GEOSEA '98 Proceedings, Geol. Soc. Malaysia Bull. 45, December 1999; pp. 455-460

Ninth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia — GEOSEA '98
17 – 19 August 1998 • Shangri-La Hotel, Kuala Lumpur, Malaysia

Important discovery of late Early Permian limestone in southern Terengganu, Peninsular Malaysia

HENRI FONTAINE[1], IBRAHIM BIN AMNAN[2] AND DANIEL VACHARD[3]

[1]8 Allee de la Chapelle
92140 Clamart, France

[2]Geological Survey of Malaysia
Jalan Sultan Azlan Shah, 31400 Ipoh, Perak, Malaysia

[3]Paleontologie, Sciences de la Terre, Universite de Lille
59655 Villeneuve d'Ascq cedex, France

Abstract: A limestone which has been uncovered during the extension of an oil palm plantation appears to be an important deposit. It is rich in relatively well preserved fossils although it out crops only 500 meters from a granite. The fossils are diverse and consist of common *Tubiphytes*, a few algae, calcispherids, smaller foraminifers, abundant fusulinaceans (including *Levenella, Pamirina, Brevaxina, Chalaroschwagerina, Leeina, Toriyamaia, Laosella*), calcareous sponges, a few bryozoans, brachiopods, bivalves, rare gastropods, ostracods and crinoids. They indicate a Late Cisuralian age (Yahtashian-Bolorian) and appear to belong to three biozones. The rocks of the area were previously considered to be Early Carboniferous in age. The limestone is commonly a packstone or a wackestone, very rarely a grainstone. Depositional environment was shallow marine. Dolomite is almost absent according to the study of thin sections and the results of chemical analyses.

In Terengganu State, north of Seri Bandi in the area of Sungai Patang (a small tributary of Sungai Tebak) about 86 km far from Kuantan and 119 km far from Kuala Terengganu, the extension of Ladang Ketengah Jaya (Ladang = Plantation) has led to the digging of trenches to drain the water away from a swampy area. As a result, a number of small limestone exposures have been unearthed at the bottom of the main and the feeder ditches, 1 to 3 meters below ground surface. These exposures are scattered in a surface of, at least, two hectares (Sheet 62 or Kerteh Sheet of the topographical map on the scale 1:63,360. Geographic coordinates of two samples from the newly uncovered exposures: 4°24'09"N, 103°16'46"E for sample 359; 4°24'21"N, 103°16'45"E for sample 350).

This newly uncovered limestone has been noticed by members of the Geological Survey of Malaysia, especially at the beginning by Tuan Hj. Mohd. Ros bin Abdul Manaf and Mr. Siew Meng Fai who collected samples and prepared thin sections of the limestone.

THE GEOLOGICAL SETTING

Granites occupy very large areas of Terengganu State. Because of their presence, metamorphism is widespread in the adjacent sedimentary rocks. This fact has suggested that fossils are absent from a large part of Terengganu.

As early as 1920, Lower Carboniferous rocks were evidenced in the Kuantan area of Pahang State just south of Terengganu State (Sheet Air Puteh or Sheet 72 of the topographical map on the scale 1:63,360); since then, they have provided fossils in abundance and the Carboniferous age (Visean to Early Bashkirian) has strongly been documented by different studies (Fontaine and Khoo, 1988). Other localities in the southern part of Terengganu State yielded also some Carboniferous fossils, especially in the Hulu Paka Sheet or Sheet 61 (Chand, 1978) and in the Chukai area of Sheet 73 (Suntharalingam, 1975; Ohana *et al.*, 1991). Sheets 61, 72 and 73 are adjacent to the sheet concerned by this paper. Recently, a limestone lens at Sungai Simpang in southernmost Terengganu has yielded Late Visean-Serpukhovian foraminifers (Fontaine and Vachard, 1988). These discoveries favoured the idea that Carboniferous sediments should be extensive in Terengganu State, especially in the southern part of this state.

