

LOWER CAMBRIAN BODY-AND TRACE-FOSSILS FROM THE TAL FORMATION, GARHWAL SYNFORM, UTTAR PRADESH, INDIA

GOPENDRA KUMAR, B. K. RAINA, D. K. BHATT¹ AND B. S. JANGPANGI

HIMALAYAN GEOLOGY DIVISION, GEOLOGICAL SURVEY OF INDIA, LUCKNOW 226 006.

¹PALAEOONTOLOGY AND STRATIGRAPHY DIVISION, GEOLOGICAL SURVEY OF INDIA, CALCUTTA 700 016.

ABSTRACT

The fauna consisting of brachiopod, *Diandongia* cf. *D. pista* and gastropod, *Pelagiella*, along with hyolithids and poriferids, and a trace fossil *Taphrhelminthopsis* cf. *T. circularis*, are recorded respectively from the Calcareous and Arenaceous Members of the Tal Formation in Garhwal Synform in the Ganga Valley near Kauriyala, Uttar Pradesh, India. These body fossils suggest Atdabanian age (Lower Cambrian) to the Calcareous Member.

The present record of the fauna and the earlier record of Tommotian small shelly fossils from the basal Chert-Phosphorite Member suggest Early Cambrian age to the lower part of the Tal Formation.

INTRODUCTION

Under the aegis of the International Geological Correlation Programme (I. G. C. P.) Project-29, Precambrian-Cambrian boundary, one of the authors (Kumar, 1983) noticed a close lithological similarity of the Blaini, Krol, and Tal succession of Lesser Himalaya with that of Late Precambrian (Sinian)-Early Cambrian the Lientuo-Nantuo, Wangjiawan-Donglongtan-Yuchucun, and Chiungchussu (Jiulaodong) Formations of China examined by him (I. G. C. P. Project 29 excursions to China during October-November, 1982). The Tal Formation in India and the Chiungchussu Formation in China both show development of phosphorite.

The Blaini-Krol-Tal succession is traditionally considered upper Palaeozoic to Mesozoic in age (Auden, 1934); though Gundu Rao (1970) recorded Precambrian oncolites from Krol and Singh (1976) proposed a Precambrian age for the same on palaeoecological considerations, and considered Tal succession to represent deposits of Late Precambrian near Precambrian-Cambrian transition (Singh, 1979).

The worldwide phosphatization during Early Cambrian, and the record of microfauna from the Chert-Phosphorite Member of Tal Formation (Azmi *et al.*, 1981) containing faunal elements found in Lower Cambrian of Siberian Platform and Lesser Karatan (Kasakhtan,) U. S. S. R. (Prof. V. V. Krashennikov in Azmi *et al.*, 1981) led the authors (GK, BKR and BSJ) to re-examine the well-exposed section of Tal Formation near Kauriyala in Ganga Valley, Tehri Garhwal district, Uttar Pradesh, India, in June, 1983 (Fig. 1). This re-examination resulted in the find of brachiopod and gastropod

fauna, besides some hyolithids and poriferids, from the Calcareous Member and a trace-fossil from the Arenaceous Member (Fig. 2) forming the lower part of Tal Formation (Shanker, 1971). The body-and trace-fossils thus recovered are described in the paper. The fossil specimens have been stored with the Palaeontology and Stratigraphy Division, Geological Survey of India, Calcutta bearing G. S. I. Type No. 19831 to 19835.

SYSTEMATIC DESCRIPTION

(i) Brachiopoda

<i>Phylum</i>	Inarticulata HUXLEY, 1869
<i>Order</i>	Acrotretida KUHN, 1949
<i>Superfamily</i>	Acrotretacea SCHUCHERT 1893
<i>Genus</i>	<i>Diandongia</i> RONG 1974

Diandongia cf. *D. pista* RONG 1974
(Pl. I—1, 2)

Material : 3 specimens, poorly preserved

Description : The shell is moderately convex, circular to oblong with faint concentric growth lines and central prominent beak.

