

**PERMIAN AND TRIASSIC
STRATIGRAPHY AND FOSSILS
OF THE HIMALAYA IN
NORTHERN NEPAL**

By

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PREFACE

This study focuses on Permian stratigraphy of the Manang district, north-central Nepal, and Carboniferous and Permian brachiopods significant from a regional Himalayan and world perspective.

Fossiliferous Late Paleozoic rocks in the Manang district of north-central Nepal are exposed north of the Annapurna Range along the north side of the Marsyangdi valley from east of Braga settlement (11500ft, 3505m) to beyond Manang settlement (11650ft, 3551m), south of the peaks of Chulu (21672ft, 6630m and 20321ft, 6200m). The rocks persist westwards for 15km across Puchenpra Peak (16883ft, 4950m) and an unnamed peak at 17315ft, 5146m, along the north and west side of a huge glacial amphitheatre called Plateau of Lakes, and continue to Mesokanto Pass (16730ft, 5099m), then descend 5km along the Thini River valley to the Kali Gandaki River and the settlement of Jomson (8900ft, 2713m). Further west lies the region of Dolpo in northwest Nepal, where similar Permian-Triassic rocks are exposed north of the Dhaulagiri massif (Fuchs 1967, 1975, 1977, Waterhouse 1977, 1978). Overall these geological observations on Late Paleozoic and Early Mesozoic rocks and fossils extend over 160km, in a band 5-20km broad.

General geological studies and maps of the Manang region by Bordet et al. (1975) and Fuchs et al. (1988) provide critical data on the regional setting, and Garzanti et al. (1994) measured four sections in the area. Five expeditions have been made to the area by the writer in 1977, 1981, 1987, 1988, 1989, each of 2-4 months duration, sufficient to allow for extensive mapping and collecting. General summaries have been published for Permian stratigraphy in Waterhouse (1979, 1987b, 1989, 1994) and Waterhouse & Shi (1991), underpinned by detailed Permian fossil studies (Waterhouse 1966, 1978, 1983a, 1988). Triassic ammonoids and stratigraphy have been examined in a series of monographs (Waterhouse 1994, 1996a, b, 1999a, b, 2002a, b) and members of the bivalve Subfamily *Claraiinae* and Family *Posidoniidae* have been described (Waterhouse 2000). In these articles a number of maps and illustrations of the region provide data on the regional topographic and geological setting, and general location for fossils. Brachiopoda and Mollusca from the Late Permian in Manang will be described separately in a study by Waterhouse & Chen (in prep.).

Summary

Part 1. Stratigraphy and Biostratigraphy

A - Stratigraphy

Formations and members of Permian age, together with the underlying Early Carboniferous, are summarized for north-central Nepal from the Kali Gandaki valley into the Manang district, and a number of sections documented to trace variation within units. The Thini Chu Group is restricted to beds of Early Carboniferous age, and is made up mostly of near-shore marine deposits, accumulated under conditions much warmer than glacial and subglacial deposits of Late Carboniferous age in east Australia and South America. The Permian involves the Chulu and Shokang Formations and Nar Volcanics of the newly proposed Ghyaru Group and the Senja and Marsyangdi Formations of the Namlang Group. The Chulu Formation is made up of Early Permian glacial diamictites and Shokang Formation is non-marine, and contains *Glossopteris* and other plant remains, possibly correlative with the Karharbari Formation of India. It is associated with the Nar Volcanics, representing part of the widespread Himalayan Panjal Volcanics. The Senja Formation is extended into the region from west Dolpo, and includes the Popa, Pija, Kyobra, Galte and Ngawal Members. Invertebrate marine fossils are abundant, and belong to the *Pyramus silicius*, *Lazarevonia arcuata* and *Biplatyconcha grandis* Zones, of Changhsingian and possibly late Wuchiapingian age. The topmost Permian Marsyangdi Formation is subdivided into thin and persistent Chho, Hongde, Munji, Braga, Tengi and Gungsang Members. Abundant marine invertebrate fossils belong to the *Retimarginifera xizangensis* Zone, shared with the Selong Group at the Selong Xishan section of south Tibet. The very latest Permian faunas, preserved in uppermost beds of the Selong Group, are not found in Nepal. Over the divide between the Kali Gandaki and Marsyangdi river systems, the Late Permian formations thin or disappear or pass into coarse marine sediments of the Puchenpra Member, to indicate shallow water and at times emergent upland, as an island or ridge termed the Kali Gandaki high.

B - Macro-invertebrate Biozones

Late Permian of the Himalayas is divided into 6 biozones, of which 4 and additional traces are represented in the Salt Range of Pakistan, 2 in Kashmir, 5 in Nepal and 4 in south Tibet.

