

Considering affinity: an ethereal conversation (part one of three)

Mary P. Winsor*

Professor Emeritus, Institute for the History and Philosophy of Science and Technology, University of Toronto, 550 Spadina Crescent, Toronto, ON Canada M5S 2J9

At the 1843 meeting of the British Association for the Advancement of Science, ornithologist Hugh Strickland displayed a wall chart on which he had written, inside 490 little ovals, the genus names of about half of all the kinds of birds then known. A year later he added all the remaining families of birds. The resulting document, over 2 m long, showed subfamilies as coloured shapes resembling islands in an archipelago, and as in a marine chart, Strickland provided a scale of degrees, the length of the lines connecting genera expressing the strength of their relationship. After his death in 1853, a black-and-white copy of the top segment of the chart was printed in his *Memoirs*. In 1868 over 6000 specimens from his bird collection arrived at the Museum of Zoology of Cambridge University, but the chart did not follow until 1892. There it remained uncatalogued, rolled up, and largely forgotten until 1992, when historian of science Gordon McOuat inquired whether the object mentioned in Strickland's *Memoirs* still existed. Discovered after a search, the chart was found to have suffered damage and become too brittle to unroll. Its restoration some years later was due to the determined efforts of Adrian Friday, then Curator of Vertebrates. In 2012 archivist Ann

Charlton urged me visit Cambridge to see it; Jamie Gundry and I photographed it where it hung, in a storeroom. Today the chart is on public view, for the first time since Strickland exhibited it 170 years ago.

Strickland was one of the zoologists Darwin had in mind when he wrote in his *Origin of Species*, 'Naturalists try to arrange the species, genera, and families in each class, on what is called the Natural System. But what is meant by this system?...many naturalists believe that it reveals the plan of the Creator....'¹ Strickland never read these words, for he died six years before the *Origin's* publication. It is natural to wonder how Strickland would have reacted had he lived to read Darwin's book, but there is not sufficient evidence on which we could base a good answer. On the other hand, we have plenty of evidence to tell us what Darwin would have thought of Strickland's ambitious attempt to portray taxonomic affinity, had he had leisure to consider it carefully.

Let us try to overhear their conversation.²

Scene: A lovely garden, in perfect weather. On a curved marble bench is seated Hugh Edwin Strickland. Enter Charles Robert Darwin ([Figure 1](#)).

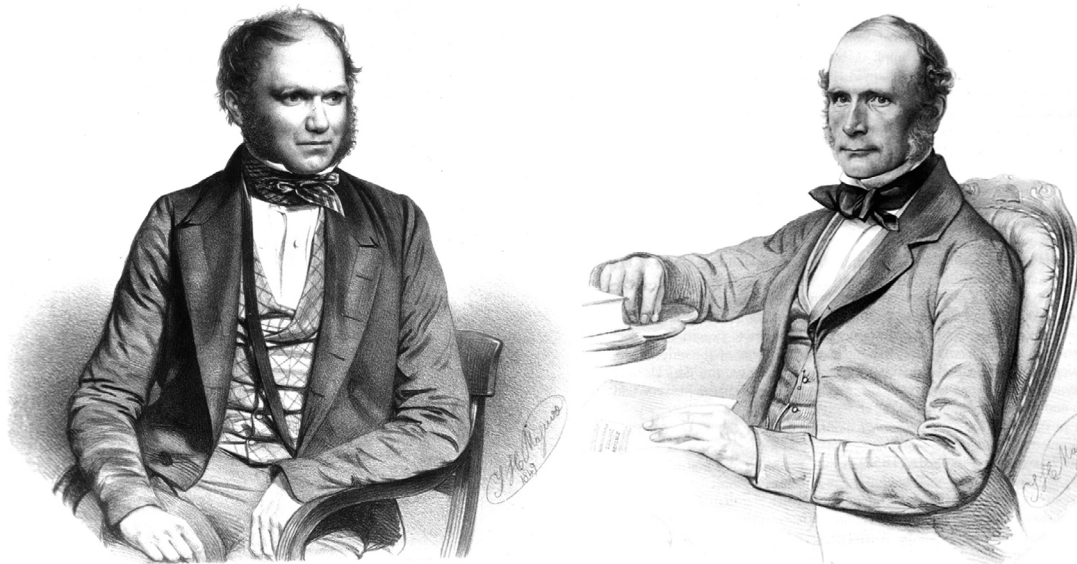


Figure 1. Charles Robert Darwin and Hugh Edwin Strickland in 1849, lithographs by Thomas Herbert Maguire, issued separately in the series *Portraits of the Honorary Members of the Ipswich Museum*.

*Tel.: +1 416 920 8645.

¹ Charles Darwin, *On the Origin of Species* (London 1859), p. 413.

² Although the dialogue is imaginary, all of the facts and ideas mentioned are based on historical evidence. Relevant quotations from the writings of Strickland and Darwin, as well as references to other primary and secondary sources, are given in [Appendix A](#), Supplementary data, and on my website, www.marypwinsor.com. Available online 2 September 2014

STRICKLAND: Oh, bless my soul, if it isn't my friend Darwin! How long has it been, thirty or forty years? You look so much older, but I couldn't fail to recognize that vast forehead and serious eyes. Such a pleasure to see you, do sit down.