The area where the limestone has been found is flat, without outcrops of rocks at ground surface; it has been mapped geologically as a small Quaternary

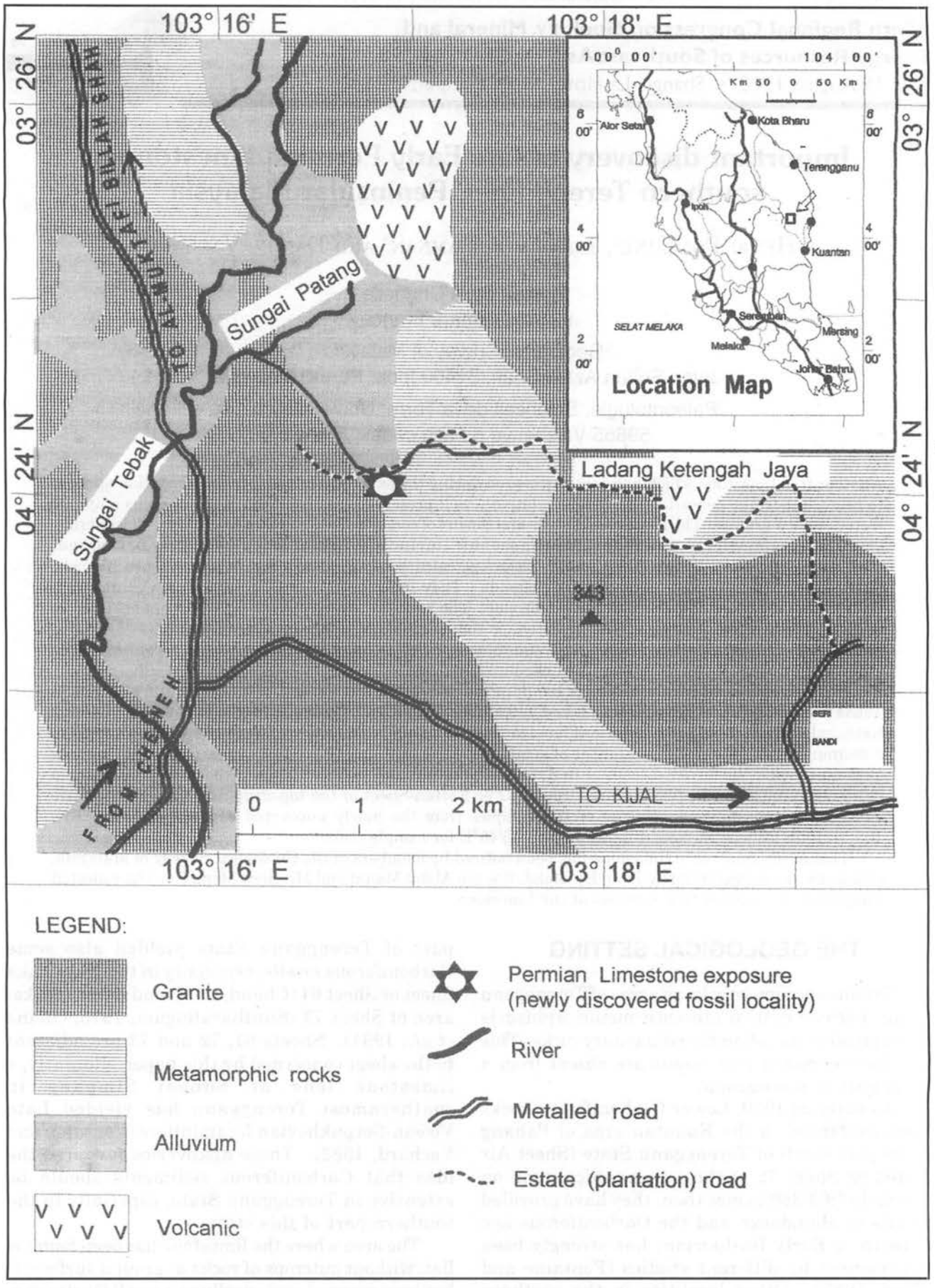


Figure 1. Location and simplified geology map of the study area.

basin lying upon Lower Carboniferous rocks (Fig. 1).

THE LIMESTONE

The limestone is gray to black in colour with a similar aspect at all the sites. It is seemingly massive, locally packed with fossils. It is commonly a packstone or a wackestone, exceptionally a grainstone. It is very slightly recrystallized; however, the fossils are still recognizable, and in some samples, very well preserved. The presence of stromatolites and oncolites within the limestone indicates a shallow marine depositional environment. 25 samples of limestone have been collected.

The chemical analysis of 2 samples has indicated that the limestone is relatively pure, with CaO contents of 53.8 and 54.1%, and MgO contents of 0.54 and 0.60%. The acid-insoluble matter ranges from 2.13 to 2.21%.

