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The Tembeling Formation—A Litho-stratigraphic Description (West Malaysia)

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Abstract: The name "Tembeling Formation" is introduced for fluviatile-deltaic-lacustrine sediments of post-orogenic origin in West Malaysia (Malaya). A type section is described in the Tekai River (Pahang), where the total thickness of the formation is over 3,000 meters. The age of the formation is probably late Triassic to Jurassic. A basal member, the "Murau Conglomerate", is described from the Mersing area (Johore); it consists of coarse red purple polymict conglomerates of fluviatile origin. These conglomerates decrease in thickness from east to west and vary in composition. The Murau Conglomerate is overlain in the Tahan Range by a sequence of red to grey shales and mudstones alternating with thick bands of arenaceous-rudaceous rocks. The top of the formation is formed by typical argillaceous red-beds, deposited under warm continental conditions. The Tembeling Formation overlies rocks of varied composition and age. An angular unconformity well developed in the east of the Peninsula decreases in importance westward. Along the east coast in the State of Johore, the formation unconformably overlies metasediments of probable Carboniferous age, whereas to the northwest in the type area in central Pahang Triassic rocks are underlying. The folded Tembeling Formation is unconformably overlain by flat-lying beds of the late Jurassic to early Cretaceous Gagau Group.

INTRODUCTION

In this paper a mappable rock-stratigraphic unit the "Tembeling Formation" is introduced and defined according to the Malaysian Code of Stratigraphic Nomenclature.

The Tembeling Formation is composed of a sequence of fluviatile-deltaic-lacustrine sediments, alternating between coarse arenaceous-rudaceous and fine argillaceous strata. They reach their maximal development in the drainage basin of the Tembeling River in the State of Pahang, where they form the Tahan Range trending from Kelantan south-southeast into Pahang and Johore. The range culminates in Gunong Tahan (7,186 ft), the highest mountain in West Malaysia.

Historical notes

The sequence was provisionally named by Scrivenor (1907a) the "Tembeling Series". He described it as estuarine rocks consisting of conglomerates of varying degrees of coarseness and containing pebbles and boulders of varied composition; sandstones which are closely associated with the conglomerates; shales and sandy shales. "Grey shale is not uncommon, but as a general rule the shale, sandstone and grit have a deep red or yellow colour that forms a pleasant contrast to the monotonous green of the landscape" (Scrivenor 1907b, p. 5). In a later publication Scrivenor (1911) discarded this name and referred to the rocks as "Gondwana Rocks", a supposed Malayan outlier of the Upper Gondwanas of India. The

name Gondwana Rocks was first suggested by Newton (1906) for the fossiliferous shale and sandstone beds exposed in the quarry of Mount Guthrie, Singapore. In 1931 Scrivenor reviewed the stratigraphic nomenclature of Malaya and proposed instead of the "Gondwanas" the more general term "Malayan Triassic". Alexander (1956) introduced the name "Younger Arenaceous Series" for the rocks which he described as follows: "the arenaceous rocks found in the State of Pahang which have been proved on palaeontological evidence, or thought on structural evidence, to be Triassic in age" (p. 310). This name was later discarded in favour of "Lipis Group" (Alexander, Paton and Jones, 1959). The group covers a much wider suite of rocks than initially included by Scrivenor in the Tembeling Series. The Lipis Group is described as "A characteristically argillo-arenaceous sequence, formerly known as the Younger Arenaceous Series, including an argillo-calcareous formation of late Triassic age". The rocks of the Tembeling Formation as defined in this paper were previously included in the Lipis Group.

In anticipation of the present full litho-stratigraphic description the author has used in a previous publication the informal name "Tembeling rocks" (Koopmans, 1966).

DESCRIPTION

General aspects

The formation is a succession of conglomerates, feldspathic and quartzitic sandstones, grey and reddish shales and mudstones. The rock strata form a distinct combination of lithological types, typical for the Tembeling area (Pahang), and which are clearly mappable as a single litho-stratigraphic unit (Koopmans, 1966). In certain areas the base of the Tembeling Formation is formed by a thick reddish-purple polymict conglomerate. Higher in the sequence well-sorted quartz-pebble conglomerates are prominent, often grading into sandstones. The sandstones show well developed cross-bedding and occasionally ripple marks. A few lentils of coal-shale occur and some fossil plants and plant fragments are found in the interbedded grey mudstones. Thick bands of homogeneous red shales and mudstones are intercalated in the higher parts of the formation with arenaceous strata. No organic remains are found in these red beds.

Type locality and geographic distribution

The type section is from the confluence of the Tembeling and the Tekai Rivers to about fifteen kilometers up the Tekai River, central Pahang (Survey Dept. map sheet 2 0/14, scale 1 inch to 1 mile, grid. ref. 460 300 to 570 230; see fig. 1). The name Tembeling is used for the unit rather than Tekai, because it was used by Scrivenor (1907a) in his "Tembeling Series" for the same sequence of rocks, and because the name is widely used for the area. Both rivers cut the formation several times. As "Series" is a chrono-stratigraphic unit and the strata here described represent a rock-stratigraphic unit, the term "Formation" is appropriate.

The base of the formation in the type section is neither well exposed nor is the lithology of the basal layer characteristic for the Tembeling Formation elsewhere. As type section for the basal layers Tanjong Murau is chosen, a

headland situated along the east coast of the Malay Peninsula, approximately 20 kilometers south-southeast of Mersing, Johore (fig. 1). The name "Murau Conglomerate" is adopted for this basal member of the Tembeling Formation.

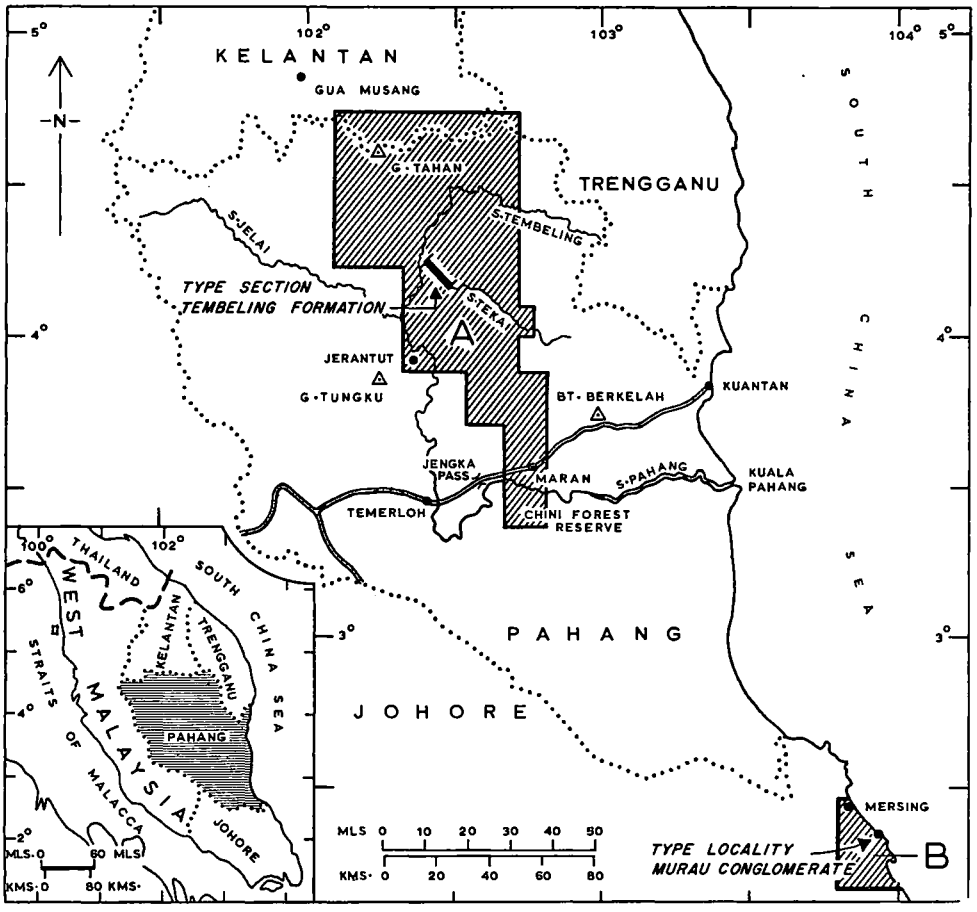


Fig. 1. Locality map showing the type section of the Tembeling Formation and type locality of the Murau Conglomerate Member. For area A see fig. 2 and for B fig. 5.

