

Considering affinity: An ethereal conversation (part three of three)

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(We resume our eavesdropping on a conversation between Hugh Strickland, who died in 1853 at the age of 42, and his near contemporary Charles Darwin, who has joined him in the afterlife in 1882. Finally free of life's cares, they can enjoy a relaxed discussion of a concept in which both men are deeply interested, the relationship that taxonomists, then and now, call affinity.)

DARWIN: Now, now, my dear fellow, I hope you were not offended by my objection to your claim that your method was pure induction. I did not mean it as a criticism, far from it, please take it as an appreciation. I consider the interplay of fact and hypotheses to be essential to scientific progress¹.

STRICKLAND: The progress of knowledge was of course what we all fervently desired. Discovering the natural system was a challenge not to be met with wild imaginings but by patient study, assembling that great edifice brick by brick.

DARWIN: I have enormous respect for the labours of a plain taxonomist. He is like the workman bearing a heavy load, a humble hod-carrier in that worthy endeavour, of which your 1843 chart was a fine expression.

STRICKLAND: Thank you for those kind words. My chart was greeted with sufficient approval at the Cork meeting of the British Association that I determined to press on with the project.

DARWIN: Surely you had already proved your point with your nearly five hundred genera?

STRICKLAND: Nevertheless, I did not stop there. This chart you have been so kind as to inspect contains only the Insessores, the largest of the four orders of birds, covering about half of all birds². I made a rough map of the other three orders in time for the British Association meeting held in York the next year. See, I have a copy of it here. I drew this from memory to amuse myself.

DARWIN: Oh ho, I was wondering about that other long roll of paper at your side.

STRICKLAND: Here, I'll unroll it.

DARWIN: Ah, I see, the remaining bird families (Fig. 1).

STRICKLAND: Now, old friend, if you will assist me, I shall replicate what I did back in 1844. Here, be so kind as to hold that edge steady. We start by gluing these two sheets together, like so.

DARWIN: Nothing like a good pot of paste and a pair of sharp scissors for the advancement of knowledge. Strickland, you are a man after my own heart. How much snipping and rearranging of papers I did in my study! Look, though, we must alter your chart's title, which reads 'Natural Affinities of the Insessorial Order of Birds.'

STRICKLAND: Nothing simpler, we just take a strip of paper, thus, covering the words 'Insessorial Order,' substituting 'Class' (Fig. 2).

DARWIN: So now we have before us what you displayed in 1844?

STRICKLAND: Not quite yet. I must add a bright blue line around the insessorial order, as I have on the other three orders. There, done.

DARWIN: I notice that this time you limited yourself to subfamilies, families and tribes. You no longer supplied cartouches containing names of genera.

STRICKLAND: Yes, I trusted that the first chart had made my method clear, and this saved a lot of work. But I freely confess to what you said about the spaces for the parrots and hummingbirds that I had left empty in 1843. It's perfectly obvious in the 1844 portion of my chart that I wasn't following the procedure proposed in my 'true method' paper. I really didn't creep along lines of affinity from genus to genus to discover the natural system, but made the assumption that groups well-known to ornithologists had been arrived at inductively.

DARWIN: Fair enough. But quite aside from viewing taxonomic groups themselves as hypothetical, I see in both portions of your chart an important hypothesis about affinity. I believe it is false, and it's a thesis to which my friend Waterhouse would not have assented.

STRICKLAND: Good George Waterhouse, who was such a solid member of our nomenclature committee. I hope he is thriving at the British Museum. He used to curate the museum of the Zoological Society, and he described your *Beagle* specimens.

DARWIN: Just the insects and mammals. Mr. Gould did the birds, and Professor Owen the fossils. Yes, Waterhouse is well.

STRICKLAND: What a shame such a capable fellow had to slave for his bread, kowtowing to employers who were his inferiors in scientific understanding. I learned at the

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¹ The first footnote of my previous two parts stated: 'Although the dialogue is imaginary, all of the facts and ideas mentioned are based on historical evidence.' I ought to have added that where evidence is lacking, but I make a guess, I signal those instances in a note. To my chagrin, there is a significant error at the end of Part One, where I made Strickland reply with surprise when Darwin informs him that he became convinced of transmutation in 1837. I had overlooked the important article by John van Wyhe, 'Mind the Gap' (*Notes and Records of the Royal Society* 61 (2007): 177–205.) which includes Strickland (p. 183) in the list of people Darwin told of his ideas. Agreeing with van Wyhe, I ought to have had Strickland say, 'Yes, I remember you once telling me that' rather than 'I am astounded to learn that.' In his book *Dispelling the Darkness* (2013, Singapore, World Scientific), van Wyhe strengthens his argument that Darwin made no secret of his belief in evolution. If any reader finds another such blunder, I hope that she or he will let me know.

² The Supplementary version of this dialogue contains numerous extra facts, citations, and comments.

