*Journal of Structural Geology*, Vol. 1, No. 3, 1979, pp. 255 to 257.


# BOOK REVIEWS

## Himalayan Tectonics

Saklani, P. S. (editor) 1978. *Tectonic Geology of the Himalaya.* Today and Tomorrow's Printers and Publishers, New Delhi. 340 pp. Price: hardcover US $40.00.

To review this book is a daunting task for someone whose active regional mapping in the Himalaya was between 1928 and 1940 apart from subsequent visits in connection with investigations of dam sites and tunnel alignments. This is not the place in which to review the expansion of Himalayan studies from a small nucleus of workers in the Geological Survey of India before 1940 to the profusion of studies now in hand, not only in the Survey, but by the Indian universities, the Wadia Institute of Himalayan Geology, the Oil and Natural Gas Commission, and by scientists from Europe, North America and Australasia. The work of Heim and Gansser on the Central Himalaya in 1939, and the classic volume of Gansser on The Geology of the Himalyas published in 1964, represent culminations in modern studies of the stratigraphy and tectonics of this mountain chain.

In the monograph under review there are 15 articles, written by 22 authors, of whom 13 are Indian, while the rest are from Czechoslovakia, Denmark, France, Taiwan or the U.S.A. The investigations extend from Ladakh to Arunchal Pradesh, an arc distance of some 2200 km. Several of the articles are concerned with the stratigraphy and tectonics of segments of the Himalaya, especially those of Kumaon, Nepal and Bhutan, while papers on fossils from the lesser Himalaya, and on the petrology, metamorphism and K/Ar age dating of rocks from eastern Nepal provide important insights into certain aspects.

Two regional maps cover approximately the same region of the west-central Himalaya. The map by Valdiya on p. 4 depicts an area of 45 000 km$^2$ on the scale of 1:1 750 000, while that of Raina which faces p. 82, utilises ERTS imagery and published information and shows an area of 65 000 km$^2$ on a scale of approximately 1:1, 1000 000 (the marginal graticules are unevenly spaced). These maps are the latest, amongst many, attempts at a synoptic view of the structure, and demonstrate the multiplicity of opinions regarding the structural sequence. Raina has 10 allochthonous units, and 14 formations within the autochthonous and para-autotochonous belts. It is surprising that he has classified the Central Himalayan Crystalline group which extends over a distance of 200 km, including the peaks of Kedarnath and Trisul, as autochthonous/para-autochthonous, for this group with virtual unanimity is regarded as overlying the Main Central Thrust. Even on Raina's interpretation this group is geographically on the same strike as, and adjacent to, his Salkhala nappe, but the actual junction of the two units is avoided by the device of a blank space on the map around coordinates 31°N: 78½°E. Validya on the other hand has five major nappes and regards the whole crystalline series between the peaks of Kedarnath, Badrinath and Nanda Devi as his Vaikrita Nappe. It should be recalled that Toni Hagen working in Nepal and in areas contiguous with those examined by Valdiya and Raina, differentiated 22 nappes in 7 nappe groups, of which three groups are confined to crystalline formations. It may be questioned if, in the absence of fossils and other marker horizons, there are sufficient diagnostic metamorphic criteria to justify sub-division into such a multiplicity of structural units.

Some of the discrepancies in interpretation arise from uncertainties regarding stratigraphical sequences. Valdiya for example considers the diamictite group containing fenestellid bryozoa at Jogira (29°48' : 78°39') as belonging to the Tal Formation, which would make the whole of the Blaini-Krol-Tal sequence as Permo-Carboniferous and older. In fact, however, the Jogira Beds belong to the Bijni nappe, and are thrust upon the Tal Formation. Moreover, the poorly preserved fossils within the Krol and Tal Formations indicate that they are Mesozoic (Gupta and Virdi, pp. 117–118). These authors state (p. 121) that the Mandi evaporite zone is Permo-Carboniferous in age on the basis of sulphur isotope analysis. An element of doubt must remain regarding the accuracy of this analysis, because of the similarity of the Mandi Salt Marl and overlying Khaira Quartzite to the Eo-Cambrian Salt Range succession. The widespread occurrence of evaporites of that period within the peninsula, such as those known at depth in the Karampur boring (29°59' : 72°22'), and at Nagaur 330 km to the south-southeast, indicate the possibility of a late Precambrian age for the Mandi Salt. Permo-Carboniferous evaporites are not known elsewhere in the region, which is characterised by the widespread occurrence of the Talchir-Blaini tillites.

