

THE PERMIAN BRACHIOPOD FAUNA OF THE HIMALAYA: PALAEOBIOGEOGRAPHIC IMPLICATIONS

TRILOCHAN SINGH

WADIA INSTITUTE OF HIMALAYAN GEOLOGY, DEHRA DUN, INDIA

ABSTRACT

The Permian brachiopods occur abundantly in the Lesser and the Tethyan belts of the Himalaya. A detailed account of the brachiopod fauna from different localities in the two belts is given in the paper. The fauna can be grouped biostratigraphically into Early and Late Permian. The Early Permian fauna is characterised by *Ambikella*, *Taeniothaerus*, *Cyrtella*, *Reticularia*, *Brachythyris*, *Wyndhamia* and others. This brachiopod fauna is characteristically associated with *Eurydesma-Deltopecten* fauna its older part. The Late Permian brachiopods include *Lammimargus*, *Costiferina*, *Uncinunellina*, *Waagenoconcha*, *Lyttonia*, *Krotovia* and others.

The palaeobiogeographic implications of the Permian brachiopod fauna of the Himalayan region have also been discussed. It is suggested that, in general, cold climatic conditions prevailed in the Himalayan region during the Early Permian except a few localities, followed by a warmer phase in Late Permian times. The analysis also suggest that this fauna belongs to Gondwana biogeographical province.

INTRODUCTION

The Permian brachiopod fauna are found abundantly in the Himalaya and are distributed throughout the Permian sequences in Salt Range (Waggen, 1882-85; Reed, 1931, 1936, 1944; Kummel and Teichert, 1970; Grant, 1970; Ibrahim-Shah, 1977; Waterhouse and Gupta, 1983), Zaskar (Nanda and Singh, 1976; Srikantia *et al.*, 1978b; Gupta and Waterhouse, 1978c), Lahaul and Spiti (Diener, 1899, 1915; Srikantia *et al.*, 1978a; Gupta and Waterhouse, 1978 a,b), Kashmir (Diener, 1915; Bion and Middlemiss, 1928; Reed, 1932; Nakazawa *et al.*, 1975; Nakazawa and Kapoor, 1981), Bhadarwah-Bhalesh-Chamba (Gupta, 1971; Kapoor, 1973; Raina *et al.*, 1975, Datta and Bhattacharya, 1975), Kinnaur (Chopra *et al.*, 1980), Garhwal (Chaturvedi and Talent, 1972; Shankar *et al.*, 1973; Waterhouse and Gupta, 1978, 1982; Gupta, 1982), Kumaun (Mamgain and Sastry, 1971; Valdiya and Gupta, 1972; Shah and Sinha, 1974), Nepal (Waterhouse, 1966, 1976, 1978), Sikkim (Muir-Wood and Oakley, 1941; Sahni and Srivastava, 1956; Gupta and Waterhouse, 1979), Bhutan (Gupta and Waterhouse, 1979), and Arunachal Pradesh (Diener, 1905; Sahni and Srivastava, 1956; Singh, 1973, 1978a,b).

These localities fall into two main belts of the Himalaya, viz. the Lesser Himalayan belt and the Tethyan Himalayan belt. The Lesser Himalayan localities include those of Bhadarwah-Bhalesh-Chamba, Garhwal, South Sikkim and Arunachal Pradesh, while the Tethyan Himalayan localities include those of Zaskar, Lahaul and Spiti, Kinnaur, Kumaun, Nepal, North Sikkim and Bhutan. However, Salt

Range and Kashmir have their separate identity which cannot be attributed to any of the above two belts.

THE BRACHIOPOD FAUNA

The brachiopods are reported from a number of localities in the Himalaya (fig. 1) as mentioned above. These localities have been grouped biostratigraphically into two faunal groups, i.e. Early and Late Permian. In the present paper, the Early Permian is regarded as comprising the Asselian, Sakmarian and Artinskian stages, and the Late Permian includes Kungarian, Kazanian, Punjabi and Djulfian stages. The distribution of brachiopod faunal localities is shown in table 1, and the brachiopods occurring in these localities are given in Appendix I.

The overall fauna is represented by 51 families. The common families include Spiriferidae, Syringothyrididae, Marginiferidae, Chonetidae, Martiniidae, Linoproductidae, Licherwiidae and Monticuliferidae. These families are represented by 97 different genera, besides some other indeterminate genera. Of these, 17 are restricted to the Early Permian, 40 to the Late Permian, and rest are common to both. The most common genera are *Neospirifer*, *Cleiothyridina*, *Spiriferella*, *Marginifera*, *Dielasma*, *Linoproductus*, *Dictyoclostus* and *Derbyia*.