Available online 2 April 2015

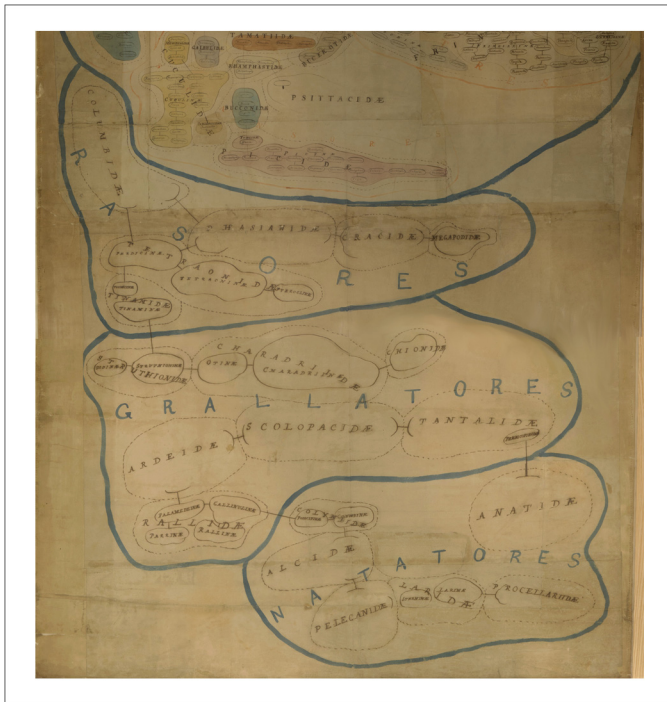


Fig. 1. The bottom portion of Hugh Strickland's chart, showing the orders Rasores (chickens etc.), Grallatores (herons etc.), and Natatores (ducks etc.). The 1843 portion ended with the family Picidae (woodpeckers), shown as two pink blobs; just below is the seam where the 1844 portion was attached. Photograph reproduced with the kind permission of the University Museum of Zoology, Cambridge.

Cork meeting in 1843 that he had a view of the orders of mammals remarkably similar to mine on the orders of birds.

DARWIN: That's most curious, for I thought his concept of affinity differed from yours in important respects. He had been sympathetic to quinarianism at one time, and I was quite disgusted when I saw him portray the ten orders of mammals with ten circles, of equal size, touching each



Fig. 2. Detail from the top of Hugh Strickland's wall chart. In 1843 it bore the title 'Natural Affinities of the Insectorial Order of Birds' (*Report of the British Association for the Advancement of Science for 1843*, 13 (2): 69). When rediscovered, its top edge had been lost, so the words 'Natural Affinities' have been inked onto new paper. An old pasted-on strip of paper bears the word 'Class', but some of 'Insectorial Order' shows through. Photograph reproduced with the kind permission of the University Museum of Zoology, Cambridge.

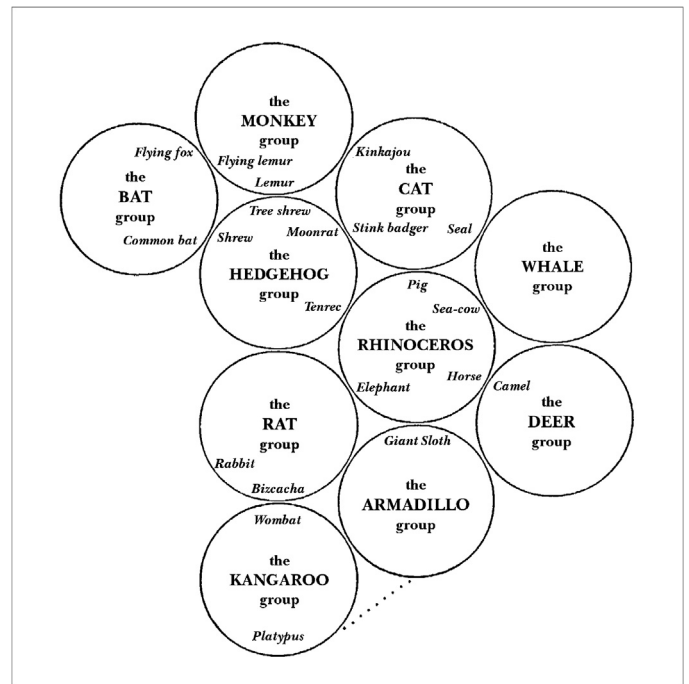


Fig. 3. In the summer of 1843 George Waterhouse displayed to the Cork meeting of the British Association for the Advancement of Science a diagram representing the orders of mammals (*Annals and Magazine of Natural History* 12 (79): 399). Darwin told him, 'as for your wicked circles, I wish they were all d[amne]d together.' (*Correspondence* 2: 416) I have replaced the scientific names on Waterhouse's diagram with English names, and removed his numbers.

other. I wished those wicked circles straight to hell and told him so (Fig. 3).