The article by Saxena (p. 313), influenced by van Bemmelen's and Meyerhoff's ideas, is of interest in not accepting the great northward drift of the Indian plate towards Eurasia. Opinions differ regarding what constitutes the Indo-Pakistan plate. I suggested (Auden 1935) the subdivision of the Himalaya into the Peninsular Himalaya and Tethys Himalaya, but was uncertain how far northwards the latter zone extended. Henri and Geneviève Termier suggested in 1977 on the basis of biogeographical studies that India, the Tethys Himal ,ya, Tibet and the Tien Shan were adjacent to each other during the Early Permian. Crawford (1974, p. 370) also considered Tibet to be an offshore part of Gondwanic India during the Palaeozoic, underlain by Precambrian continental crust. The matter is relevant in connection with the interpretation of the so-called Indus suture line, because this important fault zone is regarded by some as the union of two distinct plates and the relic of a subduction zone. Srikantia and Bhargava (p. 57) suggest that the Indus suture is due to tension following compression and the subduction of the Indian plate into a trench bordering the Asian plate. According to them the boundary is a vertical fault descending 150 km through undifferentiated crystalline rocks, an abnormal thickness of continental crust even for a mountain chain. In common with the 900 km long Chaman fault of Pakistan and Afghanistan, on either side of which, at a distance of up to 150 km, are important outcrops of ultrabasics, the Indus fault is vertical and unconnected with any existing Benioff zone of inclined hypocentres. Indeed, the only zone of intermediate-depth hypocentres in the vicinity, which might be considered to represent a present-day subduction zone, is the Hindu /Pamir arc, 700 km in length and 300 km north of Gilgit and also north of the Indo-Pakistan subcontinent. If either the Chaman or Indus faults developed during subduction, the original crustal duplication has since become absorbed, and the deeper seismicity nullified. It is possible that both the Indus and Chaman faults may represent deep fractures within a single continental plate rather than sutures between three separate plates, previously far removed from each other. It is not known if transcurrent movement has occurred along the Indus fault, but left-lateral movement along the Chaman fault may exceed 300 km, and Eocene–Oligocene flysch associated with the fault is indurated, strongly cleaved and cut by abundant calcite and quartz veins (Auden 1974).

Of great interest is the article by Krummenacher, Basett, Kingery and Layne dealing with K/Ar age determinations. The authors indicate that K/Ar ages are very young around the Main Central Thrust (8.5–3.7 Ma). The biotites in the metamorphic rocks from which the samples were taken show no chloritisation and have a normal percentage of potassium, and it is assumed that the young ages represent cooling ages of a late thermal event and very recent activity along the Main Central Thrust. A similar conclusion is reached on geomorphological and structural grounds by Jaros and Kalvoda in their article on Quaternary Relief Thrusts in Eastern Nepal. They conclude that there were two stages of nappe movement, Middle Tertiary and Quaternary.

Unfortunately it is not possible to discuss all the interesting articles in this monograph. It is well produced and edited, although it is to be regretted that in many instances legends are far removed from the maps or sections to which they apply.

*J. B. Auden*

### *References*

Auden, J. B. 1935. Traverses in the Himalaya. *Rec. geol. Surv. India* **69**, 123–167.

Auden, J. B. 1974. Afghanistan–West Pakistan. In: *Mesozoic-Cainozoic Orogenic Belts* (edited by Spencer, A. M.) *Spec. Publ. geol. Soc. Lond.* **4**, 235–253.

Crawford, A. R. 1974. The Indus Suture Line, the Himalaya, Tibet and Gondwanaland. *Geol. Mag.* **111**, 369–383.