The Early Permian brachiopod fauna occurs in the Dandot, Sardi and Amb Formations of Salt Range, Ralukung Volcanic Succession of Zaskar, Lower Kuling Formation of Lahaul and Spiti, Diamictite and Pyroclastic Divisions of Agglomeratic Slate in

Kashmir, Tramawala Formation of Bhadarwah-Bhallesh-Chamba, Boulder Slate Formation of Garhwal, Upper Palaeozoic sediments of South Sikkim, and Garu Formation of Arunachal Pradesh. The fauna is characterised by the presence of *Ambikella*, *Taeniothaerus*, *Cyrtella*, *Reticularia*, *Brachythyris*, *Wyndhamia* and others. This brachiopod fauna is characteristically associated with *Eurydesma-Deltopecten* fauna in its older part.

The Late Permian brachiopods are known from Wargal and Chhidru Formations of Salt Range, Sarchu Limestone of Zanskar, Upper Kuling Formation of Lahaul and Spiti, Zewan Formation of Kashmir, Talai Formation of Bhadarwah-Bhallesh-Chamba, Late Permian sediments of Kinnaur, Kuling Shale Formation of Kumaun, Nangung and Senja Formations of Nepal, Lachi Series of North Sikkim, and Black Mountain area of Bhutan. The characteristic

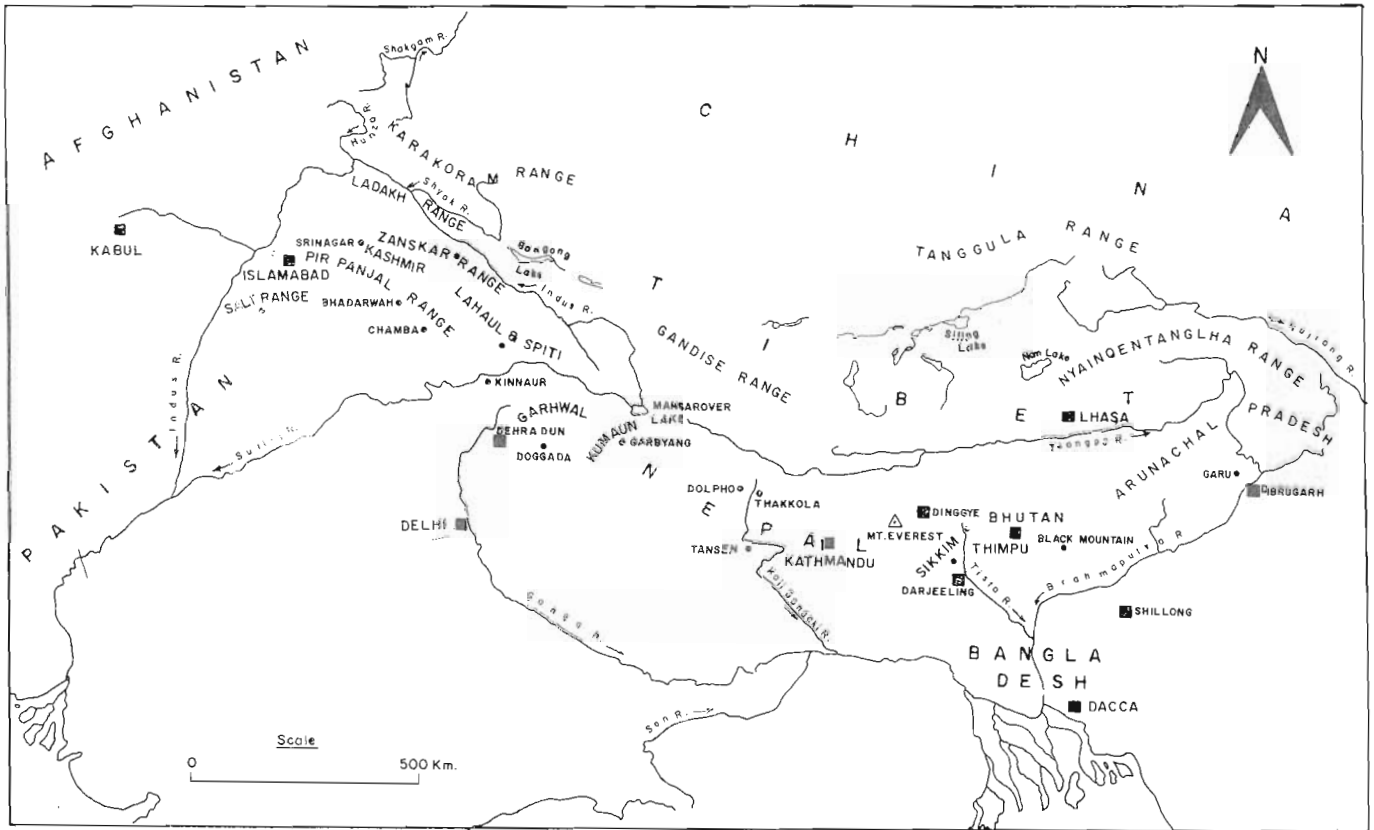


Fig. 1. Permian Brachiopod localities in the Himalaya.

