77. A Comparison of the Cambrian Trilobites between the North and South Sides of the Western Pacific Basin

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Since I have instituted *Yorkella* and *Pararaia* for Etheridge's two species of trilobites in 1942, I wrote a note on the Cambrian of Australia and New Zealand in 1971. Here the provinciality problem is taken up and considered with new facts collected on the Western Pacific side. The Lower Cambrian formation containing *Yorkella*, *Pararaia*, *Redlichia*, archaeocyathids and so forth is well developed in South Australia where Daily (1957) distinguished ten faunal assemblages. Later Pocock (1964) added *Estangia*, *Emuella* and *Balcoracania*, the latter two of which have opisthoparian facial sutures, although they reveal some resemblances with olenellids. *Redlichia* is wide spread in Central and Northern Australia and the *Redlichia* stage was proposed by Whitehouse (1936) for late Lower Cambrian rocks. In the Flinders Ranges there is the *Bemella*-bearing Parachilna Formation below these trilobite-bearing strata (Daily, 1976). This formation together with the underlying Urattana Formation containing trace fossils would be the correlative to the Meishucun (梅樹村) stage in Yunnan (Luo, 1984). Incidentally, *Charnia* was recently discovered in the Upper Sinian Tongyin (燈影) Formation in eastern Yangtze Gorge, Hubei (Ding and Chen, 1981). Its age must be near the Ediacara fauna.

In West Antarctica Lower and Middle Cambrian trilobites were found in boulders collected in the Transantarctic Mountains and Victoria Land (Palmer and Gatehouse, 1972). Among them three Lower Cambrian faunules were distinguished, namely the *Australaspis*, (neoredlichid) faunule and two *Chorbusulina* (protolenid) faunules, the *Ch. wilkesi* faunule of which contains *Redlichia* sp. indet. and archaeocyathids. According to Zhang *et al.* (1981) *Redlichia* s. l. comprises more than 85 species some 50 of which belong to *Redlichia* s. str. Redlichids are widely distributed in Korea, China, Pakistan, Near East, Mediterranean (Morocco), South Siberia (Transbaikalia), Australia and West Antarctica in the middle and upper parts of Lower Cambrian Formations. Australia and West Antarctica belong to the Redlichian province as defined in 1971, whereas North and South America are parts of the Olenellian province.

The Middle Cambrian fauna of West Antarctica is represented by two early Middle Cambrian *Xystridura* faunules and four late Middle Cambrian faunules typified by *Amphoton*, *Schopaspis* (ptychopariid), *Solenopleura* and *Nelsonia* among which *Amphoton* is a typical Taitzuan genus in China and the *Schopaspis* faunule contains *Liopeishania* which is another Taitzuan genus. *Solenopleura pruina* is allied to the Siberian and Scandinavian species of the same genus. *Xystridura* which was primarily created in Australia is known to occur in Hainan Island, South China (Zhu and Lin, 1978) where it is associated with *Pagetia* like the *X. multilinia* faunule in West Antarctica.

Cheiruroides appeared in Korea and China in the *Redlichia* age and distributed into Siberia in the north and Australia in the south in the Middle

Cambrian period when *Oryctocephalus* was wide spread in the Rocky and Andes Mountains in the east and in the west from Siberia to Australia through the Himalayas, but neither *Oryctocephalus* nor *Cheiruroides* is as yet found from the Middle Cambrian rocks in Eastern Asia (Shergold, 1969). *Amphoton* (or *Eurodeois*), *Fuchowia*, *Sunia* and *Mapania* are all Middle Cambrian genera flourished in the Hwangho basin and known now to occur in Australia (Öpik, 1961, 1982). There are a few strangers from the Paradoxidian-Olenidian province, for example, *Meneviella viatrix* Shergold, 1973, *Centropleura phoenix* Öpik, 1961 and *Olenus ogilvini* Öpik, 1963 in Western Queensland.

In New Zealand Benson discovered Cambrian trilobites in the central sedimentary belt of South Island in 1942 and Singleton and Öpik identified some Middle Cambrian agnostids and *Dorypyge*, *Kootenia* and other polymeric genera including *Pianaspis*, a Korean genus. Now Vendian acritarchs are found in the belt (Cooper, 1979).