The Tembeling Formation occurs in an area 40 kilometers wide in average and at least 180 kilometers long, in a zone previously described by Scrivenor (1907a) as the "Tahan Range" or "Tahan Coulisse". The rock sequence is folded into a number of open synclines and anticlines which trend roughly north-northwest to south-southeast (fig. 2). In the north, the formation appears near Gua Musang (Kelantan). Due to culminations in fold axes the outcrop of the Tembeling Formation is interrupted in three narrow zones; one just north of the place where the Tembeling River cuts the Berantai Syncline, a second 10 kilometers northwest of Gunong Lerek and a third zone south of Maran, a small town along the Temerloh-Kuantan road. Scrivenor traced the

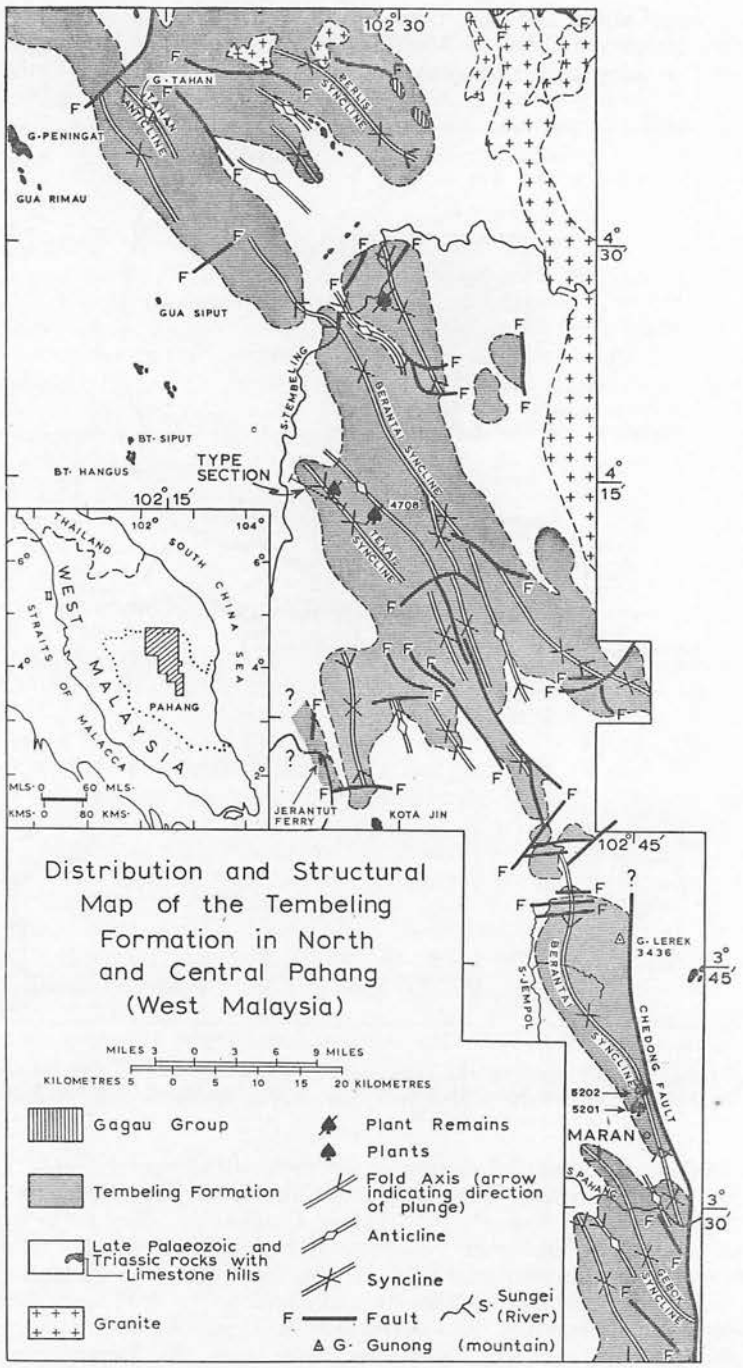


Fig. 2. Distribution map of the Tembeling Formation in North and Central Pahang, with major fold axes indicated.

Tahan Coulisse further south into Johore and Singapore. Whether the Tembeling Formation also extends further south has to be found out by future field investigations. Descriptions of similar rock types by Newton (1906) and Scrivenor (1907a; 1907b) from Singapore and Bothé (1928) from the Lingga Archipelago (Indonesia), and the presence of the Murau Conglomerate in the Mersing area (Johore), make a southern continuation probable.

To the east, outside the Tahan Range, rocks belonging to the Tembeling Formation have been found near Bukit Berkelah (2,682 ft), Pahang, and along the east coast between Tanjong Tenggaroh and Tanjong Sekakap, Johore, and in Bukit Keluang, Bukit Bubas, Bukit Dendong and Pulau Rhu (Trengganu). Without doubt this formation will be found outcropping in more localities in the eastern part of the Malayan Peninsula in future, as geological mapping has been scanty and largely on a reconnaissance basis. West of the Tahan Range the Tembeling Formation has been found outcropping in the Gunong Tungku area and in the Jengka Pass (Pahang) along the Temerloh-Maran road: the areas of outcrop here are relatively small. The sediments are found to occur in open synclines. Further west the Tembeling Formation has not been found yet.

Detailed lithology in the type section

The base of the formation is formed in the type section of the Tekai River (fig. 3) by an approximately 150 meters thick conglomerate. The pebbles in the conglomerate are of varied composition. The majority are white, subrounded quartz pebbles, ranging in size from $\frac{1}{4}$ to 5 cm. Pebbles of green and black chert occur in minor quantities, and also some subangular fragments of hornfels and a few cobbles of a red quartzite. The latter are well rounded and range in size up to 20 cm. The typical appearance however, is the large quantity of white or milky quartz and chert pebbles in this conglomerate. The matrix is arenaceous and slightly feldspathic. The pebbles are in general touching each other in the conglomerate although some intercalations of arenaceous beds occur with only a few scattered pebbles or none at all. These sandstone lenses often show scour and fill structures and a faint minor scale cross-bedding could be discerned in them. Higher up the conglomerate is less polymict and mainly made up of quartz clasts only; the sandstone becomes more feldspathic and a white to red colour prevails. This conglomerate in the type section is the same basal horizon as formed by the red polymict conglomerate found further east and south, which will be described below as the "Murau Conglomerate Member".

The quartz pebble conglomerate is overlain by incompetent red shales and red mudstones which are approximately 160 meters thick. They grade upwards into a succession of sandy mudstones and purple arkosic sandstones and conglomerates. Intercalated pebble beds become increasingly prominent higher in this unit forming a second layer of competent rocks having high relief. The individual beds range in thickness between 1 and $1\frac{1}{2}$ meters. The composition of the conglomerate clasts is less varied than that in the basal layer. Vein quartz makes up the majority of the clasts whereas in order of prominency, some chert, hornfels and quartzite pebbles occur. The clasts are well sorted, subrounded, and range in size from 2 to 4 cm.