Table 1 : Distribution of Permian Brachiopods in the Himalaya

AGE	STAGE	CHARACTERISTIC FORMS	DISTRIBUTION
LATE PERMIAN	Djulfian	<i>Lammimargus</i> , <i>Costiferina</i> ,	Wargal and Chhidru Formation, Salt Range; Sarchu Limestone, Zanskar; Upper Kuling Formation, Lahaul and Spiti; Zewan Formation, Kashmir; Talai Formation, Bhadarwah-Bhallesh-Chamba; Tidong Valley, Kinnaur; Kuling Shale Formation, Kumaun; Senja and Nangung Formation, Nepal; Lachi Series, Sikkim; Black Mountain area, Bhutan
	Punjabian	<i>Uncinunellina</i> , <i>Waagenoconcha</i> ,	
	Kazanian	<i>Lyttonia</i> , <i>Krotovia</i>	
EARLY PERMIAN	Artinskian	<i>Ambikella</i> , <i>Taeniothaerus</i> ,	Tohra, Dandot, Sardi and Amb Formations, Salt Range; Ralu Kung Volcassic succession, Zanskar; Lower Kuling Formation, Lahaul and Spiti, Diamicite and Pyroclastic Division of Agglomeratic Slate, Kashmir; Tramawala Formation, Bhadarwah Bhallesh-Chamba; Boulder Slate Sequence, Garhwal; South Sikkim; Garu Formation, Arunachal Pradesh.
	Sakmarian	<i>Cyrtella</i> , <i>Reticularia</i> ,	
	Asselian	<i>Brachythyris</i> , <i>Wyndhamia</i>	

genera of this fauna include *Lamnimargus*, *Costiferina*, *Uncinunellina*, *Waagenoconcha*, *Lyttonia*, *Krotovia* and others.

The fauna shows strong affinity with the Australian fauna. Early Permian fauna also compares closely with the Tibetan fauna.

PALAEOBIOGEOGRAPHIC IMPLICATIONS

The Permian marine sequences are not continuously exposed in the Himalayan domain, except in the Salt Range and Kashmir which provide a key to numerous other sporadically distributed less complete successions in other parts of the Himalaya. Furthermore, the Early Permian sediments have more or less a complete record of brachiopods, whereas the Late Permian brachiopods are poorly recorded. Though it is difficult to examine the fauna according to its exact superpositional relationship, the available data in lateral extent can, however, be useful in understanding the environmental conditions.

In Salt Range, the Permian sequence begins with tillite, overlain by some marine beds with a *Eurydesma* fauna. Brachiopods are particularly well represented in the Amb Formation having slightly more diversified fauna. The overlying Wargal and Chhidru Formations have a highly diversified fauna including characteristic species of *Aulosteges*, *Callispirina*, *Cleiothyridina*, *Waagenoconcha* and others. The Permian fauna here in the basal section indicates a cool environment, while that of the upper part is interpreted as changing from warm temperate to tropical one.

In Kashmir, the base of the Permian sequence is marked by the Diamicite Division which, according to Nakazawa *et al.* (1975), is not indicative of glaciogene conditions; it is, however, interpreted to represent colder conditions on the basis of the characteristic cold water brachiopod genus *Ambikella* accompanied by a *Eurydesma* fauna. Similar conditions are also indicated for the overlying Pyroclastic Division, which contains *Ambikella*, *Stepanoviella*, and other characteristic cold water forms. However, the Late Permian Zewan Formation contains a highly diversified fauna including *Costiferina*, *Waagenoconcha*, *Cleiothyridina*, *Cancrinella* and other brachiopods associated with fusulinids. This is indicative of tropical conditions. Thus, the Kashmir fauna indicates cold water conditions during the Early Permian and tropical conditions during the Late Permian.

The Early Permian brachiopod fauna of Lahaul

and Spiti, South Sikkim and Arunachal Pradesh is associated with a *Eurydesma* fauna and is closely related to the Kashmir and Salt Range faunas. This fauna is indicative of cold water conditions. However, the Early Permian fauna of Garhwal, Bhadarwah-Bhallesh-Chamba and Zanskar shows little diversification, though the analysis of brachiopod fauna (Singh, 1987) is indicative of temperate conditions. This is very significant as this fauna also contains *Eurydesma*. This might indicate intermixing of cold and warm water fauna.

The Late Permian brachiopods from Zanskar, Lahaul and Spiti, Bhadarwah-Bhallesh-Chamba, Kinnaur, Nepal and North Sikkim include *Lamnimargus*, *Waagenoconcha* and other characteristic forms indicative of warm water conditions. In contrast, the brachiopods of Kumaun Tethyan Himalaya indicate cold water conditions (Waterhouse and Bonham-Carter, 1975, p. 1096; Singh, 1987).