STRICKLAND: Now, now, I don't agree at all. I looked closely at his diagram, and was amazed at the coincidence that he was doing something so similar to what I had in mind with the chart I was unveiling at the same meeting. Waterhouse's circles weren't anything like Macleay's.

DARWIN: They were round, that's what I noticed.

STRICKLAND: But Macleay's consisted of lines of affinity, each form linked to two others, forming a ring of five. Waterhouse's circles were not lines of affinity.

DARWIN: Ah, I take your point. They surrounded each of his ten orders of mammals just as these wide blue lines mark off your four bird orders. They are not the same as your little straight lines of affinity.

STRICKLAND: Exactly, in both cases they are like a fence enclosing a herd of sheep.

DARWIN: I hated the fact that Waterhouse's circle of marsupials, containing only a few genera, was the same size as his circle of rodents, which of course contained hundreds.

STRICKLAND: Oh, come, my dear fellow, you praised my cartouches of genera, all the same size though containing various numbers of species, so you must forgive him his orders.

DARWIN: The fact that your groups are of many different sizes and utterly irregular shapes is surely closer to what we know of the natural system³.

³ Circles indicating sets in formal logic, the Venn diagrams that became familiar in the 20th century, had not yet been invented.

STRICKLAND: Yet to give Waterhouse his due, the simple circles he presented to the audience in Cork appeared soon afterwards in the *Annals and Magazine of Natural History*, whereas to publish my elaborate effort would have been horribly expensive⁴. It wasn't worth the cost, since quinarism was in decline.

DARWIN: I believe its failure was inevitable, because even before your chart, many naturalists saw that the groups they knew most intimately refused to lie in such a procrustean bed. Human nature includes an instinct for stubbornness in leaders and loyalty in followers, however, so the triumph of truth over delusion in science can sometimes be rather slow. The departure of Macleay to Australia in 1838, and of Swainson to New Zealand in 1840, doubtless hastened its decline.

STRICKLAND: And poor Vigors died shortly after the 1840 Glasgow meeting. The odd thing is, after listening to my attack and seeing my kingfisher diagram, he said it didn't matter because all systems were just artificial anyway.

DARWIN: I'd forgotten that. What exactly did Vigors say?

STRICKLAND: Something to the effect that the only natural system is the system of the universe, and that every arrangement of man is only an artificial attempt at exhibiting the affinities of objects in nature. In particular, lines and points are purely artificial.

DARWIN: Oh, my, as if you were not aware that your lines were drawn by your hand, and that living birds have nothing like lines connecting them. You could have taken offense at his words, had you wished to waste your energy on pettiness, as too many of our colleagues seemed prone to do.

And yet, really, what did the idea of the natural system mean? I sometimes wondered why naturalists were so reluctant to confront what to me were so obviously the highly interesting and significant questions that underpinned the very foundation of our enterprise. Waterhouse collapsed like a cold soufflé when I tried to get him to define the natural system. He told me 'useful' would do just as well.

STRICKLAND: I was perfectly explicit when I first attacked Swainson, who insisted his quinary groups reflected reality. Of course if he had merely offered them as conveniences, useful because five is a small number and because parallels can aid our memory, I would not object. My ire was aroused by the quinarists' claim that their system captured the actual order existing in nature.

DARWIN: To think of Vigors, having the gall to teach you about philosophy, you of all people, you who had the sharpest possible recognition, and talent for action, with regard to the enormous importance of what is both essential yet eminently artificial in our taxonomic systems, namely, nomenclature. Surely no one imagined that the names we give things, whether in Latin, Greek, or English, could ever claim to capture the essence of their being. Yet we are creatures who think and communicate by means of language. Science would be mired in confusion if we did not

agree to govern ourselves with standardizations, such as your rules of nomenclature provided.

STRICKLAND: Not my rules, dear sir, our rules. You contributed much to the committee, with your spirit of moderation and encouragement. We made the very practical decision to leave questions about the ultimate reality of species and genera beyond our purview.

DARWIN: With respect to what names to give them, that was wise, but as to the living things themselves, I could never back away from the issue as Waterhouse seemed able to do. It exasperated me at the time, so I was probably too hard on him. I did know that some years before he drew those ten circles for the orders of mammals, he really had been besotted with Macleay's idea that nature is riddled with analogies as well as affinities. Waterhouse had once explained to me dizzying patterns of crosswise relationships. His enthusiasm for quinary views had certainly faded by 1843, but I worried that those ten circles gave the appearance of renewed endorsement of Macleay. I noticed that their circumferences were in contact, as if to suggest the existence of intermediate forms linking the orders.

STRICKLAND: I am sure Waterhouse's circles only touch to save space on the page. He explicitly denied that any truly intermediate forms may be found. Each supposed case, he said, evaporates on close examination.