Measurements :

	Length	Height	Specimen No.
(i)	10 mm	8 mm	
(ii)	10 mm	8 mm	19831
(iii)	8 mm	6 mm	

Remarks : The present specimen resembles with the *Diandongia pista* Rong recorded from the *Eoredlichia-Wutin-gaspis-Mianxiandiscus* zone of Lower Cambrian Quong-

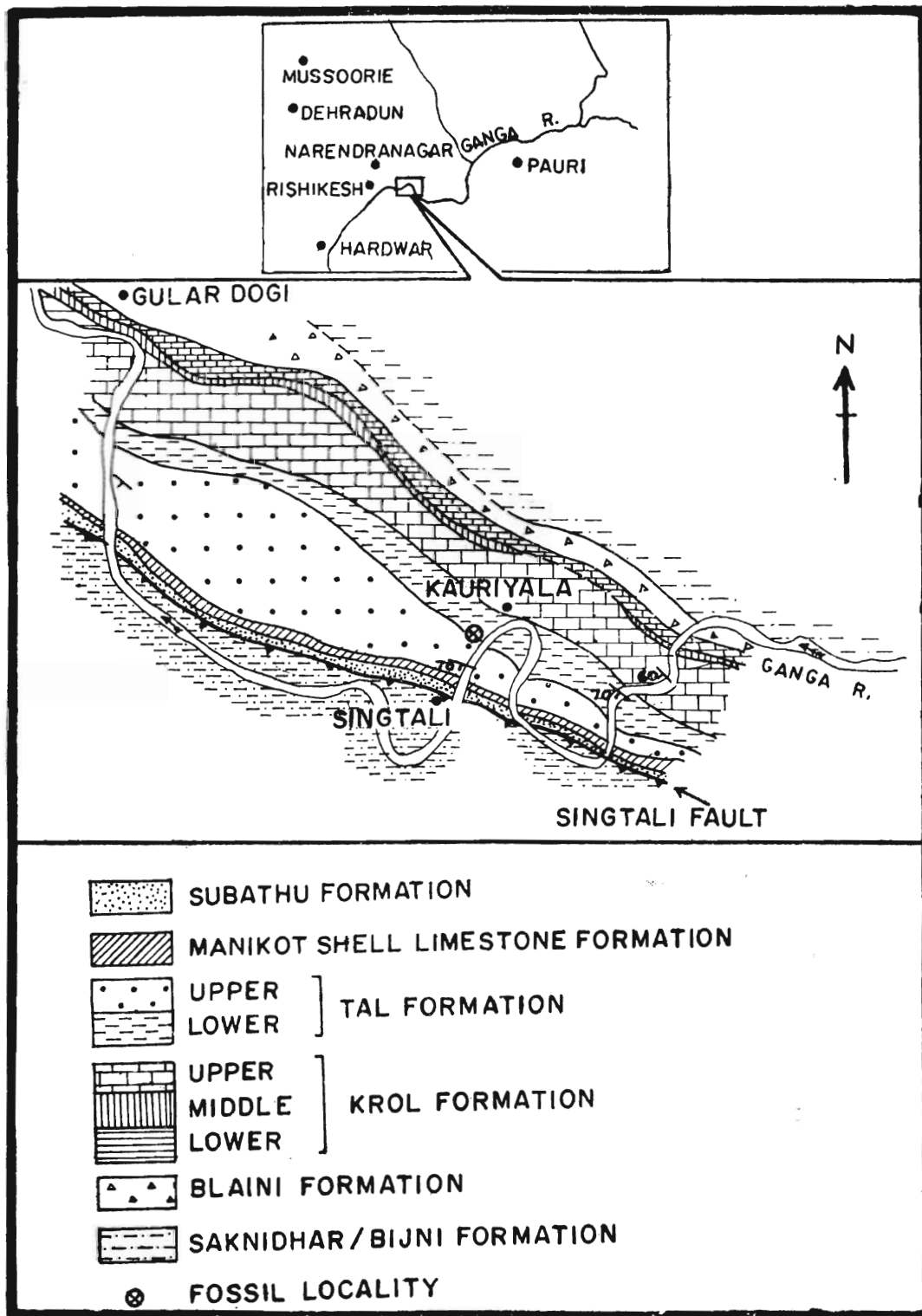


Fig. 1. Location and sketch geological map of a part of the Garhwal Synform, Ganga Valley, Uttar Pradesh showing fossil locality.

