Charles Darwin *In Memoriam*

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Are the eggs - kept and fed by the mother - the ancestral form of reproduction in onychophorans?

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ABSTRACT: **Onychophorans are the only phylum without current marine representatives and one of the few invertebrates with placenta. Here we propose that the common ancestor, which first emerged to the mainland in Pangea's time, kept its eggs inside the female, feeding them continuously through a very thin shell (matrotrophic viviparity). Therefore, this mechanism is still common and widely distributed in onychophorans throughout the world: other mechanisms evolved locally in more recent times.**

KEYWORDS: parsimony, Occam's razor, lecithotropic viviparity, matrotrophic viviparity, placental viviparity, evolutionary pressures, reproduction with placenta.

E**volutionary pressures** that have shaped the extraordinary hunting worms called onychophorans (Monge-Nájera, 1995) generated an advanced system of **reproduction with placenta**, functionally similar to the organ of mammals (Manton, 1938, Mayer & Tait, 2009). Therefore, one might think that the evolutionary sequence was first to lay eggs (oviparity), then to conserve the eggs inside the maternal body until birth (ovoviviparity) and finally, viviparity with a placenta. However, some species seem to have **regressed** (Reid, 1996) **to adapt to environments with inhospitable climate and scarce food** (Monge-Nájera, Barquero-Gonzalez, & Morera-Brenes, 2019).

We propose here that the **common ancestor** of all extant onychophorans, which first emerged to the mainland in Pangean times, kept its eggs inside the female, feeding them continuously through a very thin shell (matrotrophic viviparism). Therefore, this

mechanism is still common and widely distributed, in both families: **Peripatopsidae** (South Africa, Chile, Papua, eastern Australia), and **Peripatidae** (Southeast Asia) (Figure 1).

Factors not yet studied, perhaps a deficiency of food (Monge-Nájera et al., 2019), favored a **less expensive mechanism for the female**: keeping the egg inside her until hatching, but without providing food constantly (**lecithotropic viviparity**). This occurred early in two lines, which led to the viviparous **Peripatidae** of Southeast Asia, and in the **Peripatopsidae** of Western Australia, Tasmania and New Zealand, ending in some cases, and in those three places, in **absolute oviparity**, in which a hard covering and yolk-rich egg is placed on the ground, and takes several months to hatch (Monge-Nájera et al., 2019).

Finally, the line that would originate the **Peripatidae** of tropical Africa and the Neotropics, in an environment with abundant food and without extreme climatic events throughout the year, could take a step beyond that original **matrotrophic viviparity,** evolving to **placental viviparity** (Fig. 1).

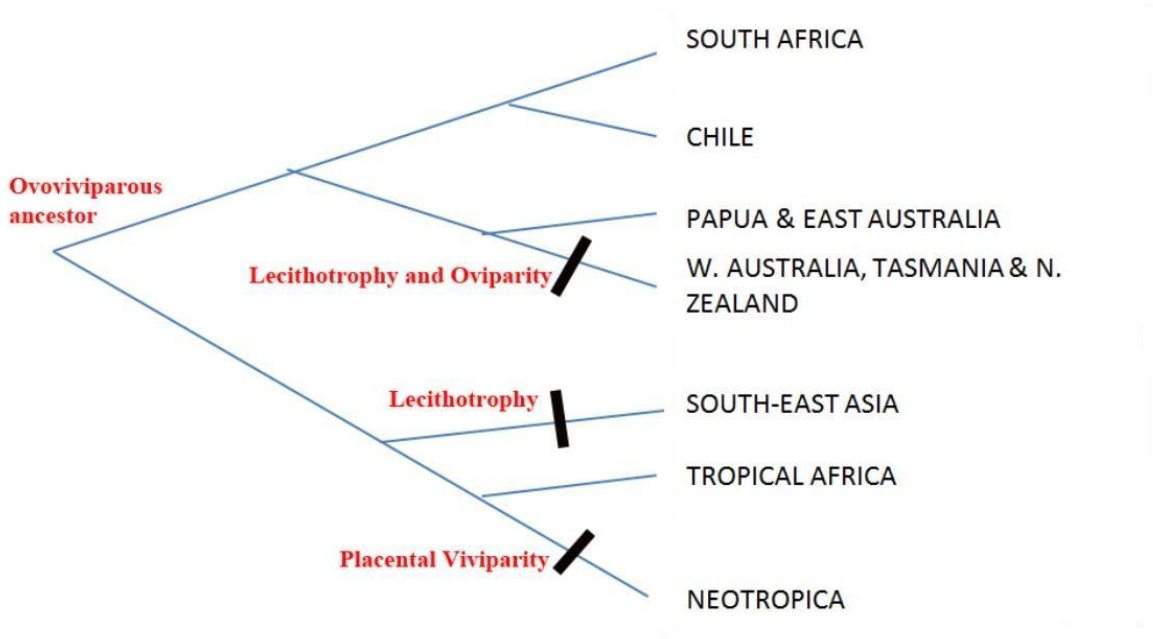

FIGURE 1. **Possible evolution of the reproductive types in onychophorans.**

DNA supports this model, and its beauty lies on its simplicity, because it needs the least amount of "evolutionary reinvention". However, although biologists often use that principle of simplicity or "**parsimony**", possibly derived from **Occam's razor** (“choose the simplest explanation”), the truth is that nature is complex, and onychophorans could still keep some surprises for us.

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