DARWIN: The pleasure is all mine, my dear Strickland. Yes, it's well over thirty years, for when you were so tragically killed by a train in 1853, it had already been a long time since you and I had crossed paths.³ My, my, how strangely vivid is this dream I'm having. I can smell every flower in this garden. And how very well I feel, no pain at all, what a relief.

STRICKLAND: I'm happy to inform you, dear fellow, this is no dream. Your spirit is here in this lovely place because it finally did escape your body, well and proper. Let me be the first to welcome you, and may I say, congratulations, for you'll never again have to suffer the least discomfort.

DARWIN: What an extraordinary thing. If I am dreaming, I pray I never wake up, it is so perfectly delightful here. Gracious, look, there's a sparrow bathing in the fountain with no fear of the hawk preening itself close by. It reminds me of the Galapagos, where all the animals were so remarkably tame. And here comes a white terrier, so very like a favourite bitch of mine. Oh my, it's the very one, with that red mark on her back, see how she greets me.

STRICKLAND: My good fellow, I am so happy you have come at last. We can converse to our heart's content about the countless questions in natural history we both loved, with no fear of being interrupted.

DARWIN: I find myself perfectly at ease, so by all means, let us talk. I admired your energy and tact when we worked together back in 1842, drafting a set of rules to govern how animals should be named. That valuable undertaking of yours succeeded in reducing chaos in scientific nomenclature. After that year we saw each other rarely, to my regret.

STRICKLAND: You will surely think me a terrible egotist, but I confess that all these years I've been wondering, what did you think of that enormous chart into which I put so much labour, the one displaying the affinities of birds?⁴ Such fun it was, when

I unrolled it at the British Association meetings at Cork in 1843 and York in 1844, to see our friends' astonished faces. But as far as I can recall, you never told me your opinion of it, or at least, not your full and frank opinion. I have a copy of it right to hand, for I've amused myself here, by writing it out from memory, off and on, a few families at a time (Figure 2).

DARWIN: I well recall that impressive chart, but as you know, I am no ornithologist.⁵ When I stumbled upon a new sort of bird during the *Beagle* voyage, like the small ostrich of Argentina or the mockingbirds and finches on the Galapagos Islands, I never knew if I had a new species, or sometimes even in which genus it belonged. I totally depended on the expertise of Mr. Gould at the Zoological Society when I came home. I have no worthwhile opinion on the classification of songbirds.

STRICKLAND: Come, come, I won't let you duck my question with a show of modesty, surely you know what I mean. The particular genera I was arranging are neither here nor there, my point was, as I stated at the time, I was proposing a new method, one that could be applied to any taxonomic group; fish or mammals would do as well as birds. I was urging upon our fellow naturalists a purely inductive approach.

DARWIN: Yes, I remember that, but I understood that the whole point of the exercise was to demolish quarianism.

STRICKLAND: That misbegotten fad of foolish minds, how I hated it! To imagine that living things naturally fall into parallel groups, exactly five members each, arranged in circles, good gracious (Figure 3). I am still amazed at the zeal with which so many naturalists embraced that fantasy.

DARWIN: The popularity of quarianism was indeed remarkable. Later generations were utterly at a loss to understand how their forebears could have found it so attractive.

STRICKLAND: A student of birds could not avoid that nonsense, for two of the busiest English ornithologists, Nicholas Vigors and William Swainson, pushed it in their publications.

DARWIN: You know it was an entomologist, William Sharp Macleay, who invented it. Perhaps you didn't know that he was a good friend of mine? When I returned from my circumnavigation in 1836,

³ William Jardine, *Memoirs of Hugh Edwin Strickland* (London: John Van Voorst, 1858; Cambridge University Press, 2011); Leendert C. Rookmaaker, *Calendar of the Scientific Correspondence of Hugh Edwin Strickland in the University Museum of Zoology*, Cambridge: University Museum of Zoology, 2010; Janet Browne, *Charles Darwin*, 2 vols. (New York: Knopf, 1995, 2002).

⁴ Biologists who classify living things still use the word 'affinity' much as early naturalists did, to mean the relationship connecting groups in a natural classification, but of course the meaning of 'natural' went through a seismic shift when evolution replaced divine creation.

⁵ Darwin was probably not in the audience when Strickland displayed his chart, but he certainly knew about it, for he wrote on the cover of his copy of Lindley's *A Natural System of Botany* 'Does not Lindley use Diagrams like the maps of Strickland?' Mario A. DiGregorio, *Charles Darwin's Marginalia* vol. 1. (New York: Garland Publishing, 1990), p. 501.



Figure 2. The wall chart titled 'Natural Affinities of the Class of Birds' made by Hugh Edwin Strickland (1811–1853) and displayed at the 1844 meeting of the British Association for the Advancement of Science. He displayed the top portion, his order Insessores, in 1843. Photograph reproduced with the kind permission of the University Museum of Zoology, Cambridge.

Macleay had just settled in London, back from ten years in Cuba. He was a most knowledgeable zoologist, delightful conversationalist, and remarkably modest about his ideas. I took the trouble of

borrowing from the library of Cambridge University his two-volume book.⁶

STRICKLAND: It was impossible to buy it, as I remember, most copies having been destroyed

⁶ William S. Macleay, *Horae Entomologicae*, parts 1 and 2 (London, 1819–1821).