DARWIN: Well and good, but didn't you think it was a significant remnant of quinarism, and in strong contrast to your ideas, that he was still interested in noticing analogies as well as affinities? For example, having learned from Owen that the dugong is related to elephants, Waterhouse placed it not just within his Pachydermata circle but at the edge, lying adjacent to Cetacea, the order containing dolphins and whales.

STRICKLAND: True enough, and he was unsure whether that resemblance was an affinity or an analogy. Yet in opposition to quinarists, he denied that analogy connected any genus to any other genus. Waterhouse insisted that when analogy exists, it can only point from a genus to another order as a whole, that is, to its type.

DARWIN: Quite so, for there is no particular cetacean that the dugong resembles more than any other; it is rather the common features, the central idea, of the order Cetacea that supplies the analogy.

STRICKLAND: I must agree with you that he was still keen to ferret out the meaning of analogy, for he proposed identifying analogies using numbered degrees. He said the beaver and the otter, water-living beasts which belong to different orders, were analogous in the fourth degree, while the beaver's analogy to the coypu (the river rat or nutria of South America) is in the third degree because they are in the same order but belong to different families.

DARWIN: Yes, I remember him numbering his degrees, both analogy and affinity, much as Blyth and Westwood had done.

STRICKLAND: When I heard Waterhouse speak of degrees of affinity, I knew he would understand the scale on my chart.

DARWIN: Perhaps if you had the opportunity to collaborate, the two of you may have come to a fruitful convergence, but as it was, there are aspects of your chart that, as

⁴ George R. Waterhouse's 1843 'Observations on the classification of the Mammalia' (*Annals and Magazine of Natural History* 12 (79): 399–412) came out on December 1st, three and a half months after the Cork meeting.

I understand you, are not just far removed but actually inconsistent with what Waterhouse wrote in that mammal paper.

STRICKLAND: He was far too good-natured a fellow to have called any inconsistency to my attention. What conflict do you think separated our views?

DARWIN: Well, it is clear that for him each genus lies nestled safely deep within its own stack of ranks. Exactly as you were saying just now about analogies, Waterhouse believed that although a genus may have affinities outside of that stack, across to some other group, those resemblances are always to the whole group rather than to any one genus within it.

STRICKLAND: It seems I didn't pay close enough attention at the time.

DARWIN: I took special pleasure in one of his examples, which now carries me back to those days in the full flower of my youth, before I became the victim of my miserable digestion. While the *Beagle* was poking up and down to improve our charts of the South American coast, Captain Fitzroy allowed me to roam across the plains of Argentina, camping under the stars with the gauchos. I was quite a horseman in my day, did you know that?

STRICKLAND: I read your narrative of the trip and was impressed at the distances you travelled on foot as well as on horseback.

DARWIN: I remember watching animals that looked for all the world like rabbits, except for their long tail, a common and welcome sight in country that's practically a desert. The locals call the creature bizcacha⁵. It is undoubtedly a rodent.

STRICKLAND: I've heard of them, because of a sweet little owl, *Athene cunicularia*, who seems to stand guard over their burrows.

DARWIN: Well, our esteemed colleague Mr. Owen made one of his innumerable anatomical reports to the Zoological Society after cutting open a female bizcacha, and Waterhouse took note of the result. It seems that this animal possesses a detail in its reproductive system somewhat resembling marsupials.

STRICKLAND: I am not surprised to learn this, for Owen seemed determined to see linkages or fill in gaps in the system wherever he could. I suspected him of sympathizing with the transmutationists.

DARWIN: Our friend Waterhouse was equally determined to deny such links, and I found his view much more congenial to my own beliefs than the lines of affinity on your chart. He insisted that the fundamental affinities that make up the natural system are never compromised by outside similarities. In deference to Owen, Waterhouse placed the bizcacha near the edge of the rodent circle, where it touches the marsupial circle, but he made a point of stating that its similarity was to the entire order rather than to any one kind of marsupial. And to drive home the point, he said the marsupial that most resembles rodents is the wombat, a creature with no particular similarity to the bizcacha. Waterhouse furthermore suggested that whatever rodent-like features one may detect in the wombat are

likely to be adaptive characters, meaning mere analogies, and not affinities after all.

STRICKLAND: Oh, dear, I am beginning to see the problem. I was very careful to always connect my subfamilies, families, and tribes by way of a line of affinity from one genus to another genus. The connection from family to family, or from tribe to tribe, was shown by a longer line of affinity, nevertheless I always made it run from one genus to another genus.

DARWIN: Which is exactly what Waterhouse said never happens.

STRICKLAND: So, you must be right, that if Waterhouse had found time to make a chart like mine, containing hundreds of cartouches for the genera of mammals, he would have drawn it very differently. Although now that I think about it, I wonder how he would draw those longer lines of affinity.

