

Triassic conodont biostratigraphy in the Malay Peninsula

I. METCALFE

Institute for Advanced Studies, University of Malaya,
Kuala Lumpur, Malaysia

Abstract : Conodonts representative of the Lower, Middle and Upper Triassic are now known in the Malay Peninsula and all the Triassic Stages except the Rhaetian are represented. The best known sequence of Triassic conodonts occurs in the Kodiang Limestone of Kedah but there are still significant gaps in the known conodont succession. In particular, Griesbachian and Dienerian conodonts are poorly known and conodonts representative of the Upper Spathian, Lower Ladinian, Middle and Upper Norian and Rhaetian are unknown. New data from the Kodiang Limestone of Bukit Mulong and Bukit Kepelu help to fill some of these gaps in the Carnian and Norian conodont succession. The Chuping Limestone of Perlis has also recently yielded some Lower Norian conodonts which implies a correlation with the Kodiang Limestone to the south. Other recent discoveries include early Late Triassic (Lower Carnian) conodonts from the Chert Member of the Semanggol Formation, Kedah, Early Triassic (Spathian) conodonts from north-west Pahang and Early Triassic (upper Dienerian) and Middle Triassic (upper Anisian) conodonts from the Jerus Limestone, Cheroh, west Pahang.

INTRODUCTION

Triassic conodonts were first described from the Malay Peninsula by Igo *et al.* (1965) and our knowledge of Triassic conodont biostratigraphy has increased immensely over the last twenty years due mainly to the efforts of Professors T. Koike, H. Igo and Y. Nogami who carried out conodont studies as part of the Association for Palaeontological Research in Southeast Asia Project. Their efforts established a solid foundation on which subsequent work has been built. Fig. 1 shows the currently known Triassic conodont localities for the Malay Peninsula. A summary of the Triassic conodont biostratigraphy in the Malay Peninsula, including published and unpublished data, is presented in this paper and an attempt is made to identify absences in the Triassic conodont record and areas of future importance for further study.

CONODONT BIOSTRATIGRAPHY

The Lower, Middle and Upper Triassic will be described separately below.