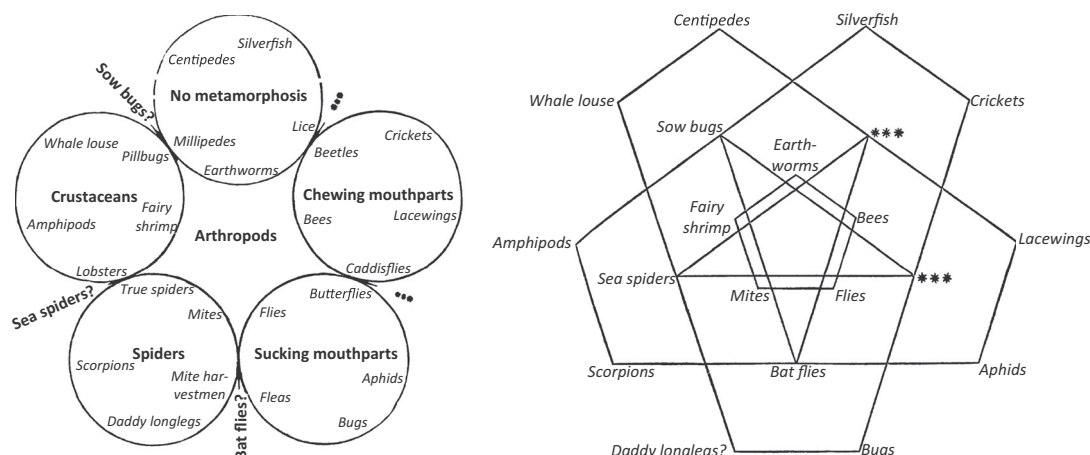


Figure 3. Arthropod relationships according to William Sharp Macleay, redrawn from his *Horae Entomologicae* (London, 1819), p. 390 and p. 395, with English examples in place of his scientific names of groups. The diagram on the left shows affinities, the one on the right shows analogies.

in a fire before they reached the book-sellers.

DARWIN: I found his work so interesting that I had my servant copy out many passages I thought useful.⁷ In 1838 Macleay sailed off to Australia, where ten years later, my young friend Thomas Huxley quite fell under his spell. I never enjoyed hearing an ill word said of Macleay.

STRICKLAND: I have no grudge against the man. Anyway, destroying quinarianism was not the chief reason for my chart. By 1840 few of the people I respected took that system seriously. Do you imagine that I could have written out, in tiny script, the names of 490 birds to quash an idea already in decline? God save the mark! You cannot imagine how many hours I spent creating my chart.

DARWIN: You can say now, with the benefit of hindsight, that Macleay's system was doomed, but I think at that time it was still influential. Don't you recall that disgraceful book, *Vestiges of the Natural History of Creation*, that got all and sundry excited about transmutation? Its anonymous author treated quinarianism as established fact. You made no secret of your wish to show the fundamental unsoundness of Macleay's principles, nor of your satisfaction that your enormous diagram contradicted them.

STRICKLAND: It's true. In the paper in which I first announced my idea of mapping bird relationships, three years before unveiling my chart, I included both direct

and indirect attacks on Swainson's quinarianism.

DARWIN: That was in your paper called 'On the True Method of Discovering the Natural System'?

STRICKLAND: Exactly so. I am greatly flattered that you should recall it.

DARWIN: With such a title, it could not fail to seize my attention.

STRICKLAND: I read it at the British Association meeting in Glasgow in 1840, and it speedily came out in print. I hope you recollect that it made clear that my primary purpose was to promote the inductive method.⁸

DARWIN: Indeed, but I see a certain irony there, for Macleay always said his work began from a discovery he made purely by accident, by induction from facts rather than deduction from a theory. That claim surely helped attract people to his system.

STRICKLAND: Quinarianism was nevertheless an outrageous tissue of hypotheses and speculation. The idea that God had arranged living things geometrically, the way He arranged the planets, led these men to squeeze and press old groupings of birds into new groups of five. Oh, dear, it has been so long since I have had to revisit this topic. To be fair, I suppose it had the virtue of making classification a lively subject of conversation.

DARWIN: I agree with you on both points. The pack was in full cry but on a false scent. You said at the time, if memory serves, that we are indebted to Macleay for giving us

⁷ Darwin made a thorough study of Macleay's book, and he found there a great deal more food for thought than the circles of affinity. Mario Di Gregorio, 'The uniqueness of Charles Darwin: His reading of W. S. Macleay's *Horae Entomologicae*,' *Historical Record of Australian Science* 11 no. 2 (1996): 103–17.

⁸ Whether science should follow Francis Bacon's inductive method or must include a deductive element, exemplified by Isaac Newton, was a hot debate in the early BAAS. Jack Morrell and Arnold Thackray, *Gentlemen of Science* (Oxford: Clarendon Press, 1981), pp. 267–76.

the first clear definition of analogy and affinity.⁹

STRICKLAND: I did say that, and I stick by it, even though Mr. Owen rapped me on the knuckles for suggesting that some of the credit for this crucial distinction belonged to naturalists working on taxonomy rather than to comparative anatomists like himself.

