35. On the Carboniferous Trilobite Provinces^{*)}

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The Carboniferous trilobites on the western Pacific side were considerably clarified in recent years. As summarized already (1978a, 1979a), twenty-nine species are known at present from Japan and ten species from Southeast Asia, i.e. Annam in Viet-Nam, Laos, Thailand and West Malaysia (1978a, 1979b). In adding eleven Chinese species listed here, the oriental species attain 50 in total. The Australian fauna comprises twenty-eight species of Carboniferous trilobites which are all distributed in Queensland and New South Wales except for *Griffithidella cannolli* (Mitchell) from Western Australia (1978b).

Ditomopyge ? *kansuensis* (Loczy, 1899). Low. ? Carb., Kansu
Waribole ellipticus (Mansuy, 1912). Low. Carb., Yunnan
Cummingella ? *cognatus* (Reed, 1927). Low. ? Carb., Yunnan
 "Phillipsia" (*Eocyphinium* or *Piltonia*) *spinifera* (Reed, 1927). Low. ? Carb., Yunnan
Neoproetus ? *sinensis* Grabau, 1936. Up. Carb., Kwangsi
Ditomopyge yunchangensis Wang, 1937. Up. Carb., Kansu
Humilogriffithides divinopleurus Inai 1936. Moscovian, Liaoning
Humilogriffithides someyai Endo, 1942. Moscovian, Kirin
Weberiphillipsia guizhouensis Yin, 1978. Low. Carb., Kweichou
Cyrtosymbole (*Dushania*) *dushanensis* Yin, 1978. Low. Carb., Kweichou
Cyrtosymbole (*Dushania*) *xiasiensis* Yin, 1978. Low. Carb., Kweichou

Our knowledge in these areas is still not so well advanced as in the classical areas, but it is less in South Asia, Mongolia, South America, Siberia and Arctic Canada (Hahn, 1969–72). As to the number of known species there is a considerable difference between the Dinantian-Mississippian and the later Carboniferous period. Although such a specio-temporal unbalance exists in the existing knowledge, an attempt is made to elucidate the Carboniferous trilobite provinciality. As the result it is found that it is similar to the Devonian provinciality (1977) except for a fundamental distinction on the elimination of the South African-Malvinian-West Antarctic sub-province out of the trilobite-sphere.

In the Carboniferous period there were the Old and New World realms. The latter best represented by the rich fauna in the Mid-continent of North America is different from the former in the

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Carboniferous trilobites of the oriental province

Age and Area	Carboniferous			Japan		China		SE Asia	
Trilobites	Lower	M	U	Kt	Ak	N	S	LA	TM
<i>Pudoproetus</i>	T				X				(X)
<i>Conophillipsia</i>	T			X					
<i>Cyrtosymbole (Dushania)</i>	X						X		
<i>Archaeogonus (Angustibole)</i>	T				X				
<i>Waribole</i>	X				X		X		
<i>Phillibole</i>	T			X					X
<i>Carbonocoryphe</i>	T				X				
<i>Phillipsia</i>	T			X					
<i>Eocyphinium</i> or <i>Piltonia</i>	?						(X)		
<i>Linguaphillipsia</i>	T V			X				X	X
<i>Palaeophillipsia</i>	T			X					
<i>Weberiphillipsia</i>	X						X		
<i>Cummingella</i>		X			X		(X)		
<i>Griffithidella</i>	T				X				
<i>Thigriffides</i>	T				X				
<i>Metagriffithides</i>			X			X			
<i>Paragriffithides</i>	T				X				
<i>Humilogriffithides</i>		X			X	X			
<i>Neoproetus</i>			?			(X)			
<i>Thaiaspis</i>		X							X
<i>Thaiaspis (Thaiaspella)</i>		X							X
<i>Paladin</i>	V	X		X					X
<i>Paladin (Weberides)</i>	V			X					
<i>Ditomopyge</i>	?		X						X
<i>Brachymetopus</i>		X			X				
<i>Brachymetopus (Brachymetopella)</i>		X			X				

