mag., Lond.* **31**, 276–85.

Supports Scrivenor's (1912c, 1913a) ideas on an older set of tin-bearing deposits (Gondwana boulder clays), here termed 'deep

[1] See appendix II.

leads', intruded by granite and overlain by a younger tin-bearing alluvium. Two unconformable limestones and two tin-bearing granites are postulated. The highly contorted lower limestone lies beneath the deep leads and the upper limestone, forming hills, lies above them. Geological sketch map.

1924b Discussion of Jones, W.R. 1923, *Min. J., Lond.* **144**, 171 only.

Not seen.

1925a The limestone hills of the Kinta Valley tin-field, Federated Malay States: their geology and physiographic origin. *Geol. Mag.* **62**, 21–7.

Summarises the conflicting opinions of Scrivenor (1913a, 1923a) and W.R. Jones (1917). Describes the topography and geology of the Kinta limestones and considers the limestone hills to be formed by differential erosion.

1925b Deep leads of the Kinta Valley. *Min. Mag., Lond.* **32**, 98 only.

Letter in reply to Jones W.R. (1925a). Not seen.

1925c Kinta valley geology. *Min. Mag., Lond.* **32**, 222–4.

A letter calling for more detailed surveys of Kinta to settle differences of opinion on the geological succession.

1925d Application of geology in the Kinta Valley tin-field. *Min. Mag., Lond.* **32**, 347–9.

Not seen.

1926 Geology of the Kinta valley. *Min. Mag., Lond.* **34**, 91–2.

A letter replying to W.R. Jones (1925b) and Scrivenor (1925a).

CAMPBELL, W.A.

1959 Geological abstracts: part XII Malaya and Singapore *Overseas Geol. Miner. Resour.* **7**, 199–208.

Thirty-one abstracts from annual reports, memoirs, papers and books published between 1949 and 1957.

CHAN, S.H.

1967 Geoelectrical study of some alluvial deposits in West Malaysia. *J. Dept. Engineering Univ. Malaya*, **6**, 95–106.

Discusses the problems encountered in successful experimental resistivity measurements in Perak and Selangor. These were designed to test the effectiveness of the resistivity method in delimiting different lithologies of the alluvium and bedrock.

CHEESEMAN, H.R.

1959 *Bibliography of Malaya,* p.123–7. London: Longmans.

About 100 references to mining and geology.

COLDHAM, J.C.

1945 Raub gold; genesis and recovery. *Proc. Australas. Inst. Min. Metall.* (n.s.) **139**, 161–94.

Not seen.

COLLET, O.J.A.

1903 *L'étain. Étude minière et politique sur les États Fédéres Malais,* 196p., 27 figs., map of Malaya 1 : 1.7M. Brussels: Librarie Falk Fils.

Includes remarks on the geology, p. 73–94.

A supposed succession of Archaean gneiss, Silurian and Devonian schist and quartzite, and Carboniferous limestone is compared to that of Burma. Notes the occurrence of alluvial tin.

COLLINGS, H.D.

1938 Pleistocene site in the Malay Peninsula. *Nature, Lond.* **142**, 575–6, 2 figs.

Tool-bearing gravel resting on laterite and overlain by volcanic ash lies at 250 ft, probably on an old terrace of the Perak river, at Kota Tampan.

COX, L.R.

1936 On a fossiliferous Upper Triassic shale from Pahang, Federated Malay States. *Ann. Mag. nat. Hist.* (ser. 10), **17**, 213–21, 1 pl.

Moulds of two species of *Myophoria* and nine other lamellibranch species are described and figured from shale exposed in the Sungei Taba, NE of Raub, Pahang. They are probably Carnian in age.

1937 On a freshwater shale with *Viviparus* from Johore (Malay States). *Geol. Mag.* **74**, 70–81, 1 pl.

A species of *Thiara ?* and a new species of *Viviparus* are described and figured from ? Upper Tertiary shale from a bore hole at Kepong, Johore.

CRAWFORD, J.

1824 Geological observations made on a voyage from Bengal to Siam and Cochin China. *Trans. geol. Soc. Lond.* (ser. 2), **1**, 406–8.

Mentions quartz at Cape Rachado and clastic sediments at Singapore.

CROIX, J.E. de la

1881 Some account of the mining district of lower Perak. *J. Straits Brch. R. Asiat. Soc.* **7**, 1–10, 2 figs.

Describes the tin mines of Kinta, Batang Padang and Bidor. Includes a geological cross section and topographic map 1 : 253,440.

1882 *Les mines d'étain de Pérak.* Paris.

Deals mainly with the exploitation of the mines and treatment of tin ore. Describes sandstone, chloritic and talc schists and limestone. Limestone hills are erosion remnants. Mentions the variable nature of the alluvium and the occurrence of tin, iron, and gold in Perak. Map of Perak 1 : 500,000 and map of Larut 1 : 200,000. Three horizontal geological sections.

1883 Le Royaume de Perak. *Bull. Soc. Geogr. comm. Paris*, (ser. 7), **5**, 333–52.

Contains a description of the granite and older sandstone, schist, and marmorized limestone of Larut and Kinta. Mentions the occurrence of 'wood-tin' and compares the tin mineralization with that of Cornwall. Illustrated by 2 horizontal sections (not seen).

1888 *Rapport sur les mines d'étain de Selangor (presqu'ile malaise) et les concessions d'Ayer Itam, Pataling, Batu.* Paris. 19pp.

Not seen.

CROOK, T.

1909 On the use of the term 'laterite'. *Geol. Mag.* **46**, 524–6.

A letter in reply to Scrivenor (1909f). 'Laterite' should be used scientifically. The original rock from Malabar, India, contains essential free hydrated alumina. Bauxite is a mineral name, laterite a rock name.

CROOK, T. and JOHNSTONE, S.J.

1912 On struverite from the Federated Malay States. *Mineralog. Mag.* **16**, 224–31.

Recorded from the alluvium of the Sg. Sebantun, Salak North, Perak. The physical characters of the grains are described and chemical analyses given. Struverite is probably a solid solution of tapiolite in rutile. Its properties are compared with those of struverite from Italy and South Dakota.

CUMMINGS, R.H.

1965 Notes on Malayan limestones. *Overseas Geol. Miner. Resour.* **14**, 418–26, 4, pls., 1 fig.

Gritty limestone from Sg. Badong, Kelantan, is probably a remanié deposit containing foraminifera probably of Upper Guadalupian age. Fine-grained limestone from Bukit Biwah, Trengganu, contains *Parafusulina* and is Leonardian. Fine-grained detrital limestone at the Jenka Pass, Pahang, and limestone fragments intimately veined and brecciated by andesite at Kampong Awah, Pahang, both contain a *Neoschwagerina-Verbeekina* fauna of Middle—Upper Permian age.

DALY, D.D.

1878 The metalliferous formation of the Peninsula. *J. Straits Brch. R. Asiat. Soc.* **2**, 194–8.

Describes the distribution of gold and tin on either side of the Main Range.

1882 Surveys and explorations in the native states of the Malayan Peninsula 1875–82, *Geogrl. J.* **4**, 393–412.

A narrative of surveying expeditions. Includes brief mention of geological features, including tin mines at Ampang, Selangor; and the Chindrass gold mines near Mount Ophir.

DAVIES, G.M.