DARWIN: I imagine such a line would have to stop at the boundary line of the family, tribe, or order without penetrating it. You were perhaps toying with exactly this question when you sketched in your orders Rasores, Grallatores, and Natatores. Some of your affinity lines connect the boundary of one subfamily to the boundary of another, while in other places you make them penetrate and attach to what looks like an unfinished cartouche within (Fig. 4).

STRICKLAND: Perhaps before the York meeting I began to see the issue, because of something Waterhouse said, but I made the chart's extension in a rush and I don't really recall.

DARWIN: From what I know of Waterhouse's ideas, by no means could he have drawn a diagram of the affinities he was talking about. I heard him say an order may be imagined to send out rays in the direction of a second order, but if the second one sent rays too, they wouldn't be in the same direction; then he hastened to add that this was merely a figure of speech.

STRICKLAND: I do wish you gentlemen had come down to visit me in Worcestershire when these questions were on the table, quite literally.

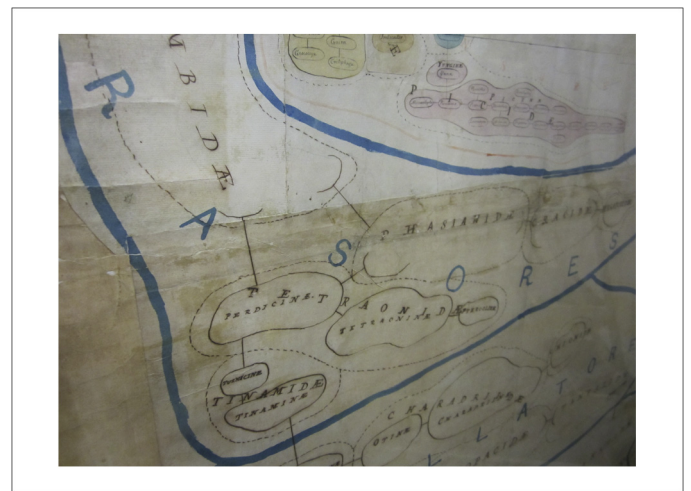


Fig. 4. Detail from Strickland's 1844 chart, showing that his lines of affinity mostly run from sub-family to sub-family (names ending in 'inæ'). In a few cases they do not penetrate the family border (dotted lines), as at the top left of the Phasianidae (chickens). Photograph reproduced with the kind permission of the University Museum of Zoology, Cambridge.

⁵ This was the plains viscacha or vizcacha, *Lagostomus maximus*, a large member of the chinchilla family.

DARWIN: In those years I was often unwell, and travelled in your direction only in search of medical treatment.

STRICKLAND: Come now, I realize I've been rather rude, worrying over this chart of mine. I did hear you say a while ago that you yourself had attempted to picture how animals are related. I have no doubt you were thinking much as I was about natural groups, that you were as convinced as I was, that analogies should have no role in classification, and that true affinities are revealed by essential characters.

DARWIN: In those days, since I didn't have to actually make any taxonomic decisions myself, I didn't worry overmuch about it. The word 'essential' was to me an everyday household word, meaning 'important'. My dear wife informed me it was essential for us to attend church, so like a wise husband I did not argue. As to characters that are adaptive, I began my cruise around the globe believing that every living thing is perfectly adapted to its station in life. Finding the upland goose in the Falklands, whose webbed feet rarely touch water, soon warned me how naive that was⁶.

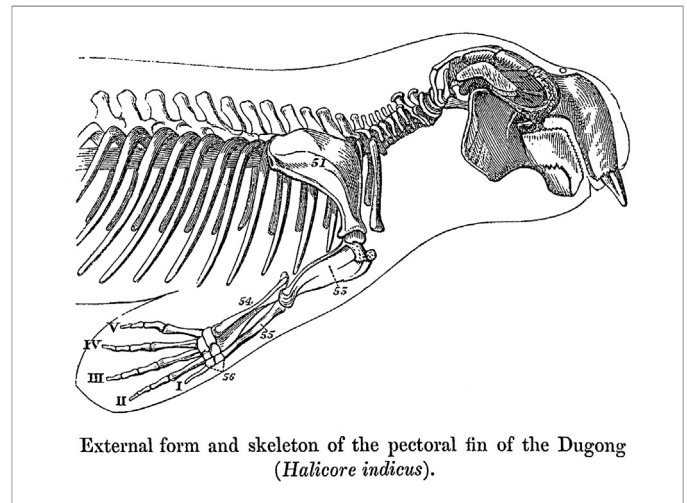
STRICKLAND: The anatomists on the continent were pointing us in a direction far more interesting than the old natural theology, which was all about the fit of form to function. A more profound view of the Creator's design has unity of plan as the first principle, with function as a secondary one. Owen's Royal Institution lecture explained that beautifully.