X: Occurrence. Brackets: Provisional. Question mark: Doubtful. M: Middle. U: Upper. Kt: Kitakami facies. Ak: Akiyoshi facies. N: North. S: South. LA: Laos and Annam. TM: Thailand and Malaysia.

absence of *Linguaphillipsia* and *Cummingella* and the presence of such endemic genera as *Exochops*, *Ameura*, *Sevillia*, *Elliptophillipsia* and *Breviphillipsia*. *Ameura* migrated into the Amazon basin in the Pennsylvanian times, while the occurrence of *Australosutura* in Argentina reveals the faunal connection from the Mid-continent to Eastern Australia through the Andean geosyncline in the Mississippian times.

Of the Old World realm the vast terrain of Eurasia is its main part, but it extends an elbow to Australia and another to Arctic Canada. In the classical Carboniferous in Europe there are two dis-

inct faunas in the Culm and Carboniferous limestone facies (Hahn, 1975), like the Devonian Rhenish and Hercynian biofacies. The extraordinary development of the Cyrtosymbolinae including blind trilobites is the unique aspect of the Culm trilobites. *Phillibole conkini* Hessler is a sole exception of the trans-Atlantic migration. On the Asiatic side on the contrary the subfamily is better represented by *Waribole*, *Phillibole*, *Archaeogonus* (*Angustibole*, *Belgibole*) and *Carbonocoryphe* in the Kirghiz steppe, Afghanistan, Yunnan, the Thai-Malayan peninsula and Japan. *Weiania* is a cyrtosymbolid occurring in New South Wales, the Urals and probably Turkestan, but unknown from Europe. *Cyrtosymbole* (*Dushania*) is an endemic genus of South China (Yin, 1978). *Particeps* is a griffithid genus of the trans-Atlantic distribution. It is known from the British isles to the Mississippi valley to the west and the Urals, Donetz basin and Turkestan to the east.

For *Griffithides convexicaudatus* Mitchell Osmolska (1970) and G. and R. Hahn (1972) respectively suggested American *Richterella* and Eurasiatic *Cummingella*. But *Linguaphillipsia* is well represented by four or more species in Australia. As pointed out elsewhere, this genus warrants the Australian branch from the Tethyan route of migration (1978, a and b). *Proetus* (*Megaproetus*) is an endemic subgenus in Queensland.

The Mongolian geosyncline was another trans-Asiatic route of migration which was taken by *Conophillipsia* and *Weberiphillipsia*. They are found in Australia on one side and Central Asia and the Kuznetsk basin on the other. Between the two sides the former genus occurs in Japan (1979a) and the latter in South China, while they are unknown from Europe and South Asia. *Cyrtoproetus* is known widely from England, Czechoslovakia, the Urals, Kirghiz Steppe and Turkestan. Then it recurs in Queensland. Which of the Tethyan or the Mongolian geosyncline was the route for this trilobite between the two areas is a question as yet unsolved. It is noteworthy that *Paragriffithides* sp. was described by Nan (1976) from the Uralian Taiyuan Series at Chunkening-chi, Inner Mongolia, because the genus was known from the Lower Carboniferous of England and Tianshan and the Westphalian of Hungary.

The faunal connection was maintained through the northern Pacific route in the Lower Carboniferous period. It is indicated by the find of *Thigriffides*, *Griffithidella* and *Pudoproetus* in the Hina limestone, West Japan (1978a). The first is the typical North American genus. The second and third genera reached western Australia to the south and the Altai, Turkestan, Kirghiz Steppe and the Urals to the west through Japan from the Mid-continent. The third genus died out in Ellesmere Island in the Moscovian (Cham-

berlain, 1977).

