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Upper Palaeozoic Stratigraphy Of The Area West Of Kampar, Perak

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Abstract: The marine sedimentary rocks of the Kampar area, estimated to be more than 5,500 ft thick, can be lithologically divided into six units, which have been dated by means of fossils. These units, with their thicknesses and ages, are as follows (starting with the oldest): Kim Loong No. 1 beds (4,150+ ft, pre-Middle Devonian); Thye On beds (450 ft, Middle Devonian); Kuan On beds (60 ft, Carboniferous); Kim Loong No. 3 beds (330 ft, Lower Permian or Upper Carboniferous?); Nam Loong beds (500 ft, Lower Permian); H. S. Lee beds (50+ ft, Lower to Middle Permian).

The Kim Loong No. 1 beds consist predominantly of dolomites and calcitic dolomites and are distinguished in the field from the grey crystalline calcitic limestones of the Thye On beds. The Thye On beds contain *Stringocephalus perakensis* Gobbett and are Givetian in age.

The Kuan On beds are characterised by oolitic limestones interbedded with laminated black shaly limestones and calcitic limestones. Gastropods mainly of the family Sinuopeidae? are present in the shaly limestones.

The Kim Loong No. 3 beds are composed mainly of unfossiliferous sandstones, black pyritiferous shales and shaly sandstones.

The base of the Nam Loong beds consists of massive crinoidal limestone. Overlying this are impure limestones rich in Lower Permian brachiopods.

The H. S. Lee beds are formed of pale limestones. The lower part is Pseudofusulina limestone and the upper part is unbedded reef limestone with *Misellina* sp. and a rich molluscan fauna.

INTRODUCTION

Purpose Of Study

The presence of Upper Palaeozoic rocks in the Kampar area (fig. 1) was first brought to the attention of Malayan geologists by Toong (1965) and Gobbett (1966). Gobbett has further investigated the stratigraphy and palaeontology of parts of the region mapped by Toong. Ishii (1966) and Dhillon and Bhatia (in press) are the only other palaeontologists who have studied respectively the fusulines and ostracodes found in the Permian limestone of the area. But other fossils from this area have been and are being studied by R. L. Batten of the American Museum of Natural History (gastropods), D. Hill and R. Gould of Queensland University, Australia (corals), C. F. Elliot and G. T. Scrutton of the British Museum Natural History (algae and corals).

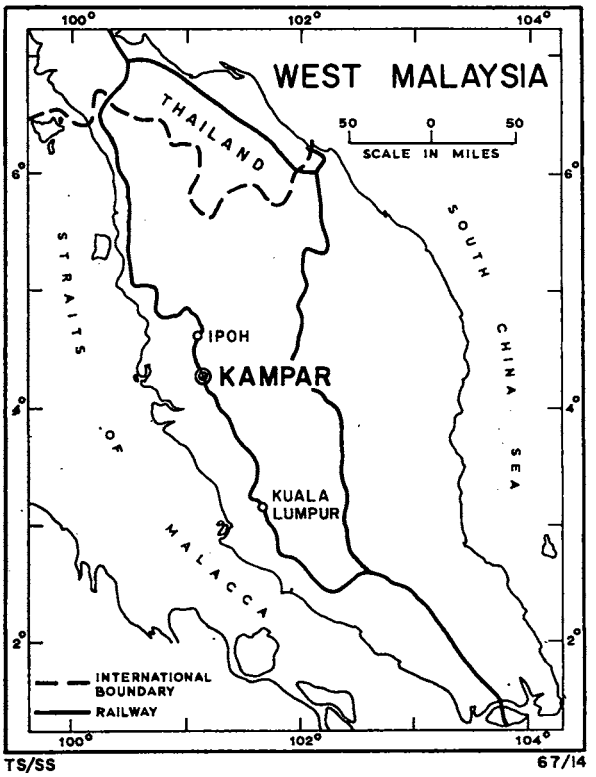


Fig. 1. Index map of West Malaysia, showing location of Kampar.

Though good exposures are not uncommon in tin mines, very little work on stratigraphy has been done in the area. This paper shows how the various beds found in the area could be stratigraphically divided into rock units and the ages of the units determined by fossil assemblages. All the mines in the area west of Kampar were visited by the writer during March—April and August 1966. Data from other mines now filled or flooded were obtained from Toong (1965).

General Setting

The area of about 25 square miles lies between longitudes 101° 5′ and 101° 10′ east and latitudes 4° 15′ and 4° 20′ north. The mapped area is flat, lies about 100 ft above sea level and is covered by alluvial deposits. It is flanked on the eastern side by the granite of the Main Range and about ten miles to the west by granite of the Kledang Range.

The thickness of alluvium seen in the mines ranges from about 10 to about 100 ft. Most of the bedrock beneath the alluvium is limestone, and where mining operations have exposed it, the limestone is often found to have been eroded and dissolved by surface and subterranean water, forming an irregular surface.

Acknowledgements

Since this paper is based on a part of my B.Sc. (Hons.) thesis, I wish to state that I have received help from many sources. I wish to thank members of the academic staff of the Department of Geology, University of Malaya and especially Dr. D. J. Gobbett and Dr. P. H. Stauffer who were the prime sources of advice, suggestions and criticism. I would also wish thank the laboratory staff of the Department of Geology, University of Malaya and the staff of the Geological Survey of West Malaysia, for all help rendered in the preparation of this paper. Miss Anna Lee typed the manuscript and Mr. S. Srinivass drew the figures. Mr. Jaafar bin Haji Abdullah made the photographs of fossils.