A preliminary geophysical survey (Ramly, 1997) has been carried out in order to evaluate the subsurface extension of the limestone. In reality, it has found two limestone bodies. The second limestone body, 800 m south of the limestone concerned by this paper, covers about 1.5 square kilometer. The thickness of the limestone in the two bodies is estimated to range from 90 to 300 m, according to a 2-D gravity modeling.

THE FOSSILS

The fossils are diverse, they are complete or fragmentary. They consist of rare debris of algae, smaller foraminifers, fusulinaceans which are locally in abundance, rare calcareous sponges, bryozoans, brachiopods (shells and rarely spines), bivalves, rare gastropods, crinoids, rare palechinid spines, a few ostracods. Corals have not been found so far. The following fossils have been identified:

Microproblematic: *Tubiphytes* is common and locally in abundance. It consists of two species: *Tubiphytes obscurus* Maslov which is the most abundant and *Tubiphytes* sp.

Algae: They are represented by a few debris of *Mizzia, Permocalculus* and *Gymnocodium* scattered in the rock. Stromatolites are well preserved and in abundance in sample 353; they are fragmentary in samples 352 and 355.

Calcispherids: *Diplosphaerina inaequalis* (Derville) is present in many samples.

Foraminifers other than fusulinaceans: They are not very common. They consist mainly of: indetermined Nodosariidae, *Protonodosaria sagitta* (Miklukho-Maclay, 1954), *Pachyphloia, Tetrataxis, Globivalvulina, Climacammina, Endothyra, Geinitzina* and Palaeotextulariidae. *Pseudovermiporella nipponica* (Endo) has been found in two samples (351 and 352) whereas *Langella* aff. *pulchra* (Lange, 1925) has been noticed in a single sample (MRF1d).

Fusulinaceans: They are locally in great abundance. Moreover, they are very interesting because they include a group of fusulinaceans almost unknown in Peninsular Malaysia and even not common in the other parts of the world.

Primitive Verbeekinoids are well represented by two genera: Genus *Pamirina* Leven 1970 and Genus *Misellina* Schenck and Thompson, 1940. Genus *Pamirina* consists of two subgenera and three species: *Pamirina (Pamirina) darvasica* Leven 1970, *Pamirina (Levenella) leveni* Kobayashi 1977, *Pamirina (Levenella) tethydis* Kobayashi 1977 (Plate 1). *Levenella* Ueno 1994 is a new name introduced to replace the invalid name *Levenia* Ueno 1991. *Misellina* is represented by transitional forms between the subgenera *Brevaxina* and *Misellina* sensu stricto. These specimens are reported in this paper as close to *Misellina (Brevaxina) dyhrenfurthi* (Dutkevich, 1939). The distinctive characteristics of *Misellina (Misellina)* have not been observed clearly in the studied samples.

Other important fusulinaceans are: *Chalaroschwagerina* cf. *decora* Skinner & Wilde 1966, *Leeina kraffti* (Schellwien and Dyhrenfurth, 1909), *Laosella* ex gr. *gigantea* (Deprat, 1913), *Toriyamaia laxiseptata* Kanmera 1956 (Plate 2).

Small Schubertellidae are common and *Schubertella* sp. has been recognized in a few thin sections.

Some Fusulinaceans have not been identified with certainty because of a lack of material; they appear to belong to *Kwantoella, Acervoschwagerina* and *Dutkevitchia* or *Laxifusulina*?

In conclusion, the fusulinacean assemblage of the Seri Bandi area is rich and diverse; it even deserves further studies.

AGE

The microfossils which have been identified indicate clearly a Permian age, and more precisely a Late Cisuralian age (= Yahtashian and Bolorian, Aktastinian and Leonardian, or Artinskian and Kungurian, according to the different chronostratigraphic schemes).

The outcrops studied in this paper are actually discontinuous. Because of that, there is a need to be careful when discussing about the detailed stratigraphy. However, a few conclusions appear to be well established.

