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Palaeogeography of Spanish lower Devonian Rhynchonellids

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ABSTRACT – Old World Realm rhynchonellid genera occur also in the Eastern America Realm. The most direct migratory way was across the Gaspé Peninsula via Meguma (New Scotland). *Plethorhyncha* originated in the Iberian Peninsula in the latest Silurian, colonized the Appalachian basin during the Pragian and earliest Emsian and finally reached Algeria through the Merrimack seaway at the beginning of the Emsian. *Tectogonotoechia* branched profusely in northern Gondwana and Baltica from Late Silurian onwards. *Tectogonotoechia* exploited the same Meguma-Gaspé way to reach the Appalachian basin during the Late Silurian. However, the genus used also a longer peri-Baltica route to colonize the Canadian Arctic Islands, Yukon, and Nevada, during the Early Devonian. *Trigonirhynchia* went on both migratory routes described above during the Emsian spreading largely on Meguma, Canadian Arctic Islands, Yukon, and Nevada, but rather surprisingly never reached the Appalachian basin.

RIASSUNTO – [Paleogeografia dei Rinconellidi del Devoniano inferiore della Spagna] – Alcuni generi di brachiopodi rinconellidi dell'Old World Realm sono presenti anche nel Eastern America Realm. Il collegamento più diretto era attraverso la penisola di Gaspé, via Meguma (New Scotland). *Plethorhyncha* si originò nella penisola iberica nel Siluriano terminale, colonizzò il bacino Appalachiano durante il Pragian e l'Emsiano inferiore e, infine, all'inizio dell'Emsiano raggiunse l'Algeria, attraversando il mare di Merrimack. *Tectogonotoechia* si diffuse ampiamente nel Nord Gondwana e in Baltica a partire dal Siluriano superiore; contemporaneamente raggiunse il bacino appalachiano attraverso la via Meguma-Gaspé, ma utilizzò anche una via molto più lunga, attorno a Baltica, per raggiungere, nel corso del Devoniano inferiore, l'Arcipelago Canadese, lo Yukon e il Nevada. *Trigonirhynchia* si servì di entrambi questi percorsi nel Devoniano inferiore per diffondersi abbondantemente in Meguma, l'Arcipelago Canadese, lo Yukon e il Nevada, ma curiosamente non raggiunse mai il bacino appalachiano.

RESUMEN – [Paleogeografía de rinconélidos del Devónico Inferior de España] – Algunos géneros de braquiópodos rinconélidos del Dominio del Viejo Mundo aparecen también en el de las Américas Orientales. El enlace más directo entre ambos Dominios fue a través de la península de Gaspé, vía Meguma (New Scotland). *Plethorhyncha* apareció en la península Ibérica a fines del Silúrico, colonizó la cuenca apalachense durante el Praguense y comienzos del Emsiense y, poco después, alcanzó, Argelia, atravesando el mar Merrimack. *Tectogonotoechia* se ramificó profusamente en Gondwana septentrional y en Baltica desde finales del Silúrico en adelante. Hacia la misma época, el género alcanzó la cuenca apalachense, aprovechando el paso Meguma-Gaspé, pero también utilizó otra ruta más larga, alrededor de Baltica, para colonizar las islas del Canadá Ártico, Yukon y Nevada, durante el Devónico Inferior. *Trigonirhynchia* explotó ambas vías migratorias durante el Emsiense, extendiéndose ampliamente sobre Meguma, las islas del Canadá Ártico, Yukon y Nevada, pero, curiosamente, no alcanzó nunca la cuenca apalachense.