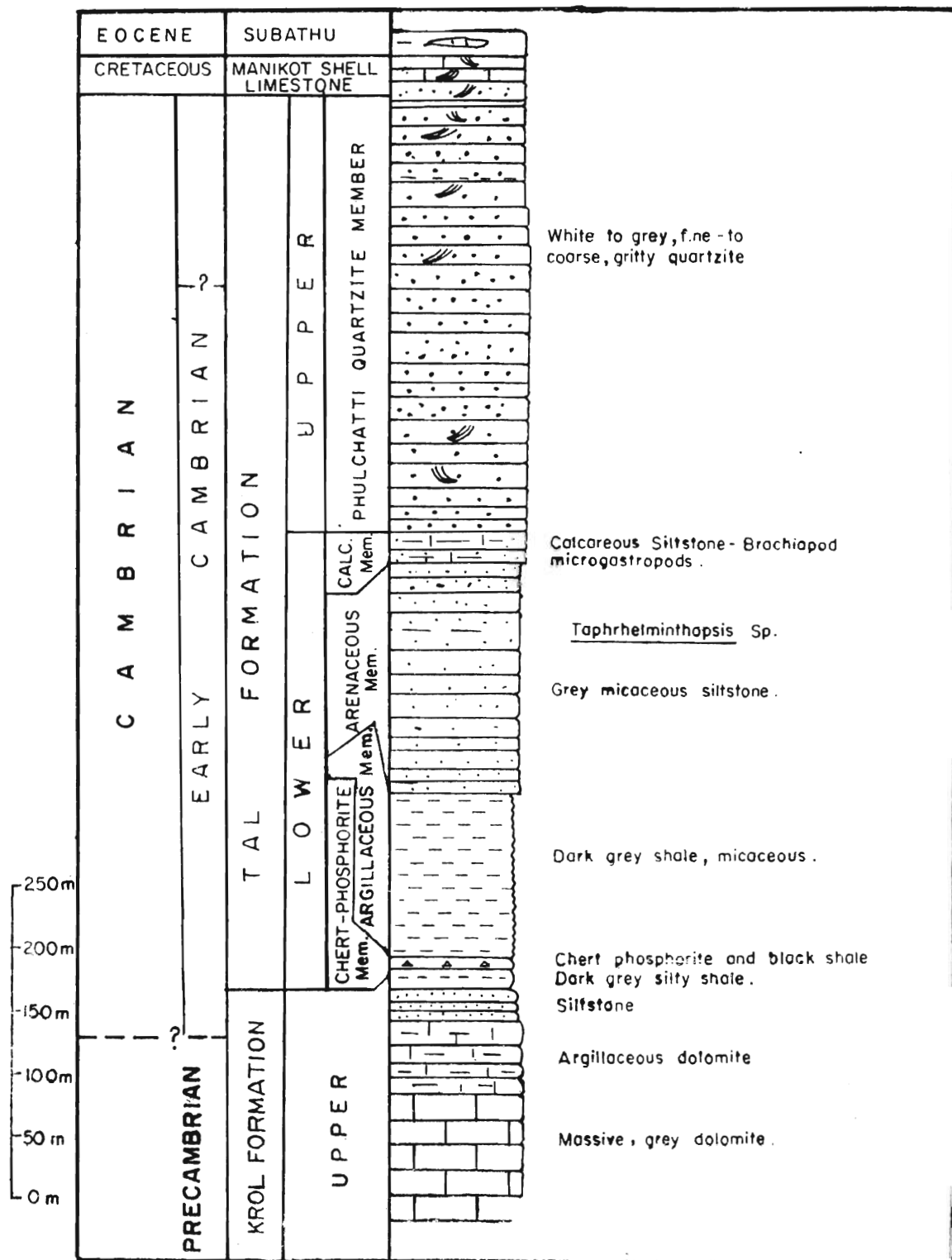


Fig. 2. Lithocolumn of the Tal Formation, Garhwal Synform, Ganga Valley, Uttar Pradesh showing distribution of trace fossil and body fossils. The Precambrian-Cambrian boundary is tentative. Rai and Singh (1983) have placed the boundary in topmost part of Upper Krol (Krol E).

zhusi (=Atdabanian) Stage in Schuwang Province, China (Jicheng *et al.*, 1980, & Liwen *et al.*, 1981).

(ii) Gastropoda

<i>Superfamily</i>	Pelagiellacea KNIGHT, 1956
<i>Family</i>	Pelagiellidae KNIGHT, 1956
<i>Genus</i>	<i>Pelagiella</i> MATTHEW, 1895

Pelagiella sp.
(Pl. I—3-5)

Material: Several specimens, well preserved in shale laminae in grey calcareous siltstone.

Description: The shell is dextrally coiled, 1 to 1.5 whorls, rotelliform above and umbilicate below with rounded periphery, and smooth surface above and sinuous ridges below.

Measurements:

Diametre	Specimen No.
(i) 1.5 mm	Slide No. 19832
(ii) 1.25 mm	Slide No. 19833
(iii) 1 mm	Slide No. 19834