DARWIN: Ah, yes, his lovely little book, *On the Nature of Limbs*. I quite devoured it, and told Owen how much I admired it. I put it to good use in my species book ten years later. The way he showed the homologies of our hand bones to the front feet of other vertebrates was a marvel. Who could have imagined, looking at a Clydesdale pulling a heavy wagon, that a horse's hoof is equivalent to the tip of one finger! I was pleased to see him picture our friend the dugong, whose smooth front flipper conceals a perfect set of five fingers (Fig. 5).

STRICKLAND: What I recall was the wonderful image of Nike sacrificing a bull at the front of that book. Owen had most cleverly numbered the bones of the goddess and her victim to show their correspondence.

DARWIN: But you were asking about my own ideas, back when I was first thinking about such things, back when I made my first abortive sketches of how living things might truly be related. Shortly after the *Beagle's* return, I spent some time trying to see if there might be some kernel of truth in Macleay's system.

STRICKLAND: Of course there were a few sound kernels in that barrel of rotten corn, but his approach was fundamentally wrong. I wrote to my friend Tom Baker that it's as if a geographer, finding two triangular islands, should announce that all other islands must also be triangles. Or because two roads wind over a river and up a



External form and skeleton of the pectoral fin of the Dugong (*Halicore indicus*).

Fig. 5. Skeleton of a dugong, from Richard Owen's 1849 *On the Nature of Limbs* (p. 5). He described the sea-cow's front limb as 'a strong, stiff, short, broad, flat, and obtusely pointed paddle or oar' yet its bones, from shoulder to fingertips, were clearly homologous to our own, proving that nature prefers to adapt one type to various functions rather than to supply new designs for each function.

hill, they represent each other, rather than each responding to the landscape.

DARWIN: Yes, the symmetry and numerical regularity in Macleay's system was obviously fantasy, but he was a thoughtful man, and I was fond of him, and his notions seemed promising to quite a few people at the time. I found it interesting to imagine that if animals of one kind, some ancestral bird for example, were to evolve into forms adapted to three modes of life, such as air, land, and water, while animals of a second kind, say some ancestral mammal, were likewise to adapt to those three elements, that would explain a pattern of three analogies between birds and mammals in a natural classification, like your boat-shaped penguin and porpoise. I imagined it as a 'triple branching in the tree of life.'

STRICKLAND: The idea that analogies represent the adaptation of distinct types to the same environment was rather a commonplace, and it implied no support for transmutation. Quite the contrary, I recall the keeper of the Ashmolean Museum at Oxford using that very idea to celebrate God's infinite goodness in ordaining such adaptations.

DARWIN: I knew that my speculations would have displeased Macleay, yet they were what occasioned my first attempt to draw images of organic relationships. Here, it will take me but a minute to reproduce them. They have never seen the light of day, so I beg you not to ridicule them too harshly.

STRICKLAND: They are scarcely more than hen-scratches (Fig. 6).

DARWIN: Please do bear with me. See, the first one is that 'triple branching in the tree of life' which could represent any group, whether mammals or birds or insects. I used dotted lines because their early history is lost. I know, it's very crude, but it helped me think.

And on the same page I scrawled another, when I was thinking about whether a bird and a fish, both being vertebrate animals, might be actual blood relatives. My

⁶ The upland geese, like the giant tortoises that differed from one Galapagos island to another, may have nudged Darwin to begin to doubt that the truth about how species arise was yet known, but the rich Darwin scholarship of the past several decades provides overwhelming evidence that even though he was familiar with the idea of evolution from his college days in Edinburgh, he did not abandon the orthodox view until after he had returned to England in 1837.

eyes were opened when I realized that if forms do change, as my teacher Grant believed, this did not mean that there had ever been a direct transformation. Followers of Lamarck would seek intermediate forms, like the earlier naturalists for whom continuity was an article of faith. Where is the transition between fish and birds, for example? Should we find support for his theory in a bird that swims underwater, like a penguin, or in a fish with wings? From the deck of the *Beagle* we saw plenty of flying fish, whose long flights we watched with amazement. What my hen-scratch helped me see was that the common ancestor of all fish and all birds was neither a bird nor a fish, and is extinct. Come, come, I thought you promised not to laugh.

STRICKLAND: I promised no such thing.

DARWIN: See, these bushy bits on the left are the birds, whose simpler ancestors have left no trace, and the later birds have diverged in many directions. On the branch to the right are the fish, which have given us a clearer picture of their evolution, because the simple ancestors of fish, things like sharks or eels, have survived along with their descendants.

STRICKLAND: I had no idea you were harbouring such bizarre thoughts.

DARWIN: I don't expect you to be convinced by these early speculations of mine. I knew I would need to find a great deal more evidence, of several sorts, to overturn the judgement of sound men like Lyell, who had rejected Lamarck. Right now, though, my point is that I realized immediately how difficult it was to use lines on paper to capture such a vast story. I did give it one more try, which was a little more successful, but also terribly inadequate. Here it is (Fig. 7).