STRATIGRAPHY

Fossils indicate a succession from Middle Devonian to Middle Permian in the area. The author believes that rocks older than Middle Devonian are present, but there is no conclusive evidence from fossils.

The succession of beds has been prepared by the correlation of sequences on both sides of the Kampar Fault (fig. 2), a postulated north-northwest trending strike fault, named after Kampar town. Wherever possible, true thicknesses of the various beds were measured. Where this was not possible, apparent thicknesses of outcrops between two mines were estimated from the average dips and horizontal distances, taking account of minor tectonic structures.

Some of the fossils listed were collected by the writer, whilst others, shown by asterisks (*), have been collected by Gobbett, Toong and others.

On the basis of lithology it is proposed to group the beds as follows:

Name of Beds (Rock Unit)	Approximate Thickness (feet)
H. S. Lee beds (youngest)	50 +
Nam Loong beds	500
Kim Loong No. 3 beds	330
Kuan On beds	60
Thye On beds	450
Kim Loong No. 1 beds (oldest)	4,150 +

Kim Loong No. 1 Beds

Lithology

These beds were seen at the far east and southeast of the area mapped (fig. 2). The type exposure is in the Kim Loong No. 1 Mine.

The main rock types are calcitic limestones, dolomitic limestones, calcitic dolomites and dolomites. Dolomites and dolomitic limestones are the dominant rock types. Dolomitic limestone pinnacles are found at Talam Mine No. 5 (fig. 2), where the strike and dip could not be measured. These dolomites are the oldest rocks observed in the area under study. Dolomites and dolomitic limestones are also present in the Ban Heap Leong, Toong Heng and Thye Loy Mines. Pure limestone was observed only at the Swee Cheng Mine.

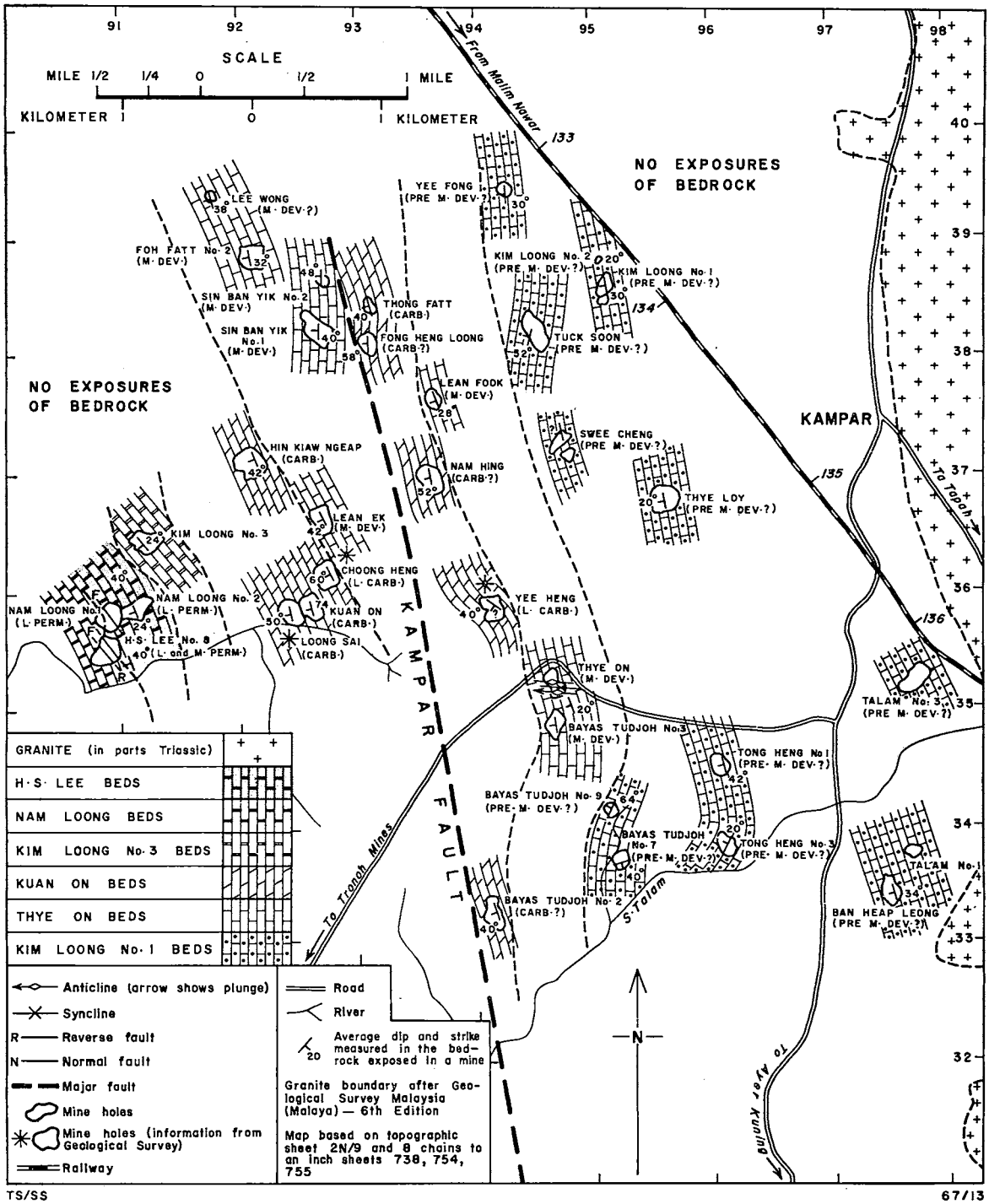


Fig. 2. Map showing bedrock geology in area west of Kampar.

