the metavolcanic unit stratigraphically overlies the 'BLTGC'.

Correlation and age.—The 'BLTGC' is unlike any known petrologic and chronostratigraphic unit in the area for the following reasons: The oldest granitic rocks of the region, namely, the various phases of the 2700 million year old Giants Range batholith[1] are practically undeformed rocks, and post-date the mafic metavolcanic succession that overlies the 'BLTGC'. A correlation of the 'BLTGC' with the two tonalitic components of the Giants Range batholith[1] is also not possible because detailed geochemical studies of rubidium, strontium, barium, lead, zinc, and niobium distributions in the Giants Range tonalitic rocks show that they formed by anatexis of volcanogenic metasedimentary rocks. A consideration of these aspects when viewed against the lower metamorphic grade of the post-'BLTGC' mafic metavolcanic rocks (greenschist facies), relative to the higher metamorphic grade of the 'BLTGC' (amphibolite facies), suggests that the 'BLTGC' represents a metamorphosed granitic intrusive sequence that pre-dates the intrusive 2700 million year old granitic rocks of the Giants Range batholith.

The 'BLTGC' as a remnant primordial sialic crust.—The salient features of the petrology, correlation, age, and the stratigraphic position of the 'BLTGC' below one of the oldest mafic volcanic piles indicate that it is possibly a remnant primordial sialic crust of the Earth. Such an interpretation is consistent with recent considerations of the Earth's early thermal history which suggest that the earliest crustal fragments would be granitic[2]. A powerful argument against a primordial sialic crust for the Earth, however, is stated to be the lack of any evidence of lowermost Early Precambrian mafic volcanic assemblages resting on granitic rocks[3]. Therefore, the author considers his discovery of the 'Buck Lake Tonalitic Gneiss Complex' to hold the key to unlock the mysteries of protocrustal evolution in very Early Precambrian times, some 3500–4000 million years ago. A detailed account of this complex, together with a critical comparison of it with the 3200–3400 million year old 'Ancient Tonalitic Gneisses' of Swaziland, a discussion of the possibility of its being an analogue of the oldest dated rocks of the Earth's crust, namely, the recently discovered 3800 million year old Amitsoq gneisses of the Godthab District of West Greenland, and the significance of the 'BLTGC' to models of early crustal evolution, will be published elsewhere.

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1. Viswanathan, S., *Lithos*, 1974, 7, 29.
2. Fyfe, W. S., *Phil. Trans. R. Soc. Lond.*, 1973, 273 A, 457.
3. Glikson, A. Y., *Geol. Soc. Am. Bull.*, 1972, 83, 3323.

MIDDLE CARBONIFEROUS FOSSIL BED FROM WESTERN RAJASTHAN

DURING the course of recent field work in Bap area (27° 25' : 72° 25') about 150 km north-west of Jodhpur, the authors found the exposures of a new fossil horizon, underlying the Bap boulder bed. This is the first known fossiliferous horizon in Peninsular India which directly underlies Upper Carboniferous tillite. It is distinctly older than the Talchir Glaciation, and consequently older than any fossiliferous bed reported from Peninsular India, so far[1-12].

The exposure is seen in a depression about 100 metres west of Bap-Badhaura, road and about a kilometre north of Bari Dhani (3 km south-west of Bap village).

The fossils occur in two bands each of about 20–30 cm in thickness and a more than 3 m thick violet and light brown siliceous limestone dipping at an angle of 10°–15° in S. 25° W direction.

The contact between the tillite and the limestone is not parallel to the bedding plane of the limestone, so it is concluded that the tillite overlies the limestone unconformably. The general stratigraphical sequence of the area is as follows:

Badhaura Formation............L. Permian.
......Disconformity.......................
Bap Boulder Bed..........U. Carboniferous.
......Unconformity........................
Unfossiliferous band of light brown limestone—50 cm
Upper fossiliferous band of light brown limestone—20 cm
Unfossiliferous band of violet and light brown limestone—10 m
Lower fossiliferous band of violet brown and light brown—30 cm limestone.

The lower fossiliferous band is violet and light brown in colour and thickly packed with *Nucula beyrichi* and *Nucula girtyi*.

The upper fossiliferous band is light brown coloured limestone containing lamellibranchs, gastropods and cephalopods with an abundance of *Nucula*:

Lamellibranchs
Nucula beyrichi
Nucula girtyi
Gastropods
Auriptygma virgatus
Strapdrollus strapdrollus
Cephalopod
Liroceras liratum

From these two bands an exhaustive collection of fossils has been made and a detailed study and identification of the entire collection is in progress.