1919 Tin-ores. *Monogr. Miner. Resour.* 33–47.

Geology of the main tin-fields is briefly described, based on the work of Scrivenor and W.R. Jones.

DERRICK, W.H.

1899 Notes on lode tin mining in the Malay Peninsula. *Trans. Inst. Min. Metall.* **7**, 12–16.

Refers to the mine of the Pahang Corporation Ltd. at Sg. Lembing.

DIXON, C.J.

1921 The tin mines in our colonies and the surrounding territories (Siam, Federated Malay States, Banka, Billiton, Sinkep). *Commercial Holland*, **3**, (no. 33), 35–8.

Not seen.

DOWDEN, C.B.

1882 *The Malay Peninsula, its mineral wealth.* London.

Not seen.

DOYLE, P.

1878 Tin mining in Larut. *Mining Journal, Railway and Commercial Gazette, London.* **48**, 1191–, 1219–, 1247–.

Not seen.

1879a *Tin mining in Larut.* 32p., 3 figs. London.

Alluvial tin-ore is associated with the weathering products of granite and is underlain by white clay. Figures sections through the alluvium.

DOYLE, P.

1879b On some tin-deposits of the Malayan Peninsula. *Q. Jl. geol. Soc. Lond.* **35**, 229–32.

In Larut, Perak, tin-ore is found in the lowest part of the alluvium and is often underlain by massive kaolin and quartz (*kong tay*). The tin-bearing layer has a maximum thickness of 10 ft. Plant remains show the tin-bearing deposits to be Recent.

DRYSDALE, J.

1936 Coal in Malaya. *J. Engng Ass. Malaya.*

Outlines the geology of five coal-bearing Tertiary basins. The high grade lignite from Batu Arang, Selangor, is economical. Cannel coal is recorded.

DUNSTAN, W.R. (ed.)

1904 The commercial utilisation of corundum from Perak, Federated Malay States. *Bull. imp. Inst., Lond.* **2**, 229–31.

Records waterworn pebbles of finely crystalline blue-grey corundum from the alluvium of the Kinta Valley.

(DUNSTAN, W.R.)

1905 Report on sample of monazitic sand from the Federated Malay States. *Perak Govt. Gazette, Supplement,* 22 Sept., 1905, 2p.

A concentrate from the Kemaman river, Trengganu, contained 41% of monazite and xenotime.

1906a Report on tin-ore containing monazite from the Federated Malay States. *Perak Govt. Gazette, Supplement,* 2pp.

Chemical analysis of a cassiterite-ilmenite-monazite concentrate. The monazite is thorium-rich.

(DUNSTAN, W.R., ed.)

1906b Occurrence of monazite in the tin-bearing alluvium of the Malay Peninsula. *Bull. imp. Inst., Lond.* **4**, 301–9.

Minerals and chemical analyses of sands and 'amang' from the Dindings; Sg. Kemaman, Trengganu; Pahang; and Kampar, Perak. Zircon, monazite, cassiterite and ilmenite are the main constituents.

1908 Tin-ores from the Federated Malay States. *Bull. imp. Inst., Lond.* **6**, 155–7.

Analyses of samples of alluvial and lode ore from Sg. Raya, Kinta. One sample contained 86% corundum.

1911a 'Amang' from the Federated Malay States. *Bull. imp. Inst., Lond.* **9**, 99–102.

Chemical analyses for tin and rare earths of samples from nine localities in Perak. The percentage of monazite is small. Copper found in one sample.

1911b Struverite, a rare tantalum mineral from the Federated Malay States. *Bull. imp. Inst. Lond.* **9**, 354–5.

From the Kuala Kangsar district, Perak. Chemical analysis given. (*See* Crook and Johnstone 1912).

1912 The coal resources of the British Crown Colonies and Protectorates. Federated Malay States. *Bull. imp. Inst., Lond.* **10**, 622–3.

The Batu Arang deposit comprises two seams, the upper over 24 ft thick. Analyses of the coal are given.

1913 Minerals from the Federated Malay States. *Bull. imp. Inst., Lond.* **11**, 243–8.

Notes on a cerussite concentrate, tungsten ore, tin ore and cave phosphate from Kinta; tin-bearing sands from Kelantan; a cassiterite-monazite-ilmenite concentrate from south Kedah; and manganese ore from Tambun, Perak. Chemical analyses given.

1914a The composition of monazite. *Bull. imp. Inst., Lond.* **12**, 57–8.

Chemical analyses of monazite from three localities in Malaya.

1914b Tin resources of Malaya and India. *Bull. imp. Inst., Lond.* **12**, 278–89.

General geology based on Scrivenor. The common 'amang' minerals are noted. Geological notes on all the main mining districts in Malaya.

DYK, P. van

1883 Tinnontginning in het district Larut Perak, Gouvernment Straits Settlements. *Jaarb. Mijnw. Ned. Oost. Ind.* **11**, 115–6.

Not seen.

EDGE, A.B.

1930 Report on geophysical prospecting possibilities in the Federated Malay States. *Rep. geol. Surv. Dep. F.M.S.* [for 1929], appendix 1. Published in a supplement to F.M.S. Govt. Gazette, Feb. 28, p.8–11.

No known methods are suitable for prospecting alluvial and residual tin deposits or small lodes. Sulphide bearing 'pipes' in limestone may be detected by electrical methods if large enough in plan and not too deeply buried. Gravimetric methods may allow the extension of coal seams at Batu Arang to be mapped but a general survey would be handicapped by rough topography.

EDWARDS, W.N.

1926 Carboniferous plants from the Malay States. *J. Malay. Brch. R. Asiat. Soc.* **4**, 171–2, 1 pl.

Pecopteris cf. *cyathea* and *Cordaites* sp. are described from shales in the Sg. Chiku, Kelantan. They correlate with the European

Upper Carboniferous and resemble a richer flora known from Sumatra. [The plant-bearing beds in Sumatra are now known to be Lower Permian.]

1933 Triassic woods from the Malay States. *J. Malay. Brch. R. Asiat. Soc.* **11**, 236–41, 2 pls.

A silicified log from Triassic beds near Jerantut, Pahang, is described as *Dadoxylon sclerosum* Walton. *Dadoxylon* sp. from the Sg. Tranang, Ulu Nenggeri, Kelantan, may also be Triassic.

1948 Lepidodendroid remains from Malaya. In: Muir-Wood, H.M., *Malayan Lower Carboniferous fossils and their bearing on the Viséan palaeogeography of Asia*, p.78–81, 1 pl., London: British Museum (N.H.).

Records obscure twig impressions, probably of *Lepidodendron* from the Sg. Terapai, E. Pahang.

ERHART, H.

1954 Sur les phenomènes d'altération pédogénétique des roches silicatées alumineuses en Malaisie britannique et à Sumatra. *C. r. hebd. Seanc. Acad. Sci., Paris,* **238**, 2012–4.

In Malaya lateritic soils have formed on an old land surface. They have a pH between 4 and 5 and the clay mineral present is kaolinite. Soils developed on Recent volcanics in Sumatra contain illite and metahalloysite and have a pH of 5.2–5.9.

EVANS, J.W.

1909 Occurrence and utilization of tungsten-ores. *Bull. imp. Inst., Lond.* **7**, 174–5.

Wolframite is known from Chumor, Batang Padang and Ulu Gopeng in Perak and scheelite from Kuala Kangsar, Perak and Bukit Argas, Raub, Pahang.