Thus, it is suggested that the cold climatic conditions prevailed in the Himalayan region during the Early Permian with the exception of a few localities, where it witnessed a warmer phase during the Late Permian time.

The analysis also suggests that the Permian brachiopod fauna of the Himalaya belongs to one biogeographic province, viz. the Gondwana biogeographic province, the northern boundary of which lies to the north of the South Tibet.

ACKNOWLEDGEMENTS

The author is grateful to his colleagues Dr. N.S. Mathur and Dr. N.S. Viridi for going through the manuscript. Facilities rendered by the Director of Wadia Institute of Himalayan Geology are thankfully acknowledged.

REFERENCES

- BION, H.S. & MIDDLEMISS, C.S. 1928. The fauna of the Agglomeratic Slate Series of Kashmir. *Pal. Indica* N.S. **22**: 1-42.
- CHATURVEDI, R.S. & TALENT, J.A. 1972. A preliminary note on the discovery of richly fossiliferous Permian rocks in Garhwal Himalayas in Lansdown area, (Abstract), *2nd Himalayan Geology Seminar*, Wadia Institute of Himalayan Geology, Delhi.
- CHOPRA, S., GUPTA, V.J., BASSI, U.K. & AHLUWALIA, A.D. 1980. Upper Permian fossils from Tidong valley, Kinnaur district, Himachal Pradesh, India. *Publ. Centr. Advanced Study in Geology*. **12**: 303-305.
- DATTA, R.K. & BHATTACHARYYA, D.P. 1975. Marine fossils from Salooni Formation, Chamba district, Himachal Pradesh. *Geol. Surv. India, Misc. Publ.* **24**(1): 59-64.