DARWIN: I think he felt you had invaded his domain – the study of form, or morphology. He had been promoting the old anatomists' idea that parts of animals, like bones or organs, should be given the same name, or not, according to strict standards of comparison. He urged that the word 'analogy' be limited to the function of an organ, as the wing for flying, and the word 'homology' be used when parts seemed to be structurally the same. It was rather a separate world, for morphologists worked in medical schools, teaching anatomy. Many serious botanists and zoologists were satisfied to compare specimens without dissecting them, and they used the word 'affinity' thinking of the similarity between entire creatures, not parts. Yet the subject was plagued by confusion, men of all stripes using words carelessly.¹⁰ I do know that Owen had considerable respect for Macleay's taxonomic judgement. A few years after your death I published a book called *On the Origin of Species*, and there I echoed your statement that Macleay deserves credit for the distinction between affinity and analogy.¹¹ The first to call attention to this very important idea was Lamarck, I believe.

STRICKLAND: You surprise me. Macleay and all his followers hated Lamarck's ideas of transmutation.

DARWIN: As I understood it, Lamarck's primary tendency was an ever-present power forcing progressive change, each species differing only slightly from the next in a series.

STRICKLAND: Of course, this linear affinity came straight from the old great chain of being; he merely turned it on its head, to run from simple to advanced instead of the old idea that we are at the top.

DARWIN: It was a radical claim indeed, to say that simple bits of living matter originated spontaneously and would transform over time into complex ones when left to themselves. But he knew perfectly well that all the best botanists and zoologists had shown, time and again, that natural affinities do not run in single straight lines, so Lamarck posited a second tendency, shoving living things off to the side, complicating the chain. That force was adaption, the ability of life to react to the demands of the environment.

STRICKLAND: The quinarrians' view of affinity obviously contradicted Lamarck's, for instead of long series of progressive change, their lines of affinity were only five units in length, each line bent around to make a circle, utterly unlike a continuous chain, or even a branching one. But I cannot agree with your lumping Lamarck's notion of adaptation with the analogies so dear to the quinarrians. These giddy gentlemen allowed almost any peculiar resemblance to count, without limiting themselves to features we would call adaptive. Their comparisons were sometimes quite absurd. I remember Swainson sketching a woodcock's bill to show it resembles a rat's muzzle. And he said birds are analogous to butterflies, because both are winged.

DARWIN: Now, now, where is your charity, can you not grant those comparisons?

STRICKLAND: You are making sport of me. Of course anything is allowable in poetry, but at the crux of their system was the claim that their circles of affinity stood in parallel to one another, tied together by these analogies like a complex piece of machinery (Figure 4). They said that such parallels prove that nature is not the result of blind forces, as Lamarck claimed, but could only be constructed by a clever, creative Mind. To me it was obvious that the only clever mind at work in their systems was their own unfettered imagination.

DARWIN: I remember that the quinarrians often showed these two kinds of relationship by means of complicated diagrams, rather than just stating their views in words, as taxonomists normally do. I wonder if their example was what gave you the idea that affinity could be displayed by a network of lines.

⁹ Hugh E. Strickland, 'Report on the recent progress and present state of ornithology,' *Report of the British Association for the Advancement of Science* 14 (1845): 170–221, p. 172. This article and most of Strickland's other articles may also be found in Jardine's *Memoirs*.

¹⁰ Ingo Brigandt and Paul E. Griffiths, 'The importance of homology for biology and philosophy,' *Biology and Philosophy* 22.5 (2007): 633–41; I. Ya. Pavlinov, 'The contemporary concepts of homology in biology: A theoretical review,' *Biology Bulletin Reviews* 2(1) (2012): 36–54.

¹¹ In the twentieth century, biologists routinely defined affinity as resemblance due to descent from a common ancestor, while similarities that had been acquired independently, by adaptation, were merely analogous. Like separate travellers who converge on the same goal, the sightless ancient ancestors of vertebrates and of mollusks both invented excellent eyes, but differences in structure are evidence that the inventions were independent, so these organs are not homologous. Modern systematists call the result of such convergent evolution 'homoplasy'. Ancestry cannot be observed, however, only inferred, so disagreements abound where evidence is ambiguous.

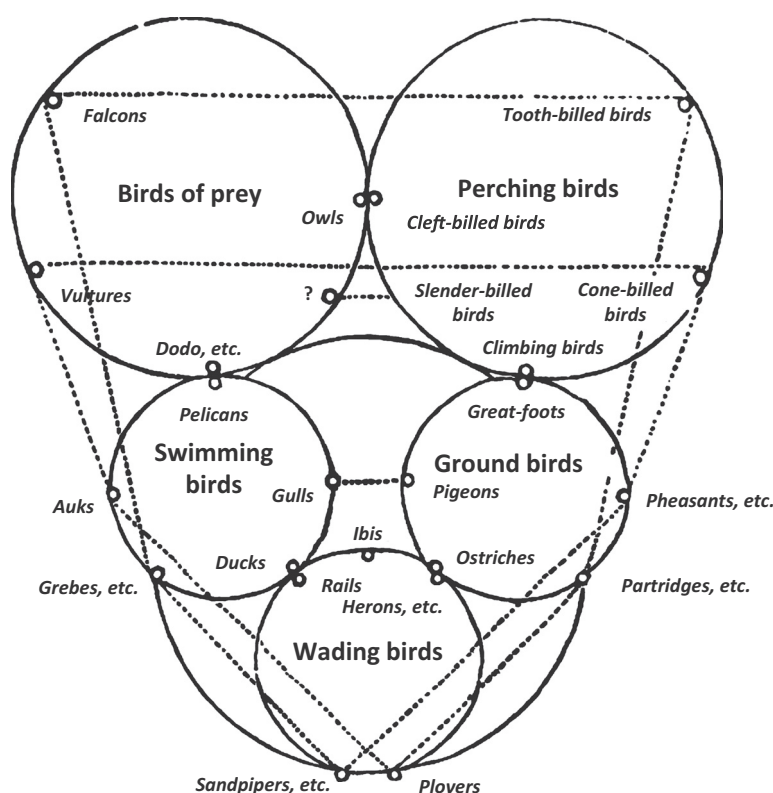


Figure 4. Relationships of birds according to William Swainson, redrawn from *On the Natural History and Classification of Birds* (London 1837, vol. 2, p. 200) with English examples in place of his scientific names of groups. The curved lines in his diagram are affinities, the dotted lines are analogies.