ERRATA : (1) At westernmost part of map, patterns indicating H. S. Lee beds and Nam Loong beds are reversed; (2) in east-central part of map, Talam No. 5 mine is mislabelled "No. 3"; (3) in legend topographic sheet 739 should also be listed.

The dolomites are fine to medium-grained, and usually light grey to light yellowish grey when fresh. The fine-grained calcitic limestones are dark grey to light grey. A thin crust (approximately 1 to 2 cm) of yellowish, chalky material is found over the fresh surface of limestone.

The original bedding of the rock is commonly preserved, and is accentuated by differential weathering and by iron staining. A bed with abundant tabulate coral (*Thamnopora* sp., identified by C. T. Scrutton of the British Museum Natural History) increases in thickness from 2 ft at Kim Loong Mine No. 1 to 4 ft at Kim Loong Mine No. 2. Inorganic primary structures, such as deformed cross bedding and laminations, are well preserved in the dolomite beds of the Ban Heap Leong Mine. This indicates that dolomitisation has not destroyed primary structures.

Jointing, though well developed, is not as obvious as bedding. Joints strike in an east-west direction in the dolomite beds of the Talam No. 5 and Ban Heap Leong Mines. Veins of secondary calcite, without any preferred orientation, are also present.

Palaeontology

Fossils were collected in some limestones and dolomitic limestone beds. The following were collected from Kim Loong No. 1 and Kim Loong No. 2 Mines :

Coelenterata:	*Amplexus*? sp., *Thamnopora* sp.
Gastropoda:	*Murchisonia* sp. G., *Straparollus* sp.
Pelecypoda:	genus and sp. indet.
Brachiopoda:	Spiriferidae? genus and sp. indet.
	Ambocoeliidae? genus and sp. indet.

Thamnopora sp. and *Murchisonia* sp. G have also been found in the dolomitic limestone beds of the Tong Heng Mines, corals in the Yee Fong Mine, and *Thamnopora* sp. in the calcitic dolomites of the Bayas Tudjoh Mine No. 9.

The rocks could not be dated precisely by these fossils. The brachiopods, which may give a clue to the age, could not be identified at the generic level because recrystallization has destroyed all internal structures. On the basis of external morphology, the large brachiopods look similar to some members of the Ambocoeliidae, which range in age from Silurian to Lower Devonian. The presence of *Thamnopora* sp. indicates the age of these beds to be Silurian or Devonian. *Amplexus?*, *Straparollus* sp. and *Murchisonia* sp. G are long-ranged Palaeozoic forms. Since the brachiopods and tabulate coral show some similarity to Silurian or Lower Devonian forms and are distinctly different from those of the Middle Devonian or Carboniferous faunas in hte Kampar area, the limestone beds are dated as pre-Middle Devonian.

Correlation Within Malaya

Further evidence that the age of the Kim Loong No. 1 beds which lie conformably below the Givetian may be Lower Devonian or Silurian is obtained by comparing the sequence with other fossil localitites in Malaya. Limestone

at Chemor (north end of the Kinta Valley) is associated with bands of graptolite-bearing, black, partly pyritiferous shale (Ingham and Bradford, 1960). In the Kuala Lumpur area, the Hawthornden Schist, a fine-grained, pyritiferous black schist, may be compared with metamorphosed graptolite-bearing black shales (Gobbett, 1965). This "shaly" sequence may be continuous from Perlis to Kuala Lumpur or further south.

The Kuala Lumpur Limestone, approximately 6,000 ft thick, overlies the Hawthornden Schist and is Upper or Middle Silurian in age (Gobbett, 1965). The limestone of Kuala Lumpur and the Kinta Valley may have been deposited at the same time.

Thye On Beds

Lithology

These beds are found on both sides of the Kampar Fault. The type exposure is in the Thye On Mine.

The rock is predominantly calcitic limestone, mainly greyish and in some cases slightly ferruginous. The grey crystalline limestones weather to a white powder, but in some places, *e.g.* Foh Fatt Mine No. 2 and Sin Ban Yik Mines, the surface of the outcrops is yellowish. This is probably due to staining by ferruginous material present in the alluvium. At Lean Ek Mine, a bed of greenish-grey crystalline limestone is interbedded with grey limestone. On the eastern end of the Lean Ek Mine the surface of beds is blackish owing to the presence of organic matter in the overlying alluvium.

Bedding is well exposed in all the mines except the Sin Ban Yik Mine No. 1. Finger-like limestone pinnacles are present in the Thye On and Lee Wong Mines. Small circular hollows having a diameter of about 1 to 3 cm are found on the bedding planes of the limestone beds of the Lean Fook and Sin Ban Yik No. 1 Mines. These hollows are probably formed as a result of "honey-comb" weathering.

Jointing is not pronounced, but secondary calcitic veins are very numerous. In some cases the veins are found to form a boxwork pattern. The most characteristic structures found in the limestone beds are stylolites, usually parallel to the bedding.

The Thye On beds differ from the Kim Loong No. 1 beds in that the dominant rock type is greyish pure calcitic limestone, whereas in the Kim Loong No. 1 beds it is yellowish-grey dolomites and calcitic dolomites. Fossils are found in nearly all horizons of the Thye On beds, and these differ from the rare fossils found in the Kim Loong No. 1 beds.