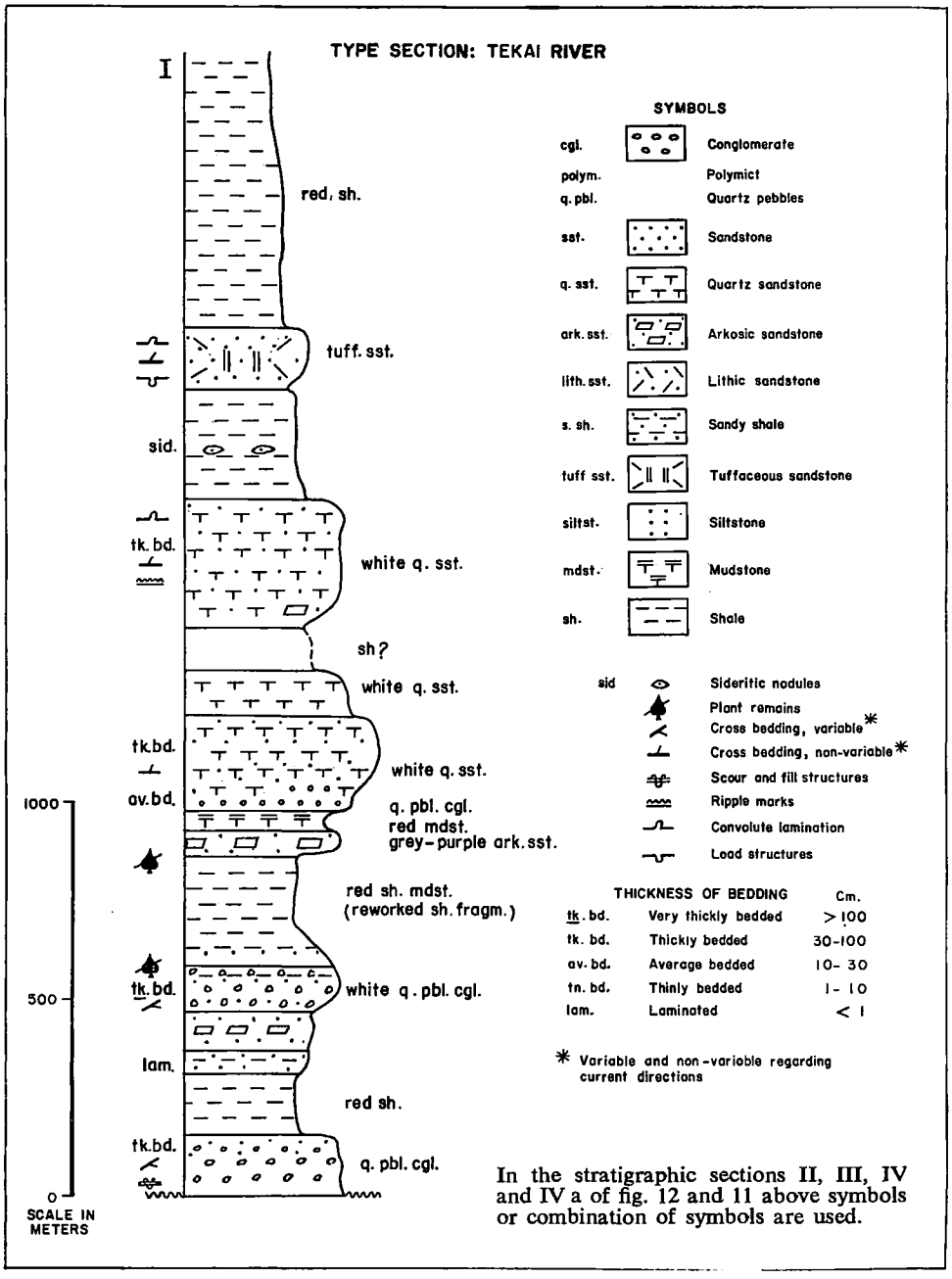


Fig. 3. Litho-stratigraphic type section of the Tembeling Formation.

On top of the conglomerate occur purple micaceous mudstones, sandy mudstones and feldspathic sandstones in which some indeterminable plant fragments were found. Further to the east upstream the Tekai River, a horizon of coal shales was found at this level in the section. The layer, approximately 2 meters thick, contains indeterminable plant fragments and a small assemblage of carbonised palynomorphs (loc. 4708, see Appendix). The collection of plant fossils (loc. 5201) from the Berentai Syncline is also derived from approximately this horizon. In this sequence a 40 centimeter thick layer of reworked shale fragments was also observed; small angular slabs, 1–2 cm in size, of red shales were washed together in a red sandy matrix.

The red-purple shales and mudstones are overlain by grey-purple thickly bedded arkosic sandstones, followed again by red mudstones. A 5 meter thick oligomict quartz pebble conglomerate forms the base of another resistent, competent rock unit which is mainly composed of white quartz sandstones and about 350 meters thick. Cross bedding is observed in these sandstones. Upwards probably argillaceous rocks occur; no outcrops were found in the type section but the low relief indicates a nonresistent nature of the rocks. This horizon could be correlated with grey-black carbonaceous shales in a section upstream. Higher in the sequence another resistent quartz sandstone band occurs which is 350 meters thick. Medium scale tabular cross-bedding is well developed (fig. 4), and ripple marks were observed in the thickly bedded whitish quartz sandstones.

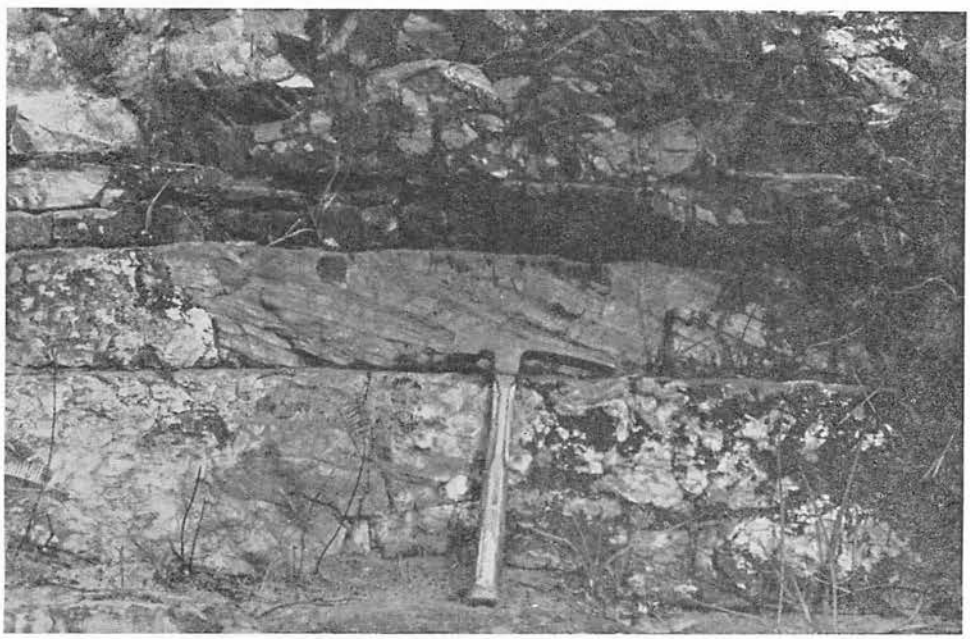


Fig. 4. Tabular cross-bedding of the Tembeling Formation in the Tekai River.