STRICKLAND: As a matter of fact, your guess is quite correct. Yet of course my approach was entirely different from theirs. Their diagrams all displayed mathematical regularity and symmetry, circles and straight lines, while I was sure that natural relationships would prove to be as irregular as a coastline.

DARWIN: What made you so sure of that? The quinarrians drew inspiration from the fact that planets trace out elegant mathematical orbits.

STRICKLAND: Plants and animals don't live in the sky. Their Creator made them so that they would fit perfectly within local climates and soils on Earth, and those are notoriously irregular things.

DARWIN: We can agree that the quinarrians' parallel circles are false but still profit by considering the distinction between close resemblances and remote ones. Never mind Swainson, his absurdities were easy to dismiss. But Westwood, curator of the Entomological Society of London, was a sober taxonomist whom I greatly respected. He wrote a little paper suggesting that the difference between analogy and affinity was merely the number of points of resemblance between two forms. He was departing from Macleay, who said analogy was a

different sort of thing from affinity. Westwood said the same feature could be either an affinity or analogy depending on the taxonomic level of your comparison.¹²

STRICKLAND: The poor man had obviously fallen into deeper philosophical seas than he had skill to swim in. Starting from Swainson's comparison of the flycatching swallow to the flycatching goatsucker, he offered us two other creatures that catch flies on the wing: the bat and the dragonfly. His proposal that every character was essential fairly made my blood boil. I instantly dashed off a fierce reply.

DARWIN: Fierce it was, I was surprised. Westwood was merely making a point I thought most naturalists would agree on, that we can only judge a character's taxonomic usefulness by comparing similar forms, not by imagining its meaning by itself. You insisted that affinity refers to essential resemblances, while analogies, because they are unessential or

¹² John Obadiah Westwood, 'Observations upon the relationships existing amongst natural objects, resulting from more or less perfect resemblance, usually termed affinity and analogy,' *Magazine of Natural History* n.s. 4 (1840): 141–44. Westwood's proposal somewhat presaged the twentieth century programme called pheneticism or numerical taxonomy in which each character has equal weight. The argument continues to this day. See Beckett Sterner, 'Well-structured biology: numerical taxonomy's epistemic vision for systematics,' in Andrew Hamilton, ed., *The Evolution of Phylogenetic Systematics* (University of California Press, 2014), pp. 213–44.

accidental, should have no place in a natural classification.¹³

STRICKLAND: Exactly so. And I was encouraged in this view when I happened to look closely at an article Edward Blyth had published a few years earlier. His views were similar to mine.

DARWIN: I know they were, for I read his every word with care. The ultimate meaning of the resemblances among living things interested me intensely at the time. Over twenty years later, while composing my book on species, I reviewed my notes from those days. Back in 1838 one statement of Owen's had struck me as so interesting that I quoted it in my book. He had dissected a carcass that a gentleman out in Penang shipped to the Zoological Society, a pickled dugong, no less.

STRICKLAND: Oh, good gracious, isn't that a mythical creature, somewhat like a mermaid?

DARWIN: Come now, I'm sure you know that dugongs are real animals, although never seen near our shores. They are called sea cows, an apt term because they are mammals and graze peaceably on sea-grass. They have paddles instead of front legs, and no hind limbs at all, just a broad flat tail. Owen declared that sea cows should be classed with rhinoceroses and elephants, rather than where Cuvier had placed them, with whales and porpoises.

STRICKLAND: It's odd how some people, even naturalists who should know better, confuse a thing's name with its definition. I remember the entomologist Newman saying that since mammals are quadrupeds, which means four-footed, whales cannot be mammals.¹⁴

DARWIN: Did he indeed, how long ago was that? Linnaeus in the eighteenth century included whales, porpoises, and sea cows in his class Mammalia.¹⁵

STRICKLAND: Nor was he the first. Their live birth and suckling of young made John Ray in the

seventeenth century, Albert the Great in the Middle Ages, even old Aristotle, recognize the affinity of marine mammals to land animals like dogs and horses. It is quite irrelevant that whales are still called great fish by ignorant folk. Newman's absurd complaint was in 1833, while you were abroad. I lost no time contradicting him. The number of limbs is obviously of less physiological value than organs of respiration and reproduction.¹⁶

DARWIN: Newman did not enjoy our advantages, neither in education nor leisure; he left school to earn a living. His love of natural history was commendable. I must admit that ranking the relative value of taxonomic characters implies some criterion that has always eluded my understanding.

STRICKLAND: Don't worry, my remarks against Newman were models of tact. How on earth did we get onto this topic? Oh, yes, the dugong. I've certainly never seen one, have you?

