Cambrian trilobite biostratigraphy for the Himalaya

KNOWLEDGE of paleontology and stratigraphy is vital for constraining tectonic and geophysical models of Himalayan evolution. Peter Jell and Hughes have recently completed a monograph that describes new taxa and revises trilobites previously described from the Himalayan Cambrian[1]. This work illustrates many of these specimens photographically for the first time, considers the effects of tectonic deformation on their form, and provides computer-aided retrodeformations which improve understanding of their original morphology. Results of this work are relevant for students of Himalayan geo-

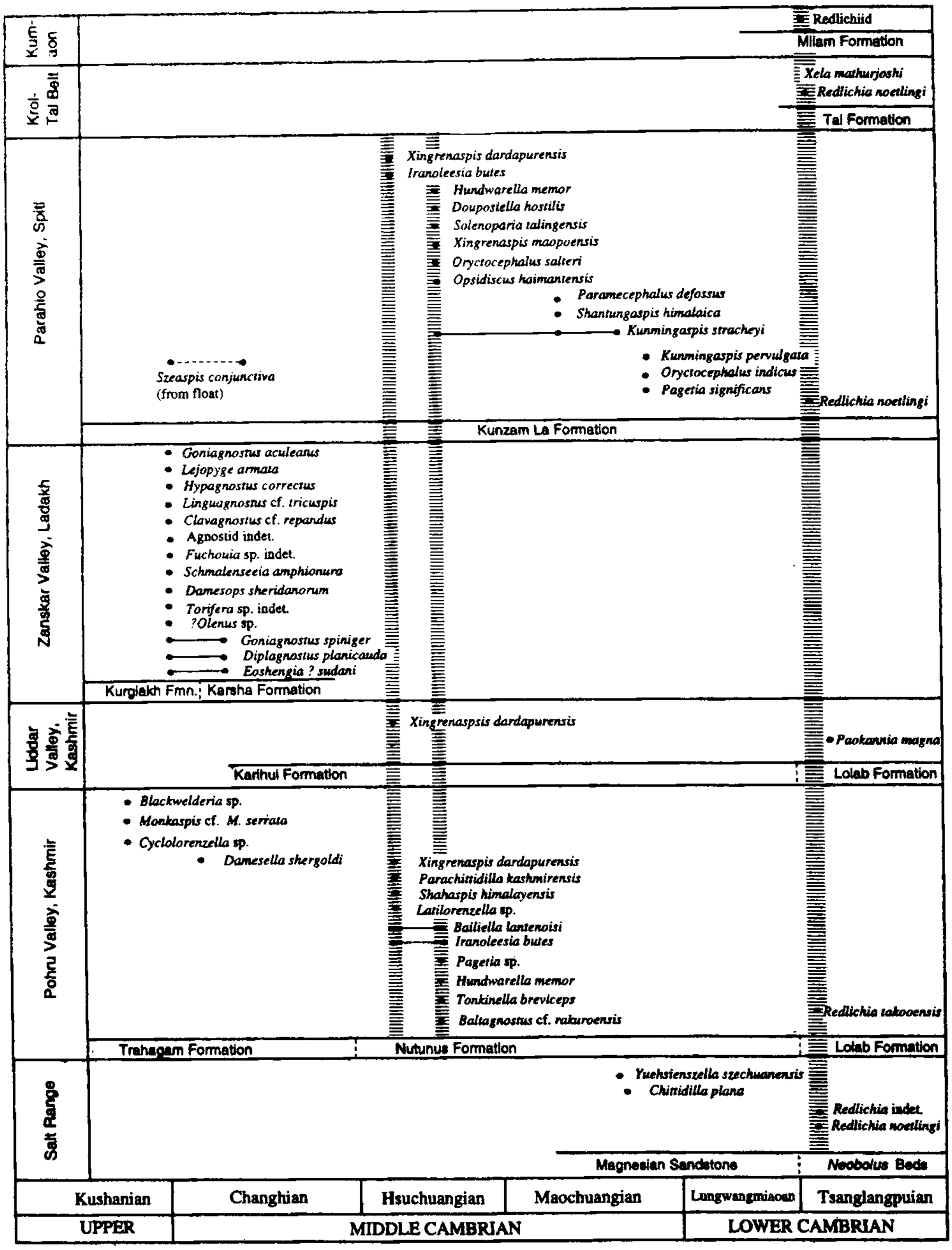

Figure 1. Biostratigraphic scheme for the Himalayan Cambrian. The Chinese stadial system is applied to the faunas of the region. Outcrop belts are ordered from west to east. Bullet points and vertical lines above taxon names indicate stratigraphic ranges; horizontal bars indicate correlations among outcrop regions. The names of local lithostratigraphic formations are shown to the left of taxonomic ranges. Dashed boundaries between formations indicated that the biostratigraphic position of the boundary is uncertain.

logy and this report presents a brief summary of our conclusions, more details of which are available elsewhere[1,2].