Age of the Bed

The lower fossiliferous band has at least two species of *Nucula, i.e.,*

(*i*) *N. beyrichi.*
(*ii*) *N. girtyi.*

The former is confined to the Pennsylvanian period and the latter has a range from Silurian to Recent. The fossils, therefore, suggest an age of Upper Carboniferous for the band.

The upper fossiliferous band has, along with the above-mentioned two *Nucula* species:

(*i*) *Auriptygma virgatus*
(*ii*) *Liroceras liratum*
(*iii*) *Strapdrollus strapdrollus*

The first is restricted to the Mississipian period (Lower Carboniferous) whereas the second is limited to the Pennsylvanian period (Upper Carboniferous) and *Strapdrollus strapdrollus* extends from Lower to Upper Carboniferous.

This bed has a mixed assemblage of Mississipian as well as Pennsylvanian North American Index Fossils. The presence of *Auriptygma virgatus* in upper limestone band with Pennsylvanian fossils in the lower band suggests that in India these fossils cannot be used to separate Mississipian beds from the Pennylvanian. The fossil assemblage in these beds indicate Carboniferous age.

This bed is underlying Bap boulder bed unconfirmably which is assigned Upper Carboniferous age[6] so these fossil beds may be middle carboniferous.

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1. Datta, A. K., *Sci. and Cult.*. 1957, 22(10), 563.
2. Dutta, A. B., *Quart. Journ. Geol. Min. Soc. Ind.*, 1965, 37 (3), 133.
3. — and Shah, S. C., *Rec. Geol. Surv. Ind.*, 1967, 97 (2), 102.
4. Gee, E. R., *Ibid.*, 1928, 60(4), 399.
5. Ghose, S. K., *Sci. and Cult.*, 1954, 19, 620.
6. Krishnan, M. S., *Geology of India and Burma*, Higginbothams (P.) Ltd., 1968.
7. Misra, J. S., Shrivastava, B. P. and Jain, S. K., *Curr. Sci.*, 1961, 30, 262.
8. Oldhan, R. D., "Memorandum on the prospect of finding coal in West Rajasthan," *Record G.S.I.*, 1886, 19.
9. Sabni, M. R. and Dutt, D. K., *Rec. Geol. Surv. Ind.*, 1962, 87 (4), 655.
10. — and Srivastava, J. P., *Journ. Pal. Soc. Ind.* (Inaugural Volume).
11. Sastry, M. V. A. and Shah, S. C., *Rep. XXII Int. Geol. Cong.*, 1964, 4, 139.
12. Shah, S. C., *Indian Minerals*, 1968, 22 (1), 56.
13. Sinor, K. P.. *Bull. Geol. Dept. Rewah State*, 1923, 2, 73.
14. Tiwari, B. S., *Sci. and Cult.*, 1958, 23. 655.

QUARTZINE AND LUTECITE AS ENVIRONMENTAL INDICATORS IN SIRBAN LIMESTONE OF RAISI, J AND K STATE

SIRBAN Limestone inlier in the Murrie belt of J and K State near the town of Raisi (33° 41′ : 74° 50′) presents a stratigraphic thickness of about 4,500 feet. A detailed mineralogical, petrographic and sedimentological study of this limestone revealed that the rocks are essentially dolomites with a flysch-like succession of thin limestone and shale at the top (Rao and Khan, 1971). The rocks show extensive silica diagenesis. A time-trend analysis of dolomite proportion in a vertical profile near Raisi (Rao, 1973) showed that silica replacement of dolomites is somewhat cyclic. Silica in these rocks at the outcrop level occurs in two forms, *viz.*, thin replacement bands of a few inches across, especially in the lower portion of the section, and as replacement masses and pore-filling cement in the upper part of the section. A microscopic examination of these chert occurrences revealed three kinds of quartz: (1) microcrystalline quartz, (2) chalcedonic/spherulitic quartz and (3) mosaic quartz (Rao and Khan *op. cit.*). Various combinations of these three kinds of quartz both in the chert bands and pore-filling cements from periphery to the centre may be observed, namely, (1) microcrystalline quartz-chalcedonic quartz-mosaic quartz, (2) microcrystalline quartz–mosaic quartz, (3) chalcedonic quartz–mosaic quartz, (4) chalcedonic quartz–microcrystalline quartz and *vice versa*, or only chalcedonic microcrystalline or mosaic quartz. Figure 1 shows chalcedonic quartz going into mosaic quartz in an intergranular cavity