- DIENER, C. 1899. Anthracolithic fossils of Kashmir and Spiti. *Pal. Indica Ser.* **15**(1) pt. 2: 1-95.
- DIENER, C. 1905. Notes on an Anthracolithic fauna from the mouth of the Subansiri gorge, Assam. *Rec. Geol. Surv. India* **32**(3): 189-198.
- DIENER, C. 1915. Anthracolithic faunas of Kashmir, Kanaur and Spiti. *Pal. Indica N.S.* **5**(2): 1-135.
- GRANT, R.E. 1970. Brachiopods from Permian-Triassic Boundary beds and age of Chhidru Formation, West Pakistan. In, *Stratigraphic Boundary Problems: Permian and Triassic of West Pakistan*, edited by B. Kummel and C. Teichert, Deptt. of Geology, University of Kansas, Special Publ. **4**: 117-152.
- GUPTA, V.J. 1971. On the age of Kalhel Limestone and associated rocks of the area around Kalhel, Chamba district, Himachal Pradesh. *Sci. and Culture*. **36**(12): 673-674.
- GUPTA, V.J. 1982. Early Permian fossils from the Bijni Tectonic unit, Garhwal Himalaya and their palaeobiogeographic implication. *Bull. Ind. Geol. Assoc.* **15**(2): 89-97.
- GUPTA, V.J. & WATERHOUSE, J.B. 1978a. *Eurydesma* from Lahaul and Ladakh. *Bull. Ind. Geol. Assoc.* **11**(2): 141-152.
- GUPTA, V.J. & WATERHOUSE, J.B. 1978b. Permian invertebrate faunas from the *Lamnimargus himalayensis* Zone of Spiti and Ladakh region, North West India. In *Contribution to Himalayan Geology*, **1** edited by V.J. Gupta, pp. 5-19, Hindustan Publishing Corp., (India), Delhi.
- GUPTA, V.J. & WATERHOUSE, J.B. 1978c. Permian invertebrates faunas from the Ralaking Volcanics, Ladakh Himalaya, India. In *Recent Researches in Geology*, **5**, a collection of papers in honour of Prof. M.R. Sahni, pp. 31-49. Hindustan Publishing Corp., (India), Delhi.
- GUPTA, V.J. & WATERHOUSE, J.B. 1979. Permian fossils from Sikkim and Bhutan. *Bull. Ind. Geol. Assoc.* **12**(2): 253-255.
- IBRAHIM-SHAH, S.M. (Ed.) 1977. Stratigraphy of Pakistan. *Mem. Geol. Surv. Pakistan*. **12**: 1-138.
- KAPOOR, H.M. 1973. On the stratigraphy of Bhadarwah and Bhallesh, Jammu and Kashmir. *J. Pal. Soc. India*. **17**: 55-66.
- KUMMEL B. & TEICHART, C. 1970. Stratigraphy and Palaeontology of the Permian-Triassic boundary beds, Salt Range and Trans-Indus Range, West Pakistan. In, *Stratigraphic Boundary Problems: Permian and Triassic of West Pakistan*, Deptt. of Geology, University of Kansas, Specl. Publ. **4**: 1-110.
- MAMGAIN, V.D. & SASTRY, M.V.A. 1970. New Permian fossil localities from the Niti area of Kumaun Himalaya. *Ind. Min.* **24**(3): 309-311.
- MUIR-WOOD, H.M. & OAKLEY, K.P. 1941. Upper Paleozoic faunas of North Sikkim. *Pal. Indica N.S.* **31**(1): 1-91.
- NAKAZAWA, K., KAPOOR, H.M., ISHI, K., BANDO, Y., OKIMURA, Y. & TOKUKA, T. 1975. The Upper Permian and the Lower Triassic in Kashmir, India. *Mem. Faculty of Science, Kyoto Univ., Series of Geol. and Mineralogy*. **42**(1): 1-106.
- NAKAZAWA, K. & KAPOOR, H.M., (Eds.) 1981. The Upper Permian and Lower Triassic faunas of Kashmir. *Pal. Indica N.S.* **46**: 1-205.
- NANDA, M.M. & SINGH, M.P. 1976. Stratigraphy and Sedimentation of the Zanskar area, Ladakh and adjoining parts of the Lahaul region of Himachal Pradesh. *Him. Geol.* **6**: 367-388.
- RAINA, B.K., AALOK, B.K. & SUNDRAM, R.A. 1975. On the discovery of Permo-Triassic fauna in the Bhallesh area, Bhadarwah Tehsil, Doda district, Jammu and Kashmir. *Geol. Surv. India. Misc. Publ.* **24**: 65-70.
