

The miraculous platypus

Roger V. Short

Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne, Vic. 3010, Australia.
Email: r.short@unimelb.edu.au

The platypus, *Ornithorhynchus anatinus*, is surely one of the most amazing animals in the world, and it still has so much to tell us about the whole of mammalian evolution. It is therefore particularly appropriate on the 200th anniversary of the birth of Charles Darwin in 1809 to recall his first encounter with a platypus during the voyage of the Beagle, and show how he was able to use it to support his concept of the gradual evolution of species over time.

The first platypus to come to the attention of the Western world was the skin, and an accompanying drawing of the animal in life, sent by John Hunter, Governor of the Penal Settlement at Port Jackson, Sydney, to the Literary and Philosophical Society of Newcastle-upon-Tyne in 1798. Some of the recipients dismissed it as a hoax – how could you have a mammal with a duck's bill? But Shaw (1799) described it as he saw it, naming it *Ornithorhynchus anatinus* – duck-like bill. It was Home (1802) who provided the first accurate anatomical description of the platypus, showing that, like the closely related echidna, *Tachyglossus aculeatus*, it differed from all conventional mammals in having a single common urogenital opening or cloaca for the passage of both urine and faeces, as in birds. He therefore classified the platypus and echidna as belonging to a new subclass, the Prototheria, in the order Monotremata (having one hole). He recognised that their reproductive tracts were quite unlike those of any other mammal, and more like those of ovoviparous lizards; did they lay eggs? Thoroughly perplexed, he decided to call the platypus *Ornithorhynchus paradoxus* – a bird-billed enigma. He could not even call it a mammal, as he failed to find any sign of that distinguishing feature, a mammary gland, in the one female that he dissected. However, this was soon corrected by Meckel (1824) who was able to dissect a lactating female platypus that had well developed mammary glands. So monotremes were mammals after all.

This set the scene for the young Charles Darwin in his voyage around the world on H.M.S. Beagle. She anchored in Sydney Cove on 12 January 1836. On 18 January he rode out on horseback to a nearby property called Walerawang, and spent the following day with the farm manager and his greyhounds trying to catch a kangaroo, but in vain. Then Darwin records that 'in the dusk of the evening I took a stroll along a chain of ponds, which in this dry country represented the course of a river, and had the good fortune to see several of the famous *Ornithorhynchus paradoxus*.

They were diving and playing about the surface of the water, but showed so little of their bodies that they might easily have been mistaken for water rats. Mr. Browne shot one; certainly it is a most extraordinary animal; a stuffed specimen does not at all give a good idea of the head and beak when fresh; the latter becoming hard and contracted' (Darwin 1839).

This brief encounter must have made a deep impression on Darwin, because in *On the Origin of Species* (Darwin 1859) he