Part 2. Systematics

A. Upper Paleozoic Brachiopoda

Chonetidina, Stenoscismatoidea

New genera are proposed, including *Nisalarinia*, type species *Rugaria nisalensis*

Waterhouse, 1978 (Family Rugosochonetidae), *Pitakpaivania*, type species *Kutorginella aprica* Grant, 1976 (Superfamily Productoidea), *Miniliconcha*, type species *Taeniothaerus miniliensis* Coleman, 1957 (Superfamily Aulostegoidea), *Sedecularia*, type species *Stenoscisma glabra* Waterhouse, 1987a, *Liufaia*, type species *Stenoscisma tetricum* Grant, 1976 and *Bicamella*, type species *Camarophoria timorensis* Hayasaka & Gan, 1940 (Superfamily Stenoscismatoidea). New species include *Chonetella semicostata*, *Retimarginifera sheni*, *Wyatkina tibetensis*, *Echinalosia zaga*, *Goleomixa? archboldi*, *Stenoscisma hamleti*, *Coledium? cheni*, *C. costacurtosus* and *Cyrolexis zhangii*. Rugariini is proposed as a new tribe within Plicochonetinae.

Spiriferidina

Permian members of spiriferoid, paeckelmannelloid and brachythyridoid brachiopods are described, classified and discussed from the Salt Range, Himalaya and elsewhere. Several species are delineated and offer moderately good potential for correlation. New genera include *Ovispirifer*, type species *Spirifer oldhamianus* Waagen, 1883, *Gobbettifera*, type species *G. angulata* n. sp., *Fasciculatia*, type species *S. greenlandicus* n. sp. (Subfamily Gypospiriferinae), *Maxwellispirifer*, type species *Neospirifer campbelli exora* McKellar, 1965 (Subfamily Neospiriferinae), *Wadispirifer*, type species *Neospirifer grandis* Archbold & Thomas, 1986 (Subfamily Kaninospiriferinae), *Cracowspira*, type species *Fusispirifer laminatus* Waterhouse, 1987a (Subfamily Fusispiriferinae), *Koenigoria*, type species *Trigonotreta neoaustralis* Archbold & Thomas, 1986 (Subfamily Trigonotretinae), and *Aequalicosta*, type species *Eliva inflata* Cooper & Grant, 1976 (Subfamily Purdonellinae). Angiospiriferin brachiopods are also discussed in part, with three new genera, *Varuna*, based on *Spirifer varuna* Diener, 1915, *Unicostatina*, type species *Sulciplica subglobosa* Clarke, 1990, and *Georginakingia*, type species *Spirifera avicula* Morris, 1845, and new genus *Costuloplica*, type species *Neospirifer senilis* Maxwell, 1964 (Subfamily Costuloplicinae). The pterospiriferin (paeckelmannelloid) new genus *Johncarteria*, type species *Spirifernaella scalpata* Cooper & Grant, 1976, is proposed. Additional new species are *Betaneospirifer shii*, *Costuloplica robertsi*, *Crassispirifer broilii*, *C. transversa*, *C. acuta*, *Cratispirifer macroplica*, *Fusispirifer jini*, *Kaninospirifer costellinus*, *Neospirifer poletaevi*, *N. kalashnikovi*, *Pterospirifer waageni*, *Sulciplica chatsworthensis* Balfe & Waterhouse, *Trigonotreta thomasi* and *Wadispirifer hongdeensis*. New subfamilies Gypospiriferinae, based on *Gypospirifer* Cooper & Grant, 1976, and Fusispiriferinae, name genus *Fusispirifer* Waterhouse, 1966, are proposed within Spiriferidae and Neospiriferidae, and new subfamily Costuloplicinae, name genus *Costuloplica* n. gen. is proposed within Trigonotretidae. Tribe Grantoniini, from *Grantonia*

Brown, 1953, is proposed within Trigonotretinae, and new tribe Georginakingiini from new genus *Georginakingia* within Angiospiriferinae.

Significant Afghanistan, Canadian, United States, Timor and other Spiriferellidae are examined for comparison with Himalayan genera and species. New genera are *Bamberina*, type species *Elivina? annectens* Cooper & Grant, 1976, *Canalisella*, type species *Spiriferella leviplica* Waterhouse & Waddington, 1982, *Quispira*, type species *Elvinia detecta* Cooper & Grant, 1976, and *Dissimiliplica*, type species *Spirifer mexicanus compactus* Girty, 1909 within Family Spiriferellidae. Newly named species are *Spiriferella grunti*, *S. legrandblaini*, *Arcullina angiolinii*, and *Elivina? termieri*. New Subfamily Elivininae is recognized within Spiriferellidae. Brachythyridoidea are rearranged, and new Family Brachythyrididae, based on *Brachythyrina* Fredericks, 1929, and Subfamily Pustuloplicinae, based on *Pustuloplica* Waterhouse, 1968, are proposed, with new species *Brachythyrina boonlomi*.

Family Alphaneospiriferidae is proposed, based on *Alphaneospirifer* Gatinaud, and of uncertain affinities because of the apparent presence of tabellae, costate plicae and lack of adminicula.

B. Triassic Mollusca

Ammonoidea

Corrigenda and records of subsequently described taxa and illustrations are provided for the series of Palaeontographica monographs on Early and Middle Triassic ammonoids from the Himalaya.

Bivalvia

Figures are provided for species of Claraiinae and Posidoniidae from the Early Triassic of Dolpo and Manang, Nepal.

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