Remarks: The genus *Pelagiella* is restricted to Cambrian. It appears in the Atdabanian Stage of Lower Cambrian, and is known from the *Strenuella* Limestone of Gornly, England (in Matthew and Missarzhevsky, 1975,) the lower reaches of Lena river (Missarzhevsky in Raaben, 1969) and Maidiping area Schuwang Province, China.

(iii) Trace fossil

<i>Ichnogenus</i>	<i>Taphrhelminthopsis</i> SAGGO, 1888
	<i>Taphrhelminthopsis</i> cf. <i>T. circularis</i> CRIMES, LEGG, MARCOS & ARBOLEYA, 1977
	(Pl I—6)

Material: Examined *in situ* on the bedding surface of grey siltstone

Description: It occurs as irregularly criss-crossing meandering bilobate trail with a prominent deep median furrow. The traces are 2 cm wide and 3-4 mm deep with rounded lobes.

Remarks: The present specimen resembles with *Taphrhelminthopsis circularis* described from Lower Cambrian of Spain (Crimes, Legg, Marcos & Arboleya, 1977) though the circling is mostly not complete. In India, the *Taphrhelminthopsis circularis* is reported from the Cambrian sediments of Kashmir (Bhargava and Srikantia, 1982). It is considered to be a trace made by gastropod.

DISCUSSION

The *Diandongia-Pelagiella* association, along with hyolithids and poriferids, is indicative of Atdabanian age