Of the Kushan fauna I have described its history of research and discussed problems on its biostratigraphy and correlation in detail in 1967 and 1971. It is indeed a very rich fauna in which the family Damesellidae accompanied by *Liostracina*, *Teinistion* and other distinctive genera is included. This fauna has flourished in China and Korea in Eastern Asia and Northwestern Queensland in Australia. *Damesella*, *Blackwelderia*, *Stephanocare*, *Drepanura* (or *Palaeadotes*) and *Liostracina* as genera and *Stephanocare richthofeni* as a species are known to occur in these areas. *Damesella* and *Blackwelderia* appeared first in the Wenshuei stage in Shantung and in the *Annamitia* zone in Yunnan-Tonkin (Viet Nam) border. Later the Kushan fauna flourished in Eastern Asia, particularly in the Hwangho basin. *Drepanura*, *Blackwelderia* and *Liostracina* are, however, found also in the Yangtze basin in the Machari facies, but the associate trilobites are different from the typical Kushan fauna as called Para-Kushan in 1967. *Drepanura*, *Damesella* or/and *Blackwelderia* are reported from Siberia in the north and Tasmania (*Blackwelderia*) in the south. The western limit of distribution is North Iran (Kushan, 1973), except for *Drepanura eremita*, a stranger in Sweden. The Kushan trilobites appeared in the late Middle Cambrian and sporadically developed in the early Upper Cambrian age till their annihilation.

Upper Cambrian trilobites, brachiopods and molluscs are known from Northern Victoria, and Antarctica (Shergold *et al.* 1976; Shergold and Cooper, 1985). Several fossil horizons are found there in the Mariner Group. *Stigmatia* and *Notoasphelaspis* show sea connection toward Eastern Australia. *Prochuangia* aff. *granulosa* Lu and *Proceratopyge* cf. *liaotungensis* Kobayashi and Ichikawa indicate affinities to the Paishan fauna of the Hwangho basin. *Olentella* and *Pedinocephalus* are two genera primarily erected in Kazakhstan. The Kushan fauna is as yet unknown in Antarctica.

The post-Kushan trilobites are well represented in Western Queensland. The Idamean fauna contains *Pagodia* (*Idameas*), *Prochuangia*, *Parakoldinioidia* and *Proceratopyge* (Shergold, 1982). Judging from them this fauna is allied to the Changshan or Paishan fauna. *Wuhuia*, *Maladioidella*, *Taishania*, *Wentsuia*, *Koldinioidia*, *Prochuangia*, *Peichiashania*, *Parakoldinioidia* and *Haniwooides* occur in the Chatsworth Limestone (Shergold, 1980) and their age is probably Paishan-Daizan. The Gola Beds containing *Kaolishania*, *Mansuyia*, *Paramansuyia* and *Kaolishaniella* (Shergold, 1971) are evidently the Daizanian equivalent. The Trilobite beds of the Burke River Structural Belt yield *Koldinioidella*, *Wuhuia*, *Wanwanaspis*, *Andersonella*, *Sinosaukia*, *Mictosaukia*, *Asioptychaspis*, *Quadrati-*

cephalus, *Maladioidella*, *Haniwa*, *Pagodia* (*Pagodia*), *Mansuyia*, *Parakoldinioidia*, *Tsinania* and *Dictyites* (Shergold, 1975). These genera are in the range from Daizanian to Wanwanian, and most of them are Fengshanian. The above trilobites as a whole warrant the intimate relationship between Australian and Eastern Asiatic faunas.

In summary it can be said that the Redlichian fauna and the Kushan fauna are very well defined. The former is late Lower Cambrian in age and the latter early Upper Cambrian starting from latest Middle Cambrian. These two faunas constituted in these ages a faunal province extending from Eastern and Southern Asia to Australia and probably to West Antarctica. The Middle Cambrian faunas of the Southwestern Pacific side including New Zealand are more closely related to the Asiatic faunas than the South American ones. The close relationship was further emphasized in the post-Kushan Upper Cambrian faunas.

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^{*)} See Kobayashi (1967, 1971) for earlier references.

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