Palaeontology

Fossils have been found in all mine exposures of the Thye On beds. They are listed below:

Thye On Mine

Stromatoporoidea:	*Actinostroma* sp., *Amphipora* sp. (identified by G. F. Elliot)

Gastropoda:	Rhaphistomatidae, *Murchisonia* sp. A
Pelecypoda:	*?Pteridae gen. and sp. nov.
Cephalopoda:	**Cyrtoceras* sp. ? *Oncoceratid Nautiloid
Brachiopoda:	**Stringocephalus perakensis* Gobbett

Lean Ek Mine

Stromatoporoidea:	*Actinostroma* sp., *Amphipora* sp.
Gastropoda:	Rhaphistomatidae, *Murchisonia* sp. B (fig. 10)
Cephalopodo:	**Cyrtoceras* sp.
Brachiopoda:	**Stringocephalus perakensis* Gobbett

Bayas Tudjoh No. 3 Mine

Stromatoporoidea:	*Amphipora* sp. ?
Gastropoda:	*Murchisonia* sp. A., Rhaphistomatidae
Cephalopoda:	Nautiloid
Pelecypoda:	indeterminate species
Brachiopoda:	*Stringocephalus perakensis* Gobbett

Sin Ban Yik Mines

Stromatoporoidea:	*Amphipora* sp. ?
Pelecypoda:	indeterminate species
Gastropoda:	*Murchisonia* sp. C, *M.* sp. D, *M.* sp. E, *M.* sp. F
Brachiopoda:	**Stringocephalus perakensis* Gobbett

Foh Fatt Mine No. 2

Corals:	indeterminate species
Gastropoda:	*Murchisonia* sp. C (fig. 12), *M.* sp. E, *M.* sp. F
Brachiopoda:	unidentified

At the Thye On Mine, the grey crystalline limestone containing *Stringocephalus perakensis* is dated as Givetian, Middle Devonian (Gobbett, 1966). Similar limestones with *S. perakensis* were found at the Sin Ban Yik, Lean Ek, and Bayas Tudjoh No. 3 Mines.

The lower beds of Foh Fatt Mine No. 2 have lithology and fossils similar to those of the upper beds of Sin Ban Yik Mine No. 1. The beds of these two mines lie on the same strike and the difference between the average dips is only 8°. For these reasons the Foh Fatt Mine No. 2 is regarded as probably Middle Devonian. The outcrops at the Thye On and Lean Fook Mines lie on the same strike of 340° and the lithology and fossils of these two mines are similar. Gobbett (personal communication) regards the sequences at the Lean Ek and Thye On Mines as similar on the basis of fossils and lithology. In conclusion, it is probable that the same sequence of beds occurs in the Thye On, Lean Ek, and Lean Fook Mines.

Stringocephalus was not found in the Lee Wong Mine and the rocks in this mine may be younger, *i.e.* Upper Devonian. The beds of the Lee Wong Mine are placed here because the fauna and rock type are similar to the uppermost beds of the Lean Ek Mine and lie on the same strike.

Kuan On Beds

Lithology

These beds occur west of the Kampar Fault. The good exposures of well-bedded limestones in the Kuan On Mine are taken as the type exposure.

The rocks are mainly grey, carbonaceous, slightly dolomitic limestones and calcitic dolomites interbedded with carbonaceous, laminated, shaly limestones. These shaly beds are black to pale grey and weather to a black powdery mass. The black colour is due to carbonaceous material. A bed of grey-green oolitic limestone is seen in the Kuan On and Hin Kiaw Ngeap Mines. In certain parts the ooliths have been destroyed.

The beds dip steeply towards the west and bedding is made clear by differential weathering. Faults and joints oriented mainly in a northeast-southwest direction disrupt the bedding. Along the joints, concretion of calcitic material with impurities are present. Numerous calcitic veins are also present. Some of the small veins are found to cut fossils in two. Rounded pure calcitic concretions from 1 to 10 cm in diameter occur along the bedding planes.

The lithology of the Kuan On beds, consisting mainly of grey crystalline limestone interbedded with shaly laminae, differs from that of the Thye On beds, which are mainly pure calcitic limestones. The oolitic limestones further serve to distinguish the Kuan On beds. The fossils of the Kuan On beds are completely different from those of the Thye On beds.

Palaeontology

The fossils collected from the various mines exposing the Kuan On beds are listed below:

Loong Sai Mine (Gobbett, quoted in Toong, 1965)

Dasycladacean algae?	
Gastropoda:	Sinupeidae? sp., *Hypergonia*? sp., *Callistadia*? sp., Eotomariidae, Neritopsidae sp., Gastropoda indet.
Pelecypoda:	*Schizodus* sp.?
Cephalopoda:	*Cyrtoceras* sp.?

Kuan On Mine

Dasycladacean algae?	
Gastropoda:	Sinuopeidae? sp., Holopeidae? sp., Neritopsidae sp., Eotomariidae?
Pelecypoda:	*Schizodus* sp.?
Cephalopoda:	Nautiloid

Gobbett (quoted in Toong, 1965) deduced the age of the beds in the Loong Sai Mine to be Carboniferous. The presence of *Schizodus* indicated the rock to be younger than Devonian, but the presence of *Cyrtoceras* suggested that the rock is not as young as Permian; thus suggesting a Carboniferous age. The

similar fossils found at the Kuan Mine, again including *Schizodus*, also indicate that the age may be Carboniferous. The two mines are closely adjoining, with the beds of the Kuan On Mine apparently underlying those of the Loong Sai Mine. The rocks in both have similar strikes and dips. The Hin Kiaw Ngeap Mine has similar fossils and rocks to the Kuan On Mine and the sequence is similar in both.