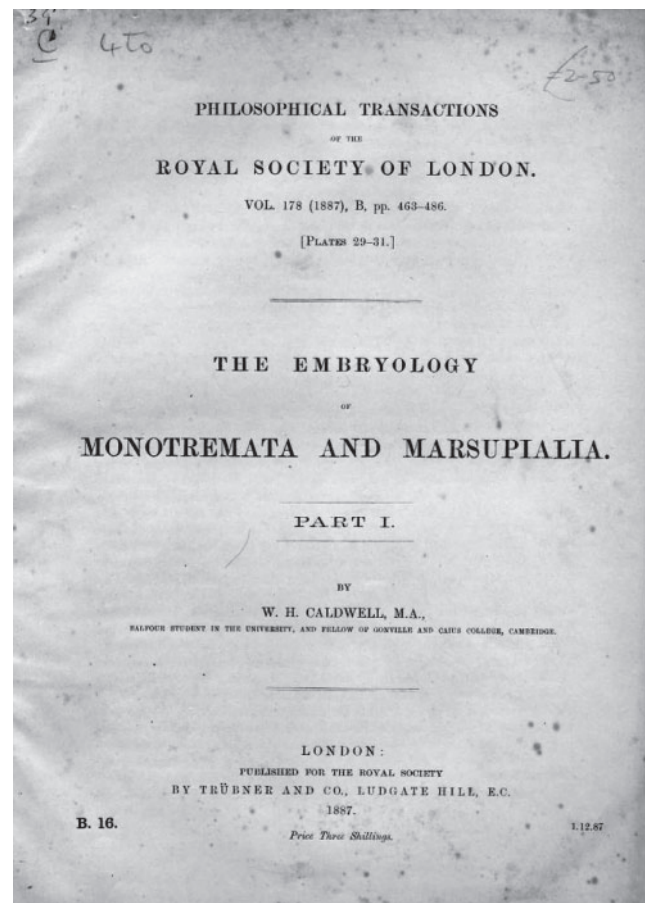


Fig. 1. Caldwell's (1887) first (and only) paper.

This Foreword also appears in the related special issue of *Reproduction, Fertility and Development* 21(8), 2009.

describes how: 'in fresh water we find some of the most anomalous forms known to the world, as the *Ornithorhynchus* and *Lepidosiren* which, like fossils, connect to a certain extent two Orders at present widely sundered in the natural scale. These anomalous forms may be called living fossils; they have endured to the present day, from having inhabited a confined area, and from having been exposed to less varied and therefore less severe competition'.

He then goes on speculate that: 'If the *Ornithorhynchus* had been covered with feathers instead of hair, this external and trifling character would have been considered by naturalists as an important aid in determining the degrees of affinity of this strange creature to birds'.

So what exactly is the platypus – is it fish, flesh or fowl? Could a mammal really lay eggs, as Everard Home was suggesting?

The next stage in this eventful history was when a Scottish biologist, W. H. Caldwell, came to Queensland in 1884 and persuaded the local Indigenous community, for a small fee, to catch echidnas and platypuses for him in large numbers. In the third week of August he found an echidna with an egg in its pouch, and in the following week he found a platypus that had just laid an egg and had another still in the cervix. He was over the moon! Knowing that the British Association for the Advancement of Science was meeting in Montreal in the following week, he sent them a momentous four-word telegram, which was read out to the stunned audience on 2 September: 'Monotremes oviparous, ovum meroblastic' (Fig. 1; Caldwell 1887). (For the uninitiated this means that monotremes really are egg-laying mammals and that the egg itself cleaves only on the surface of the yolk-sac, as in fish, birds and reptiles, but they are unlike marsupials and eutherians that have holoblastic cleavage where the entire conceptus divides.)

And so we come to today. With its genome sequenced, the platypus can take pride of place as a branch at the base of the mammalian evolutionary tree that split off 166 million years ago from the lineage that led to the therian mammals (marsupials and eutherians). The platypus retains several of the reptilian features of its forebears, such as pectoral and pelvic girdles and a leathery egg shell, whereas birds came from flying dinosaurs and their ancestors split off from the amniotes 315 million years ago.

So the platypus is flesh, not fish or fowl. It is certainly not a flat-footed duck, and has no feathers in its cap! It is a one-holed wonder from Down Under, the oldest mammal in existence.

References

- Caldwell, W. H. (1887). The embryology of the Monotremata and Marsupialia. *Philosophical Transactions of the Royal Society B. Biological Sciences* **178**, 463–486. doi: 10.1098/rstb.1887.0016
- Darwin, C. (1839). 'Journal of Researches into the Natural History and Geology of the Countries Visited during the Voyage of the H.M.S. Beagle round the world under Captain Fitz Roy, R.N.' (Reprinted by the Folio Society: London, 2003.)
- Darwin, C. (1859). 'On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life.' (John Murray: London.)
- Home, E. (1802). A description of the anatomy of *Ornithorhynchus paradoxus*. *Philosophical Transactions of the Royal Society of London* **92**, 67–84. doi: 10.1098/rstl.1802.0006
- Meckel, J. F. (1824). Über die Säugethiernatur des *Ornithorhynchus*. *Notizen aus dem Gebiete der Natur-und Heilkunde* **6**, 144.
- Shaw, G. (1799). Platypus anatinus. In 'The Naturalist's Miscellany: or Coloured Figures of Natural Objects Drawn and Described Immediately from Nature'. Vol. 10, June 1799. Fascicle, near plates 385 and 386. (Johann Blumenbach: Abbildungen, Vol. 5, Part 41, April 1800.)