1913 The coal resources of the Federated Malay States. In: *The coal resources of the world*, vol. 1, 349–50. Toronto.

Tertiary coal beds of Batu Arang are briefly described and an analysis of the coal is given.

FAWNS, S.

1904 Tin-lode mining in Trengganu. *Min. J., Lond.* **76**, 377–.

Not seen.

1905 *Tin-deposits of the world,* xii + 240p. illustr. London: Eyre and Spottiswoode.

Includes a contemporary review of Malayan alluvial and lode tin deposits.

FERGUSON, H.G. and BATEMAN, A.M.

1912 Geologic features of tin deposits. *Econ. Geol.* **7**, 209–62, 1 pl. 34 figs., 7 tabs.

A summary of the world occurrence of tin. Malaya is referred to but no specific features of Malayan tin deposits are recorded.

FERMOR, L.L.

1939a Coal veins in Malaya. *Geol. Mag.* **76**, 465–72, 2 pls.

Veins of dull vitrain, a few inches thick, cut Recent alluvium and weathered schist at several localities in Kinta. They are probably formed by the gelation of colloids derived from wood in the alluvium.

1939b Varved sediments in Malaya. *Geol. Mag.* **76**, 473–8, 1 pl.

Cleaved siltstones from Sg. Lembing mines show a primary regular alternation of light and dark layers, $\frac{1}{4}''$ to 1″ thick. Similar rock was seen at Bt. Besi iron mine, Trengganu. The rock is interpreted as seasonally banded but not necessarily deposited in a peri-glacial environment.

1940 The Mineral resources of Malaya. *Bull. imp. Inst., Lond.* **38**, 69–82.

A useful historical review.

1949 The mineral resources of Malaya and other far eastern countries. *Proc. 4th. Emp. Min. Metall. Congr.* **1**, 81–109, discussion 206–16.

Mainly an account of production and resources of metalliferous ores; brief but useful summary of the geology of the main ore deposits.

FITCH, F.H.

1940a Bauxite in the basalt area near Kuantan *Yb. Chamb. Mines F.M.S.* [for 1939], 174–6.

A search yielded no economic deposits.

1940b Progress report of the geological survey of a part of Pahang near Kuantan. *Rep. geol. Surv. Dep. F.M.S.* [for 1939], 24–30.

Coarse and fine-grained biotite granite and coarse-grained epidote granite outcrop. Olivine basalt around Kuantan is associated with dolerite dykes cutting the granite. Quartz porphyry dykes are younger than the dolerite. Lower Carboniferous fossils are recorded from limestone hills near Sg. Lembing and from shales in Sg. Terapai. At the Pahang Consolidated Co.'s mine at Sg. Lembing, clastic sediments in the metamorphic aureole of the granite have a simple structure and dip east. A banded shale (Fermor 1939b) forms a marker horizon. Cassiterite-bearing lodes trend east and contain quartz, sulphides and brecciated sediments.

1941 The Gambang mining field. The possibility that other payable areas may occur in its vicinity. *Yb. Chamb. Mines F.M.S.* [for 1940], 135–9.

Cassiterite is mined from weathered quartzite at Sg. Kakura. Tin-ore is most likely to be found in the recently exposed roof of the granite. Sketch map 1 : 500,000.

1947a Progress report of geological work in part of Pahang near Kuantan. *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 47–57.

Rhyolitic ash and agglomerate occur at Tg. Cherating. Lower Carboniferous brachiopods and other fossils are recorded from Myah Mine, Sg. Lembing. In the Sg. Lembing mines, tin mineralization is confined to the granite-slate contact. Here the granite is rich in feldspar phenocrysts but lacks biotite, and in places muscovite rock occurs. Magnetite-haematite ore is present as lenses in sheared quartz-porphyry invaded by epidote granite in Ulu Rompin. Commercial bauxite is found in Anak Sg. Endau.

1947b The tin mines of the Pahang Consolidated Co. Ltd. *Bull. Inst. Min. Metall., Lond.* B, **493**, 1–27; discussion in *ibid*, **495**, 25–44; **498**, 45–6; **506**, 59–64. Reprinted (1951) in *Trans. Inst. Min. Metall., Lond.* **57**, [for 1947–8], 195–221, 2 pls., 5 figs. 1 tab. (Discussion 221–47, 6 figs.)

Includes a detailed account of the geology of the mine. See also Fitch (1952).

1948 Progress report on geological work near Kuantan, Pahang. *Rep. geol. Surv. Dep. Malay. Un.* [for 1947], 23–30.

Unconformity between the Lower Carboniferous and younger (? Triassic) sediments is shown by a 40° difference in the strike of the two formations; felspathic tuffs are associated with the former, and Viséan fossils are listed. The distribution of granites and their thermal aureoles are outlined. Granite porphyry and dolerite dykes cut the granite. Along the coast, old sea beaches lie up to 4 miles inland and 36 ft above sea-level.

1949a Progress report on geological work near Kuantan, Pahang. *Rep. geol. Surv. Dep. Fed. Malaya.* [for 1948], 37–42.

Quartzite, shale with fragmentary plant remains, and conglomerate mapped in Sg. Endau, Sg. Taweh and Sg. Riam areas. A new collection of Viséan fossils from Sg. Lembing is listed. Some reopened mines of Pahang Consolidated Co. Ltd. have cassiterite-bearing lodes associated with faults and shatter zones. Primary ore at Bt. Besi iron mine in Trengganu is haematite and magnetite in large masses, 300 ft by 100 ft or more, situated near granite-shale contact: secondary limonite is abundant.

1949b Evidence for recent emergence of the land in east Pahang. *J. Malay. Brch. R. Asiat. Soc.* **22**, 115–22, 1 pl., 2 figs.

An older, 35 ft, and younger, 15 ft, set of raised beaches lie up to 4 miles inland south of Chukai, Trengganu. Sea caves now 10 ft above mean sea-level are associated with the younger beaches. Coastal alluvium lies 50 ft, above mean sea-level at Kuantan airfield, now 9 miles from the coast. Limestone rock shelters at Bt. Tenggek and Bt. Sagu lie up to 30 ft above present base level. River terraces and knick points also attest recent emergence.

1950 Progress report on geological work near Kuantan, Pahang. *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1949], 35–8.

Summarizes the geological history and economic geology of the area (Fitch 1952).

1952 The geology and mineral resources of the neighbourhood of Kuantan, Pahang. *Mem. geol. Surv. Dep. Fed. Malaya*, **6**, 143p., 14 pls., 30 figs., 4 geol maps 1 : 63,360, 3 geol. sections.

Shale and subordinate limestone containing a Viséan fauna are unconformably overlain by quartzites, conglomerates and shales (Arenaceous Series) believed to be Triassic. Biotite-granite intrudes these sediments. Younger dolerite dykes and basalt flows are possibly Lower Tertiary and are cut by quartz-porphyry dykes and vein quartz some of which is slightly auriferous. Raised

beaches, high-level alluvium and rejuvenated rivers evidence Pleistocene sea-level changes. Details two bores through coastal alluvium, records 'coal veins' and describes heavy mineral concentrates from valley alluvium. The geology of the Pahang Consolidated Co. Ltd. mines at Sg. Lembing and that of the Gambang tin mining field is given in detail.

FLINTER, B.H.

1959a Re-examination of 'struverite' from Salak North, Malaya. *Am. Miner.* **44**, 620–32, 3 figs., 4 tabs.