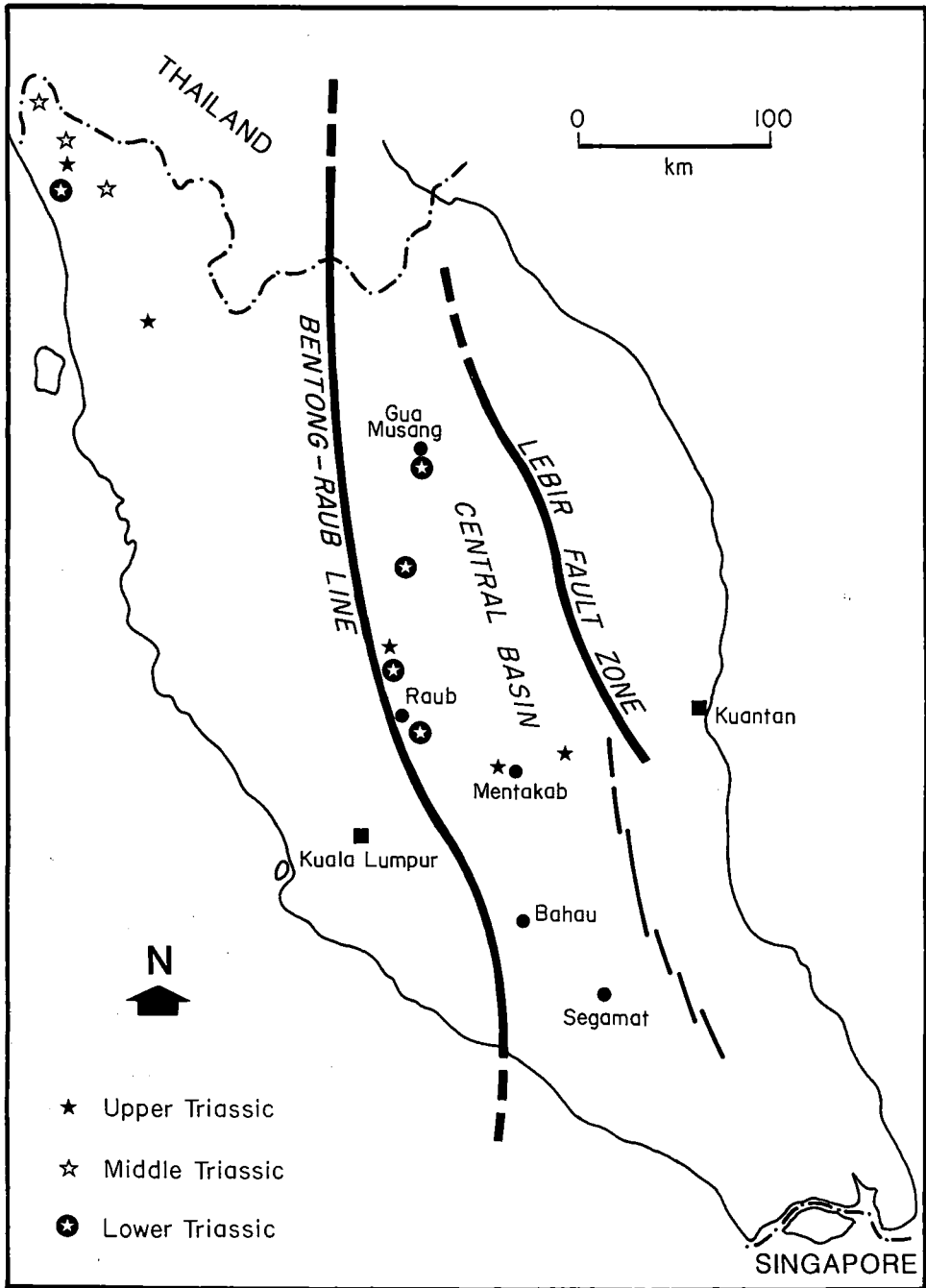


Figure 1: Map showing Lower, Middle and Upper Triassic conodont localities in the Malay Peninsula.

Lower Triassic (Fig.2)

Griesbachian

The only known Griesbachian conodont recorded from the Malay Peninsula is a single specimen of *Isarcicella isarcica* (Huckriede). This specimen was recovered from limestone near Raub which contains Spathian conodonts and it is regarded as reworked (Metcalf unpublished). The same sample also contains reworked Permian conodonts. *Isarcicella isarcica* is characteristic of the *I. isarcica* Zone of the lower Griesbachian.

Dienerian

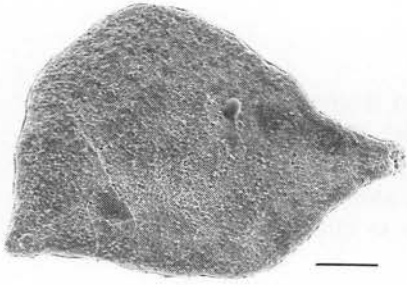
Dienerian conodonts were until recently unproved in the Malay Peninsula. Faunas recently recovered from the Jerus Limestone, Cheroh, Pahang include *Neospathodus conservativus* (Muller), *Neospathodus cristagali* (Huckriede), *Neospathodus dieneri* Sweet and *Neospathodus pakistanensis* Sweet which indicate a latest Dienerian age and represent the *Neospathodus pakistanensis* Zone (Metcalf, in press a).

Smithian

Smithian conodonts are a little better represented. The fauna described by Igo *et al.* (1965) from the Gua Musang Formation (Gua Panjang) of Kelantan contains *Neospathodus conservativus* and *Neospathodus bicuspidatus* Muller associated with ammonoids of the *Meekoceras glacialitatis* Zone and is of middle or late Smithian age, probably representing the *Neospathodus waageni* conodont zone. Smithian conodonts with *Neospathodus dieneri*, *Neospathodus conservativus*, *Neospathodus pakistanensis*, *Neospathodus waageni* Sweet, *Platyvillosus costatus* (Staesche) and *Platyvillosus hamadai* Koike were also reported from Gunong Keriang, Nr. Alor Star, Kedah (Metcalf, 1981; Koike, 1982). A fauna containing *Neospathodus bicuspidatus*, *Neospathodus waageni* and *Neospathodus dieneri* was reported from the Kodiang Limestone of Bukit Hantu, Kedah by Metcalf (1981) which indicates a probable middle or upper Smithian age and is representative of the *Neospathodus waageni* Zone of Carr and Paull (1983). This limestone hill also yields late Permian conodonts (Metcalf, 1981) and therefore exposes the Permian - Triassic boundary.