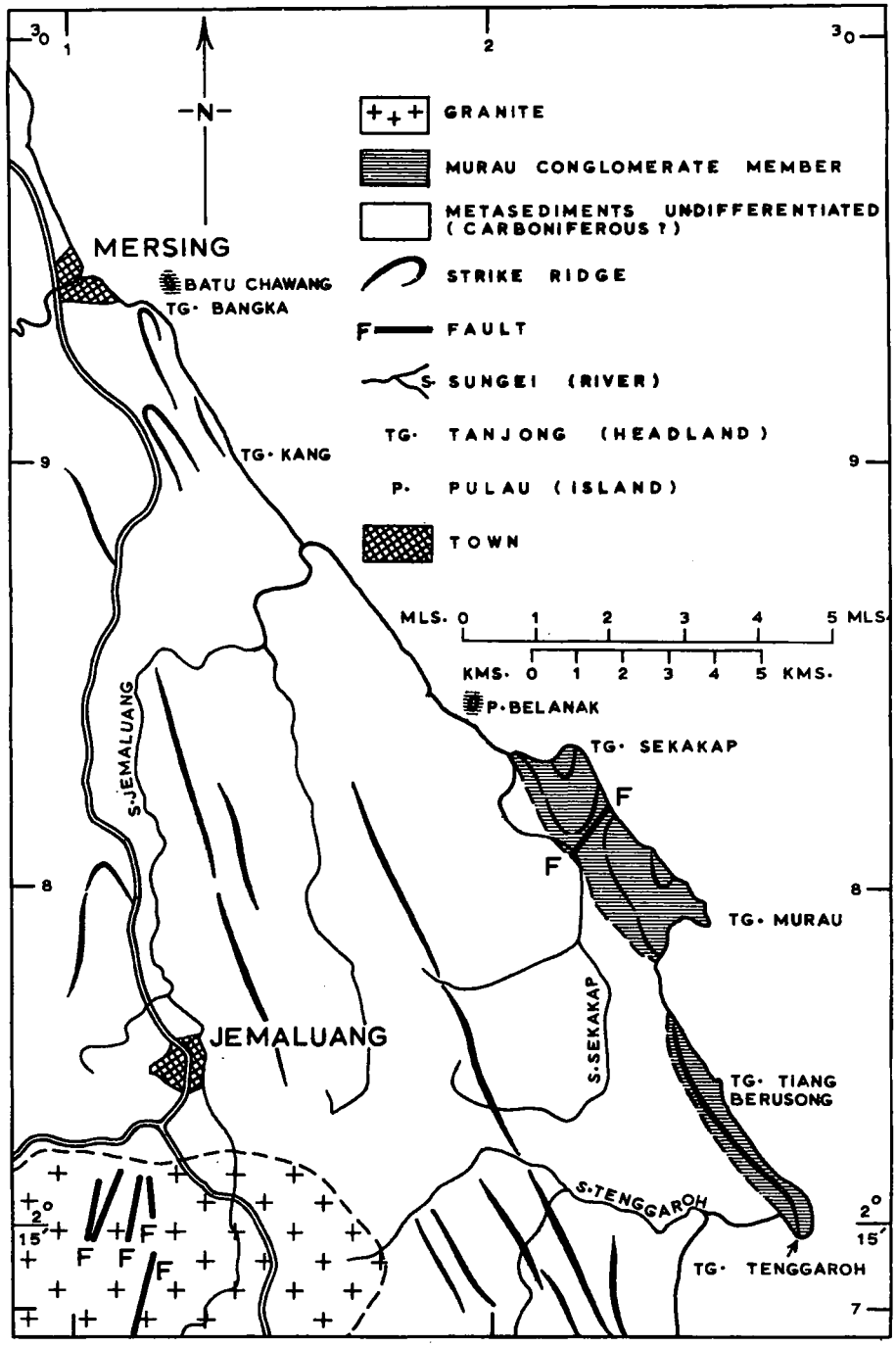


Fig. 5. Distribution map of the Murau Conglomerate Member southeast of Mersing. (Johore).

Red shales and mudstones overlie these competent rocks. Bedding in these is difficult to detect; the shales are often heavily jointed and form "pencil" shales. The thickness of these red-beds is difficult to ascertain but is estimated to be about 280 meters.

A grey micaceous tuffaceous sandstone occurs above and is interbedded with grey-green mudstones. The arenaceous rocks exhibit medium scale tabular cross-bedding, load structures and a few layers with small reworked shale pellets.

The highest part of the formation consists of homogeneous red mudstones and shales. Some layers contain a large amount of solution holes filled with iron hydroxides. No fossils have been found in these beds. They are typical red beds in which the iron has been oxidized. The thickness is probably over 800 meters and might be much larger. The top of the beds is not exposed.

Murau Conglomerate Member

The "Murau Conglomerate Member" is proposed for the basal red resistent polymict conglomerate of a post-orogenic fluviatile origin.

Type locality and geographic distribution

The type locality is Tanjong Murau, a headland situated 20 kilometers south-southeast of Mersing, Johore, along the east coast of West Malaysia (Survey Dept. Map sheet 119, New Series, scale 1 inch to 1 mile, grid ref. 250 793; see fig. 1). The Murau Conglomerate crops out in sea cliffs between Belanak

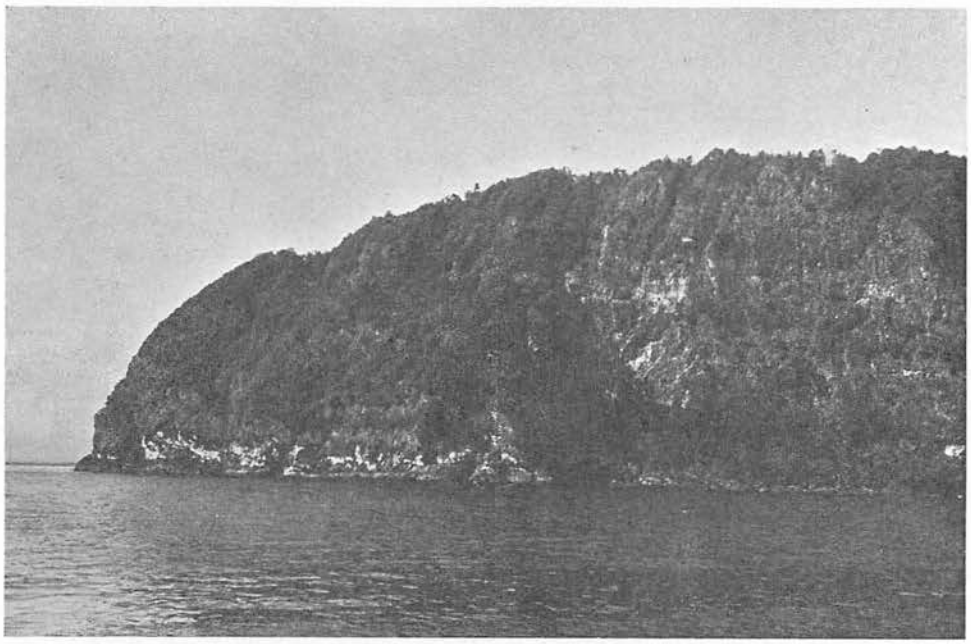


Fig. 6. Cliffs largely made up of Murau Conglomerate, Pulau Rhu (Trengganu).

Island and Tanjong Murau and at Tanjong Tenggaroh, five kilometers further south along the coast (fig. 5). To the north a small outcrop of the Murau Conglomerate forms Batu Chawang, a rock emerging out of the sea half a kilometer from the coast opposite Mersing. These conglomerates occur also along the Kuantan-Maran trunk road near the Berkelah River and near Maran town, from where they can be traced southwards and northwards into the Chini Forest Reserve and Berkelah Forest Reserve respectively. Near the Jerantut ferry over the Pahang River the basal conglomerate is still reddish-purple in colour but less polymict in composition. Further north along the Tembeling River the basal conglomerate loses its typical polymict character and a whitish quartz-pebble conglomerate is found. In cliff exposures at Bukit Keluang, Bukit Bubus, and Bukit Dendong, along the coast in north Trengganu, red polymict conglomerates occur which are lithologically similar and correlated here with the Murau Conglomerate. On Pulau Rhu, an island $2\frac{1}{2}$ kilometers off the coast, these conglomerates are also found (fig. 6). Mapping in future might reveal a farther extent of the conglomerate outcrops between the Tembeling Valley and the east coast.