The sample analysed by Crook and Johnstone (1912) was contaminated by ilmenite and cassiterite; also an incorrect, high value of tantalum was obtained (but see Flinter 1964). Magnetic separation, X-ray powder data and polished section studies show the mineral to be intermediate between rutile and tapiolite and to consist essentially of titanium, niobium, tantalum and iron.

1959b The alteration of Malayan ilmenite grains and the question of 'arizonite'. *Econ. Geol.* **54**, 720–9, 4 figs., 4 tabs.

Ilmenite grains from Malayan alluvium weather progressively through an amorphous phase, here termed hydroilmenite, marked by decreasing mass magnetic susceptibility, increasing TiO_2 and H_2O content, and increasing $Fe_3//Fe_2$ ratio. The final stage, so far unknown from Malaya, is a recrystallized mixture of TiO_2 and Fe_2O_3 minerals—'arizonite'.

1959c The magnetic separation of some alluvial minerals in Malaya. *Am. Miner.* **44**, 738–51, 2 figs., 9 tabs.

Trials with a Franz Isodynamic Separator allowed 25 alluvial mineral species of grain size 0.2 to 0.4 mm to be successfully separated, using currents increased by steps of 0.1 amp to 1.4 amps and different side slopes of the separator. Tables show the minerals separated at each current strength and side slope.

1960 The effects of heat, hydrochloric acid and lead chloride on some Malayan mineral grains. *Overseas Geol. Miner. Resour.* **8**, 53–6.

In Malaya two types of magnetic cassiterite are found. One, associated with iron-ore deposits, loses its magnetism after heating for 15 minutes at 830°C and may contain sub-microscopic inclusions of magnetic iron oxide. The other, associated with columbite, has ex-solution inclusions of tapiolite and heating it to 1000°C does not destroy its magnetism. Hot concentrated hydrochloric acid, the Frantz Isodynamic Separator, and molten lead chloride are used in separating iron oxides, ilmenite, columbite, wolframite, rutile, and Ta-Nb rutile from heavy mineral concentrates.

1963a A note on ferroan gahnite from Malaya and its bearing on the published data for hercynite. *Am. Miner.* **48**, 194–99, 4 figs., 1 tab.

Alluvial dark green spinel from Johore and Kedah is shown by its physical properties to lie between gahnite and hercynite. Two chemical analyses gave a Zn-Fe ratio of 2 : 1 and 3 : 1. Assuming that density, refractive index, and unit cell dimension vary linearly with composition, the positions of the two samples in the gahnite-hercynite series as calculated from physical properties do not agree with those calculated from chemical composition. Thus it is suggested that the published data for pure hercynite are incorrect and new values of density, refractive index and unit cell dimension are given.

1963b The occurrence of radioactive minerals in Malaya. *Proc. 9th. Pac. Sci. Congr.* **5**, 116–8.

All known occurrences are associated with the Main Range granite. Flakes of torbernite and metatorbernite are present in joint and shear zones in weathered granite in Ulu Selangor. Monazite is a common alluvial mineral and is found occasionally in pegmatites. Uranothorite in hornblende granite is known from Pahang. Alluvial zircon, xenotime, and allanite contain small amounts of U and Th. Ti-Ta-Nb oxides have been recorded from alluvium near Bedong, Kedah; Bakri, Johore; and Titi, Negri Sembilan.

1964 Re-examination of 'struverite'—a further note. *Am. Miner.* **49**, 792–4.

Another sample of 'struverite' was analysed and confirmed the original analysis of Crook and Johnstone (1912), the mineral being richer in tantalum than in niobium (see Flinter 1959a). Some if not all the tin occurring in the sample is probably present in the 'struverite' lattice. X-ray powder pattern was of the rutile type.

FLINTER, B.H., BUTLER, J.R. and HARRAL, G.M.

1963 A study of alluvial monazite from Malaya. *Am. Miner.* **48**, 1210–26, 1 fig., 5 tabs.

Sixteen samples were analysed for rare earths, Th, U, Ca, and Si. Correlation between composition and physical properties is difficult because of the compensating nature of the various elements present. Three samples were unusual in being rich in Eu, Gd and U, and Dy respectively.

FRANCIS, M.A.

1914 Notes on the tin-lodes of Ulu Kelantan district. *Malay. Tin Rubb. J.* **3**, 19–21. Reprinted from *Mining in Malaya:* F.M.S. Information agency.

Not seen.

GOBBETT, D.J.

1965a The Lower Palaeozoic rocks of Kuala Lumpur, Malaysia. *Fedn. Mus. J.* **9**, 67–79, 3 pls., 2 figs., 2 tabs.

Quartz-mica schist is conformably overlain by graphite-bearing schist and this by limestone and dolomite of Silurian age, which forms a karst surface beneath alluvial flats. The sequence has been twice folded to form a tectonic basin and has been intruded by Mesozoic granite, which has introduced fluorine and boron into its narrow metamorphic aureole. Quartz dykes later then the granite are aligned on a bearing 100°E. of north. Subsequent faulting along, and at right angles to, this bearing has modified the outcrop of the tectonic basin. The dolomite contains a coral-brachiopod-gastropod fauna.

1965b The formation of limestone caves in Malaya. *Malay. Nat. J.* **19**, 4–12, 2 pls., 2 figs.

The distribution of limestone hills is shown on a map 1 : 1.9M. These form a 'tower karst' scenery, and contain abundant caves, originally formed probably by phreatic water at or just below the water table. However they have been later strongly modified by underground streams which have formed most of their present erosive features. Undercuts around the base of limestone hills are due to marine erosion, stream erosion and solution by swamp water.

1966 The brachiopod genus *Stringocephalus* from Malaya. *J. Paleont.* **40**, 1345–8, 1 pl., 3 figs.

A description of *S. perakensis* sp. nov. from near Kampar, Perak. Its presence proves a Givetian (Middle Devonian) age for the limestone in which it occurs.

GOWDA, S.S.

1965 Age of the Temerloh limestone (Calcareous Series) of Malaya. *Bull. geol. Soc. India,* **2**, 58–61, 1 fig.

Foraminifera and algae typical of the Middle permian Neoschwagerina-Verbeekina zone are listed from limestone associated with volcanic breccia near Temerloh, Pahang.

GREENSTREET, V.R.

1926 Malayan guano deposits. *Malay. agric. J.* **14**, 106–15.

Cave deposits of bat guano and rock phosphate are described from limestone hills of Selangor, Perak, Pahang, and Perlis. Analyses of 75 samples are tabulated.

GREIG, G.E. and SCRIVENOR, J.B.

1924 Monazite. *Bull. imp. Inst., Lond.* **22.**

Notes the appearance and properties of Monazite. In Malaya, monazite derived from granite is found widely scattered in detrital deposits. Mineral compositions of three monazite-bearing concentrates are given.

GRUBB, P.L.C.

1963 Critical factors in the genesis, extent, and grade of some residual bauxite deposits. *Econ. Geol.* **58**, 1267–77, 3 figs., 2 tabs.

In SE Johore residual bauxite is developed on acid tuff, lava, schist and granite. It is frequently separated from the host rock by a relatively thick layer of red koalinitic clay with disseminated gibbsite and quartz crystals, and is superficially altered to yellow kaolinitic clay with authigenic quartz. It is argued that bauxite is formed only under very precise conditions of pH, porosity, ionic potential, position relative to the water table, and type of vegetative cover. In Johore, rhyolite, with its finer grain, high abrasion pH value and close jointing, produces the highest grade bauxite.