Spathian

Early Spathian conodonts are recorded from three localities in the Malay Peninsula. Conodonts representative of the early Spathian *Neospathodus triangularis* Zone have recently been discovered in N.W. Pahang (Metcalf, in prep. a). This fauna includes *Neospathodus triangularis* (Bender), *Neospathodus dieneri*, *Platyvillosus costatus* and *Platyvillosus hamadai*. Thin limestones interbedded with siltstones and shales near Raub, Pahang have yielded conodont faunas containing *Platyvillosus*, *Neospathodus collinsoni* Solien and *Neospathodus homeri* (Bender) of early Spathian age together with reworked Griesbachian and Permian conodonts (Metcalf, unpublished). The third early Spathian conodont locality is the Kodiang Limestone of Bukit Kalong, Kedah, where *Neospathodus triangularis* has been recorded together with *Neospathodus waageni* (S.S. Yii, Unpubl. Honours thesis, University of Malaya, 1979). Upper Spathian conodonts have not as yet been recognised in the Malay Peninsula.



1



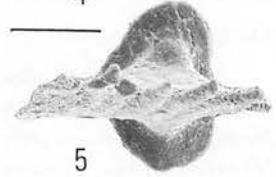
2



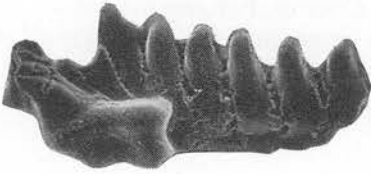
4



3



5



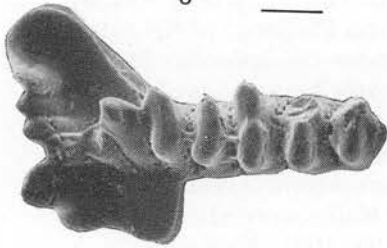
6



8



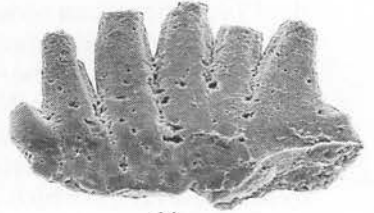
10



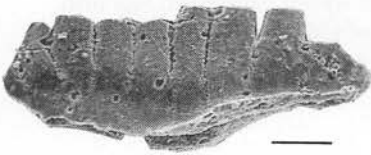
7



9



11



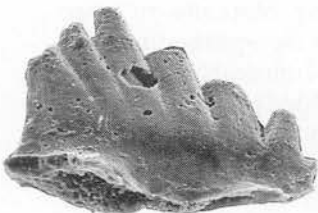
12



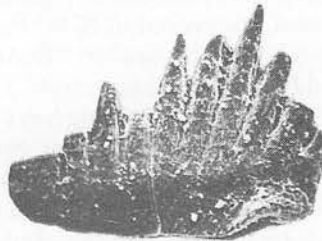
13



16



14



15



17

Plate 1 : Stratigraphically important Lower Triassic conodonts from the Malay Peninsula.

Fig.1. *Platyvillosus hamadai* Koike, oral view, Spathian, West Pahang.

Figs. 2 & 3. *Platyvillosus costatus* (Staesche), lateral and oral views, Spathian, Raub, Pahang.

Figs. 4 & 5. *Neospathodus triangularis* (Bender), lateral and oral views, Spathian, West Pahang.

Figs. 6, 7 & 17. *Neospathodus collinsoni* Solien; 6 & 7, lateral and oral views, Spathian, Raub, Pahang; 17, oral view, Spathian, Raub, Pahang.

Figs. 8 & 9. *Isarcicella isarcica* (Huckriede), oral and outer lateral views, Griesbachian conodont reworked into Spathian limestone, Raub, Pahang.

Fig. 10. *Neospathodus bicuspidatus* Muller, lateral view, Smithian, Kodiang Limestone, Bukit Hantu, Kedah.

Fig. 11. *Neospathodus pakistanensis* Sweet, lateral view, Dienerian, Jerus Limestone, Cheroh, Pahang.

Fig. 12. *Neospathodus conservativus* (Muller), lateral view, Dienerian, Jerus Limestone, Cheroh, Pahang.

Fig. 13. *Neospathodus homeri* (Bender), lateral view, Spathian, Raub, Pahang.