DARWIN: I have never laid eyes on one myself, but I understand it is quite an ugly animal, with a blunt face like a walrus. There was a picture of one in the encyclopedia we had aboard the *Beagle*. (Figure 5) A giant species used to live in the North Pacific, discovered by Bering's eighteenth-century voyage of exploration, but sadly it was soon exterminated. There are sea cows called manatees on the east coast of the Americas, but the *Beagle* never encountered one.

STRICKLAND: Owen claimed dugongs should be classed with elephants, you said?

DARWIN: Following the lead of Henri de Blainville.

STRICKLAND: Aha, that brilliant anatomist, appointed to Cuvier's chair after his death in 1832.

DARWIN: And who had shown himself to be a bold and independent thinker long before that.

STRICKLAND: So, since walruses and sea lions are classed with true lions in Carnivora, now we have marine mammals scattered into three different orders: Carnivora, Cetacea, and Pachydermata. Doesn't it give one the feeling that these animals were created expressly for the purpose of demonstrating the futility of rational classification!

DARWIN: It is so inconsistent with common sense that I regard it as evidence that natural history has achieved maturity. In my species book I wrote, 'No one regards the external similarity of a mouse to a shrew,

¹³ Hugh Strickland, 'Observations upon the affinities and analogies of organized beings,' *Magazine of Natural History* n.s. 4 (1840): 219–26. Strickland defined affinity as 'the relation which subsists between two or more members of a natural group, or in other words, an agreement in essential characters.' [his italics] *ibid.* p. 221; Jardine *Memoirs* p. 402. It has been claimed that 'essentialism,' a philosophy traceable to Plato, contributed to naturalists' resistance to evolution, but Strickland's concept entirely depended upon the post-Linnaean concept of taxonomic groups, which grew out of an inductive rather than a deductive approach to classification.

¹⁴ Harriet Ritvo, *The Platypus and the Mermaid and other Figments of the Classifying Imagination* (Harvard University Press, 1997), pp. 11–38.

¹⁵ In the 10th edition of *Systema Naturae* of 1758, which zoologists used as the starting point for naming, Linnaeus put the only sea cow he knew, the manatee (*Trichechus manatus*) next to elephants in his mammalian order Bruta, probably because he used the absence of front teeth as a character; he put whales and dolphins in the mammalian order Cete. However, in the previous edition Linnaeus had put whales in his class Pisces, noting that they had the structure of mammals but the life-style of fish. This should remind us that Linnaeus stated explicitly that in his classification, only species and genera were natural, while classes and orders were artificial. D. Graham Burnett, *Trying Leviathan* (Princeton University Press, 2007), pp. 10–14, 62–6.

¹⁶ Edward Newman, 'Observations of the nomenclature of divisions in systematical arrangements of the subject of natural history,' *Magazine of Natural History* 6 (1833): 481–5; Hugh Strickland, 'Observations on classification, in reference to the essays of Messrs. Jenyns, Newman and Blyth,' *Magazine of Natural History* 7 (1834): 62–4.



Figure 5. Dugong and dolphin from an encyclopedia carried aboard the *Beagle*, *Dictionnaire classique d'Histoire naturelle* (ed. Bory de Saint-Vincent, Paris, 1831, vol. 31, p. 141). The dugong image was copied from Everard Home, *Philosophical Transactions of the Royal Society of London* 1820, pl. 25. By permission of the Thomas Fisher Rare Book Library, University of Toronto.

of a dugong to a whale, of a whale to a fish, as of any importance.' Those external similarities are all analogies.

STRICKLAND: How greatly a ferocious little shrew differs from a mouse is known to any farm child, but there must be many respectable city folk who don't know the difference, so obviously when you said no one is misled by their similarity, you didn't mean no human being.

DARWIN: I hope it was clear I meant no respectable naturalist.

STRICKLAND: And the dugong's similarity to a whale, surely you didn't mean to insult the

memory of Cuvier, who called them both cetaceans?

DARWIN: Certainly not. I meant only well-informed naturalists in 1859. The taxonomists of my acquaintance had immediately accepted Owen's opinion that the dugong is a pachyderm. That chapter in my book was a sort of review of how scientific classification was done, so my reference was to people whose opinions matter, to competent systematists.

STRICKLAND: My, my, how that brings back memories. When we worked on that nomenclature committee, you and I, we were forced to

accept that in the present state of knowledge, we could not construct firm definitions of species and genera. We decided that what should govern the naming of species and genera is the judgement of competent naturalists, rather than a definition.¹⁷ I say, isn't it time for tea? Ah, here they come with it now.

DARWIN: With my favourite sandwiches, how delightful. I must apologize for having dragged us so far from your remarkable chart, but I recall why I did. When you wrote against Westwood, I was very struck by the fact that you used the same language Owen had used. He said that in classification we must not confuse a 'merely adaptive character' with an 'essential character'.

STRICKLAND: I certainly agree with that, though I must not say 'great minds think alike' or risk immodesty. Owen was widely admitted to be England's greatest anatomist.

DARWIN: He was an enormous help as well as inspiration to me, when I settled in London upon the *Beagle's* return, and I admired him greatly. For the dugong, Owen claimed that reproductive organs give a clear indication of an animal's true affinities because they are not linked to its means of getting nourishment. I certainly understood what you both meant when you used the word 'essential', that some features supply us with a good indications of true relationships while others are secondary or even misleading. Nevertheless, I could not help but think that all features of an organism must be both adaptive and essential. If you were a dugong, your teeth for munching vegetation and your tail for swimming would doubtless feel quite as much a part of your fundamental nature as details of your male organ. What entitles a naturalist to decide that some features are essential while others should be ignored as mere analogies?