for Calcareous Member of Tal Formation. The *Diandongia pista* occurs in association with *Pelagiella emeishanensis* and earliest trilobites in the Qiongzhusi (=Atdabanian) Stage in the Schuwang Province, China (Jicheng *et al.*, 1980 and Liwen *et al.*, 1981), while *Pelagiella* is also found in Europe (U. S. S. R. and England) along with the oldest trilobites in the Atdabanian Stage (Matthew and Missarzhevsky, 1975). Although the trilobite body fossils make their appearance in the Atdabanian Stage, the same are not recorded so far from the present area. It is significant that from the underlying Arenaceous Member, which encloses trace fossil *Taphrhelminthopsis* cf. *T. circularis* in the present section, rich and diversified trace fossils of trilobite affinity with abundant *Skolithos* (Singh and Rai, 1983) and *Aulichnites* (Banerjee and Narain, 1976) are recorded from the Mussoorie Synform. In the Higher Himalaya (Tethyan realm) such varied type of trilobite tracks and other diversified trace fossils have been recorded from the sediments underlying the Lower Cambrian horizon containing trilobite—*Redlichia noellingeri*, and brachiopods in the Lolab Valley (Raina *et al.*, 1983, and Shah and Sudan, 1983), in association with low lower Cambrian trace fossil—*Astroplithon*, in the Liddar Valley, Kashmir (Kumar *et al.*, *in press*), and ? Lower Cambrian-Middle Cambrian trilobites and brachiopods in the Spiti Valley, Himachal Pradesh (Bhargava *et al.*, 1982). However, in these areas no fossil record is available in sediments below the trace fossil horizons to fix the lower age limit, but in the present area of Lesser Himalaya, the record of small shelly fossils of Tommotian age from the underlying Chert-Phosphorite Member of Tal Formation (Krashennikov in Azmi *et al.*, 1981 and Bhatt *et al.*, 1983) clearly suggests that the diversified trace fossils of trilobite appear between the fossiliferous Tommotian horizon below and the Atdabanian horizon above. However, such diversification in trace fossils has been noticed elsewhere in the world only in the Tommotian Stage, slightly above the Precambrian-Cambrian boundary but below the Atdabanian Stage (vide discussions of G K with Dr. T. P. Crimes, Liverpool University, England during I. G. C. P. Project 29 Excursions, China, 1982). In view of this, the Arenaceous Member bearing the trace fossils can be referred to late Tommotian for the present.

A late Tommotian age for the Arenaceous Member is further supported by the record of early Tommotian small shelly microfossils and hyolithids from the underlying chert-Phosphorite Member (Bhatt *et al.*, 1983). A late Tommotian-Atdabanian age has been proposed by Singh and Rai (1983) for the trace fossil bearing Arenaceous Member of Mussoorie Syncline.

In view of continuous succession in the lower part of the Tal Formation from Chert-Phosphorite Member yielding Tommotian small shelly fossils to Calcareous

Member enclosing body fossils suggestive of Atdabanian age, the Cambro-Ordovician age assigned to the Chert-Phosphorite Member, and? Silurian-? Devonian age to Arenaceous-Quartzite Members (Phulchatti Quartzite, Kumar and Dhaundiyal, 1979) by Azmi *et al.* (1981), Azmi and Joshi (1983) and Azmi (1983) cannot be accepted.

CONCLUSION

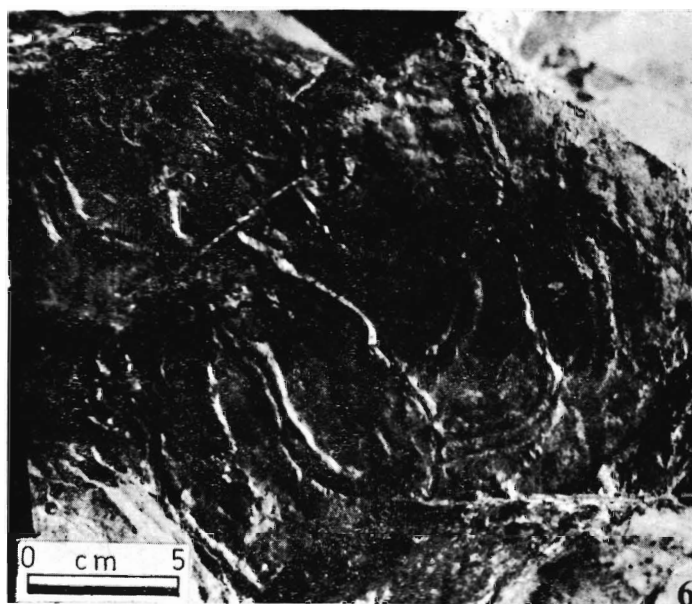
The present find of brachiopod and gastropod suggests an Atdabanian age to the Calcareous Member of Tal Formation. The earlier record of small shelly fossils from Chert-Phosphorite Member is indicative of Tommotian age. It, therefore, establishes that the lower part of Tal Formation ('Lower Tal Formation', Shanker, 1971) is of an Early Cambrian age.