Detailed lithology of the Murau Conglomerate

The Murau Conglomerate must be over 200 meters thick in the type locality, but the exact thickness could not be measured. The composition and texture varies laterally as well as vertically through the sequence. Alternating layers with more or less matrix or with clasts of varying size cause a coarse bedding (fig. 7). Reddish-pink shales and sandy shales occur locally as thin interbeds in the conglomerate. Scour and fill structures indicate intensive river action (fig. 8).

Fig. 7. Murau Conglomerate along the Kuantan-Maran Road near Berkelah River. Note the polymict character, poor sorting and sub-angularity of the clasts.

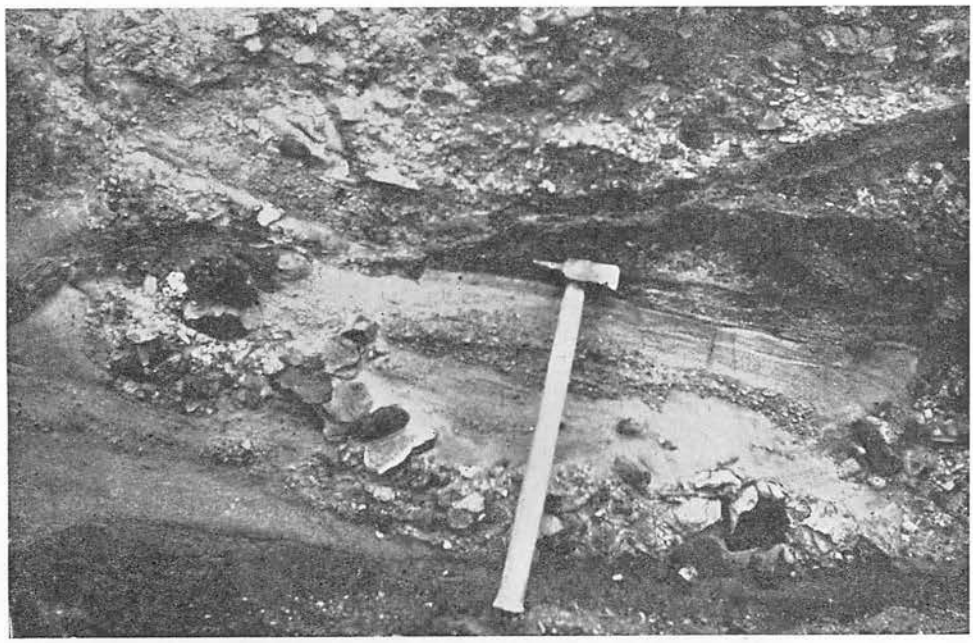


Fig. 8. Scour and fill structures near the base of the Murau Conglomerate. Locality: Tanjong Murau, Johore.

Locally a mud flow deposit is found at the base of the sequence. Angular phyllite and slate fragments occur in a matrix of red mudstone. The size of the fragments is up to 7 cm, but the average size is 1½ cm. The flat fragments show in general an alignment of long dimensions; they are 0.1–0.5 cm thick and are oriented in the bedding plane. A few other clasts of different composition occur but in subordinate amount. Flow structures can still be observed. This deposit is only 1–2 meters thick. The phyllite from which the clasts are derived lies unconformably directly underneath the conglomerate.

The composition of the clasts throughout the Murau Conglomerate is highly variable. Quartzite clasts are predominant, but arkose, rhyodacite, volcanic tuff, slate, phyllite, schist, chert, vein quartz and granite clasts are also present in variable amounts. The size of the clasts ranges from a few millimeters to over two meters; they also vary strongly in angularity and sphericity. The matrix is of graywacke composition and generally purple. The amount of matrix present varies laterally as well as vertically. In general, however, the large clasts do not touch each other.

On Belanak Island angular blocks of 1–2 meters diameter occur in the conglomerate near its base. These are composed of strongly quartz-veined quartzites and are derived from the metasediments underneath. The blocks can only have been transported a short distance.

Some boulders of folded quartzites have also been found in the conglomerates at Tanjong Murau (fig. 9). In the red-pink interbedded shales some plant fragments (loc 2342) have been found which were however indeterminable (cf. *Yuccites*—written communication, Miss C. Serra).

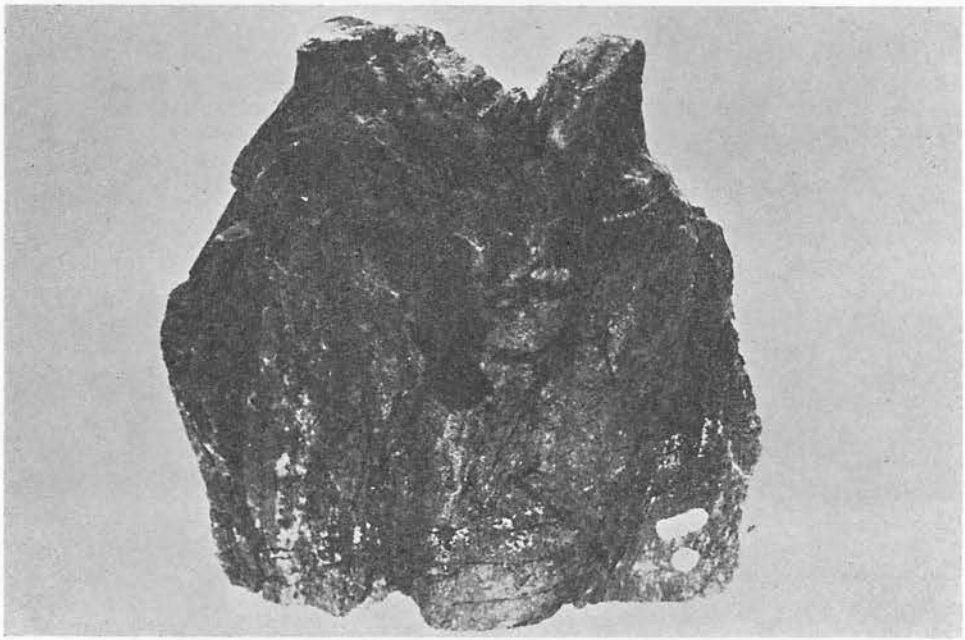


Fig. 9. Boulder of folded metasediment from the Murau Conglomerate (x ½). Locality; Tanjong Murau, Johore.

The Murau Conglomerate appears to decrease in thickness and the clasts decrease in size in a west-northwesterly direction.

THICKNESS OF THE TEMBELING FORMATION

In the type section along the Tekai River a thickness of 2,200 meters has been measured. The top of the formation however is not known. The higher part is formed by red-purple shales and mudstones which have reacted as an incompetent rock to subsequent deformations. The deformation in the purple shales is difficult to recognise, because bedding or layering is hardly present. Repetition of beds due to folding is likely to occur. Taking this into account a minimum thickness of 800 meters has been estimated for the upper layer of red-beds bringing the total thickness of the Tembeling Formation to 3,000 meters. The lower part of the succession consisting of arenaceous-rudaeous and argillaceous beds has been measured in the field and from aerial photographs in several sections throughout the Tahan Range (fig. 10) most of which give similar figures with a tendency to decrease slightly towards the north (fig. 11).