1965 Undersaturated potassic lavas and hypabyssal intrusives in north Johore, *Geol. Mag.* **102**, 338–46, 3 tabs.

Three lava flows, 60 to 140 ft thick, are gravitatively differentiated into potassic ankaramite, leucite basanite, and leucite tephrite. The tops of the flows are bolitized and the flows are intruded by thin shoshonitic dykes and a large undifferentiated shonkinite sill. These rocks are probably of Tertiary age and contemporaneous with the nepheline basalts of Kuantan. They are chemically similar to the hybrid rocks of Gunong Benom and may have resulted from the hybridization of peridotite by granite.

1966 Distribution and genetic significance of aluminium hydrates in south-east Johore. *Proc. R. Soc. Vict.* **79**, 257–65, 2 pls., 3 figs., 2 tabs.

Recent bauxite contains gibbsite, mainly in concretions, and boehmite, confined to the 'clay' fraction. Diaspore occurs only

in Tertiary laterites. It is apparently a late-stage product, essentially metamorphic in origin. Johore bauxites are compared to some Australian bauxites. In accordance with experimental work it is considered that boehmite is formed first and is later progressively replaced by gibbsite.

GRUBB, P.L.C. and HANNAFORD, P.

1966a Ferromagnetism and colour zoning in some Malayan cassiterite. *Nature, Lond.* **209**, 677–8.

Large crystals from Palepah Kanan, Johore contain dark ferromagnetic zones. These zones may be due to a fine dispersion of a paramagnetic ferrous stannate which on heating to 380°C coagulates and reverts to magnetite. The solid solution of iron in tin can be most closely compared to the haematite-ilmenite series.

1966b Magnetism in cassiterite; its source and paragenetic significance as exemplified by a prominent Malayan tin deposit. *Mineralium Deposita,* **2**, 148–71, 6 figs., 7 tabs.

Large cassiterite crystals from the Pelepah Kanan tin mine in Johore show strong colour zoning related to varying magnetic properties within the crystal. Mossbauer spectroscopy reveals that ferroan inclusions in the darker, magnetic, fraction have a higher Fe_2/Fe_3 ratio than in the colourless, non-magnetic fraction, and that less than 10% of the iron atoms in these inclusions can have a magnetically ordered environment. Electron diffraction d-spacings comparable with paramagnetic $FeSn(OH)_6$ are found in the magnetic fraction; spacing comparable with lepidocrocite is found in the non-magnetic fraction. When the former is heated in air to 600°C the finely dispersed particles of hydrated ferrous stannate seem to coagulate, become anhydrous, and form a series of compounds with haematite which are analagous to $Fe_{2-x}Ti_xO_3$. For x near 2/3 the latter series is ferromagnetic. Similarly the magnetism in the cassiterite may be due to a similar anhydrous ferrous stannate-haematite compound in small regions of the primary ferrous stannate hydrate. Thermal demagnetisation studies show that it is possible for cassiterite to contain a series of magnetic compounds with Curie points in the range 50–250°C which correspond closely to the magnetic region of the $Fe_{2-x}Ti_xO_3$ series. The origin of zoning in cassiterite may be due to the formation of colloids following condensation of the primary gaseous ore fluids.

GRUTTERINK, J.A.

1915 Enkele minder bekende mineralen uit Indie. *Geol. Mijnb. Genoot. Kol., geol. sect.* **11**, 18–19.

Summary in Dutch of Crook and Johnstone (1912). Not seen.

HADA, S.

1966 Discovery of early Triassic ammonoids from Gua Musang, Kelantan, Malaya. *J. Geosci. Osaka City Univ.* **9**, 111–3, 2 pls.

Six mid-Scythian species are recorded from the railway cutting at Gua Panjang.

HAMPTON, J.H.

1886a The tin-deposits of the Straits. *Iron Age,* **38**.

Not seen.

1886b Cassiterite of the Straits Settlements. *Mineralog. Mag.* **7**, 71 only.

Mentions water-worn detrital cassiterite grains in association with tourmaline. "White cassiterite" is frequent and "ruby ore" found occasionally.

1887 Tin-deposits of the State of Perak, Straits Settlements. *Trans. Min. Assoc. Inst. Cornwall,* **1**, 143–.

Not seen.

1899 On the occurrence of tin. *Trans. geol. Soc. S. Afr.* **4**, 37–40.

Describes the occurrence of alluvial tin in Larut, Perak. Suggests that the tin ore was derived from the east and deposited in the alluvium under marine conditions.

HARRIS, E.F.

1924 Rahman tin mines, Federated Malay States. *Chemical Engineering and Mineral Review, Melbourne,* 297–. Summary in *Bull. imp. Inst., Lond.* **22**, 518–9.

Tin-ore occurs in E–W trending quartz veins. These are enriched where they cross a series of N–S shear zones.

HARRIS, H.G. and WILLBOURN, E.S.

1936 *Mining in Malaya,* 96p., 44 figs. London: Malayan Information Agency. Revised by A. G. MacDonald and E. S. Willbourn, 2nd. ed. (1940), 108p., illus.

Includes a summary of the geology.

HELLSTRÖM, B.

1941 Några iakttagelser över vittring erosion och slambilduing i Malaya och Australien. [Some observations on weathering, erosion and silt deposition in Malaya and Australia]. *Geogr. Annlr.* **23**, 102–24.

Mentions granite weathering in Perak and Penang.

HESS, F.L. and HESS, E.

1912 Bibliography of the geology and mineralogy of tin. *Smithsonian Misc. Coll.* **58**, (2), 1–408.

The first part is arranged by countries. Ninety-three annotated references are given for the Malay Peninsula. Indexed.

HILL, J.H.

1964 The mineral belts of Malaya. *Proc. Australas. Inst. Min. Metall.*, map 1 : 2M.

The metalliferous deposits lie in belts mainly parallel to the structural grain of Malaya. The western tin belt can be divided into several minor zones lying parallel to each other and separated by barren granite. A line of hot springs runs close to its axis. The major primary tin deposits lie in a belt near the east coast. Tungsten ores are associated with primary cassiterite. Contact metamorphic iron deposits occur along the east coast where they are contaminated by cassiterite; replacement iron deposits occur throughout the centre of the country and in Perak. A gold belt extends down the centre of Malaya. A manganese belt is postulated lying between the gold and the eastern tin belts. Zn-Pb-Cu ores associated with volcanic rocks trend NW across central Pahang and similar ores are present along the same trend in Perak, associated with granite.

HILL, R.D.

1966 Changes in beach form at Sri Pantai, northeast Johore, Malaysia. *J. trop. Geogr.* **23**, 19–27, 1 pl., 7 figs., 2 tabs.

Over short periods sand movement results in erosion as the tide rises and slower accretion as it falls. The seaward platform of fine sand is a stable feature, although broad, low banks of mixed coarse and fine sand are developed on it. The beach form over longer periods is dominated by erosion during the northeast monsoon and by accretion for the rest of the year, when offshore sand bars migrate landwards to the high tide beach and may later be colonised by vegetation.

HITCHEN, J.S.