ACKNOWLEDGEMENT

The authors are indebted to Mr. C. Tripathi, Deputy Director General, Northern Region, Geological Survey of India, Lucknow for his valuable suggestions and encouragement during the course of work. They are grateful to Dr. I. B. Singh, Department of Geology, Lucknow University, for discussions.

REFERENCES

- AUDEN, J. B. 1934. The Geology of the Krol Belt. *Rec. Geol. Surv. India*. **67**(4) : 357-454.
- AZMI, R. J. 1983. Microfauna and age of the Lower Tal phosphorite of Mussoorie Syncline, Garhwal. *Him. Geol.* **11** : 375-409.
- AZMI, R. J. AND JOSHI, M. N. 1983. Conodonts and other biostratigraphic evidence on the age and evolution of the Krol belt. *Him. Geol.* **11** : 198-223.
- AZMI, R. J., JOSHI, M. N. AND JUYAL, K. P. 1981. Discovery of the Cambro-Ordovician conodonts from the Mussoorie Tal Phosphorite : its significance in correlation of the Lesser Himalaya. (ed. A. K. Sinha) In *Contemp. Geosci. Res. Himalaya*, **1**: 245-250. Bishan Singh Mahendra Pal Singh, Dehradun.
- BANERJEE, D. M. AND NARAIN, M. J. 1976. Trace fossils in the Lower Tal Formation of Mussoorie and their environmental significance. *Jour. Sed. Petrol.* **46** : 234-239.
- BHARGAVA, O. N., KUMAR GOPENDRA AND GUPTA, S. S. 1982. Late Lower to Early Middle Cambrian trace-fossils, Spiti Valley, Himachal Himalaya. *Jour. Geol. Soc. Ind.* **23**(4) : 183-191.
- BHARGAVA, O. N. AND SRIKANTHA, S. V. 1982. *Taphrohelminthopsis circularis* from ? Cambrian sediments of Southeast Kashmir Valley. *Jour. Geol. Soc. Ind.* **23**(8) : 406-407.
- BHATT, D. K., MAMGAIN, V. D., MISRA, R. S. AND SRIVASTAVA, J. P. 1983. Shelly microfossils of Tommotian age (Lower Cambrian) from the Chert-Phosphorite Member of Lower Tal Formation, Maldeota, Dehradun district, Uttar Pradesh. *Geophytology*. **13**(1) : 116-123.
- CRIMES, T. P., LEGG, I., MARCOS, A. AND ARBOLEYA, M. 1977. ? Late Precambrian-Low Lower Cambrian trace fossils from Spain. *Trace Fossil 2* (ed. Crimes, T. P. and Harper, J. C.), *Geol. Jour. Special issue*. **9** : 91-138.
- GUNDU RAO, C. 1970. A note on 'oolites' in the Krol series and their age significance. *Pub. Centre of Adv. study in Geology, Panjab University, Chandigarh*. **7** : 127-129.
- JICHENG, Yin, LIANFANG DING, TINGGUY HUI, SHILIN LI, LIJUAN SHEN, 1980. The Palaeontology and sedimentary environment of the Sinian System in Emei-Ganluo area, Sichuan, People Republic of China (in Chinese).
- KUMAR, GOPENDRA 1983. Report on the I. G. C. P. Project 29 (Precambrian-Cambrian boundary) Field Conference and Symposium, China, 1982. *Geol. Surv. India* (Unpublished).
- KUMAR, GOPENDRA AND DHAUNDIYAL, J. N. 1979. Stratigraphy and structure of Garhwal Synform, Garhwal and Tehri Garhwal districts, Uttar Pradesh : A reappraisal. *Him. Geol.* **9**(1) : 18-41.
- KUMAR, GOPENDRA, RAINA, B. K., BHARGAVA, O. N., MAITHY, P. K. AND BABU, RUPENDRA *In Press*. The Precambrian-Cambrian boundary in parts of Northwest Himalaya, India. *Geol. Mag.* **21**.