1. The presence of the *Pamirina (Levenella) leveni*

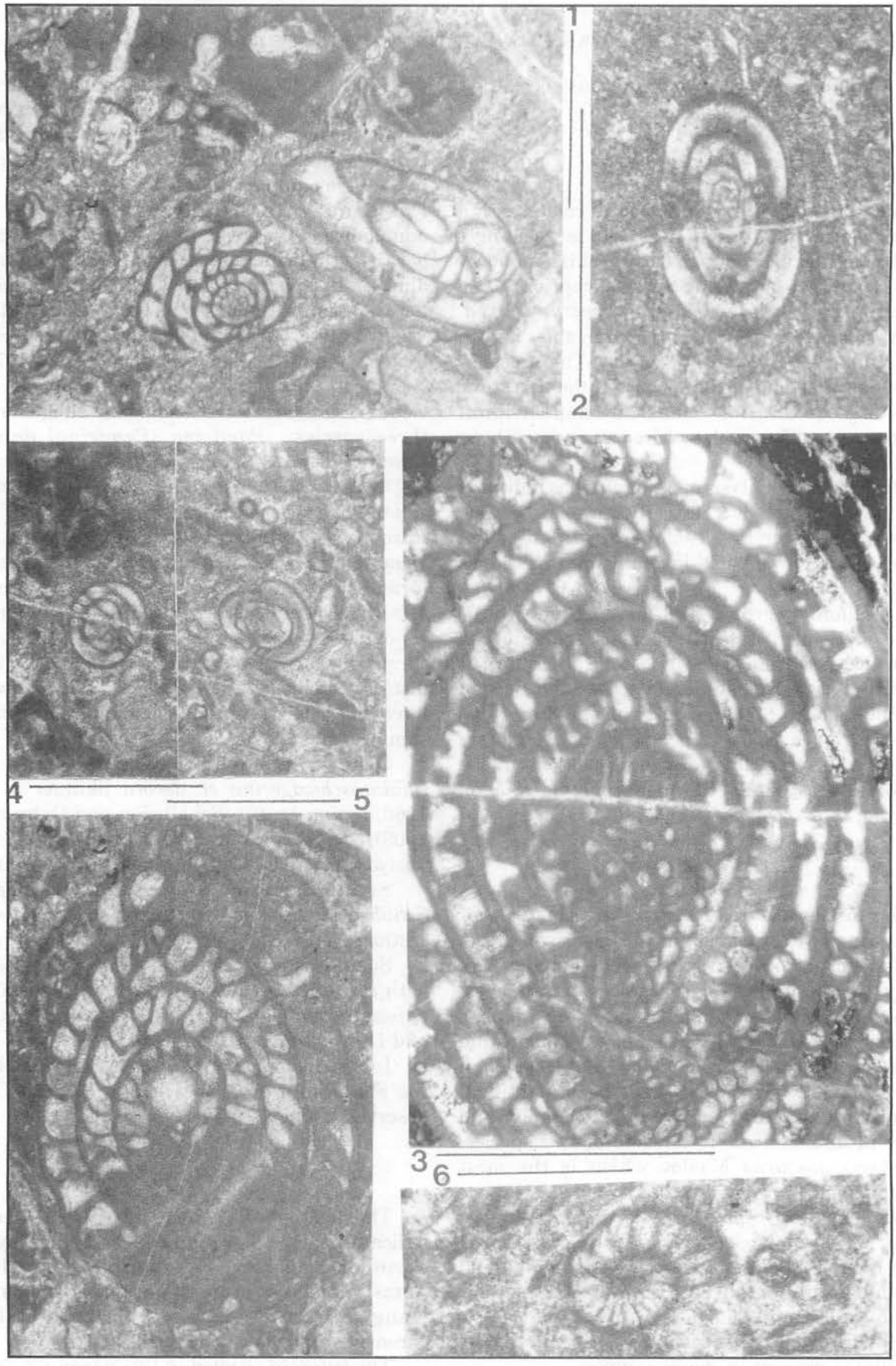


Plate 1. Scale bar = 1 mm

1. *Pamirina (Pamirina) darvasica* Leven 1970, subtransverse section; *Toriyamaia laxiseptata* Kanmera 1956, subaxial section; *Tubiphytes obscurus* Maslov 1956. Sample 352.
2. *Pamirina (Levenella) leveni* Kobayashi 1977, axial section. Sample 354.
3. *Laosella* ex gr. *gigantea* (Deprat, 1913), subaxial section. Sample MRF1.
4. *Pamirina (Levenella) tethydis* Kobayashi 1977, subaxial and axial sections. Sample 358.
5. *Leeina kraffti* (Schellwien & Dyhrenfurth, 1909), oblique section. Sample 358.
6. *Schubertella* sp., tangential section. Sample 351.