Siphonophyllia sp., indicating a Visean age, has been found in the Yee Heng and Choong Heng Mines (R. Gould, 1965, written communication to D. J. Gobbett). The Yee Heng Mine is east of the Kuan On and Loong Sai Mines on the west side of the Kampar Fault. The Choong Heng Mine occurs on the other side of the Kampar Fault just west of the Thye On Mine. The Yee Heng and Choong Heng Mines had ceased to function at the time of the author's field work, but the rock type has been described as grey crystalline limestone, arenaceous in part (K. S. Toong, personal communication). It is possible that the Kuan On beds may belong in part to the Upper Carboniferous because they appear to overlie the Visean beds in Yee Heng and Choong Heng Mines.

Kim Loong No. 3 Beds

There is a complete change in lithology between the Kuan On beds and the clastic beds of the Kim Loong No. 3 Mine. Black shales, grey-black sandy shales, and argillaceous sandstones are found interbedded in this sequence. The pyritiferous black shales show a metallic lustre. Yellow to red-brown iron pans or encrustations, about 15 cm thick in places, have formed on the surface of these rocks.

Fossils have not been found in these beds. Their apparent stratigraphic position suggests a Late Carboniferous or Early Permian age.

Nam Loong Beds

Lithology

These beds are located at the far west of the area. Sections could not be measured precisely, because the beds are massive, thick and disturbed. The thickness of these beds is estimated to be more than 500 ft. The Nam Loong No. 1 Mine is the type exposure.

Bedding is obscured by intense faulting and jointing. In some cases only massive limestone is seen, as in the crinoidal limestone at the eastern end of the Nam Loong No. 1 Mine. Well-bedded brachiopod limestones were noticed in the western part of the mine.

The rocks are mainly bioclastic limestones, including crinoidal limestones, brachiopod limestones, molluscan limestones. These rocks are grey-black in colour because of a high percentage of carbonaceous material.

The crinoidal limestones are faulted off at the eastern end of the Nam Loong Mine No. 1. West of the fault the succession passes upward into a brachiopod-rich horizon. This horizon is truncated by a north-south fault, across which is black carbonaceous limestone containing *Bellerophon* (*Pharkidonotus?*) sp.

Palaeontology

The fossils collected from the brachiopod horizon are listed below (Gobbett, quoted in Toong, 1965):

Brachiopoda:	*Derbyia* sp., *Chonetes* sp., *Linoproductus* cf. *lineatus* (Waagen), *Cancrinella* sp., *Waagenoconcha* sp., *Spirifer* sp., *Costispinifera*? sp., *Camerophoria* sp., *Camerotoechia* sp., *Martinia* sp., *Composita* sp., *Cleiothyridina* sp.
Polyzoa:	*Fenestella* sp., Cyclostomata

The age of the Nam Loong beds is dated by the brachiopods as Lower Permian.