STRICKLAND: I gave considerable thought to exactly this question, and I confess I'm rather proud of my answer. We know with certainty the ultimate cause of all living things: they were willed into existence by the Creator, even though the means by

which He chose to do this is still obscure to us. It is evident that He intended to fill the world with endless and beautiful variety. It is equally evident that He has chosen to subject organic beings to the same laws by which He governs the inorganic world. Animals and plants must be adapted to things like sunlight, rocks, and water. My favorite illustration of this is that any animal that must move quickly through water, whether a cuttlefish, a penguin, or a diving beetle, must have a shape like the hull of a boat. Macleay's system pays special attention to analogies like this, the fusiform shape shared by a mollusk, a bird, and an insect, animals otherwise remote in their affinities. Yes, the shape is a real feature, quite important to its possessors, but we ought not use an analogy like that as a taxonomic character when we build a natural system.

DARWIN: I don't see on what grounds you exclude it.

STRICKLAND: The issue is comparable to the moral distinction we find in Aristotle. He taught his son Nicomachus to distinguish between a good act done by a person forced to do it by some circumstance, in contrast to the good act a virtuous man chooses to do even though he doesn't have to. Aristotle called that principle *prohairesis*, which means acting deliberately.¹⁸

DARWIN: I take you to be saying that the Creator exercised His free will in giving to cuttlefish and squid characters proper to the cephalopod class of the molluscan type, such as their soft bodies, large eyes and parrot-like beaks, but once He decided to make them swim like a fish instead of creep around like an octopus, He was forced to give them a fusiform shape.

STRICKLAND: My meaning exactly.

DARWIN: I have an uneasy feeling we have wandered outside the purview of science.

STRICKLAND: To me, the true naturalist is a man who feels veneration for the Creator and delights in tracing His handiwork. Nevertheless, I understand your unease. After all, it was the references to divine intention that had so bothered me about the quinarrians. There was Swainson saying with a straight face that the long tail of horses symbolically represents the tail of a peacock, and that hummingbirds have small eyes because pigs do! The idea

¹⁷ 'Nature affords us no other test of the just limits of a genus (or indeed of any other group), than the estimate of its value which a competent and judicious naturalist may form.' Strickland 'Report on the recent progress,' p. 218. Darwin made the same appeal to expertise at the species level: 'Hence, in determining whether a form should be ranked as a species or a variety, the opinion of naturalists having sound judgement and wide experience seems the only guide to follow.' *Origin*, p. 47. Darwin's sentence has often been cited as proof that he did not believe in the reality of species, but James Mallet refutes this in *The Cambridge Encyclopedia of Darwin and Evolutionary Thought*, ed. M. Ruse (Cambridge University Press, 2013), p. 110.

¹⁸ What Strickland wrote was that '...relations of analogy are not to be regarded as affording any evidence of προαίρεσις, or intention, in the scheme of creation...'. Strickland, 'Observations upon the affinities' p. 224. Aristotle's *Nicomachean Ethics*, Book 3 chapter 2, was likely Strickland's source for the Greek, although Aristotle was discussing human behaviour, not God's.

that a feature of one creature is there not for its own sake but to imitate or represent a feature of some other quite unrelated animal is surely preposterous. A childish idea, one which derogates the Divine Power.

DARWIN: A feature of one animal created for the purposes of representing a feature in another...but isn't that exactly what Owen said homology was? The small, useless splint bones in a horse's leg are rudiments of our metatarsal bones.

STRICKLAND: Certainly not. Organs that are homologues are ones that correspond, between creatures belonging to the same type, or what he called archetype. One is not made for the sake of representing the other, rather, both are constructed on the same plan.

DARWIN: Those words puzzle me. My young friend Huxley scoffed at Owen, saying the archetype was a warmed-over Platonic idea, unworthy of modern science, yet Huxley seemed content with a metaphor, pointing to the ground-plan an architect makes for a row of houses that will be similar but not identical.

STRICKLAND: It would be impossible to think about the Creator at all if we did not allow ourselves metaphors. But as to the method proper to science, I composed my 'True method' paper with Whewell's recent volumes on inductive science at my elbow. You read that great work of his too, I know, and we tried to get him to help us with our nomenclature committee, but he declined; he said he had already put into print whatever he knew about the principles of naming.

DARWIN: Which was probably quite true. He never claimed to be a naturalist himself. When he was appointed professor of mineralogy at Cambridge, he probably couldn't have told a rock made of basalt from one of granite, but he quickly got up the subject from reading. I thought that his comments on botanical and zoological classification, past, present, and future, were perceptive. Yet many naturalists didn't find time to read Whewell.

STRICKLAND: I'm sure you're right, but then again, I think men are born with different temperaments. A skilled woodcarver who can create a beautiful mantelpiece may not be able to put into words how he does it. Some of the best taxonomists are like that; give them a strange plant from the colonies and they can guess where it should be classified, and their guess is afterwards confirmed by microscopic inspection of its flower. If you ask them

their method, either they cannot answer, or you can tell that they were not following their own rules. Whewell said they were employing a 'sort of latent naturalist instinct,' a good description.