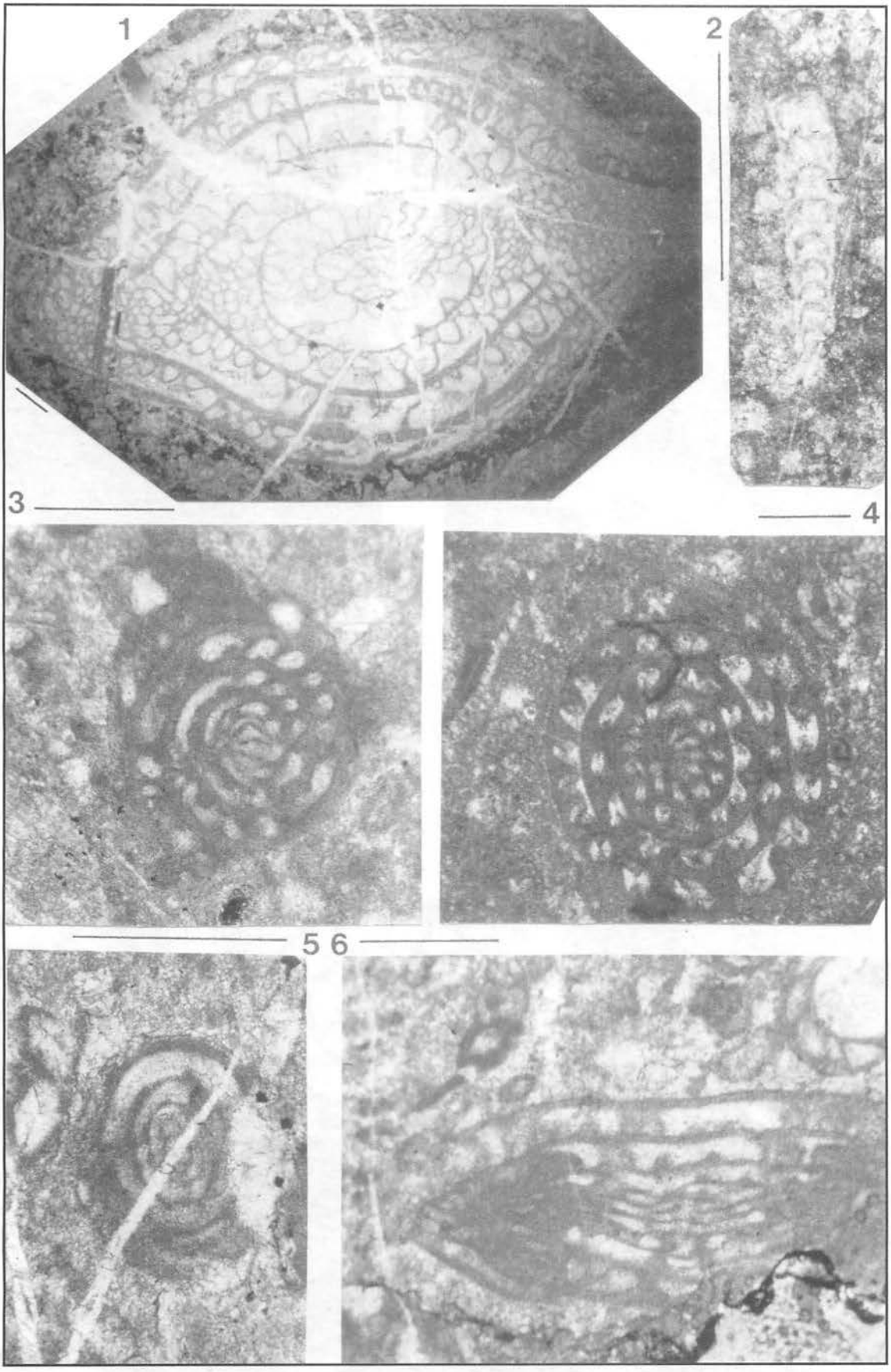
