

## The Spiti Ordovician-Silurian Succession

R. K. GOEL AND N. G. K. NAIR

### Abstract

Classic Pin valley section in Spiti (Himachal Pradesh) India, has been re-examined and formal stratigraphic nomenclature in terms of the Lower Paleozoic succession of Spiti is proposed.

Sir Henry Hayden's classic Pin River section in Spiti was re-examined in early September 1971 and 1972 and representative collections made as part of a programme of co-operation between the School of Earth Sciences, Macquarie University and the Department of Geology and Geophysics, university of Roorkee. Little can be added to the succession described in detail by Hayden (1904), though it is clear that formal stratigraphic nomenclature can be readily applied to the area.

We did not probe the relationship of the Cambrian Parahio Formation (Parahio 'series' of Hayden) to the underlying Haimanta 'series', but there is a readily mappable lithological contrast between the 400 metres or so of slates, quartzites and dolomites that go to make up the Parahio Formation from the two Ordovician units in the area: a lower terrigenous unit consisting of about 550 metres of quartzites, conglomeratic lower in the section, passing upwards through shaley and flaggy sandstones with orthoid brachiopods into about 90 metres of carbonates, of which the basal 60 metres or so is dark and foetid, with intercalations of more shaley limestones and shales. It is from this unit and approximately in the middle of the unit that we collected a rich and diverse fauna of brachiopods, with a few trilobites and corals. Much of the fauna is delicately silicified and therefore has great potential for adding to our knowledge of the faunas already described by Reed (1912a and b). We propose to call these units the Shian quartzite and Pin limestone respectively.

The Pin limestone is overlain by about 15 metres of grey limestone with halysitid and other corals to which a Silurian age has been attributed, though the presence of *Stylarea* has been taken to indicate a continuing Ordovician element (Reed, 1912a); it is accordingly most likely late Ashgill or early Llandovery. Reed has argued for a Llandovery age for the succeeding 20 metres or so of grey siliceous and flaggy limestones weathering red-brown; collections made from this unit consist almost entirely of brachiopods. This is succeeded by about 25 metres of reddish brown calcareous quartzites and quartzites containing *Pentamerus oblongus* according to Reed and if so, this argues strongly for an early Silurian age, perhaps late Llandovery as this form is not known from post Llandovery rocks.

It was clear to us that there is a gradual increase in clastics up this section and a gradual transition to the supposed Devonian Muth quartzite, just the same as there appears to be in Kashmir in the Naubag sections, and the age of the Muth cannot be far removed from the age of the underlying strata, i.e. not younger than Wenlock, and certainly not Devonian. It is a near-shore unit with parting lineation testifying to intertidal deposition; such environments are narrow, restricted geographically and it is therefore unlikely that the outcrops in Kashmir are synchronous with those in Spiti, though they may well be representative of the same regressive phase.

The question of diachronism in the Muth quartzite *sensu stricto* (i.e. the Muth of the Spiti valley-type locality at Muth in the Pin valley) and its supposed correlates in Kashmir, Kumaon and elsewhere in Himachal Pradesh (especially undoubted Devonian of Kinnaur) is outside the scope of this communication, but will

be taken up elsewhere. A hint of the complexity of the problem as regards Kashmir has already been given by Boucot and Gauri (1968). Gupta (1973) provides a key to much of the relevant literature. Dasgupta (1971) feels that this quartzite sequence may be divided arbitrarily into lower, middle and upper members based on petrological characteristics and suggests an aeolian origin for the upper member of Muth quartzite.

In summary the section along the Pin river is as follows, units considered in descending sequence:

|  |     |                    |
|--|-----|--------------------|
| Muth quartzite—passing down gradually into:  | ... | 110–245 metres     |
| Unnamed quartzites—transitional to:  | ... | 25 metres          |
| Unnamed siliceous and flaggy limestone—Llandovery  | ... | 20 metres          |
| Thanam limestone (new name)  |     |                    |
| —Late Ashgill or Llandovery coral fauna  | ... | 15 metres          |
| Pin limestone (new name)   |     |                    |
| Unit 4—Shaley limestone with non-descript fauna (described by Cowper Reed)                     | ... | 10 metres          |
| Unit 3—dolomitic and siliceous limestone with shales   | ... | 12 metres          |
| Unit 2—limestone, weathering brown   | ... | 10 metres          |
| Unit 1—dark foetid limestone with shaley limestone and shale bands, brachiopods and trilobites | ... | 80 metres          |
| Shian quartzite (new name)   |     | approx. 550 metres |
| -----Unconformity-----best observed in Barachud (=Parahio) valley                              |     |                    |
| Parahio Formation—Cambrian   |     | 390 metres         |

*Acknowledgements:* This report is part of a broader collaborative programme of stratigraphic and structural investigations in Himalaya between University of Roorkee, India and Macquarie University, Australia under the aegis of the International Union of Geological Sciences and the Australian Research Grants Committee. We are indebted to professor John Talent (Macquarie University), the principal investigator of this project, for providing us the opportunity to work, for accompanying one of the authors (Dr. Goel) to Spiti in Aug. - Sept. 1972, for critically reviewing this short note and for many fruitful discussions. Grateful thanks are also due to Professor R. S. Mithal, Head of the Department of Geology & Geophysics, University of Roorkee for constant encouragement and advice.

#### References

- BOUCOT, A. J. and GAURI, K. L., (1968) Age and Relationship of Basal Muth Quartzite of Kashmir, India. *Geol. Soc. Am. (Abst.)*, p. 33.
- DASGUPTA, P. K., (1971) On textural characteristics of the Muth Quartzite of Spiti and Kuti regions, Central Himalayas. *Jour. Geol. Soc. India*, v. 12 (2), pp. 152-158.
- GUPTA, V. J., (1973) *Indian Paleozoic Stratigraphy*, p. 204, Hindustan Publishing Corporation, New Delhi.
- HAYDEN, H. H., (1904) Geology of Spiti with parts of Bashahr and Rupshu. *Mem. Geol. Surv. India*, v. 36 (1), pp. 1-129.
- REED, F. R. C., (1912a) Ordovician and Silurian fossils of Central Himalayas. *Pal. Ind. Geol. Surv. India*, Ser 15, v. 7 (2), pp. 1-168.
- (1912b) Silurian fossils from Kashmir. *Pal. Ind. Geol. Surv. India*, v. 42 (1), pp. 16-33.

#### Address of the authors

R. K. GOEL and N. G. K. NAIR, Dept. of Geology & Geophysics, University of Roorkee.