Fig. 14. *Neospathodus cristagali* (Huckriede), lateral view, Dienerian, Jerus Limestone, Cheroh, Pahang.

Fig. 15. *Neospathodus waageni* Sweet, lateral view, Smithian, Kodiang Limestone, Gunong Keriang, Kedah.

Fig. 16. *Neospathodus dieneri* Sweet, lateral view, Dienerian, Jerus Limestone, Cheroh, Pahang.

* Scale bars represent 0.1mm.

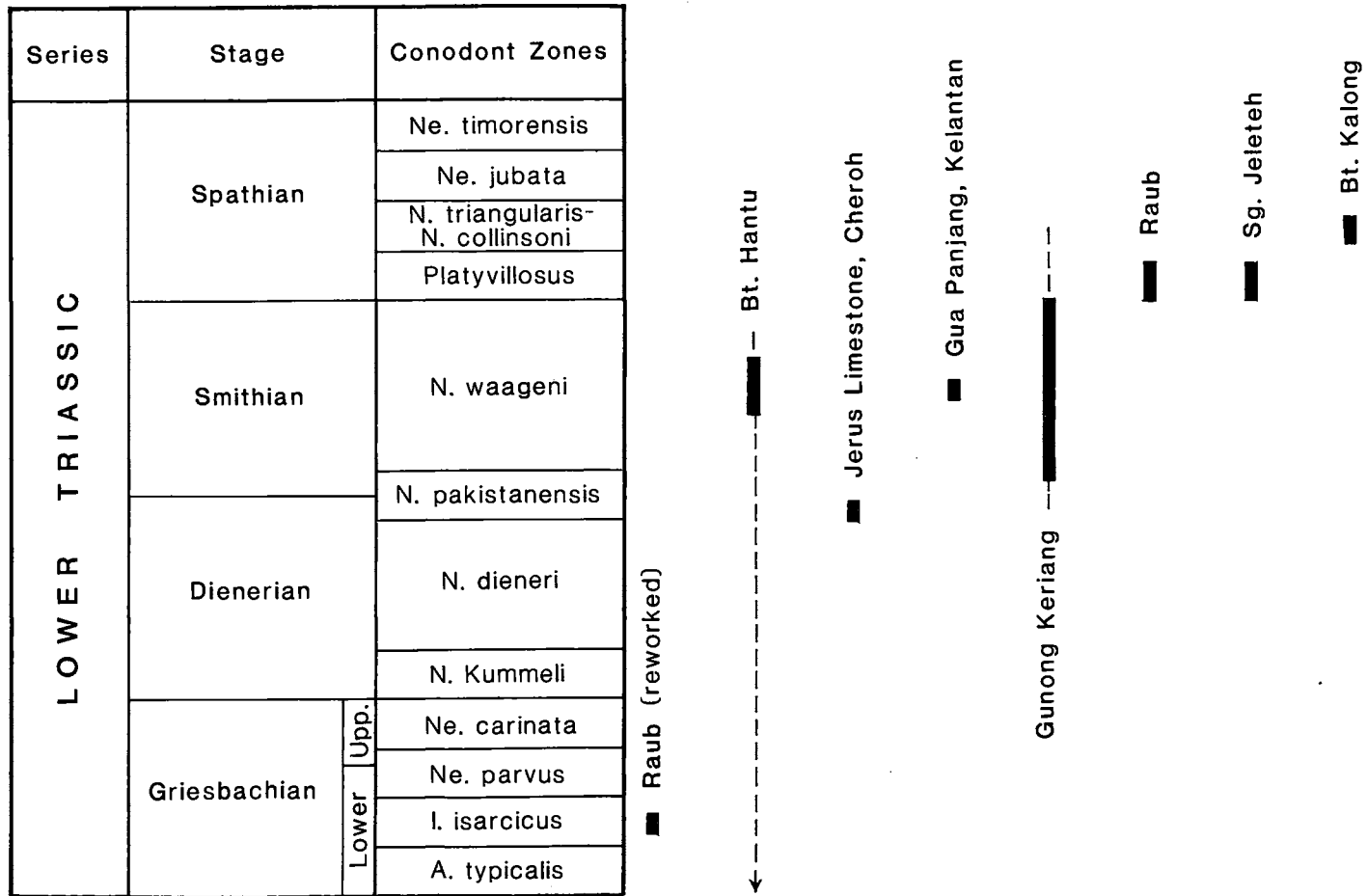


Figure 2: Lower Triassic conodont zonation and proved (solid bars) Lower Triassic conodont faunas in the Malay Peninsula. N. = Neospathodus, Ne. = Neogondolella, I. = Isarcicella, A. = Anchignathodus.