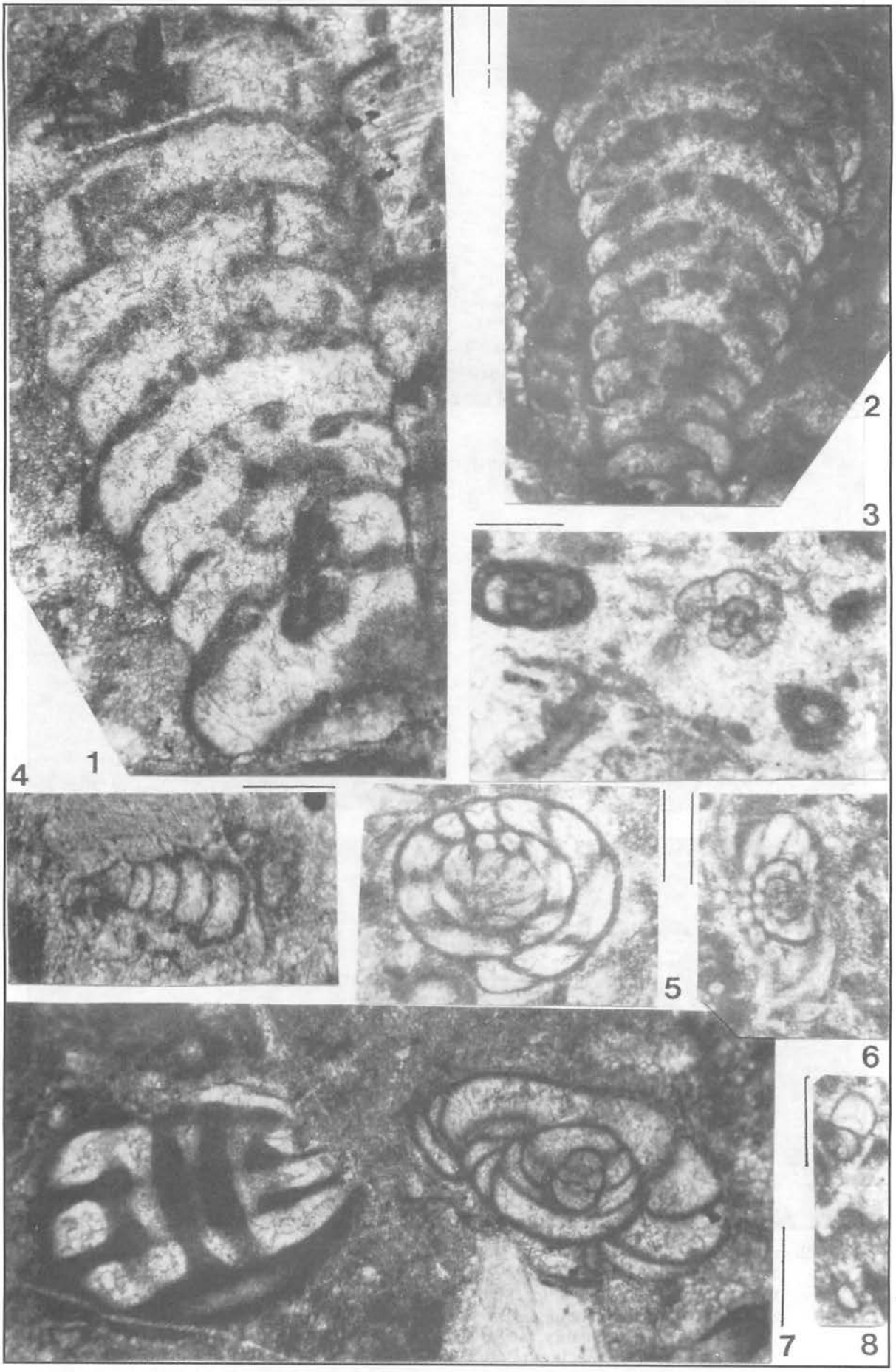