H. S. Lee Beds

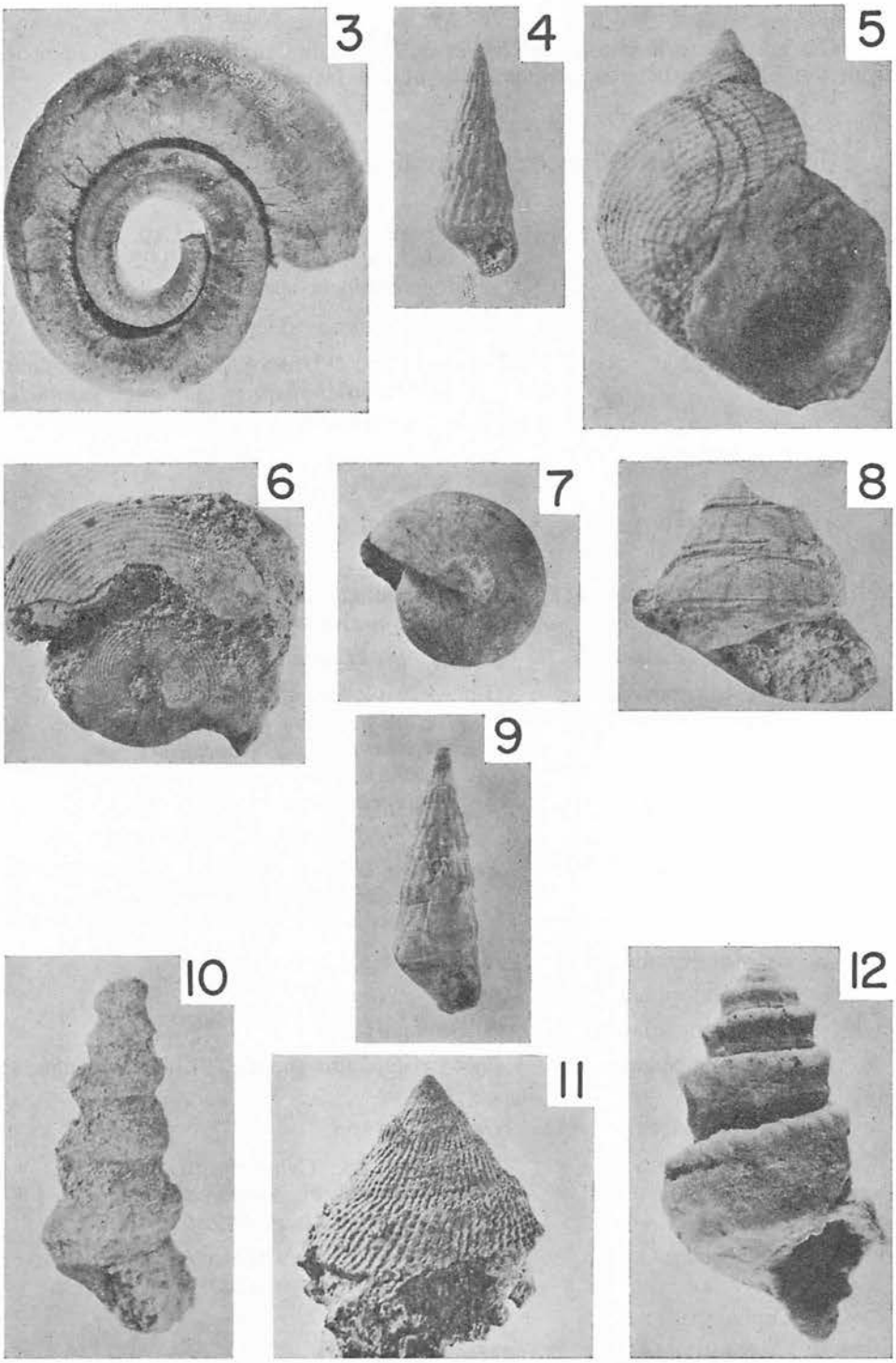
Lithology

These beds, totalling only 50 ft of known thickness, occur in the H. S. Lee and Nam Long No. 1 Mines. The type exposure is in the southeast section of the H. S. Lee No. 8 Mine.

Lowest in this succession are Pseudofusulina limestones. The fusulines are abraded and well rounded, indicating that they have been transported. Fusuline limestones are present in both the mines, but in the Nam Loong No. 1 Mine some of the fusuline limestones are dolomitised.

A massive limestone about 20 ft thick and rich in fossils is present in the H. S. Lee Mine. The limestone is mainly of organic origin, but a small amount of limestone could have been precipitated chemically. There is a reverse fault cutting these beds. There are also a few smaller faults running parallel to this main fault. A large normal fault present in the H. S. Lee Mine separates the H. S. Lee beds from the Nam Loong beds.

Fig. 3. *Straparollus* (*Euomphalus*) sp., top view (UM Collection Number 4841). Fig. 4. *Microptychia* sp., apertural view (4849). Fig. 5. *Trachydomia* sp. B, apertural view (4843). Fig. 6. *Agathiceras* sp., top view (4865). Fig. 7. *Bellerophon* cf. *timorensis*, left side view (2418). Fig. 8. *Euconospira* sp., apertural view (4826). Fig. 9. *Palaeozygopleura* sp., apertural view (4850). Fig. 10. *Murchisonia* sp. B, apertural view (4862). Fig. 11. *Sallya* sp., top view (4823). Fig. 12. *Murchisonia* sp. C, apertural view (4859).



Figures 3–12 (individual captions, opposite page). Fossils from the Kampar area, all X 2. *Murchisonia* are from the Thye On Beds (fig. 10: Lean Ek Mine; fig. 12: Foh Fatt Mine No. 2), all others from the H.S. Lee Beds (H.S. Lee Mine No. 8).

The grey-white limestones of the H. S. Lee beds can be easily distinguished from the black, carbonaceous limestones of the Nam Loong beds.

Palaeontology

The fossils collected from the massive limestone beds of the H. S. Lee Mine are listed below:

Algae:	*Permopora* sp., *Epimastopora* sp. nov. (identified by G. F. Elliot), 2 indeterminate species
Foraminifera:	*Misellina claudiae* (Deprat.), Endothyridae
Coelenterata:	**Chaetetes* sp., **?Iranophyllum* (Iranophyllum) sp., *Pavastehphyllum* (*Sakamotosawanella*) *permicum* Chi
Polyplacophora:	**Lepidopleurus* sp. tail valves and indeterminate valves
Scaphopoda:	*Prodentalium* spp.
Gastropoda:	
Bellerophontacea:	*Bellerophon* cf. *timorensis* (fig. 7), *Knightites* (*Retispira*) *quadratus* Wanner, *Warthia* sp.
Euomphalacea:	*Straparollus* (*Euomphalus*) sp. (fig. 3)
Pleurotomariacea:	*Glabrocingulum* sp., *Eirlysia* sp., *Neoplayteichum dickinsi*, *Mourlonia* (*Mourlonia*) sp., *Mourlonia* (*Pseudobaylea*) sp., *Lacunospira* sp., *Glabrocingulum* (Ananias) sp., *Euconospira* sp. (fig. 8), *Borestus* sp.
Neritacea:	*Trachydomia* 2 spp. (fig. 5), *Trachyspira* sp., *Naticopsis* (*Naticopsis*) sp., *Naticopsis* sp., **Planospirina* 2 spp.
Murchisoniacea:	*Halicespira* sp., *Platyzona* sp.
Pseudophora:	*Sallya* sp. (fig. 11)
Anomphalacea:	*Anomphalus* sp.
Loxonematacea:	*Palaeozygopleura* sp. (fig. 9), *Microptychia* sp. (fig. 4).
Cerithiacea:	*Orthonema* spp.
Subulitacea:	*Meekospira* sp., *Cylindritopsis* cf. *ovalis*?, *C.* cf. *vaningeni*?, *Oncochilus* cf. *globulosus*?
Pelecypoda:	*Parallelodon* 2 spp., *Schizodus* sp., *Pteriacea? genus and species novum
Cephalopada:	
Nautiloidea:	**Metacoceras* sp.