DARWIN: All very true, yet it doesn't satisfy me. When I read that, I was sure it signalled our serious ignorance about an important subject. Naturalists observe that living nature is shot through with a maze of resemblances, but what causes them?

STRICKLAND: I didn't consider it my job to worry about questions that are probably not answerable. As Bacon showed, the bedrock of science is the collection of facts, avoiding bias or hypotheses. For me, the task of the zoologist or botanist is simply to record the living world, much as a surveyor does when he makes a map of a new continent or ocean. He is judged by the accuracy of his observations and is not expected to speculate about causes.

DARWIN: That was certainly how Captain FitzRoy understood the *Beagle's* mission, charting coastlines for the benefit of future sailors, and it's doubtless how Her Majesty's government views geological map-making. But I'll never forget how thrilled I was, quite beside myself, truly, when I first read Lyell's *Principles of Geology*. He led me to see valleys and cliffs and rocks not as part of a permanent landscape, but as things that could be explained, phenomena with a history, a history that could be reconstructed by thoughtful extension of the processes we can observe in the present day.

STRICKLAND: Yes, Lyell deserved our admiration, but he didn't invent that way of thinking. When I travelled across the Auvergne region of France in 1835, I carried with me Scrope's excellent book, which showed how volcanoes at different periods had created rock, and then rivers had cut channels through it.

DARWIN: Somehow we keep wandering away from your great chart of the birds. I had not realized it was Westwood's innocent little paper that aroused you to action. What so offended you about it? He merely suggested that we count the number of features shared by two forms. If they share a great many characters, we put them in the same genus. He called that the first degree of affinity; his second degree of affinity is when there are not quite so many characters in common, so the species are in the same family but different genera. At the other extreme, two forms with only one character in common exhibit, in Westwood's formula,

the first degree of analogy. The affinities of the dragon-fly lie with other insects, and the bat's affinities lie with mammals, so the single resemblance of their mode of feeding we call analogical. He never mentioned what may have been in the Creator's mind.

STRICKLAND: You cannot be serious. You must be playing the Devil's advocate in pretending to like Westwood's idea. I am sure you understood as well as I did that a natural classification must use only essential characters and exclude all other resemblances.

DARWIN: Come now, you must see as well as I do that it depends upon how one decides which characters are essential and which are not. And you have quite neglected the apparent paradox that the same character is an analogy from one perspective and an affinity for another.

STRICKLAND: For example?

DARWIN: The fusiform body and fin-like front limbs of the whale are, we agree, merely analogues in relation to fishes, but they belong in the long list of characters that make the sperm whale, beluga, killer whale, and porpoise resemble one another, so those same characters, in relation to the cetacean order, count towards their affinity. As long ago as 1837 I had concluded that what naturalists were seeking, in our search for what we called the natural system, were in truth real genealogical connections, stretching back in time to common ancestors that lived countless ages ago. For me the only difference between a '*merely* adaptive' and an '*essential* character' was whether it had been acquired in the recent past or in the distant past.

STRICKLAND: I am astounded to learn that you believed in transmutation.

DARWIN: I confided my views to several close friends, including George Waterhouse and Joseph Hooker, but I knew that my reputation as a sound naturalist would be at risk if I proclaimed support for a theory so greatly at odds with the

orthodox view. For many years I gathered my evidence quietly, although my keen interest in the distinction between varieties and species was widely known.

STRICKLAND: I'd be most interested to hear what evidence you managed to gather, for although I knew that the identification of species was often difficult, I never saw reason to doubt that there are strict limits to their plasticity.

DARWIN: I'll be glad to take you through my entire mental warehouse of facts and arguments in support of transmutation, but there is plenty of time to do that later. For now, let us continue exploring this difficult topic of essential characters, for it is part and parcel of the idea of taxonomic affinity, which was certainly at the core of this remarkable chart of yours.

Acknowledgements

I am greatly indebted to the many people who have patiently assisted my research on the Strickland chart. Gordon McOuat called the object to my attention and stimulated my interpretation of its meaning. Ann Charlton, Archivist of Cambridge University's Museum of Zoology, welcomed my inquiries, urged me to visit, and encouraged my research far beyond the call of duty. Jamie Gundry generously provided me with the high-resolution image that made possible my close study of the chart. Paul Brakefield, Director of the Museum, arranged for a new colour image of the chart and granted permission to publish it. The hospitality of Peter Bowler and of George and Heather Fussey made my visit to Cambridge possible.

My work was encouraged, inspired, and materially assisted by three students at the University of Toronto's Institute for the History and Philosophy of Science and Technology: Jennifer Coggon, Craig Knox, and Ari Gross. Special thanks are due to Dr. Gross for his skilful management of images.

At key moments I was given invaluable words of advice by Christie Henry and Audra Wolfe. Daryl Domning shared with me his expert knowledge of Sirenia. His comments on the whole draft were helpful, as were comments from Herbert Odom, Jennifer Coggon, Lynn O'Leary, Peg Winsor, and William Leach. I am especially grateful to Tania Munz for her advice and support.

My understanding of issues in the history of systematics has benefitted from conversations with Joel Velasco and David Lindberg.

I thank also the many others who have assisted me, while sincerely apologizing for not mentioning them by name.

What emboldened me to eavesdrop on departed spirits was the faith of my late cousin Nadia Williams and the stunning example of Patrick O'Brian.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.endeavour.2014.06.002>.