1929 Cubic magnetite and haematite. *Min. Mag., Lond.* **40**, 158 only.

Refers to Scrivenor (1929b) and suggests that the pseudomorphs were originally haematite and suffered partial conversion to magnetite by thermal metamorphism.

HOCKIN, H.W.

1957a Ilmenite from alluvial deposits in Malaya. *Bull. Mines. Dep. Fed. Malaya,* **1**, 6p., 3 pls.

Alteration of ilmenite grains, probably to a mixture of sub-microscopic hydrated rutile and amorphous iron oxide, causes the TiO_2 content to greatly exceed the theoretical value for ilmenite. Some grains consist of sub-graphic intergrowths of ilmenite and rutile.

1957b Tantalum/Niobium minerals in Malaya. *Bull. Mines Dep. Fed. Malaya.* **2**, 16p., 4 pls.

Ferrocolumbite with a Nb/Ta ratio of 4 : 1 is mined at Semiling in Kedah and at Bakri in Johore. Columbite and possibly tapiolite are also found in small amounts associated with cassiterite in alluvial concentrates. Niobian rutile is widespread in alluvial concentrates from the west of Malaya and is often intergrown with cassiterite. Nb and Ta can probably replace Sn ions in cassiterite. Some alluvial cassiterite and ilmenite contains about 1% $(TaNb)_2O_5$. Euxenite, betafite, pyrochlore-microlite and other complex niobotitanates have been recognised in Malaya.

1957c A note on an occurrence of stannite in Malaya. *Bull. Mines Dep. Fed. Malaya,* **3**, 3p., 3 pls.

Stannite is found with other sulphides and cassiterite, at Kepong, Selangor. The stannite replaces pyrite and contains small residuals of cassiterite. It is replaced extensively by sphalerite and lead sulphosalts.

HOLLIS-BEE, R.J.

1959 *Some notes on the igneous rocks of Singapore,* 51p., 41 pls., 5 figs. Singapore: Govt. Press.

Based on studies which were primarily to determine the suitability and availability of aggregates for concrete. The igneous complex includes hornblende granites, granodiorites, gabbro and norite, cut by dykes of granite porphyry, quartz porphyry and dolerite. Rock specimens and all quarries are catalogued, Eighty-two photomicrographs form the bulk of the paper.

HOOIJER, D.A.

1963 Report upon a collection of Pleistocene mammals from tin-bearing deposits in a limestone cave near Ipoh, Kinta Valley, Perak. *Fedn. Mus. J.* **7**, 1–5.

Rhinoceros sondaicus, Sus, Hippopotamus, Cervus, Duboisia santeng, and *Bibos* c.q. *Bubalus* are briefly described from Tambun. They are probably Middle Pleistocene.

HUTCHISON, C.S.

1959 Engineering properties of common Malayan rocks. *J. Engng Soc. Univ. Malaya,* **2**, 13–16.

Building stones available in Malaya are granite, gabbro, dolerite, andesite, laterite and limestone. Malayan rocks recommended for road aggregates are, in order of preference, basic igneous, intermediate igneous, marble, and granite.

1961a The basement rocks of Malaya and their paleogeographic significance in South-East Asia. *Am. J. Sci.* **259**, 181–5, 2 figs.

"In northeastern Malaya a north-south-trending belt of schists of amphibolite facies of apparently anticlinal form is overlain unconformably to the east and west by Carboniferous sediments. It is suggested that these schists are of Precambrian age and represent a remnant of a north-south axis which was active during the Palaeozoic. The control of this axis on the paleogeography of Malaya appears to have been very great up to the end of the Devonian". (Author's abstract)

1961b The basement rocks of Malaya and their paleogeographic significance in South-East Asia—a reply. *Am. J. Sci* **259**, 806–13.

A reply to Alexander, MacDonald and Slater (1961) clarifying his viewpoint and countering criticism.

1963 Interesting coastal exposures east of Kuah, Pulau Langkawi. *Malay. Nat. J.* **17**, 165–9, 2 pls., 1 fig.

Granite exposed in low cliffs contains microcline phenocrysts showing planar flow structure. Quartz tourmaline dykes cut the granite and tourmalinize it. Marble of the Setul Formation lies farther east and contains spectacular stylolites formed by pressure solution during tectonic deformation of the original limestone.

1964 A gabbro-granodiorite association in Singapore Island. *Q. Jl. geol. Soc. Lond.* **120**, 283–97, 4 figs., 3 tabs.

A gabbro-norite body forming Bt. Gombak and Bt. Panjang lies at the margin of a granodiorite batholith. The contact is irregular, the gabbro has been retrogressively metamorphosed and granodiorite dykes bearing gabbro xenoliths anastomose through the gabbro. Basic xenoliths altered to 'quartz monzonite' are found in the main granodiorite. Late basic dykes cut gabbro and granodiorite. Chemical analyses show the gabbro and granodiorite to belong to two distinct magma series and it is concluded that the former is pre-orogenic, the latter orogenic.

HUTCHISON, C.S. and LEOW, J.H.

1963 Tourmaline greisenization in Langkawi, northwest Malaya. *Econ. Geol.* **58**, 587–92, 3 figs.

Hydrothermal quartz-tourmaline dykes cut and metasomatize biotite granite southeast of Kuah jetty. The zones of greisenization are proportional to the dyke widths and contain prominent tourmaline segregations and secondary muscovite and quartz. Similar greisenized and tourmalinized granites carry cassiterite and wolframite in other parts of Malaya.

ICHIKAWA, K., ISHII, K. and HADA, S.

1966 On the remarkable unconformity at the Jenka Pass, Pahang, Malaya. *J. Geosci. Osaka City Univ.* **9**, 123–30, 1 pl.

Steeply dipping Middle Permian sandstone, mudstone and limestone with a fauna of fusulinids, brachiopods and bivalves are overlain unconformably by conglomeratic sandstone and minor mudstone (Jenka Pass formation). The latter contains scarce bivalves, brachiopods, *Isocrinus* sp. and plants (*Sagenopteris* sp. and *Equisitites* sp.) which are probably late Triassic.

ICHIKAWA, K. and YIN, E.H.

1966 Discovery of early Triassic bivalves from Kelantan, Malaya, *J. Geosci. Osaka City Univ.* **9**, 101–6, 1 pl.

A description of deformed specimens of *Claraia intermedia multistriata* ssp. nov. and *Eumorphotis* sp. from Scythian shales outcropping 10.5 km SSW of Gua Musang.

IGO, H.

1964 Permian fossils from northern Pahang, Malaya. *Jap. J. Geol. Geogr.* **35**, 57–71, 1 pl., 7 figs. Reprinted in: Kobayashi, T. (ed.) *Geology and Palaeontology of southeast Asia,* vol. 1, 191–207.

"Permian fusulinids, corals and brachiopods collected from Ulu Sg. Atok and Sg. Spia, northern Pahang, Malaya are described. They are all characteristic species of the Tethyan upper Neoschwagerina-Verbeekina Zone to the lower Yabeina Zone, and their geological age is late Middle Permian. *Wentzelella malayensis* is new." (Author's abstract)

1966 Some Permian fusulinids from Pahang, Malaya. In: Kobayashi, T. and Toriyama, R. (ed.) *Geology and Palaeontology of southeast Asia,* vol. 3, 30–8, 6 pls., 2 figs.

Fusulinids listed from the Jenka Pass and Kg. Awah show limestones at both these localities to belong to the upper Neoschwagerina zone and lowermost part of the Yabeina zone. Four species, one new, are described.