Middle Triassic (Fig. 3)

Middle Triassic conodonts are fairly well represented in the Malay Peninsula and Anisian and Ladinian faunas are dealt with separately below.

Anisian

Lower Anisian conodonts representative of the *Neogondolella regale* Zone were reported from Bukit Kalong, Kedah by Yii (1979). Middle Anisian conodonts were recorded from the same hill by Koike (1982) which include *Neospathodus kockeli* (Tatge) and *Neogondolella bulgarica* (Budurov and Stefanov) which are representative of the middle Anisian zones named after these species. Another middle Anisian fauna containing *Neospathodus kockeli* and *Neogondolella navicula navicula* (Huckriede) is recorded from bedded chert of the Semanggol Formation near Tawar, Kedah (Koike, 1973, 1984). Limestones in the Kampong Awah area, Pahang have also yielded Anisian conodonts (Koike, 1973) but it cannot yet be determined if these represent the middle or upper Anisian (Koike, 1982). Upper Anisian conodonts are known from two localities in the Peninsula, the Kodiang Limestone of Bukit Kodiang yields a fauna with abundant *Neogondolella bulgarica*, *Neogondolella excelsa* Mosher and *Gladigondolella tethydis* (Huckriede) and two small faunas from the Jerus Limestone, Cheroh, Pahang yield *Neogondolella excelsa* (Metcalf, in press a).

Ladinian

Lower Ladinian faunas have not so far been recognised in the Malay Peninsula. Upper Ladinian conodonts are known from the Kodiang Limestone of Bukit Kecil, Bukit Kalong and Bukit Kodiang, Kedah where they represent the *Carinella mungoensis* and *Neogondolella foliata* Zones (Ishii and Nogami, 1966; Koike, 1973).

Upper Triassic (Fig.4)

Carnian

Lower Carnian faunas are known from two localities, Bukit Kodiang, Kedah (Koike, 1973) and the Chert Member of the Semanggol Formation at Bukit Barak near Kuala Nerang, Kedah (Metcalf, in press b). At both localities the only platform conodonts present are *Metapolygnathus polygnathiformis* (Budurov and Stefanov). Upper Carnian conodonts are known from the Kodiang Limestone of Bukit Mulong, Kedah where the exposed sequence spans the boundary between the *Metapolygnathus polygnathiformis* and *Metapolygnathus nodosa* Zones (Metcalf, in prep. b).

Norian

Lower Norian conodonts have been recorded from the Kodiang Limestone of Bukit Kepelu, Kedah (Metcalf, in prep. b) and from the Chuping Limestone of

Series	Stage		Conodont Zones
MIDDLE TRIASSIC	Ladinian	Upper	Ne. foliata
		Upper	C. mungoensis
		Lower	Ne. mombergensis
		Lower	Ne. constricta- Ne. excelsa
	Anisian	Middle	N. kockeli
		Middle	Ne. regale
		Lower	

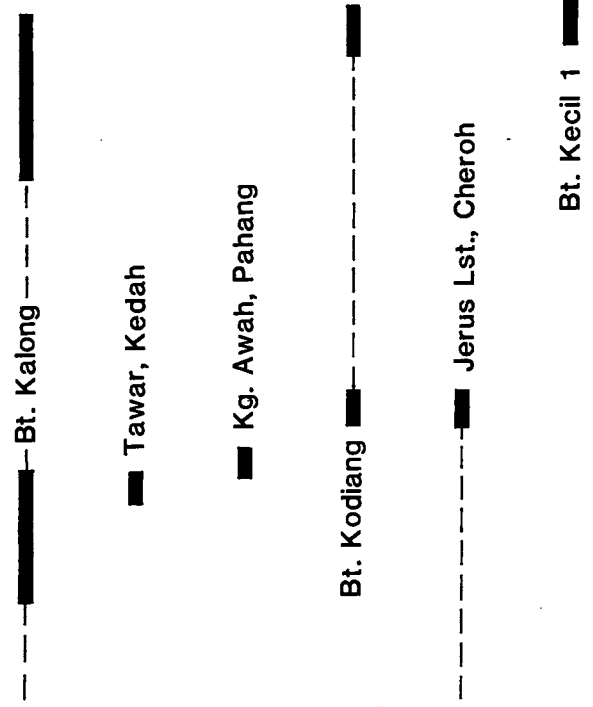


Figure 3 : Middle Triassic conodont zonation and proved (solid bars) Middle Triassic conodont faunas in the Malay Peninsula.
 N. = Neospathodus, Ne. = Neogondolella, C. = Carinella.