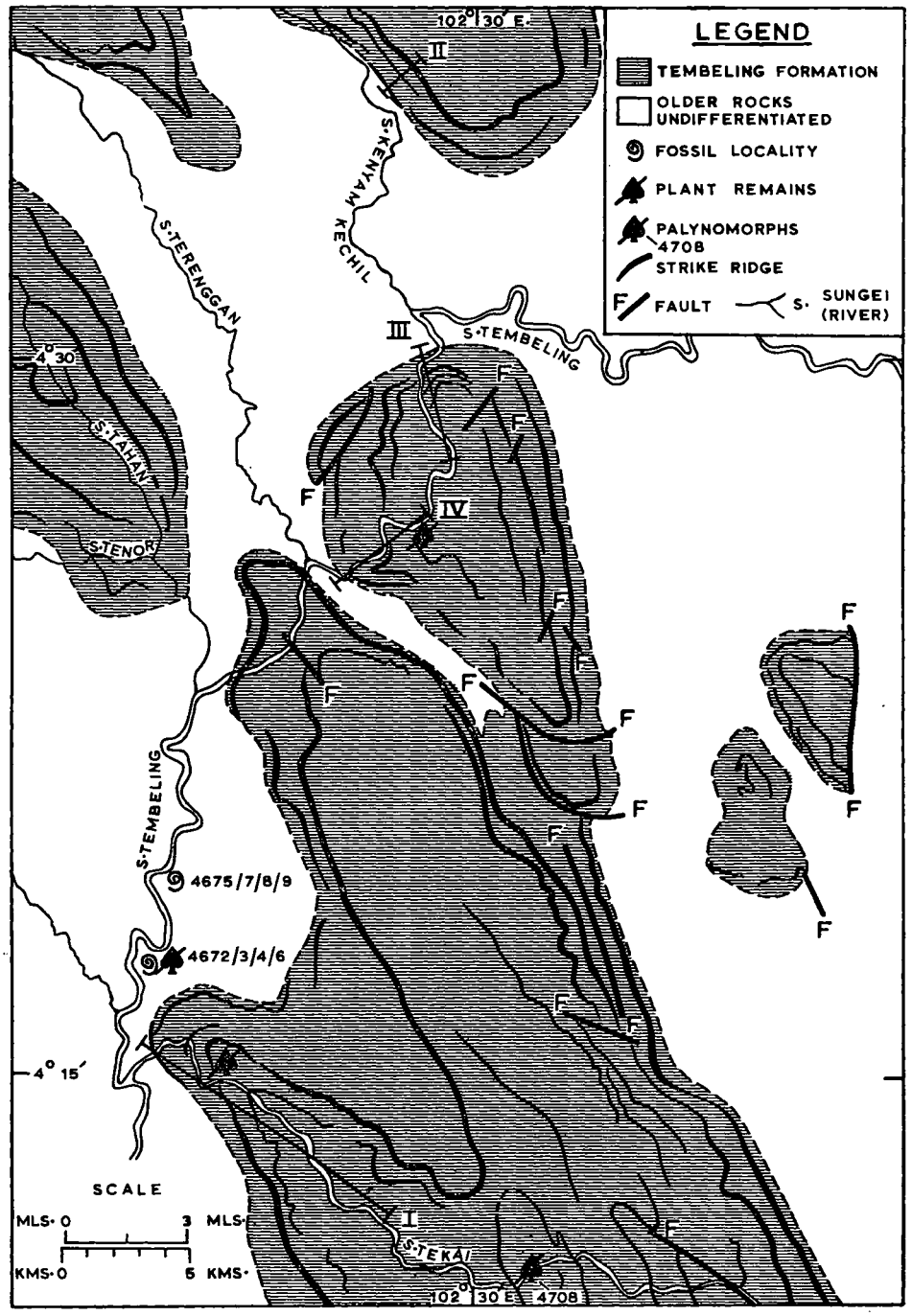


Fig. 10. Locality and relation of the type section I (see fig. 3) with the reference sections II, III, and IV of the Tembeling Formation (see figs. 11 and 12). Only the most prominent strike ridges as inferred from the air photographs are indicated.

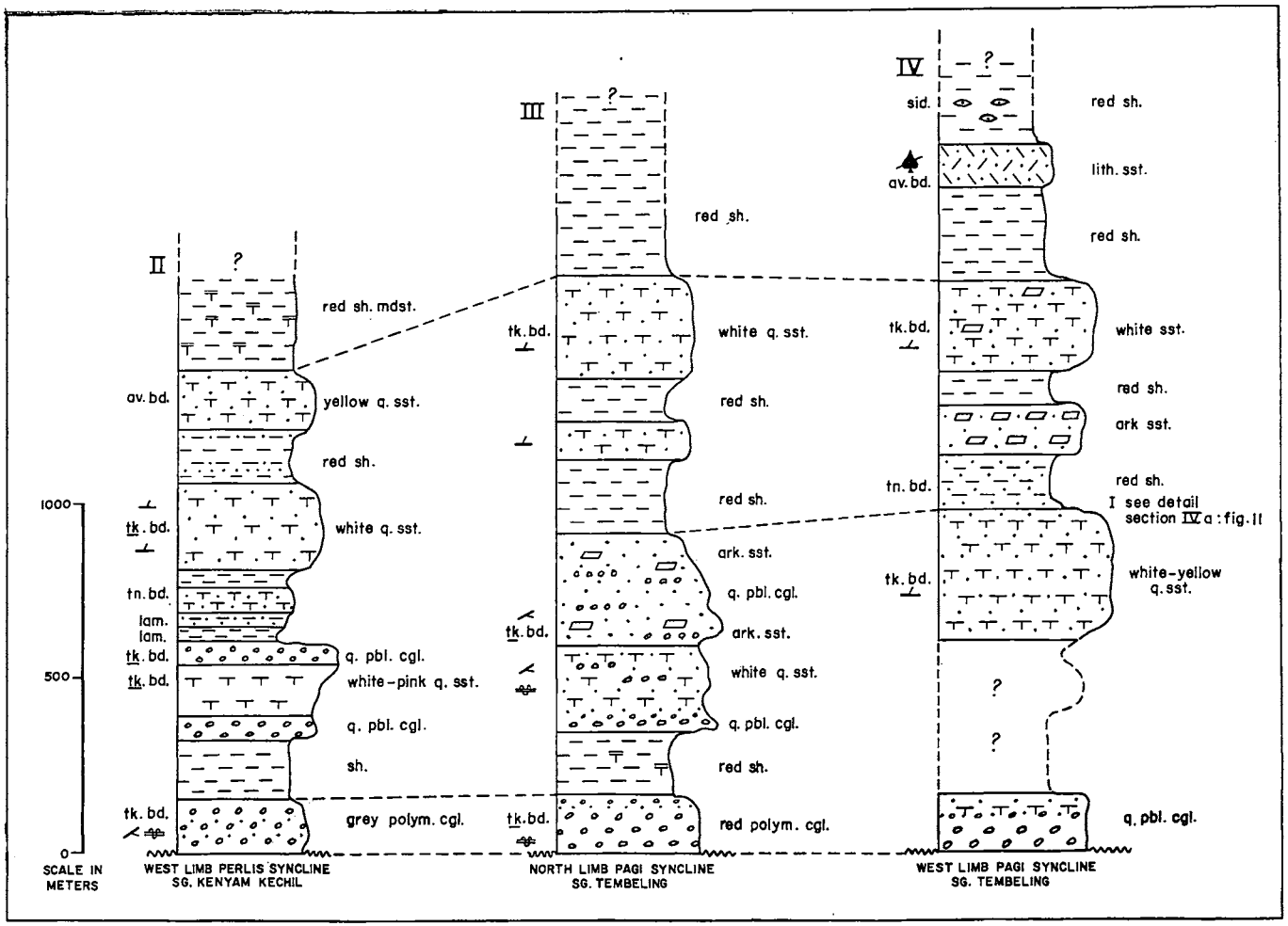


Fig. 11. Litho-stratigraphic reference sections of the Tembeling Formation; for locality see fig. 10 and for symbols fig. 3.