INTRODUCTION

Devonian palaeogeographical studies have often referred to the so-called "afro-appalachian" migratory route, which Old World Realm faunas took to colonize the Appalachian Province of the Eastern Americas Realm. This migratory way has been hypothesized mainly for faunal exchanges from the Emsian onwards. Earlier in the Lochkovian, a more direct and short Ibero-Armorian (North Gondwanan)-Laurentian link could be that of the Gaspé Peninsula via Meguma (New Scotland). The neat Old World Realm look of the Meguma Lochkovian faunas was stressed by Boucot (1960) long time ago. A recent paper by Brice *et al.* (1997) gives strong support to Boucot's results. On the other hand, Brice *et al.* (1997) have reported connections between both Meguma and Gaspé from the Lochkovian onwards. In this last view the Gaspesia domain would represent the beachhead for some Old World Realm faunas to conquer the Appalachian basin.

PALEO BIOGEOGRAPHY OF SPANISH RHYNCHONELLIDS

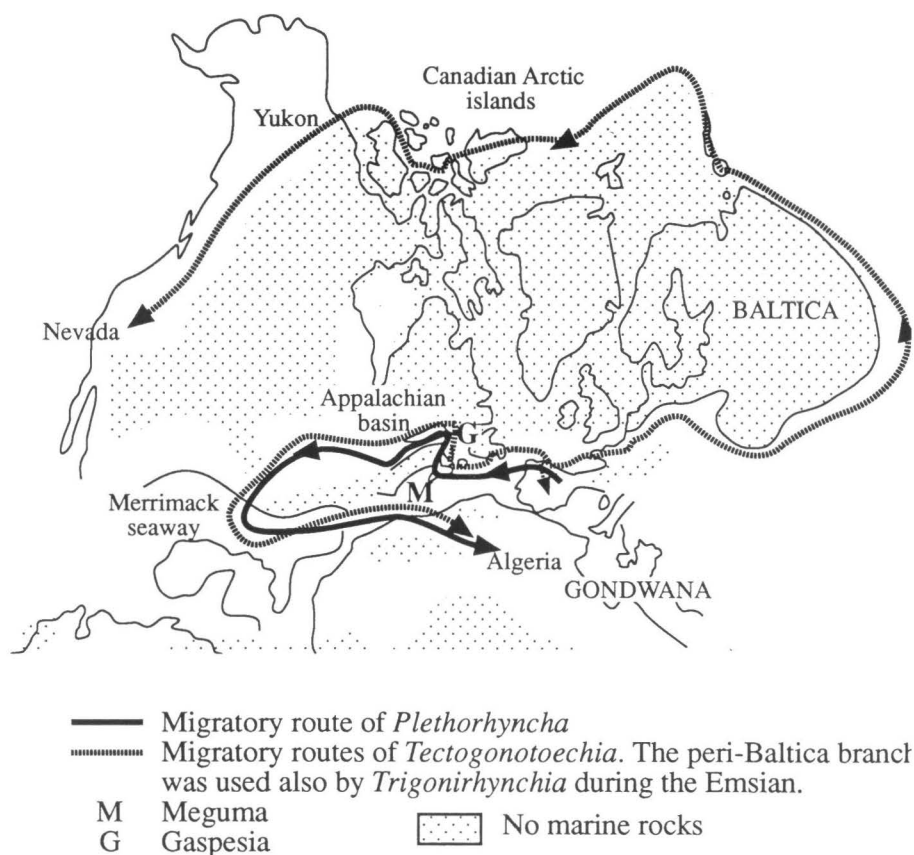
The paleogeographical distribution of Lochkovian/Pragian Spanish rhynchonellids demonstrate the existence of the Meguma-Gaspé and other migratory routes towards the Laurentian basins. For example, *Plethorhyncha* Hall & Clarke extended over North Spain, East Canada, Eastern North America and Algeria (Text-fig. 1). The oldest species, *Plethorhyncha* (*Struvetoechia*) *sdzuyi* Carls *nom. nud.* and *P. (Plethorhyncha)* *polentinoi* Binnekamp occur in the Pridolian of Aragón and in the Lochkovian of the Cantabrian Mountains in Spain, respectively, (P. Carls, pers.comm., and García-Alcalde, 1998). *P. (P.) barrandi* (Hall) occurs in the Grande Grève Fm. (Pragian) of the Gaspé Peninsula. This species spread quickly from Gaspesia to the Appalachian basin interior settling in New York, Pennsylvania, New Jersey, Maryland, Tennessee, Missouri and Oklahoma during the Oriskanian