Our study was based on examination of previously described type material held in the Geological Survey of India, the University of Jammu, and Yale University, in addition to new collections from Kashmir, Zanskar, and Spiti. Resolution of the effects of tectonic deformation, and other styles of variation, on trilobite morphology[3] has resulted in the synonymy of many previously described taxa into a total of 34 identifiable species belonging to 29 genera, with an additional 10 taxa questionably assigned to species or discernible at the generic level only.

On the basis of these revisions, a new Cambrian biostratigraphy for the Himalaya is proposed (Figure 1). Intraregional correlations can be established at three horizons. The lowermost horizon can be correlated among six sections from the Salt Range to the Lesser and Tethyan Himalaya, and is characterized by redlichiid trilobites of late Early Cambrian age. The two other horizons are based on shared species of primitive libristomate trilobites, and are of mid Middle Cambrian age. These two horizons are recognized within the Tethyan Himalaya only.

Ninety-seven per cent of the genera and 48% of identified species are found outside the Himalaya. These taxa either possess an equatorial-Gondwanan or a cosmopolitan distribution (e.g., *Bailiella*, *Tonkinella*, *Lejopyge*). Himalayan Cambrian trilobite diversity is generally low. This may be largely because the majority of trilobite-bearing Himalayan Cambrian rocks were deposited in deeper water settings. The Himalayan Cambrian bears greatest similarity at the species level to faunas from South and North China, with seven and five species in common, respectively. Fewer species in common with Australia, Vietnam, and Iran may reflect the fact that fewer trilobites have been described from those areas. This information on faunal distribution is concordant with current paleogeographic models for the Cambrian[4] which place South and North China, Vietnam, Iran, and Australia in close geographic proximity, and at similar equatorial latitudes. Given the low regional diversity of the Himalayan fauna and its similarity to those of China, the Chinese stadial scheme has been applied directly to the Himalayan Cambrian, rather than erecting a separate Himalayan scheme (Figure 1).

The revised taxonomy and new biostratigraphy permits the following conclusions about the Himalayan Cambrian: (1) the earliest trilobites known from the Himalaya are of late Early Cambrian (Tsanglangpuian) age[5]; (2) deposits of this age are the most widespread trilobite-bearing deposits of the Himalayan Cambrian; (3) Middle Cambrian (Maochungian–Changhian) deposits are restricted to the Tethyan Himalaya and the Salt Range; (4) the top of the Spiti section correlates with the base of the Kashmir section, and hence the supposed discreteness of these faunas[6] is partly the result of biostratigraphic differences between the areas; (5) faunal differences occurring between contemporary Kashmiri and Spiti faunas are likely the result of biofacies differences; (6) all taxic distributions are consistent with current understanding of Cambrian paleogeography and there are no marked faunal anomalies within the region; (7) faunal similarity is greatest with areas positioned at similar palaeolatitudes and; (8) the youngest Cambrian trilobites yet recorded in the region are from northwestern Kashmir and are of early Late Cambrian (Kushanian) age[7].

There has long been debate over the relationship between Cambrian successions in the Pohru Valley, Kashmir and in Spiti[6,8]. Biostratigraphic overlap only occurs between the top of the Spiti section and the base of the Kashmiri section. Three Middle Cambrian trilobite-bearing horizons in Spiti are older than any known in Kashmir. Of the 20 Middle Cambrian species recorded from these basins, seven belong to intervals unique to one or other area. Of the 13 contemporary species, three are common to both areas, four are unique to Kashmir, and six are unique to Spiti. Paleoenvironmental differences may be responsible for differences between contemporary Kashmiri and Spiti faunas[9], but the sedimentology of both areas is too poorly known to evaluate this further. Despite these differences, none of the taxa in either basin is exotic to the equatorial peri-Gondwanan realm. Only one new genus and three new species have been recognized during the study, and these forms all have relatives in the equatorial peri-Gondwanan region. The relatively small number of endemic taxa suggests that trilobite-bearing Himalayan Cambrian environments had open access to a broad equatorial peri-Gondwanan faunal realm.

The Himalayan Cambrian trilobite fauna is consistent with the passive-margin-model for the northern margin of India[10], and with current concepts of regional land mass distributions. The faunal similarity of Himalayan sequences with those of South China supports arguments that the South China block was the complimentary passive margin to the Himalaya during the earliest Phanerozoic[11].

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ACKNOWLEDGEMENTS. I thank P. A. Jell who undertook the majority of the taxonomic work upon which this paper is based. Funding was provided by the Natural Environment Research Council, the Queensland Museum and Cincinnati Museum Center, and IGCP 303, 320, and 366. Thanks to officers of the Geological Survey of India, S. K. Shah and C. S. Sudan of Jammu University, and R. D. White of Yale University for access to collections. Prof. Shah and Dr Sudan provided much helpful insight. I also thank M. Gaetani, Shyamali Khastigir, V. K. Mathur, A. K. Moitra, T. Lahiri, S. and G. Sarkar, J. and R. Sheridan, J. A. Talent, and H. B. Whittington for their practical help. Constructive comments by a reviewer significantly improved the paper.

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