Goniatitina:	**Stacheoceras* sp., **Crimites* sp., **Andrianites* sp., *Agathiceras* sp. (fig. 6)
Brachiopoda:	*Derbyia* sp., Rhynchonellid, Dielasmid
Ostracoda:	*Bairdia* sp., *Bairdiopillata* sp., *Bairdiocypris* sp., *Healdea* sp., *Bythocypris* sp., *Cytherella* sp.
Echinodermata:	Cidaroid spines and plates

From the above list it can be observed that a complex animal assemblage existed in this area. The large pelecypod shells occur in large numbers in well defined horizons. Most of the fossils are undamaged with well-preserved ornamentation. Some of the *Bellerophon* cf. *timorensis* shells are found to be distorted. It was difficult to extract the fossils from the massive limestone without damaging them. The lower parts of the massive limestone are highly weathered, probably owing to the action of subaerial and subterranean water. Fossils in a good state of preservation were collected from this zone. This mixed assemblage of individuals probably lived in a reef complex.

The fauna and flora indicate a Middle Permian age. The main index fossils found are *Crimites* sp.,*Adrianites* sp., *Agathiceras* sp., *Misellina claudiae* (Deprat). The majority of the Pleurotomarians are found in Permian beds in other areas of the world. Ishii (1966) divided the rocks in the H.S. Lee Mine into two zones using fusulines. The two zones are the Misellina claudiae zone and the Pseudofusulina kraffti zone. The former occurs at the base of the massive limestone containing the rich fauna. The Pseudofusuline limestone occurring in the Pseudofusulina kraffti zone is below the Misellina zone. Ishii (1966) said that these two zones belong to the uppermost part of the Lower Permian. It was found later also that the highest sequence in the Nam Loong No. 1 Mine contains a similar mid-Permian fauna. The age of the H.S. Lee beds is thus Early to Middle Permian.

Correlation with the rest of the world

Many of the gastropods found in these mid-Permian beds are either new genera or new species. One or two species, *e.g. Bellerophon* cf. *timorensis* and *Knightites* (*Retispira*) *quadratus* Wanner are similar to the Timor gastropods and to those of the agglomeratic slates of Kashmir (Batten, 1966, written communication to D. J. Gobbett). A number of fossils from these middle Permian beds look similar to the normal Permian Tethys types.

CORRELATION OF KAMPAR SEQUENCE WITH OTHER AREAS IN MALAYA

An attempt has been made to correlate the Palaeozoic sequence west of Kampar with other areas in Malaya (fig. 13). The sources of data are shown in figure 13 and in the list of references. The Kanthan limestones were provisionally dated as Late Devonian (Alexander and Müller, 1963) but lately have been found to include Middle and Lower Devonian (K. J. Müller, 1967, written communication to D. J. Gobbett). The Karak beds ("Bentong group") are thought to be of early Devonian age (Jones, 1967).