Series	Stage		Conodont Zones
UPPER TRIASSIC	Rhaetian		
	Norian	Upper	M. hernsteini
			E. bidentata
		Low Mid	E. multidentata
		Low	E. abneptis
	Carnian	Upper	Me. nodosa
		Lower	Me. polygnathiformis

■ Bt. Barak, Kedah

■ Bt. Kodiang

■ Bt. Mulong

■ Bt. Keteri

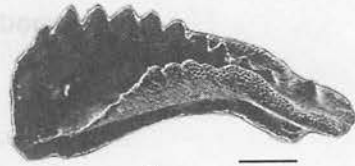
■ Bt. Jerneh

■ Bt. Kepelu

Figure 4 : Upper Triassic conodont zonation and proved (solid bars) Upper Triassic conodont faunas in the Malay Peninsula. Me. = Metapolygnathus, E. = Epigondolella, M. =



1



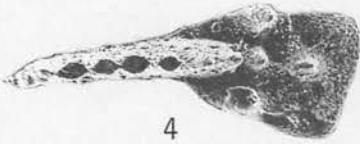
2



3



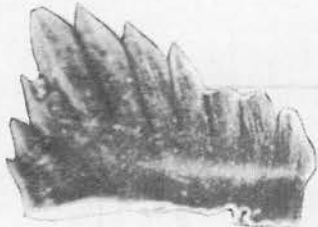
5



4



6



9



7



10



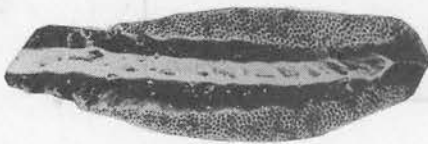
8



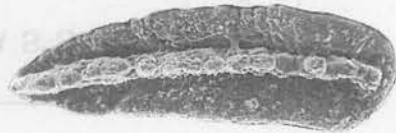
11



13



12



14

Plate 2 : Stratigraphically important Middle and Upper Triassic conodonts from the Malay Peninsula.

Figs. 1 & 2. *Metapolygnathus nodosa* (Hayashi), oral and lateral views, Carnian, Kodiang Limestone, Bukit Mulong, Kedah.
Figs. 3 & 4. *Epigondolella abneptis* (Huckriede) Subsp. A Orchard, inner lateral and oral views, Norian, Chuping Limestone, Bukit Jerneh, Perlis.

Figs. 5 & 6. *Epigondolella abneptis* (Huckriede) Subsp. B Orchard, outer lateral and oral views, Norian, Chuping Limestone, Bukit Keteri, Perlis.

Figs. 7 & 8. *Metapolygnathus polygnathiformis* (Budurov and Stefanov), inner lateral and oral views, Carnian, Semanggol Formation, Bukit Barak, Kuala Nerang, Kedah.

Fig. 9. *Neospathodus hockeli* (Tatge), lateral view, Anisian, Kodiang Limestone, Bukit Kalong, Kedah (= fig.7, plate VI of Koike, 1982).

Fig. 10. *Gladigondolella tethydis* (Huckriede), oral view, Anisian, Kodiang Limestone, Bukit Kalong, Kedah (= fig.28, plate IV of Koike, 1982).

Fig. 12. *Neogondolella bulgarica* (Budurov and Stefanov), oral view, Anisian, Kodiang Limestone, Bukit Kalong, Kedah (= fig.22, plate IV of Koike, 1982).

Figs. 13 & 14. *Neogondolella excelsa* Mosher, inner lateral and oral views, Anisian, Jerus Limestone, Cheroh, Pahang.