IGO, H. and HAMADA, T.

1964 Stratigraphy of northwestern Malaya. *Report on the stratigraphical and palaeontological reconnaissance in Thailand and Malaysia 1963–64, section 9,* p. 67–72. Overseas Technical Cooperation Agency. Cyclostyled.

Outlines the succession in Kedah and Perlis. Lists fossils from 22 localities.

IGO, H. and KOIKE, T.

1966 Ordovician and Silurian conodonts from the Langkawi Islands, Malaya. In: Kobayashi, T. and Toriyama, R. (ed.) *Geology and Paleontology of southeast Asia,* vol. 3, 1–29, 3 pls., 6 figs.

Thirty-one species (8 new) are described from the Setul limestone of Pulau Langgon. The lower part of the limestone is divided into a lower Zonule of *Scolopodus staufferi—S. giganteus* of Lower to Middle Ordovician affinities; and two upper Zonules (*Acodus similaris—Drepanodus altipes* and *Acodus mutatus—Acontiodus hamari*) of Middle-Upper Ordovician and some Silurian affinities. The upper part of the limestone contains less abundant simple, cone-like conodonts (*Panderodus unicostatus* Zonule).

IGO, H., YIN, E.H. and KOIKE, T.

1965 Triassic conodonts from Kelantan, Malaya. (Studies of Asiatic Conodonts, part III). *Memoirs of the Mejiro Gakuen Woman's Junior College,* **2**, 5–19, 2 pls., 1 fig.

Twenty-six species of conodonts are described from limestone at Gua Panjang in S. Kelantan. They are associated with Lower Triassic ammonoids and are probably Scythian or Anisian in age.

INDIA, GEOLOGICAL SURVEY

1945a Western Malaya. *Strategic Branch Technical Note,* **51**, 1. General information, 25p.; 2. Geological maps with strategic index 7 p., geological maps 1 : 500,000.

An account of the general geology of western Malaya with data on topography, soils, water supply and construction materials with regards to military operations. (*fide* Campbell 1959)

1945b Malaya; the Kuala Lumpur area. *Strategic Branch Technical Note,* **52;** 1. general 16p; 2. geological map with strategic index, 6p., map 1 : 500,000.

An account of geological features of military importance in the Kuala Lumpur region. Includes data on water supply and construction materials. (*fide* Campbell 1959)

INGHAM, F.T.

1930 The tin deposits of Gunong Bakau. *Min. Mag., Lond.* **42**, 151–6, 5 figs.

At Chinchong quartz-topaz rock forms horizontal tabular ore-bodies lying in granite. At Bakau, cassiterite-bearing topaz aplite cuts sill-like bodies of quartz-topaz. Also quartz-mica veins with cassiterite and torbernite cut both granite and topaz aplite. A modification of the aplite contains green mica and beryl. Ingham agrees with Scrivenor (1914d) that the quartz topaz bodies are intrusive and do not resemble the secondary deposits of the Erzgebirge as was thought by W. R. Jones (1916a).

1933 Economic minerals of British Malaya with comments on various commercial considerations. *J. Engng Ass. Malaya,* **1**, 216–22.

Lists the economic minerals.

1938a Report. *Rep. geol. Surv. Dep. F.M.S.* [for 1937], 17–27.

Includes notes on Kinta and Selangor mines, and on the geology and economic geology of the Batang Padang district, Perak. Gives chemical analyses of recent lignite veins from Kinta. Notes the geology around the Temangan iron mine, Kelantan, where the ore body is thought to be of secondary limonite.

1938b The geology of the neighbourhood of Tapah and Telok Anson, Perak, Federated Malay States, with an account of the mineral deposits. *Mem. geol. Surv. Dep. Fed. Malaya,* **2**, 72p., 7 pls., 3 figs., 2 geol. maps 1 : 63,360.

The oldest rocks are supposed Carboniferous meta-limestones and argillites forming two facies between which stratigraphical relations are obscure. The bleaching of black phyllites on weathering is mentioned. There is a small outcrop of supposed Triassic quartzites and phyllites. Biotite-muscovite granite intrudes the older rocks and crops out extensively. The coarse granite of the Main Range is usually porphyritic and commonly contains tourmaline. Medium and fine granular granites occur locally. Gives chemical analyses and trace element spectoscopic analyses for the granites. The southern part of the Changkat Rembian granite is strongly sheared. The distribution of tin-ore and notes on the tin mines are recorded. Alluvial gold is widespread. Describes the occurrence of lignite veins in alluvium.

1939 *Rep. geol. Surv. Dep. F.M.S.* [for 1938], 1–15, 51–2.

Upper Triassic lamellibranchs identified from Mentakab, Pahang; late Quaternary molluscs recorded from alluvium of Singapore and Johore. Middle Pleistocene hand axes are recorded from gravels underlying rhyolite ash at Kota Tampan, Perak. Sixteen feet of similar ash is described from Kg. Dong, Pahang. This ash is probably derived from the Lake Toba eruption in Sumatra. Boring in the Dindings proved economic 'karang' below thick barren alluvium. Two records of cassiterite in limestone from Kinta. Bauxite deposit described overlying volcanics near Kuala Kim Kim, Johore.

1941 Notes on bore samples obtained by the Banka drill. *Yb. Chamb. Mines F.M.S.* [for 1940], 127–9.

Methods of examination outlined for the non-geologist.

1947a *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 1–13, 57–8.

Summarises the mining carried out during the Japanese occupation. Columbite was mined in Johore and Kedah, and lithia-mica at Chenderiang, Perak.

1947b Progress report on geological work in south Selangor. *Rep. geol. Surv. Dep. Malay. Un.* [for 1946], 14–18.

Limestone underlies most of the flat ground around Kuala Lumpur. Pelitic rocks dip below it and outcrop extensively south of Serdang, Younger arenaceous rocks form hills to the west of Kuala Lumpur. All these rocks are intruded by mainly coarse porphyritic granite.

1949a *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1948], 1–6, 46.

So-called 'Thorotungstite' from Kramat Pulai, Kinta, found to contain no thorium. Lead tungstate (? stolzite) and iron tungstate occur associated with it.

1949b Notes on the mineral resources of Malaya. *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1948], 6–13.

Outlines the geological history of Malaya. Mineral distribution map of Malaya, 1 : 760,320, shows granite outcrop and main economic occurrences of Sn, Au, Fe, Mn, W, bauxite and coal. The text summarizes these resources and also china clay and ilmenite. Non-economic minerals are mentioned.

1949c A short account of the deep alluvial tin-deposits of Malaya near the granite-limestone contact. *Bull. Malay. min. Staff. Assoc.* **4**, 1–9, 1 pl., 3 figs.

Erosion of limestone at its contact with granite is aided by the presence of sulphides which, on weathering, produce sulphuric acid. The deep gully so formed is a tin-ore trap. The Hong Fatt mine at Sg. Besi, Selangor, and mines on the west side of the Kinta valley are described as examples.

1950a *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1949], 1–7, 45–6.

Fluorescent stolzite (lead tungstate) recorded from tin-ore concentrate from Pengkalan Lahat.

1950b Notes on the mineral resources of Malaya. *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1949], 7–14.

Reprint of Ingham (1949b).

1950c Notes on radioactive minerals. *Rep. geol. Surv. Dep. Fed. Malaya,* [for 1949], 14–18.