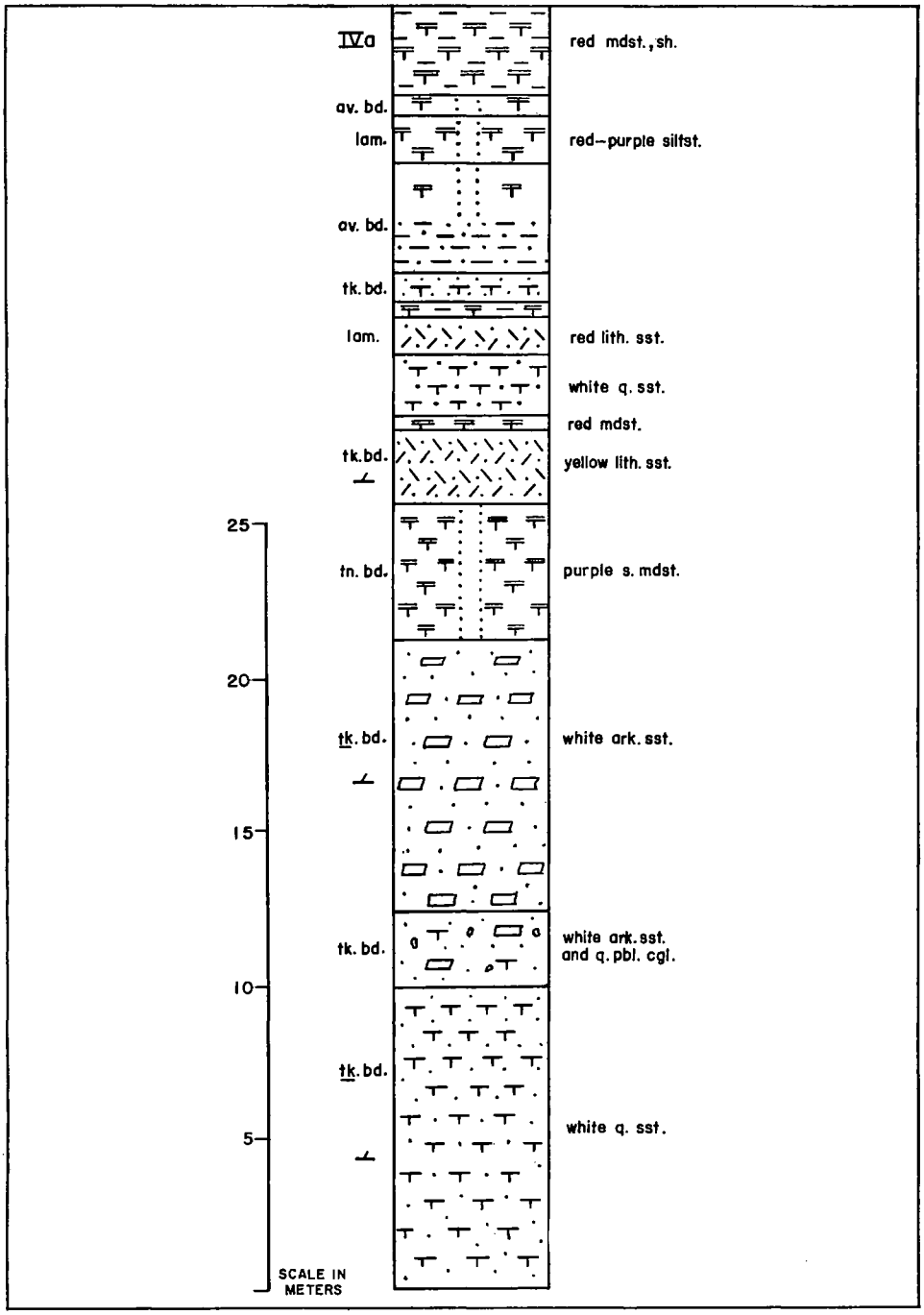


Fig. 12. Detail of section IV through the western limb of the Pagi Syncline (see fig. 11). For symbols see fig. 3.

In the middle part of Section II through the Perlis Syncline the lithology seems less argillaceous than in the type section. We have to realise however, that the sections, as represented in figures 3 and 11, are not measured along continuous rock outcrops, but have been constructed from information of scattered outcrops together with information obtained from field and aerial photograph studies of the geomorphology of river sections. Interpretation of aerial photographs enabled the author to correlate the different sections and rock outcrops. The section in figure 12 is compiled from detailed measurements along a continuous rock outcrop and can be taken as a representative example of the transition of the top of an arenaceous unit into the overlying red shale and mudstone unit.

West of the Tahan Range in the Tungku Syncline thickness of the sequence decreases considerably and ranges from 1,200–1,500 meters. Here however the upper part of the formation as found in the Tahan Range has been eroded off.

ROCK-STRATIGRAPHIC POSITION (SEE TABLE)

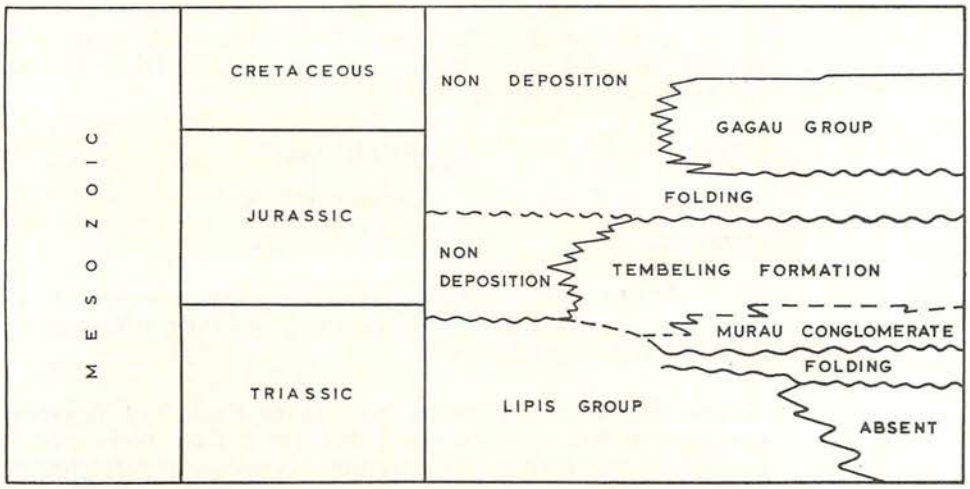
In the area shown in figure 2 the rocks underlying the Tembeling Formation are mainly of volcanic composition alternating with graywackes and shales; the composition of the volcanic rocks varies from acid to basic. Shales and graywackes of Triassic age are underlying the Tembeling Formation in the type section in the Tekai River; near the confluence of the Tahan and Tembeling Rivers a vesicular diabase was found underneath the basal conglomerate, whereas further north, in the headwaters of the Kenyam Kechil River, argillaceous and calcareous rocks of unknown age occur. In the southern extension of the Berantai Syncline near the Jempol River an andesite flow underlies the Tembeling Formation and still further south along the west flank of this syncline volcanic rocks of rhyolitic composition were found.

All these underlying rocks belong probably to the Triassic Lipis Group. The contact between the Tembeling Formation and these rocks seems to be conformable in the field. The large variety of strata underlying the Tembeling Formation in different localities and the lithological character of the basal Murau Conglomerate suggest, however, an unconformable contact in the Tahan Range. The nature of the contact might have been obliterated by later folding, as fold directions in the Tembeling Formation are parallel to the pre-Tembeling fold direction present in the older rock sequences.