STRICKLAND: Ah ha, now I see clear ramifications.

DARWIN: This diagram represents the idea that as forms multiply, many of the descendants must go extinct, because I assumed that the world is about equally filled with life in past and present ages.

STRICKLAND: Now that looks very much like the real tree upon which I suggested some museum could mount related birds.

DARWIN: Not unless you shooed the birds off the branches and only allowed them to roost on the very tips of twigs. I decided the tree metaphor didn't work as well as a coral, but that's not much better, so I just called this sketch a diagram.

STRICKLAND: You recall I did insist that lines of affinity can branch, ramify if you prefer, which is clearly a feature of my Alcedinidae map of 1840.

DARWIN: The idea that transmutation must include branching is indeed crucial to my theory. But the lines in my diagrams represent animals in the past, whereas the affinity lines on your map connect the living genera of kingfishers⁷.

STRICKLAND: Although I was never tempted to believe in transmutation, I can grant that the fact that living things exhibit affinities seems to point in that direction.

DARWIN: Reviewing what you and Blyth, Owen, Waterhouse and many other taxonomists said and did, I

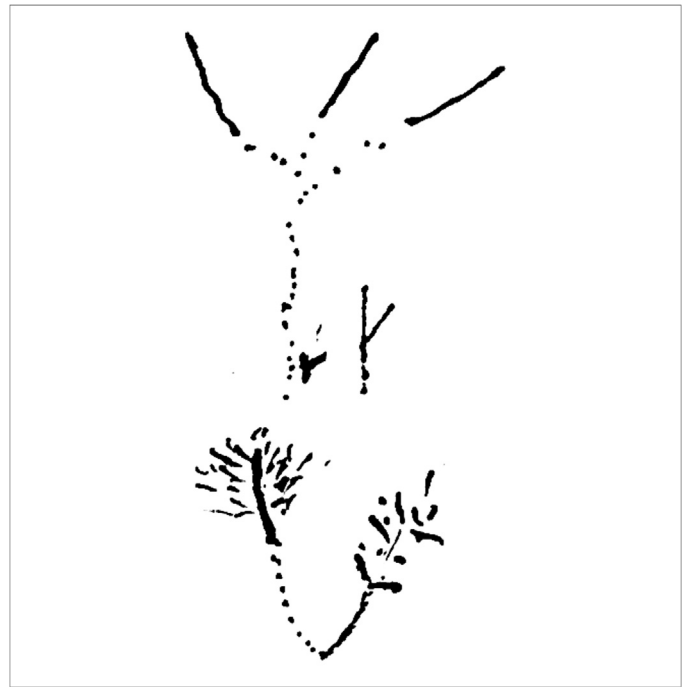


Fig. 6. From page 26 of Darwin's notebook B, his first two branching sketches of evolution. Reproduced by the kind permission of the Syndics of Cambridge University Library.

felt my theory not only explained your belief in a natural system, and rules for classifying, but also explained why all your rules were riddled with exceptions. Adding to that what we were learning about fossils, geography and embryology, the resemblances between living things provide overwhelming evidence that they must have evolved.

STRICKLAND: You published your theory a few years after my death, you say?

DARWIN: In 1859, and I was so fortunate as to keep at my work for another two decades. I had time to publish about how flowers are adapted to the insects that carry their pollen, and how earthworms and climbing plants exhibit intelligence, and how courtship has shaped colourful sexual characters. Although the idea I called natural selection left many naturalists unconvinced, my theory of

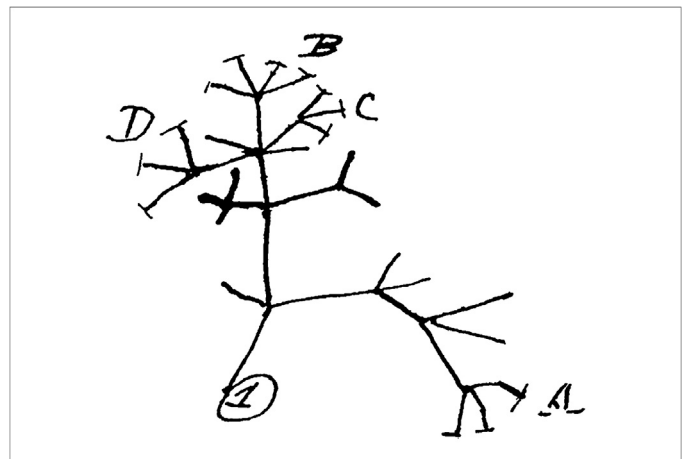


Fig. 7. From page 36 of Darwin's notebook B, under the words, 'I think'. The T-shaped ends represent living species, the other lines and ends are in the past. Reproduced by the kind permission of the Syndics of Cambridge University Library.