- REED, F.R.C. 1931. New fossils from the *Productus* Limestone of the Salt Range, with notes on the other species. *Pal. Indica N.S.* **17**: 1-56.
- REED, F.R.C. 1932. New fossils from the Agglomeratic Slate of Kashmir. *Pal. Indica N.S.* **20**(1): 1-79.
- REED, F.R.C. 1936. Some fossils from the *Eurydesma* and *Conularia* beds (Punjabian) of the Salt Range. *Pal. Indica N.S.* **23**(1): 1-36.
- REED, F.R.C. 1944. Brachiopoda and Mollusca from the *Productus* Limestone of the Salt Range. *Pal. Indica N.S.* **23**(2): 1-596.
- SAHNI, M.R. & SRIVASTAVA, J.P. 1956. Discovery of *Eurydesma* and *Conularia* in the Eastern Himalaya and description of associated faunas. *J. Pal. Soc. India*. **1**(1): 202-214, 1956.
- SHAH, S.K. & SINHA, A.K. 1974. Stratigraphy and tectonics of the "Tethyan" zone in a part of western Kumaun Himalaya. *Him. Geol.* **4**: 1-27.
- SHANKAR, R., DHAUNDIYAL, J.N. & KAPOOR, H.M. 1973. The age of fossiliferous bed (Boulder Slate Member) of Garhwal Syncline. *J. Pal. Soc. India*. **17**: 50-54.
- SINGH, TRILOCHAN 1973. Note on the Upper Paleozoic fauna from Subansiri district, Arunachal Pradesh. *Him. Geol.* **3**: 401-410.
- SINGH, TRILOCHAN 1978a. A new species of Spiriferoid genus 'Subansiria' from Subansiri district, Arunachal Pradesh. In *Contribution to Himalayan Geology* **1**, edited by V.J. Gupta, Hindustan Publishing Corp. (India), Delhi: 162-164.
- SINGH, TRILOCHAN 1978b. Brachiopods from Permian Formation of Siang district, Arunachal Pradesh, in *Contribution to Himalayan Geology*, **1**, edited by V.J. Gupta, pp. 171-188, Hindustan Publishing Corp. (India), Delhi.
- SINGH, TRILOCHAN 1987. Permian biogeography of the Indian subcontinent with special reference to the marine fauna, *Gondwana Six: Stratigraphy, Sedimentology, and Palaeontology*. *Geophysical Monograph*, American Geophysical Union **41**: 239-249.
- SRIKANTIA, S.V., BHARGAVA, O.N. & KAPOOR, H.M.: 1978a. A note on the occurrence of *Eurydesma* and *Deltopecten* assemblage from the Kuling Formation (Permian), Baralacha Ban area, Lahaul Valley, Himachal Himalaya. *J. Geol. Soc. India* **19**(2): 73-78.
- SRIKANTIA, S.V., GANESAN, T.M., RAO, R.N., SINHA, P.K. & TIRKEY, B. 1978b. Geology of Zanskar area, Ladakh Himalaya. *Him. Geol.* **8**(11): 1009-1033.
- VALDIYA, K.S. & GUPTA, V.J. 1972. A contribution to the Geology of North Eastern Kumaun with special reference to the Hercynian gap in Tethys Himalaya. *Him. Geol.* **2**: 1-33.
- WAAGEN, W. 1882-1885. Salt Range Fossils, I. *Productus*-Limestone Fossils, *Pal. Indica*, Ser. **13**, pt. 4 (fasc. 1) Brachiopoda, pp. 329-390, 1882; pt. 4 (fasc. 2) Brachiopods, pp. 391-546, 1883; pt. 4 (fasc. 3) Brachiopoda, pp. 547-610, 1884; pt. 4 (fasc. 4) Brachiopoda, pp. 611-728, 1884; pt. 4 (fasc. 5) Brachiopoda, pp. 729-770, 1885.
- WATERHOUSE, J.B. 1966. Lower Carboniferous and Upper Permian brachiopod from Nepal. *Jb. Geol. B.-A.* **12**: 5-99.
- WATERHOUSE, J.B. 1976. The Permian rocks and faunas of Dolpo, Northwest Nepal. *Colloq. Intern. du Centre de la Resh. Sci.*, **268**, CNRS, Ecologie de Geologie de l'Himalaya: 479-497.
- WATERHOUSE, J.B. 1978. Permian brachiopoda and Mollusca

