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COMMENT ON DENHAM'S DISCUSSION ON E. O. WILSON'S BOOK *GENESIS*.

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This review of Dr Denham's discussion of EO Wilson's concept of "Sociality" brings a stimulating spirit to this journal, likely in the spirit of not only encouraging others to read Wilson's book, but potentially also to stimulate some debate in these pages. Overall, the review is fair, playful and deeply thought.

Firstly, a formal note – early in the review, Denham states that he doesn't review the book – this is not really true, as he does in fact make comments on its readability, content and aims – all basically favourable.

More substantially, the review then draws on some of Wilson's perspectives to make broader points. For example, the review notes that Wilson critiques W.D. Hamilton's work as being incapable of making any prediction. This is a strong criticism, and given the centrality of Hamilton's approach to so much work on sociality, it is important that Denham has commented on the argument. It is reasonable to point the reader to appropriate sources for that argument, but as importantly, Denham observes that Wilson himself makes no predictions in *Genesis*. It is not obvious to me how Wilson can justify the charge against Hamilton, at least to the extent that Hamilton (and others) have defined quite well under what conditions cooperation at least – which seems to me an essential component of sociality – can be expected to survive and/or spread. And, if Wilson also makes no predictions, perhaps it is worth asking whether a theory of sociality should be able to make predictions, and if so, of what sort.

Actual and possible forms of sociality are then outlined and extended – including a suggestion that groups of planets or stars linked by gravity embody a form of sociality. This seems to me almost flippant in order to make a point. My perhaps simple or naïve interpretation of sociality is that it involves some cognitive element or patterns of behaviour, and in effect, a choice – either at some conscious level, or "hard-wired" into evolved behaviour patterns and strategies. If planets or stars are in some way consciously maintaining group cohesion over and above the force of gravity, then describing them as "social" would seem reasonable. Denham provides a perspective on his broad definition of sociality and comments on the undesirability of limiting the definition to living entities (as an extreme example of speciesism). I am not convinced by this perspective, but the proposal is provocative and requires the reader to think more deeply about the nature of sociality. In my case, the term "true sociality" I infer to imply some form of cohesion other than simply co-location.

Denham then discusses emergence in a somewhat idiosyncratic way, with the implication being that the development of some level of order or organisation from something less organised, is emergent. Including natural selection in a list of emergent phenomena is not obvious – natural

selection is automatic wherever there is variation-selection-(imperfect)replication – so perhaps one could say that evolutionary change in gene frequencies over time "emerges" from the combination of variation-selection-(imperfect)replication.

This observation is not a criticism – simply a reflection of needing to think carefully about the meaning of "emergent", and perhaps also of whether it matters whether sociality is emergent or not. More generally, the ways in which a taxonomic tree of sociality is constructed raises interesting questions about what the structural elements of the tree are, in particular taking account of "non-descendant" links through the tree. For this reader, the importance of this discussion is to encourage a much broader perspective on identifying similarities or relationships among different examples of sociality.

Denham's extensive Table 3 is thus a quite detailed expansion of Wilson's stages of sociality, or a considerably enriched application of the idea to the history of life. The intent of this taxonomy appears to be to prompt the reader to think about the different forms of sociality and what generated them: as noted above, to think beyond the usual perhaps low-dimensional approaches to such taxonomies.

Stimulated by reading the review, one way of thinking of sociality is as a form of combination underpinned or guided by some rule or set of rules – which is I think consistent with the Maynard Smith and Szathmary structure. If this is reasonable, then an interesting and perhaps central question is under what conditions is the transition to such new forms or levels of combination inevitable. (In the same way that evolution by natural selection is inevitable wherever there is variation-selection-(imperfect)replication). This is not quite the same thing as saying "under what conditions will cooperation survive or spread", but is analogous to it. For example, something resembling sociality at least metaphorically exists in the enormous seemingly hyper-dimensional interactedness of the genome – which I think can be interpreted to imply that wherever there are units that can interact, some will (as long as there is variation), and there is a chance that such interacting units will be preferentially selected, as long as the interaction is positive for some measure of fitness. The conditions under which group selection can work have been defined, and similarly, the study of epistasis at the gene level is simply the study of the selection of "social" genes ie genes that do something together such that the whole is greater than the sum of the parts.

Denham's material about group selection and following is an interesting discursion, but then hones in on the issue of paucity of data, and its apparent mis-interpretation. This by way of parallel is a widespread problem in relation to epistasis – the evidence required to "prove" its existence can be daunting, and under many circumstances simple additive combination provides seemingly as strong an explanation of observed data. But epistasis can be present and ubiquitous, and still statistically not provable. An important link here is made through the commentary on hunter-gatherers in general and the Alyawarra people in particular. Almost by definition, studies and data derived from such studies are limited on such groups, and this coupled with their usually numerically small populations makes detecting forms of sociality, let alone advanced or sophisticated sociality either very unlikely and/or very slow. However, as Denham points out,

meta-analyses across numbers of such studies keep pointing to deep and important sociality – existing over long time periods, but metaphorically and literally at the edges of our (Western, scientific) detection and comprehension. This points to the idea that sociality may usually seem ephemeral, but that beneath the individual instances or evidences of sociality, at least some species and other populations of interacting entities are in fact "wired" to be social – but potentially in diverse ways within their category. It is the intention to be social that is important, or as important as how the being social is actually manifested.

In the concluding section of the review ("imagining the future"), Denham's point about Wilson implying or opining that evolution has ended brings to mind Steve Jones' (Jones (2009)) dismissal of the argument that evolution in general has ended, which makes clear that such statements imply complete lack of understanding of evolution. If Wilson means that something is the highest point that eusociality can reach, I think one could take that to pieces relatively easily. If it is meant to imply that no higher level of sociality than that exhibited by present humans is possible, that too could be challenged. A set of examples from science fiction suggest that humans can at least imagine higher levels of sociality, and within limits that suggests that they may be possible. Denham's examples under T14 are ways of imagining forms of further evolution of sociality – and all interesting.

The classification of eusociality ie the elements or stages of it, are reminiscent of high school biology definition of life – if these X things are present, then you have life. Of a form. And exceptions to most of critical elements seem to be able to be argued. I was left feeling that rather than defining sociality, what is most interesting are questions such as under what conditions is sociality expected, or inevitable, or will survive; what types of interacting things can we describe as being social, or potentially social, and what would constitute higher and lower forms of sociality (Denham's point about the Alywarra as having sociality without conflict is a nice one – it effectively does define "high sociality").

The review is an interesting and stimulating read. In places the flow of ideas is not simple to follow, but overall it seems that Denham is positive about Wilson's book, and through the review uses it as a launch-pad for an exploration of sociality and extension of thinking on it to some questions or places Wilson does not go.

References

Jones, Stephen, 25 September 2009. Is Human Evolution Over? University of Edinburgh: Enlightenment Lecture Series. https://www.youtube.com/watch?v=XE_Oy1eRyVg