West of the Tahan Range, in the Jengka Pass, the basal layer of the Tembeling Formation overlies a rock sequence of sandstones and mudstones with intercalated limestone lenses. These rocks have been named the Permian Formation by Ishikawa, Ishii and Hada (1966), a name which I will not adopt here as it confuses time and rock stratigraphic nomenclature. An angular unconformity between the two formations is visible in the road section at Jengka Pass.

East of the Tahan Range, in the Berkelah River, the Murau Conglomerate overlies Permian or Carboniferous shales and siltstones, whereas in the type locality of the basal member south of Mersing an angular unconformity was found between the conglomerates and the older metasediments which are probably of Carboniferous age. The latter age determination is based on a correlation with other metasediments outcropping along the east coast of the Malay Peninsula.

Table — Stratigraphy of the Mesozoic in the Central and Eastern part of Malay Peninsula.



The Tembeling Formation is unconformably overlain by rocks of the Gagau Group on Gunong Penumpu (3,597 ft) and on another peak towards the south-east. The upper part of the Gagau Group has been dated as late Jurassic to early Cretaceous (Alexander, Paton and Jones, 1959).

West of the Berantai Syncline a facies change of the Tembeling Formation is apparent. The continental deltaic rocks are partly grading into and probably partly unconformably overlying rocks of a marine facies belonging to the upper part of the Lipis Group.

TIME-STRATIGRAPHIC POSITION

The Tembeling Formation is practical barren of fossils. Some plant fossils have been found in grey shales and siltstones at two localities in the middle part of the formation in the Berentai Syncline by Mr. Mohammad Ayob. A preliminary identification of these floras by Miss C. Serra (written communication) included *Zamites* sp. (loc. 5202) of Rhaetic to Lower Cretaceous age, *Ptilophyllum* sp. (loc. 5202) mainly restricted to the Jurassic, and fronds of the genera *Klukia* or *Cladophlebis* (loc. 5201) of an age ranging from Jurassic to Lower Cretaceous. Spores and pollen from a sample of coal-shale from the Tekai River also indicate a Jurassic age: B. E. Morgan of Esso Production Research Company writes (personal communication). "Sample 4708 yielded a small assemblage of carbonised palynomorphs associated with organised organic debris. The main constituents of the assemblage are *Classopollis classoides* Pflug and *Circulina* sp. Because this species association is known in the Jurassic from other areas, the sample is interpreted as Jurassic."

Scrivenor (1931) reported the presence of a stem of a conifer and vascular tissue of roots found in a chert pebble from conglomerates in the Tekai River.

A. C. Seward (in Scrivenor, 1931, p. 78–79) wrote the following: "The specimens are unquestionably of a stem of a conifer, and in all probability the conifer was araucarian".

From the base of the formation at the Jengka Pass a few fossils have been collected and described by Ishikawa, Ishii and Hada (1966). The following determinations have been made by them:

Aequipecten sp.	*Brachiopoda*
Nuculanid?	*Sagenopteris* sp.
Isocrinus sp.	*Equisetites* sp.

These fossils indicate a Mesozoic age. Ishikawa writes regarding the age of this fauna that *Aequipecten* sp. "has certain notable features in common with a group of Late (–Middle) Triassic *Aequipectinoids*."

Newton (1923) described a fauna from the "Gondwana Rocks" of Singapore as being of Rhaetic age. It has not been established yet if these rocks can be considered as equivalent to the Tembeling Formation. Scrivenor (1908) grouped them under his "Tembeling Series."

The Tembeling Formation is underlain in the Jengka Pass area by late Middle Permian beds (Foraminifera zone of Yabeina, determinations by K. Ishii in Ishikawa, Ishii and Hada, 1966). In the area of Gunong Tungku Middle Triassic fossils are found in the underlying tuffs (Ja'afar Ahmad, personal communication), whereas just north of the type section, lamellibranches and trilobites indicate an Anisian age (loc. 4672 to 4679). Determinations by Sato (written communication) are:

Ceratites (*Paraceratites*) sp. juv. (4675)

Tropigastrites sp. (4676)

Sturia sansovini Mojs. (4679)

Gymnites cf. (4678)

Sturia sp. (4679)

The upper limit of the time interval during which the Tembeling Formation must have been deposited is determined by the unconformably overlying Gagau Group, which higher lacustrine beds have been dated as late Jurassic to early Cretaceous (Alexander, Paton and Jones, 1959 and Kon'no, 1966).

At the moment the Tembeling Formation is therefore considered as late Upper Triassic to Jurassic in age. A more definite age determination might be obtained from the collected fossil flora in future. The age of the plant fossils and palynomorphs from the Tembeling Formation however seems to indicate that Jurassic sediments are more widespread throughout West Malaysia than previously supposed.

ENVIRONMENT

The Tembeling Formation was deposited under fluviatile-deltaic-lacustrine conditions. A few shallow marine intercalations might be represented by the grey mudstone, but no marine fossils have been found with the exception of those recorded by Ishikawa, *et al* (1966) from a bed at the Jengka Pass, about 16 kilometers west of the Berentai Syncline, along the Temerloh-Maran Road.

The beds are of a typical molasse facies, formed as erosional products of an uplifted orogene. The polymict basal conglomerate, the Murau Conglomerate, characterised by its enormous volume, angularity and size of clasts of different composition and by a reddish colour, was deposited as a torrential sediment relatively close to its source area. In western or northwestern direction this conglomerate seems to thin out. It becomes better sorted and the size of the clasts diminishes. Sedimentary structures observed in this conglomerate are in agreement with a transport direction in a west-northwesterly direction.

Higher in the sequence quartz-pebble conglomerates and sandstones are predominant which show in many places well developed medium-scale tabular cross-bedding and become better sorted upwards. The arenaceous sediments were deposited in a deltaic environment. The interbedded greyish to red shales and mudstones represent probably lacustrine conditions under a relatively warm and dry climate. The scarce occurrence of fossil plants and the few layers of coal shales or carbonaceous material indicate that locally some swampy areas were present. The top of the formation is formed by typical red-beds, deposited under warm continental conditions leading to the oxidation of iron content.

The rocks of the Tembeling Formation represent a typical post-orogenic deposit.

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APPENDIX

Fossil Localities

The first numbers refer to the collection of the Department of Geology, University of Malaya, Kuala Lumpur, Malaysia.

Collection No.	Locality	Map (Topo. maps of Malaya Nat. Series 1:63,360)	Grid ref. (Malay Grid.)
2342	Tg. Tiang Berusong, Johore	119 (New Series)	253 753
4672	Sg. Tembeling, Pahang	2 0/10	462 355
4673	— do —	— do —	— do —
4674	— do —	— do —	— do —
4675	— do —	— do —	473 388
4676	— do —	— do —	462 355
4677	— do —	— do —	473 388
4678	— do —	— do —	— do —
4679	— do —	— do —	— do —
4708	Sg. Tekai, Pahang	2 0/15	632 221
5201	1½ miles N. of Maran, Pahang	3 C/8	929 519
5202	4 miles N. of Maran, Pahang	3 C/8	920 553

DISCUSSION: Attention was drawn to the marked unconformity below the Tembeling Formation, the underlying rocks varying from Middle Triassic to Carboniferous in age.

H. C. Olander suggested that the Gagau Formation was composed of two disconformable series. Was the lower of these to be regarded as belonging to the Tembeling Formation? The speaker replied that on lithological and structural grounds he regarded the two formations as distinct.

The speaker was asked if the rocks unconformably overlying the Permian at the Jengka Pass in Pahang were part of the Tembeling Formation. He replied that they resembled the Tembeling rocks both structurally and lithologically and he regarded them as belonging to the formation.