- LIWEN XIANG, SHANJI, LI, RUNSHAW NAW, GUA ZHENMIOG, YANG JIALU, ZHOU GUOQIANG, AN TAIKIANG, YUAN KEXING AND QIAN YI. 1981. *The Cambrian system of China. Stratigraphy of China*, No. 4. Geol. Publishing House, Beijing, China (in Chinese).
- MATTHEW, S. C. AND MISHARZHEVSKY, V. V. 1975. Small shelly fossils of Late Precambrian and Early Cambrian age: a review of recent work. *Jour. Geol. Soc. London*. **131** : 289-304.
- RAABEN, M. E. 1969. *The Tommotian Stage and the Cambrian Lower Boundary Problem*, Amerind Publishing Co. Pvt. Ltd., New Delhi (English translation of 1981).
- RAI, VIBHUTI AND SINGH, I. B. 1983. Biological aspects of sedimentation in Upper Krol Carbonate, Mussoorie Hills, Uttar Pradesh. In: *Carbonate Rocks of Himalaya, Symp. Ind. Geologists' Assoc. Chandigarh*, 24-25 October, 1983 (Abstract).
- RAINA, B. K., KUMAR, G., BHARGAVA, O. N. AND SHARMA, V. P. 1983. Precambrian-low Lower Cambrian ichnofossils from the Lolab Valley, Kashmir Himalaya, India. *Jour. Pal. Soc. India* **28** : 194-202.
- SHAH, S. K. AND SUDAN, C. S. 1983. Trace fossils from the Cambrian of Kashmir and their stratigraphic significance. *Jour. Geol. Soc. India*. **24**(4) : 194-202.
- SHANKER, RAVI, 1971. Stratigraphy and sedimentation of Tal Formation Mussoorie Syncline, U. P. *Jour. Pal. Soc. India*. **16** : 1-15.
- SINGH, I. B. 1983. Evolution of Himalayas in the light of marine transgressions in the Peninsular and Extra-Peninsular India. *Proc. 125th Ann. Celebr. Geol. Surv. Ind. Lucknow Symp. Lucknow*. (Abstract).
- SINGH, I. B. 1979. Comment on 'Environment and age of the Tal Formation of Mussoorie and Nilkanth areas of Garhwal Himalaya' by I. B. Singh, *Jour. Geol. Soc. Ind.* **20**(5) : 214-225. Author's reply. *Jour. Geol. Soc. Ind.* **20**(12) : 620-622.
- SINGH, I. B. AND RAI, VIBHUTI, 1983. Fauna and Biogenic structures in Krol-Tal succession (Vendian—Early Cambrian), Lesser Himalaya : their biostratigraphic and palaeoecological significance. *Jour. Palaeont. Soc. India*. **28** : 67-92.



EXPLANATION OF PLATE

PLATE I

Body-and trace-fossils from the Calcareous and Arenaceous Members of the Tal Formation, Ganga Valley, Garhwal Synform, Uttar Pradesh, India.

1. *Diandongia* cf. *D. pista* Rong \times 1.8. Calcareous Member of the Tal Formation (Specimen No. 19831).
2. *Diandongia* cf. *D. pista* Rong \times 6 showing faint concentric ornamentation. Calcareous Member of the Tal Formation (Specimen No. 19831).
3. *Pelagiella* sp. \times 23, top view. Calcareous Member of the Tal Formation (Specimen No. 19832).
4. *Pelagiella* sp. \times 35, side view. Horizon same as for (3) (Specimen No. 19833).
5. *Pelagieflo* sp. \times 23, top view. Horizon same as for (3) (Specimen No. 19834).
6. *Taphrhelminthopsis* cf. *T. circularis* Grimes, Legg, Marcos & Arboleya showing freely winding nature of the trail. Field photograph. (Geol. specimen No. 19835).