Torbernite is found along joints and fracture planes in cassiterite lodes at Ulu Bakau and Sanka Dua, Ulu Selangor. Monazite is widespread in tin-bearing alluvium and contains up to 9% ThO_2.

1952 Notes on the iron-ore deposits of the Federation of Malaya. *Int. geol. Congr. 19, Algiers;* Symposium sur les gisements de fer du Monde, **1**, 565–80.

A list of these deposits and a map, 1 : 3.2M, showing their distribution. The main ore minerals are haematite, magnetite and limonite; the majority are genetically related to the granite. Notes are given on the geology and genesis of the main deposits and analyses are included.

INGHAM, F.T. and BRADFORD, E.F.

1960 The geology and mineral resources of the Kinta Valley, Perak. *Mem. geol. Surv. Dep. Fed. Malaya,* **9**, 347p., 18 pls., 22 figs., 17 tabs., 2 geol. maps 1 : 63,360, 3 geol. sections.

The sediments forming the Calcareous Series are largely of limestone, strongly folded and with interbedded shales and schists. The Tekka clays and western Boulder Clays are largely weathered schist. The younger Arenaceous Series of quartzites and subordinate shales have a limited outcrop. These sediments are intruded by Mesozoic biotite granite, often porphyritic, flanking the Kinta Valley which itself is covered with alluvium including the 'Gopeng Beds'. Granite porphyry and quartz porphyry occur locally. Carboniferous fossils are recorded from limestone near Batu Gajah; black shales contain diplograptids near Chemor. The limestone forming a karst topography beneath the alluvial floor of the valley is continuous with that of the hills and there is no evidence of block faulting. Tourmaline-corundum rock was probably formed by the contact metamorphism of shale or bauxite with boron metasomatism. Hot springs are recorded.

INOUYE, K.

1940 The iron-ores of Indo-China and the Malay Peninsula and archipelago. *J. Geogr., Tokyo,* **52**, 291–310. In Japanese with English summary.

Not seen.

ISHII, K.

1966a On some fusulinids and other foraminifera from the Permian of Pahang, Malaya. *J. Geosci. Osaka City Univ.* **9**, 131–6, 2 pls.

Fossils from Jenka Pass and Kg. Awah are figured and *Yabeina asiatica* sp. nov. is described.

1966b Preliminary notes of the Permian fusulinids of H.S. Lee Mine No. 8 limestone near Kampar, Perak, Malaya. *J. Geosci. Osaka City Univ.* **9**, 145 only.

Limestone with *Pseudofusulina kraffti* (Schellwien) is succeeded by limestone with *Misellina claudiae* (Deprat). This succession can be correlated with the upper part of the Lower Permian of S. China and Japan.

ISHII, K., ICHIKAWA, K. and HADA, S.

1966 Notes on the geology and palaeontology of Malaya. *J. Geosci. Osaka City Univ.* **9**, 89–91.

Introduction to Ishii and Nogami (1966), Ichikawa and Yin (1966), Hada (1966), Ichikawa *et al.* (1966), Ishii (1966a, b). Index map of the fossil localities mentioned in the above.

ISHII, K. and NOGAMI, Y.

1966 Discovery of Triassic conodonts from the so-called Palaeozoic limestone in Kedah, Malaya. *J. Geosci. Osaka City Univ.* **9**, 93–8, 1 pl.

Middle and Upper Triassic conodonts from Bt. Kechil and Bt. Kalong, near Kodiang, are listed and figured.

JACK, W.

1822 Extract from a letter from Mr. William Jack to H.T. Colebrooke, Esq. V.P.G.S. & c. containing a notice respecting the rocks of the islands of Penang and Singapore. *Trans. geol. Soc. Lond.* (ser. 2) **1**, 165–6.

Mentions that Penang is formed of granite; and Singapore of red sandstone, conglomerate and slaty clay. Sandstone and ironstone are widespread and seem to be connected with the alluvial tin deposits of Selangor and Perak.

JOHNSEN, A.

1908 Sekundäre Zwillingslamellen im Zinnstein. *Zentbl. Miner. Geol. Palaont.* [for 1908], 426–31, 1 fig.

Refers to cassiterite from Selangor.

JOHNSTON, R.W. and TILLEY, C.E.

1940 On fluoborite from Selibin, Malaya. *Geol. Mag.* **77**, 141–4, 1 pl.

A F-rich member of the fluoborite series is described. It is associated with phlogopite, tremolite, talc, fluorite, dolomite, arsenopyrite, and cassiterite.

JONES, C.R.

1959 Graptolites recorded from Malaya. *Nature, Lond.* **183** 231–2.

Upper Ordovician—Lower Silurian graptolites occur in NE Langkawi Islands and in N Kinta, Perak. The nearest previously known graptolites were from the Shan States of Burma.

1961a A revision of the stratigraphic sequence of the Langkawi Islands, Federation of Malaya. *Proc. 9th. Pacif. Sci. Congr.* **12**, 287–300, 5 figs.

The work of Scrivenor and Willbourn (1923) is revised. The Upper Cambrian Machinchang Formation consists of 4,500 ft of

quartzite, siltstone, shale and flagstone. It is succeeded conformably by the Setul Formation, 7,500 ft of massive limestone with an Ordovician cephalopod-gastropod fauna. Near the top of this formation two flaggy horizons contain Lower Silurian graptolites. Carboniferous shales outcrop on Thai islands east and west of the Langkawi group. The Lower Palaeozoic of Langkawi is compared to that of Thailand and Burma, and the Langkawi area is interpreted as having lain at the head of a gulf extending southwards from an embryo Tethys in Lower Palaeozoic time.

[At this time it was not known that Upper Palaeozoic flags and limestone were present in Langkawi and that a major thrust plane separated the main development of the Setul Formation from the Upper Palaeozoic limestone—*see* Jones, C. R. 1965 MSb.; Kimura and Jones, C. R. 1966; and Koopmans 1965].

1961b Fossils in Malaya: their use to the geologist and the case for the conservation of certain fossil localities. *Nature conservation in Western Malaysia,* p. 83–8, 2 pls. 2 figs. Kuala Lumpur: Malayan Nature Society.

Points out the value of fossils in stratigraphy and in what sort of situations they are likely to occur. Includes a tabulated stratigraphic column for Malaya.

1965 The limestone caves and cave deposits of Perlis and north Kedah. *Malay. Nat. J.* **19**, 21–30, 2 pls., 2 figs.

The Setul Formation in west Perlis forms a limestone massif containing extensive networks of narrow passages and caverns filled with tin-bearing alluvium. The isolated limestone hills of the Chuping Formation contain large high-vaulted caverns floored by thick, phosphatic cave earths. Marine undercuts and marine caves from north Kedah are described.

1967 Graptolites of the *Monograptus hercynicus* type recorded from Malaya. *Nature, Lond.* **215**, 497 only.

Lower Devonian graptolites, associated with tentaculitids, are recognised from Kedah, Perak, and Pahang.

JONES, C.R., GOBBETT, D.J. and KOBAYASHI, T.

1966 Summary of fossil record in Malaya and Singapore 1900–1965. In: Kobayashi, T. and Toriyama, R. (ed.) *Geology and Palaeontology of southeast Asia,* vol. 2 p. 301–59, 9 tabs., 1 map 1:2.9M approx. University of Tokyo Press.