Plate 2. Scale bar = 0.5 mm

1. *Chalaroschwagerina* cf. *decora* Skinner & Wilde 1966, subaxial section. Sample 359.
2. *Protonodosaria sagitta* (Miklukho-Maclay, 1954), longitudinal section. Sample 357.
3 & 4. Specimens belonging to *Misellina (Brevaxina)* ex gr. *dyhrenfurthi* (Dutkevich, 1939) sensu lato. In reality, they are transitional forms between *Misellina dyhrenfurthi* and *Misellina aliciae*, it is to say between the subgenera *Brevaxina* and *Misellina* sensu stricto. Figure 3: oblique section, sample 351; figure 4: transverse section, sample 354.
5. *Pamirina (Pamirina) darvasica* Leven 1970, subaxial section. Sample 355.
6. Indetermined genus: *Kwantoella*? sp., subaxial section. Sample 353.


1
2
3
4
5
6
7
8

biozone, as recognized by Ueno 1994 in Southwest Japan, is strongly documented in Seri Bandi area.

2. This *Pamirina leveni* biozone is underlain by another biozone characterized by *Leeina kraffti* and *Chalaroschwagerina* cf. *decora*. Can this latter biozone be divided into two or even three more detailed horizons? In Southwest Japan, Ueno (1996) has recognized two *Chalaroschwagerina* biohorizons below the *Leeina kraffti* biohorizon. In the Seri Bandi area, it is difficult to assume that there is more than one biohorizon in the present state of our knowledge.
3. The *Pamirina (Levenella) leveni* biozone is overlain by a third biozone containing primitive *Misellina* sensu stricto, identified in this paper as *Misellina (Brevaxina) dyhrenfurthi* (Plate 3). The first representatives of the Subgenus *Misellina (Brevaxina)* appear at the top of the *Pamirina (Levenella) leveni* zone in Southwest Japan (Ueno, 1996). As a matter of fact, the samples from Seri Bandi area are transitional forms between *Misellina (Brevaxina)* and *Misellina (Misellina)*, they indicate a higher horizon.

The limestone of Seri Bandi area appears to turn out younger in age from the southeast (Samples 358 and 359 with *Chalaroschwagerina* and *Leeina kraffti*) to the northwest (Sample 351 with *Misellina (Brevaxina) dyhrenfurthi).*

The other Permian limestones known in Terengganu State are those of Bukit Biwah and Bukit Taat in the northern part of the state. They are Kubergandian-Early Murgabian in age, an age equivalent to the base of the Guadalupian (Fontaine, *et al.*, 1988a and b). As a result, the limestone of the Seri Bandi area is a little older.

THE SIGNIFICANCE OF THIS DISCOVERY

At first, a deposit of limestone has been discovered in a state where limestone is not common. This deposit appears to be important and is built up by a limestone relatively pure.

From a palaeontological and biostratigraphical point of view, many fossils which have been discovered were unknown previously in Peninsular Malaysia. In addition to that, they indicate an age which has been rarely mentioned in Peninsular Malaysia and, when a similar age was determined, it was based on one or two species of the Seri Bandi assemblage or on other fusulinaceans.

A species of Genus *Chalaroschwagerina* (*C. ampla* Skinner and Wilde, 1966) had been found already in southeastern Kelantan (Vachard, 1990); it was an isolated discovery without close relationship with other sedimentary horizons. It is the same for *Darvasites contractus* (Schellwien, 1909), a Sakmarian-Yahtashian species reported at another locality of southeastern Kelantan (Vachard, 1990).

At Sungai Sedili in Johor, Igo *et al.* (1979) mentioned poorly oriented specimens of *Misellina*, several specimens of *Cuniculinella* associated with *Eoparafusulina, Parafusulina* and *Monodiexodina.* This fauna is almost of the same age as the fauna of the Seri Bandi area; however, it shows a different assemblage of fusulinaceans.

Ishii (1966) mentioned only two species of fusulinaceans at a tin mine (H.S. Lee Mine) of the Kinta Valley: *Pseudofusulina (= Leeina) kraffti* (Schellwien & Dyhrenfurth) in the lower part of a limestone and *Misellina claudiae* (Deprat) in the upper part of the same limestone. A recent study of thin sections stored at the Geological Survey of Malaysia (new data) has confirmed the presence *of Leeina kraffti* at the H.S. Lee Mine, but has not observed the presence of *Misellina claudiae*, probably because the collection of the Geological Survey is presently incomplete. Other thin sections from the same locality contain *Cancellina (Maklaya)* ex gr. *pamirica* Leven 1967 associated with *Parafusulina* cf. *undulata* Chen 1934 and *Parafusulina* aff. *japonica* (Gumbel). The limestone of the H.S. Lee Mine appears to range up to the Kubergandian.

Plate 3. Scale bar = 2 mm

1 & 2. *Climacammina* sp., oblique sections. Figure 1 is from a thin section of sample MRF4b whereas figure 2 is from a thin section of sample MRF4c.
3. *Endoteba*? sp.and *Endothyra* sp., transverse sections; *Tubiphytes obscurus* Maslov. Sample MRF4d.
4. Palaeotextulariidae, oblique section. Sample MRF4b.
5. *Pamirina (Levenella)* sp., subtransverse section. Sample MRF4a.
6. *Schubertella* sp., oblique section. Sample MRF4a.
7. *Misellina (Brevaxina)* ex gr. *dyhrenfurthi* (Dutkevich, 1939), tangential section; *Toriyamaia laxiseptata* Kanmera 1956, oblique section. Sample MRF4b.
8. *Diplosphaerina* ex gr. *inaequalis* (Derville, 1931). Sample MRF4a.