(Deerparkian) times (Upper Pragian-?Lowermost Emsian in present day terms). All over this migratory process the species repeatedly branched giving origin to *P. (P.) speciosa* (Hall), known in New York, Pennsylvania and Maryland, *P. (P.) principalis* (Hall), from New York and Missouri, and perhaps others. *P. (P.) principalis*, or a very close form, ended the long *Plethorhyncha* travel reaching Algeria through the Merrimack seaway (Text-fig. 1) at the beginning of the Emsian (Le Maître, 1952).

Tectogonotoechia ("Camarotoechia" of many former authors), a small rhynchonellid genus largely spread in the Old World Realm (García-Alcalde, 1998), could exploit the same way although the available chronostratigraphical data are not sufficient to suggest an origin for it. In fact the genus branched in forms as "*C. moydartensis*", "*C. glomerosa*", "*C. marklandensis*" and "*C. planorugosa*" (cf. Harper, 1973) of the Upper Silurian and Lochkovian of northern Meguma. Also the "*Camarotoechia*" aff. *paretiformis* of the Lochkovian of southern Meguma (Brice *et al.*, 1997) could belong altogether to *Tectogonotoechia*. The genus extended over

the Appalachian basin (*Cupularostrum* ? sp. Boucot, of the Lochkovian of Maine; *Ancillotoechia cumberlandica* (Rowe), of the Lochkovian of Pennsylvania, Maryland and Virginia; (cf. Johnson, 1970), and *Camarotoechia* ? *haraganensis* Amsden, of the Lochkovian of Oklahoma). *Tectogonotoechia* branched profusely from the Upper Silurian onwards in northern Gondwana (N Africa, Iberian Peninsula, Armorican Massif), Ardenno-Rhenish area (Belgium, Germany) and Baltica (Podolia, Ukraina) (García-Alcalde, 1998). Podolian populations of *T. nucula* (Kozłowski, 1929, non Sowerby) or related forms must have migrated to the north, surrounding the Old Red Sandstone continent. Starting from the latter forms, *Tectogonotoechia* would have finally colonized the Canadian Arctic Islands, Yukon and Nevada (*Ancillotoechia gutta*, *A. aptata* and related forms; cf. Johnson, 1979; Johnson *et al.*, 1973; Perry, 1984; Smith 1980) (Text-fig. 1).

As indicated above, the Meguma link remained open in post-Lochkovian times. Brice *et al.* (1997) quoted many European Pragian and Emsian brachiopods and crinoids in New Scotland. Among



Text-fig. 1 - Migratory routes of *Plethorhyncha*, *Tectogonotoechia* and *Trigonirhynchia* during Lochkovian-Pragian times (modified from García-Alcalde, 1998). Paleogeographical base after Johnson (1979), a little modified.

them, the rhyntonellid *Trigonirhynchia* Cooper shows a rather surprising distribution. It is known in Meguma from *T. fallaciosa* (Bayle), well known also in the Pragian of the Ibero-Armorican domain. However, the genus never reached the Appalachian basin (quotations of *Trigonirhynchia* in this domain correspond generally to other Upper Silurian and Lochkovian genera). Nevertheless, *Trigonirhynchia* went on the long peri-Baltica route described before for the *Tectogonotoechia* northern migration, to colonize the Canadian Arctic Islands, the Yukon and Nevada (*T. occidentis* and related forms; Johnson, 1970; Perry, 1984, and others) during the Emsian (Text-fig. 1). Quotations of the genus in North Africa and Iran correspond to other genera.

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