from Nepal. *Palaeontographica* **A160**: 1-178.
 WATERHOUSE, J.B. & BONHAM-CARTER, G.F. 1975. Global distribution and character of Permian biomes based on brachiopod assemblages. *Canadian J. Earth Sci.* **12**(7): 1085-1146.
 WATERHOUSE, J.B. & GUPTA, V.J. 1978. Early Permian fossils from the Bijni Tectonic unit, Garhwal Himalaya. In *Recent Researches in Geology*, **4**, a collection of papers in honour of Prof. G.W. Chiplonkar, Hindustan Publishing Corp. (India) Delhi : 410-437.

WATERHOUSE, J.B. & GUPTA, V.J. 1982. Palaeoecology and evolution of the Permian bivalve genus *Eurydesma* Morris. *Bull. Ind. Geol. Assoc.* **15**(1): 1-20.
 WATERHOUSE, J.B. & GUPTA, V.J. 1983. An early Djuflian (Permian) brachiopod faunale from Upper Shyok valley, Karakorum Range, and the implications for dating of allied faunas from Iran and Pakistan. In *Contribution to Himalayan Geology*, **2**, edited by V.J. Gupta, Hindustan Publishing Corp., (India), Delhi : 234-245.

Appendix - 1 : Brachiopod Fauna of the Himalayan Localities

LOCALITY	AUTHORS	GROUP/ FORMATION	AGE	BRACHIOPOD FAUNA
I. SALT RANGE	Waagen (1882-85), Reed (1931, 1936, 1944), Kummel and Teichert (1970), Grant (1970), Waterhouse and Gupta (1983)	Chhidru Formation	Late	<i>Orthis</i> , <i>Aulosteges</i> , <i>Callispirina</i> , <i>Chonetella</i> , <i>Cleiothyridina</i> , <i>Derbyia</i> , <i>Enteletes</i> , <i>Hemiptychina</i> , <i>Hustedia</i> , <i>Kiangsiella</i> , <i>Lyttonia</i> , <i>Martinia</i> , <i>Neospirifer</i> , <i>Orthotichia</i> , <i>Notothyris</i> , <i>Richthofenia</i> , <i>Spiriferella</i> , <i>Mentzelia</i> , <i>Waagenoconcha</i> , <i>Spirigerella</i> , <i>Spiriferina</i> , <i>Whitspakia</i> , <i>Meekella</i> , <i>Athyris</i> , <i>Ruthenia</i> , <i>Linoproductus</i> , <i>Strophalosia</i> , <i>Chonetes</i> , <i>Chonetinella</i> , <i>Oldhaminia</i> , <i>Streptorhynchus</i> , <i>Dictyoclostus</i> , <i>Buxtonia</i> , <i>Cancrinella</i> , <i>Marginifera</i> , <i>Uncinunellina</i> , <i>Uncinella</i> , <i>Camarophorina</i> , <i>Dielasma</i> , <i>Eliivina</i> , <i>Purdonella</i> , <i>Spiriferellina</i> , <i>Pugnax</i> , <i>Juresania</i> , <i>Haydenella</i> , <i>Chonetina</i> , <i>Lissochonetes</i> , <i>Rhynchophora</i> , <i>Dielasmina</i> .
		Wargal Formation	Permian	
		Amb Formation	Early	
		Sardi Formation	Permian	
II. ZANSKAR	Nanda and Singh (1976), Srikantia <i>et al.</i> (1978b), Gupta and Waterhouse (1978c)	Warchha Formation	Early	<i>Orthis</i> , <i>Orthotichia</i> , <i>Derbyia</i> , <i>Dictyoclostus</i> , <i>Marginifera</i> , <i>Neospirifer</i> , <i>Strophalosia</i> , <i>Dielasma</i> , <i>Chonetes</i> , <i>Notothyris</i> , <i>Martiniopsis</i> , <i>Athyris</i> , <i>Spirifer</i> , <i>Discina</i> , <i>Streptorhynchus</i> , <i>Aulosteges</i> , <i>Rhynchophora</i> , <i>Dielasmina</i> , <i>Hemiptychina</i> , <i>Hustedia</i> , <i>Uncinella</i> , <i>Spiriferella</i> , <i>Martinia</i> , <i>Paeckelmanella</i> , <i>Mentzelia</i> , <i>Spiriferellina</i> , <i>Cleiothyridina</i> , <i>Spirigerella</i> , <i>Pugnax</i>
		Dandot Formation	Permian	
III. LAHAUL AND SPITI	Diener (1899, 1915), Srikantia <i>et al.</i> (1978a), Gupta & Waterhouse (1978a, b)	Tobra Formation	Early	<i>Lamnimargus</i> , <i>Spiriferella</i> , <i>Spiriferellina</i> , <i>Neospirifer</i> , <i>Camerotoechia</i> , <i>Athyrus</i> . ? <i>Derbyia</i> , <i>Kiangsiella</i> , <i>Juresania</i> , <i>Refimargomtfera</i> , ? <i>Reticulatia</i> , <i>Cleiothyridina</i> , <i>Linoproductus</i> , <i>Spirifer</i> , <i>Spiriferella</i> , <i>Chonetes</i> , <i>Marginifera</i>
		Sarchu Limestone	Late Permian	
IV. KASHMIR	Diener (1915), Bion & Middlemiss (1928), Reed (1932), Nakazawa <i>et al.</i> (1975), Nakazawa & Kapoor (1981).	Ralukung Volcanic Succession	Early Permian	<i>Marginifera</i> , <i>Chonetes</i> , <i>Lamnimargus</i> , <i>Anidanthus</i> , <i>Spiriferella</i> , <i>Productus</i> , <i>Cleiothyridina</i> , <i>Neospirifer</i> <i>Neospirifer</i> , <i>Cleiothyridina</i> , <i>Dielasma</i> , <i>Kiangsiella</i> , <i>Streptorhynchus</i> , <i>Aulosteges</i>
		Kuling Formation	Late Permian	
V. BHADAR- WAH BHALLE- SH- CHAMBA	Gupta (1971), Kapoor (1973), Raina <i>et al.</i> (1975), Datta & Bhattacharyya (1975)	Zewan Formation	Late Permian	<i>Schellwienella</i> , <i>Derbyia</i> , <i>Chonetina</i> , <i>Lissochonetes</i> , <i>Marginifera</i> , <i>Pustulla</i> , <i>Waagenoconcha</i> , <i>Costiferina</i> . <i>Linoproductus</i> , <i>Athyris</i> , <i>Cleiothyridina</i> , <i>Neospirifer</i> . <i>Dielasma</i> , <i>Wellerella</i> , <i>Ruthenia</i> , <i>Spingerella</i> , <i>Camarophorina</i> . <i>Lyttonia</i> , <i>Dictyoclostus</i> , <i>Haydenella</i> , <i>Hemiptychina</i> , <i>Spiriferellina</i> <i>Stepanoviella</i> , <i>Taeniotherus</i> , <i>Buxtonia</i> , <i>Neospirifer</i> , <i>Ambikella</i> , <i>Wyndhamia</i> , <i>Spiriferella</i> , <i>Cyrtella</i> , <i>Trigonotreta</i> , <i>Fusispirifer</i> , <i>Streptorhynchus</i> , <i>Syringothyris</i> , <i>Martiniopsis</i> , <i>Reticularia</i> , <i>Cancrinella</i> , <i>Strophalosia</i> , <i>Fusella</i> , <i>Brachythyris</i>
		Pyroclastic Division and Diamictite Division	Early Permian	
		Talai Formation	Late Permian	<i>Lissochonetes</i> , <i>Marginifera</i> , <i>Spiriferella</i> , <i>Spiriferina</i>