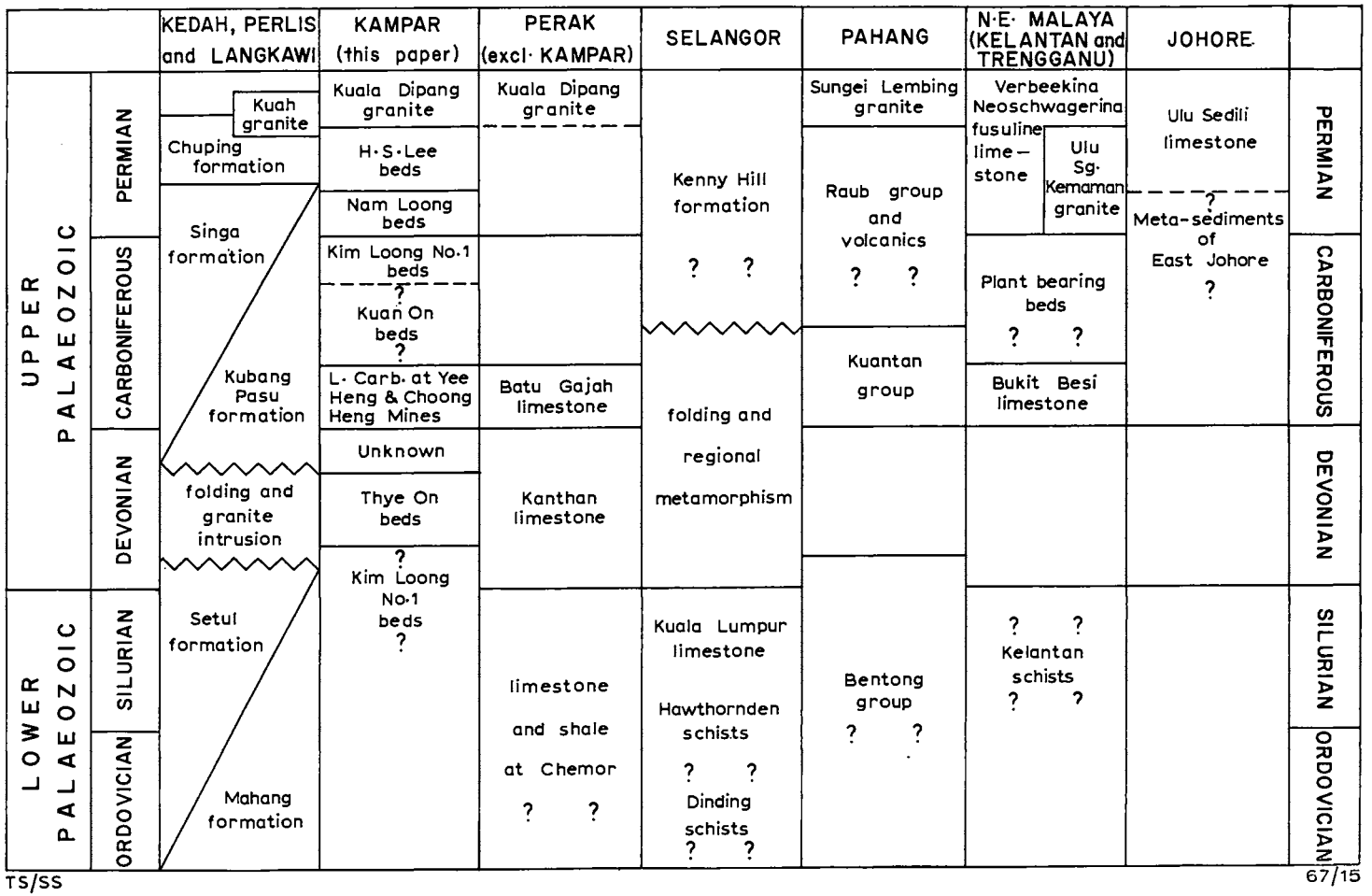


Fig. 13. Correlation chart of Palaeozoic in West Malaysia. Data for areas other thanKampar largely based on Jones, *et al.* (1966).

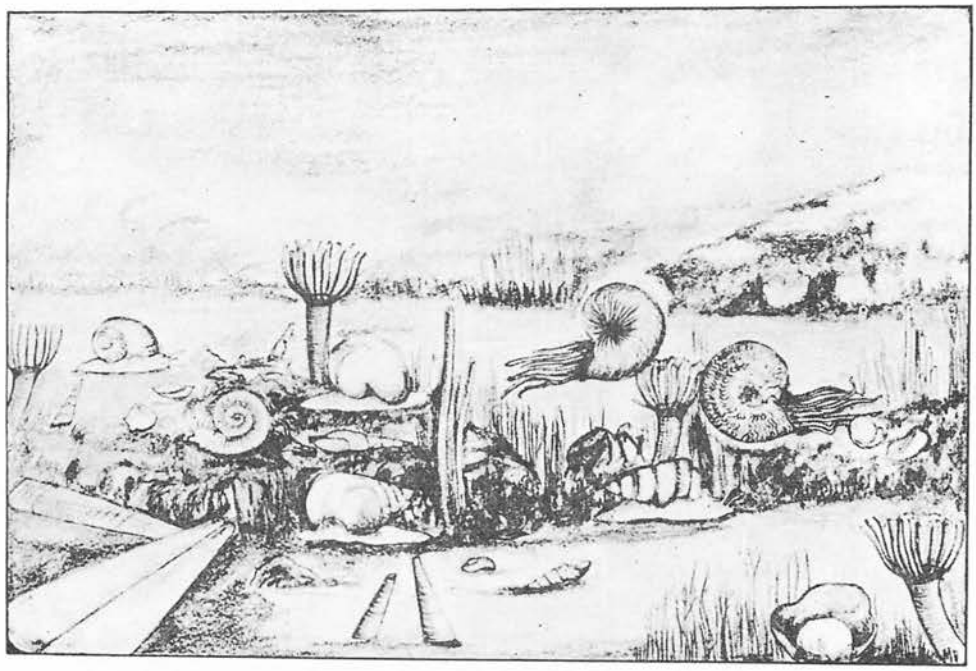


Fig. 14. Reconstruction of Middle Permian sea floor in Kampar area. Drawing by Mohammed bin Haji Majid.

REFERENCES

ALEXANDER, J.B., and MÜLLER, K.J., 1963. Devonian conodonts in stratigraphic succession of Malaya *Nature, 197,* p. 681.

DILLON, D.S. and BHATIA, S.B., in press. Some Ostracoda from the 'Calcareous Series' from near Kampar, Malaysia *Jour. of Paleontology.*

GOBBETT, D.J., 1965. The Lower Palaeozoic rocks of Kuala Lumpur, Malaysia. *Fed. Museums Jour., 9,* p. 67–79.

GOBBETT, D.J., 1966. The brachiopod genus *Stringocephalus* from Malaya. *Jour. of Paleontology, 40,* p. 1,345–1,348.

INGHAM, F.T., and BRADFORD, E.F., 1960. *The geology and mineral resources of the Kinta Valley, Perak, Malaya. Geol. Survey Dept., Fed. Malaya, Memoir 9,* 347 p.

ISHII, K., 1966. Preliminary notes of the Permian fusulinids of H.S. Lee Mine No. 8 limestone near Kampar, Malaya: *Osaka City Univ. Jour. of Geosci., 9,* p. 145.

JONES, C.R. 1967. Fauna from the Foothills Formation at Tuan Estate, Karak, Pahang and its significance: *Geol. Soc. Malaysia Newsletter, 7.*

JONES, C.R., GOBBETT, D.J., and KOBAYASHI, T., 1966. Summary of fossil record in Malaya and Singapore 1900–1965. *Geology and Palaeontology in South East Asia, 2,* p. 309–359.

TOONG, K.S., 1965. 1964 progress report of Geological Survey work done in the Kinta Valley in topographical sheet 2 N/9. *Geol. Survey Malaysia (Malayan Region) Prof. Paper E–65.2–G,* p. 16–19.

DISCUSSION: The environment of deposition of the Upper Palaeozoic limestones of the Kampar area was discussed. D. Santokh Singh drew attention to about twenty oolitic horizons and the presence of cross bedded limestones and reef talus in similar rocks near Batu Gajah. These indicated very shallow water and strong currents.