Outside Malaysia, the Seri Bandi fauna displays strong affinities with faunas described in the Kwanto Mountains of Central Japan (Kobayashi, 1977) and in the Akiyoshi Limestone of Southwest Japan (Ueno, 1991, 1996).

REFERENCES

CHAND, F., 1978. Geology and mineral resources of the Ulu Paka area, Terengganu. *Geol. Surv. Malaysia District Mem.*, 16, 124p., 1 geol. map.

FONTAINE, H. AND KHOO, H.P., 1988. Palaeontological research in Terengganu State, Peninsular Malaysia: a review. *CCOP Newslet., 13(1)*, 25–30 and *CCOP Techn. Publ., 20*, 97–103.

FONTAINE, H., LYS, M. AND NGUYEN, D.T., 1988a. Some Permian corals from east Peninsular Malaysia: associated microfossils, palaeogeographic significance. *Journ. Southeast Asian Earth Sc., 2(2)*, 65–78, 7 pl.

FONTAINE, H., KHOO, H.P. AND VACHARD, D., 1988b. Note on Bukit Taat, Terengganu, Malaysia. *CCOP Newslet., 13(4)*, 17–18 and *CCOP Techn. Publ., 20*, 107–109.

FONTAINE, H. AND VACHARD, D., 1988. Discovery of Lower Carboniferous limestone in Kemaman District, Terengganu, Malaysia. *CCOP Newslet., 13(2)*, 25–26; 1990, *CCOP Techn. Publ., 20*, 105.

IGO, H., RAJAH, S.S. AND KOBAYASHI, F., 1979. Permian Fusulinaceans from the Sungei Sedili area, Johore, Malaysia. *Geol. Palaeont. Southeast Asia, 20*, 95–118, pl. 15–26.

ISHII, K., 1966. Preliminary notes of the Permian Fusulinids of H.S. Lee Mine n° 8 Limestone near Kampar, Perak, Malaya. *Journ. Geosc. Osaka City Univ., 9(4–VI)*, 145.

KOBAYASHI, F., 1977. Some considerations on the ancestor of the family Verbeekinidae (Fusulinacea). *Trans. Proc. Palaeont. Soc. Japan, n.s., 105*, 1–16, pl. 1–2.

OHANA, T., KIMURA, T. AND KHOO, T.T., 1991. Further discovery of some Carboniferous plant fossils from Tanjung Mat Amin, Terengganu, Peninsular Malaysia. *Journ. Southeast Asian Earth Sc., 6(2)*, 93–101.

RAMLY MOHD RAIS BIN, 1997. Gravity survey to map the extension of limestone in Ladang Ketengah Jaya, Kemaman, Terengganu. *Geol. Surv. Malaysia Report, n° GF 17/97*. Unpublished.

SUNTHARALINGAM, T., 1975. Carboniferous flora from Pahang and Terengganu, Peninsular Malaysia. *Ann. Rep. Geol. Surv. Malaysia 1974*, 151–154.

UENO, K., 1991. Early evolution of the families Verbeekinidae and Neoschwagerinidae (Permian Fusulinacea) in the Akiyoshi Limestone Group, southern Japan. *Trans. Proc. Palaeont. Soc. Japan, n.s., 164*, 973–1002, 10 figs.

UENO, K., 1994. *Levenella*, a new name for *Levenia* Ueno, 1991 (Foraminiferida, Fusulinacea), non Gray, 1947. *Trans. Proc. Palaeont. Soc. Japan, n.s., 173*, 405, 2 figs.

UENO, K., 1996. Late Early to Middle Permian fusulinacean biostratigraphy of the Akiyoshi Limestone Group, Southwest Japan, with special reference to the Verbeekinid and Neoschwagerinid fusulinacean biostratigraphy and evolution. *Ann. Mus. Civ. Rovereto, sez. Arch., St., Sc. Nat., suppl. 11*, 77–104 with 4 pl.

VACHARD, D., 1990. Fusulinoids, smaller foraminifera and pseudo-algae from southeastern Kelantan (Malaysia) and their biostratigraphic and paleogeographic value. *CCOP Techn. Publ., 20*, 143–167, 9 pl.

Manuscript received 29 May 1998