LOCALITY	AUTHORS	GROUP/ FORMATION	AGE	BRACHIOPOD FAUNA
		Tramawala Formation	Early Permian	<i>Ambikella</i> , <i>Cleiothyridina</i> , <i>Derbyia</i> , <i>Dictyoclostus</i> , <i>Fusispirifer</i> , <i>Lissochonetes</i> , <i>Neospirifer</i> , <i>Pseuoosyrinx</i> , <i>Streptorhynchus</i> , <i>Taeniothaerus</i> , <i>Trigonotreta</i> , <i>Marginifera</i> , <i>Schellwienella</i>
VI. KINNAUR (TIDONG VALLEY)	Chopra <i>et al.</i> (1980)		Late Permian	<i>Spiriferella</i> , <i>Costiferina</i> , <i>Lamnimargus</i> , <i>Waagenoconcha</i> , <i>Cleiothyridine</i> , <i>Dielasmatids</i> , <i>Neospirifer</i> .
VII. GARHWAL LESSER HIMALAYA	Chaturvedi & Talent (1972), Shankar <i>et al.</i> (1973), Waterhouse & Gupta (1978, 1982), Gupta (1982)	Boulder Slate Sequence	Early Permian	<i>Spirifer</i> , <i>Neospirifer</i> , <i>Eomarginifera</i> , <i>Pseudomarginifera</i> , <i>Linoproductus</i> , <i>Dictyoclostus</i> , <i>Derbyia</i> , <i>Wyndhamia</i> , <i>Lissochonetes</i> , <i>Cancrinella</i> , ? <i>Anidanthus</i> , <i>Brachythyridina</i> , <i>Cleiothyridina</i> , <i>Strophalosia</i> , <i>Streptorhynchus</i> . <i>Waagenoconchu</i> . <i>Chonetes</i> .
VIII. KUMAUN TETHYS HIMALAYA	Mamgain and Sastry (1971), Valdiya and Gupta (1972), Shah & Sinha (1974)	Kuling Shale Formation	Late Permian	<i>Paramarginifera</i> , <i>Spiriferella</i> , <i>Linoproductus</i> , <i>Chonetes</i> . <i>Dielasma</i> , <i>Waagenoconcha</i> , <i>Cleiothyridina</i> , <i>Spirigerella</i> , <i>Marginifera</i> , <i>Costiferina</i> , <i>Strophalosia</i> , <i>Lyttonia</i> , <i>Productus</i> , <i>Martinia</i> , <i>Neospirifer</i> , <i>Ruthenia</i>
IX. NEPAL TETHYS HIMALAYA	Waterhouse (1966, 1976a, 1978)	Senja Formation And Nangung Formation	Late Permian	<i>Aulostegid</i> , <i>Krotovia</i> , <i>Dictyoclostus</i> , <i>Canerinella</i> , <i>Terrakea</i> , <i>Cleiothyridina</i> <i>Suleirugaria</i> , <i>Echinalosia</i> , <i>Lialosia</i> , <i>Paucispinauria</i> , <i>Spiriferella</i> , <i>Martiniopsis</i> , <i>Reticularina</i> , <i>Callispirina</i> , <i>Hoskingia</i> , <i>Megasteges</i> , <i>Platyconcha</i> , <i>Orthotichia</i> , ? <i>Arctitreta</i> , <i>Sulcataria</i> , <i>Chonetinella</i> , <i>Strophalosia</i> , <i>Waagenoconcha</i> , <i>Marginifera</i> , ? <i>Echinauris</i> , <i>Lamnimargus</i> , <i>Reticulatia</i> , <i>Costiferina</i> , <i>Cancrinella</i> , <i>Uncinunellina</i> , <i>Stenoscisma</i> , <i>Neospirifer</i> , <i>Pteroplecta</i> , <i>Ambikella</i> , <i>Spiriferellina</i> , <i>Rhynchophora</i> , <i>Dielasmina</i>
X. NORTH SIKKIM	Muirwood & Oakley (1941), Gupta and Waterhouse (1979)	Lachi Series	Late Permian	<i>Dictyoclostus</i> , <i>Linoproductus</i> , <i>Marginifera</i> , <i>Waagenoconcha</i> , <i>Uncinunellina</i> , <i>Spiriferella</i> , <i>Syringothyris</i> , <i>Architreta</i> , <i>Suleataria</i> , <i>Cleiothyridina</i> , <i>Syringothyridina</i> , <i>Fusispirifer</i> , <i>Neospirifer</i> , <i>Pustella</i> , <i>Chonetes</i> , <i>Camarotoechia</i> .
XI. SOUTH SIKKIM	Sahni and Srivastava (1956)		Early Permian	<i>Neospirifer</i> , <i>Productus</i> , <i>Ambikella</i> , <i>Spirifer</i> , <i>Syringothyris</i> , <i>Cyrtella</i>
XII. BHUTAN (BLACK MOUN- TAIN AREA)	Gupta and Waterhouse (1979)		Late Permian	<i>Linoproductus</i> , <i>Stenoscisma</i> , <i>Lamnimargus</i> , <i>Anidanthus</i> . <i>Leptodus</i> , <i>Spiriferella</i> , <i>Neospirifer</i>
XIII. ARUNA- CHAL PRADESH	Diener (1905), Sahni & Srivastava (1956), Singh (1973, 1978a, b)	Garu Formation	Early Permian	<i>Chonetes</i> , <i>Lissochonetes</i> , <i>Linoproductus</i> , <i>Subansiria</i> , <i>Neospirifer</i> , <i>Ambikella</i> , <i>Martinia</i> , <i>Productus</i> , <i>Spirifer</i> , <i>Spiriferina</i> , <i>Reticularia</i> , <i>Dielasma</i> , <i>Syringothyris</i>