Bukit Keteri and Bukit Jerneh in Perlis (Metcalf, in press b). These faunas contain the lower Norian forms *Epigondolella abneptis* (Huckriede) subsp. A Orchard and *Epigondolella abneptis* (Huckriede) subsp. B Orchard. Middle and upper Norian conodonts have so far not been recognised in the Malay Peninsula.

Rhaetian

Rhaetian conodonts have not been recorded in the Malay Peninsula nor in Southeast Asia.

DISCUSSION

Although Triassic conodonts are fairly well known in the Malay Peninsula, there are still significant gaps in the conodont record. Griesbachian and Dierenian conodonts are poorly represented and upper Spathian, lower Ladinian, middle and upper Norian and Rhaetian conodonts are unknown. Documentation of transitions from one conodont zone to another is lacking apart from the *Me. polygnathiformis* Zone - *Me. nodosa* Zone transition at Bukit Mulong (Metcalf, in prep. b) and much more detailed sampling is required to effect this. One of the more interesting localities for further study is Bukit Hantu, Kedah where limestones span the Permian - Triassic boundary. Recent finds of early Triassic limestones in the Central Basin of the Malay Peninsula suggests that there are many more Triassic conodont localities to be discovered in that area and since Permian strata and conodonts also occur, there is a strong possibility of locating the Permian - Triassic boundary in the Central Basin. The occurrence of conodonts in cherts and associated limestones of the Semanggol Formation in Kedah and Perak (Koike, 1973; Metcalf, in press b) indicates that a study of the conodont biostratigraphy of that formation would be a valuable undertaking, particularly in view of the recent sedimentological studies that have taken place. The recent discovery that the Chuping Limestone of Perlis is in part equivalent to the Kodiang Limestone of Kedah (Fontaine *et al.*, 1988; Metcalf, in press b) suggests that a detailed conodont study of the Chuping Limestone is highly desirable.

REFERENCES

- CARR, T.R. and PAULL, R.K. 1983. Early Triassic stratigraphy and palaeogeography of the Cordilleran miogeocline. In Reynolds, M.W. and Dolly, E.D. (eds) *Mesozoic palaeogeography of the west-central United States*, pp.39-55, S.E.P.M., Denver, Colorado.
- FONTAINE, H., KHOO, H.P. and VACHARD, D. 1988. Discovery of Triassic fossils at Bukit Chuping, in Gunung Sinyum area and at Kota Jin, Peninsular Malaysia. *Jour. Southeast Asian Earth Sci.*, 2, pp.145-162.
- IGO, H., KOIKE, T. and YIN, E.H. 1965. Triassic conodonts from Kelantan, Malaya. *Mem. Mejiro GaKuen Women's Junior Coll.*, 2, pp.5-20.
- ISHII, K. and NOGAMI, Y. 1966. Discovery of Triassic conodonts from the so-called Palaeozoic limestone in Kedah, Malaya. *Jour. Geosci. Osaka City Univ.*, 9, pp.93-95.

- KOIKE, T. 1973. Triassic conodonts from Kedah and Pahang, Malaysia. *Geol. Palaeont. Southeast Asia*, 12, pp.91-113.
- KOIKE, T. 1982. Triassic conodont biostratigraphy in Kedah, West Malaysia. *Geol. Palaeont. Southeast Asia*, 23, pp.9-51.
- KOIKE, T. 1984. Summary of Triassic conodonts of Southeast Asia. *Geol. Palaeont. Southeast Asia*, 25, pp.295-302.
- METCALFE, I. 1981. Permian and early Triassic conodonts from northwest Peninsular Malaysia. *Geol. Soc. Malaysia Bull.* No. 14, pp.119-126.
- METCALFE, I. in press a. Lower and Middle Triassic conodonts from the Jerus Limestone, Pahang, Peninsular Malaysia. *Jour. Southeast Asian Earth Sci.*
- METCALFE, I. in press b. Triassic conodonts from northwest Peninsular Malaysia and their implications. *Geol. Mag.*
- METCALFE, I. in prep. a. Lower Triassic (Spathian) conodonts from northwest Pahang, Peninsular Malaysia.
- METCALFE, I. in prep. b. Upper Triassic conodonts from the Kodiang Limestone, Kedah, Peninsular Malaysia.
- YH, S.S. 1979. Conodont biostratigraphy of the Kodiang Limestone, Kodiang, Kedah, West Malaysia. Unpub. Final Year Hons. Thesis, University of Malaya.