Finally, *Griffithides* (*Metagriffithides*) *seminiferus kuleschi* (Ivanov in Weber, 1937) from the lower Visean of Irkutsk is particularly important for the Mongolo-Ohkotsk geosyncline because *Metagriffithides* is distributed in England and Ireland on one side and in the Mid-continent on the other where it is represented by *G. (M.) bufo* (Meek and Worthen, 1870). Because little is known of Carboniferous trilobites in the Arctic coast of Siberia, the Alaskan *G. (M.) ? bufo* by Chamberlain (1977) in Alaska migrated probably through this route.

In summarizing the above statements, (1) the Carboniferous trilobite sphere may be divisible into the Old and New World realms as here defined, (2) the Tethyan and Mongolian geosynclines were two main routes of the trans-Eurasiatic migration and (3) there were certain faunal connection through the northern and southern Pacific routes. How to divide the Eurasiatic part of the Old World realm into provinces, will be discussed in other occasion.

Here only a brief note is given of the oriental province of the realm. It extends in the Japanese Islands, China, Indochina and Thailand-Malaysia where some twenty-five genera and subgenera are known of trilobites. As tabulated on page 176, most of them are Lower Carboniferous, but some ranges from Visean to Bashkirian beside four Moscovians and a few Upper Carboniferous ones. Indigenous elements are Lower Carboniferous *Cyrtosymbole* (*Dushania*) of South China, Moscovian *Humilogriffithides* of Japan and Northeast China (formerly Manchuria) and upper Moscovian *Thaiaspis* (*Thaiaspis* and *Thaiaspella*) of Thailand. On the other hand *Linguaphillipsia*, *Cummingella* and cyrtosymbolids, typical of the realm, are well represented in the oriental fauna. As exemplified already, the oriental sea was confluent with the neighbouring ones of the Mongolian and the Tethyan geosynclines. Some genera represent the faunal connection with the Australian fauna, while a few others show it with the trilobites of the Mid-continent, North America.

References

- Chamberlain, C. K. (1977): Carboniferous and Permian trilobites from Ellesmere Island and Alaska. *J. Paleont.*, **51**, 758-771.
- Hahn, G. and R. (1969, 1970, 1972): Trilobitae carbonici et permici, I-III. *Animalium Catalogus* I, pars 12, 531 pp.
- (1975): Die Trilobiten der Ober-Devon, Karbon und Perm. *Gürich und Krömmelbein: Leitfossilien*, vol. 2, 267 pp.
- Kobayashi, T., and Hamada, T. (1977): Devonian trilobites of Japan in comparison with Asian, Pacific and other faunas. *Pal. Soc. Japan Spec. Pap.*

- no. 20, 202 pp., 12 pls.
- (1978a): Three Suites of Carboniferous trilobites in Southeast Asia. *Proc. Japan Acad.*, **54B**, 92–95.
- (1978b): On the relationship of Carboniferous trilobites between Australia and Eurasia. *Ibid.*, **54B**, 96–100.
- (1979a): Outline of the Carboniferous trilobites in Japan. *Ibid.*, **55B**, 104–108.
- (1979b): Permo-Carboniferous trilobites from Thailand and Malaysia. *Geol. Pal. SE Asia*, **20**, 1–23, pls. 1–3.
- Nan, Junsan (1976): Trilobites, p. 333–352, pls. 190–201. *Fossil Atlas of Northeast China. Inner Mongolia (1), Palaeozoic Part*, 501 pp., 232 pls.
- Osmolska, H. (1970): Revision of non-cyrtosymbolid trilobites from the Tournaisian-Namurian of Eurasia. *Pal. Polonica*, no. 23, 165 pp., 22 pls.
- Weber, V. (1937): Trilobites of the Carboniferous and Permian Systems of U.S.S.R. I, Carboniferous trilobites. *Pal. U.S.S.R. Monogr.*, vol. 71 (1), 159 pp., 11 pls.
- Yin, Kung-cheng (1978): Trilobita, p. 440–445, pl. 141. *Fossil Atlas of Northwest China, Kweichow*, vol. 2, Carbon.-Quaternary, 638 pp., 165 pls.