

# Turning denticles inside-out.

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Two thoughts at the beginning of this new year... firstly a **Handsel** to you all, that is an expression of good wishes, a word dating from the 13<sup>th</sup> Century and in Scotland used to describe Handsel Monday -the first Monday of a New Year.. and apparently that was the ONLY holiday of the year for the industrious Scots! But at least they received good wishes too.

So a sincere **Handsel** to start the year!

Secondly , an intriguing paradoxical enquiry on the evolution of teeth...**the Inside-Out or Outside-In dilemma**. Brought to mind by consideration of a paper in this issue which in part explores some of the extraordinarily complex dentition of shark teeth. The question is raised as to whether those shark teeth point towards the evolutionary path leading to mammalian dentition, including of course *Homo sapiens*.

The development of jaws and teeth made a major contribution to the evolutionary success of vertebrates, a fact well accepted and understood. However, considerable controversy perseveres regarding just how teeth actually evolved. The shark could perhaps offer a clue! Amongst its fearsome armaments, this predator has an external integument fully equipped with structures which tear the skins of prospective prey, inducing copious bleeding which then stimulates the shark to attack in earnest. Those integumental structures are denticles, named for their close resemblance to teeth—or is it that the teeth bear a close resemblance to denticles???

That is the essence of the Inside-Out/Outside-In controversy. Did teeth develop as a result of the migration of denticles, ( or denticle like structures), INTO the mouth.. or did teeth develop intraorally as new structures independently? There is certainly circumstantial evidence that teeth and denticles (or scales) share structure and organogenesis and that phylogenetically in vertebrates denticles appeared earlier than teeth. All support for the Outside-In theory. The Inside-Out theory has depended upon evidence that endoderm is required for dental development, that tooth -like structures evolved before denticles appeared and that teeth may have evolved on multiple occasions. Now there are opposing claims, for more recent work has shown that teeth may develop from dermal, endodermal or mixed epithelia. In addition, the pharyngeal “teeth” seen in some fish evolved separately from true teeth. Strong opinions are expressed that ‘odontodes’ were expressed first in the dermal skeleton and that their distribution extended internally through the oral cavity.. and nasal and pharyngeal orifices.<sup>1</sup> In other words, the capacity to develop teeth was transferred from the external dermis to the internal epithelia. Discard the Inside-Out and embrace the Outside-In!! In the long run, the development of internal odontodes, or teeth, and the development of external odontodes or denticle scales, have probably become distinct and separate modules in modern vertebrates.<sup>1</sup>

So while we may view with shuddering horror the bristling teeth in the jaws of the shark, we realise that in fact we are looking at evidence of how **we** have teeth.. and of how our patients have teeth -without which we could not practice!

Exploring a little further the Inside-Out and Outside-In theories it is intriguing to know that explanations of evolution in Biology and in the Galaxy have invoked the theories. Did the eukaryotic cell enjoy an evolution of the nucleus and endomembrane system **within** the cytoplasm of a prokaryotic cell. OR, did the cell extrude membrane arms to encircle ectosymbiotic proto mitochondria and in this way enclose the future cell contents? That would fit the Inside-Out theory.<sup>2</sup>

The growth of the galaxy is being further elucidated by the application of the Inside-Out theory in which bursts of star formation at the centre may be followed, billions of years later, by star birth at the outer edges.<sup>3</sup>

Would it not be wondrous if there is indeed similarity in the manners in which minute cells develop and the limitless galaxy expands?

Evolution is a continuous process... and that continuity is reflected in the Journal for we are scheduled this year to evolve by expanding to some 60 pages of content. The front cover pictures will illustrate aspects of the development of the hominid dentition. The Journal will of course remain an essentially scientific publication but especially now with expanded pages we shall warmly welcome additional clinical content. Reports of clinical cases, observations of clinical presentations, summaries of lectures and seminars will all be considered for publication.

A **Handsel** is also a gift or token for good luck..and the Journal hopes to extend such a Handsel of stimulating reading to readers, and is confident that the Journal in turn will receive the **Handsel** of continued papers from authors.

#### References

1. Donoghue, PCJ, Rücklin, M. The ins and outs of the evolutionary origin of teeth. <https://www.researchgate.net/publication/2655646287>
2. Baum, DA, Baum, B. An Inside-Out origin for the eukaryotic cell. <https://doi.org/10.1186/s12915-014-0076-2>
3. New evidence supports "Inside-Out" theory of galaxy evolution. <https://scitechdaily.com/new-evidence-supports-inside-theory-galaxy-evolution/>



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