⁷ Darwin here means two diagrams, my Fig. 7 and the only one he published (in the *Origin of Species*). He is not including his first two 'hen-scratchers' (my term, Fig. 6) on which the solid lines do represent living as well as past animals.

branching transformation with extinction won many firm supporters, to my great satisfaction.

STRICKLAND: Do you mean to tell me that naturalists nowadays are in agreement that taxonomic affinity really means genealogy?

DARWIN: I would say so, yes, with a caveat. Many taxonomists carried on their work unaffected by my theory one way or another, so you could scarcely tell whether they agreed with it from their monographs. Not that I blame them, indeed I expected it, because their principles of looking for constant characters and treating no rules as absolutes were already compatible with what my theory predicted.

STRICKLAND: You were writing in the same spirit yourself, I suppose, when you published your taxonomic work on barnacles in 1851, for you had not yet announced publicly your unorthodox ideas.

DARWIN: Indeed that's so. The customary methods of taxonomy, giving names and listing the characters that diagnose groups, along with imagining morphological types, were adequate to the task. Anatomists had long been speaking freely of forms being modified in this or that direction, without implying transformation, so I did not have to prevaricate in order to classify cirripedes without mentioning my theory.

STRICKLAND: Although you had at one time told me of your sympathy for transmutation, I imagined that the barnacles would have swept from your mind such speculative ideas.

DARWIN: I did my best to avoid mere speculation, following Lyell's example as I worked on this great question. Had I succumbed to illness, you might have learned about my theory in painful detail, for my wife might have sent you my two-hundred-page manuscript, requesting you to see it through to press.

STRICKLAND: You named me your literary executor? I didn't know.

DARWIN: Well, not exactly. Your name was on a list along with several others, in a letter that thankfully my wife never had to open, since fate spared me to expand and publish my work myself. I was confident you would treat my manuscript fairly even if my arguments did not convert you.

STRICKLAND: In your barnacle monograph, I suppose you couldn't have published a tree, or even a branching diagram, without giving the game away.

DARWIN: Whyever not? The branching lines of affinity on your bird chart didn't make anyone think you were a transmutationist, did they?

STRICKLAND: Certainly not.

DARWIN: You are correct that I could not have drawn the sort of diagram that later illustrated my species book, where the branches represented forms of past eras, most of them extinct but some of them ancestral to today's species⁸. But my monographs had a job to do, to arrange known species of Cirripedia in categories according to their affinities, that is, the strong similarities such as any good

taxonomist would see. Reducing those affinities to lines would not have added any information that I couldn't express better in words, and would have left the impression that their relationships were understood better than any of them actually were.

STRICKLAND: Well, birds are infinitely better known than barnacles.

DARWIN: Beyond a doubt. Still, I do worry that the lines you drew to represent affinity concealed the bases of your judgements. Your lines of affinity are of different lengths, indicating close or remote affinity, but you do not state which characters had contributed to your judgement. What I liked about the traditional procedures, for which Linnaeus established such detailed rules and set us such a good example, was that a taxonomist is required to spell out, one by one, every character he is relying on.

STRICKLAND: With respect, I do not think you appreciate the impression a well-chosen picture can have on human understanding. Allow me to prove it. I shall treat your theory as proven, for the sake of argument, and I shall modify my chart accordingly. To begin with, I'm changing my scale to read 'degrees of consanguinity', or would you prefer 'degrees of relatedness'?

DARWIN: Whatever you call it, I do not conceive it as a line connecting living forms. Kinship is a relationship that lies in the past.

STRICKLAND: My, but you can be hard to please! Look here, we have behind us this beautifully trimmed hedge of boxwood; let's make its flat top play the role of a table. See here, I can lay my chart upon it, there's scarcely a breeze, and these pebbles can hold it flat.

DARWIN: What a good sport you are, Strickland, to play along with my theory.

STRICKLAND: Purely for my pleasure, I assure you. You agree, I hope, that the boxwood bush can represent extinct birds, the ancestors of today's birds.

DARWIN: To me their real existence in the past is utterly certain, even if most of them left no fossil remains.

STRICKLAND: So now you must accept my chart as a perfect reflection of your theory. My blue boundary lines around my four orders enclose the tops of twigs that can be traced down to where four main branches diverge, close to the ground, at the base of this congenial bush. Surely with a little imagination you can grant that my six tribes of the insessorial order correspond to six secondary branches, a short distance further up.

DARWIN: Very pretty. Let us now suppose there is a little red beetle at one of your cartouches. I command her to pay a visit to her distant cousin, located in a neighbouring genus. Your lines of affinity appear to give her a direct route, but I cannot grant her that shortcut. She can only run along material pathways, and not along a bridge drawn by your imagination. Watch her in your mind's eye; she must run down this twig until she comes to a fork, where she will take a sharp turn and run upwards.

STRICKLAND: What a pleasant way of picturing the connections.

DARWIN: I'm afraid my species book was rather dull in comparison.

STRICKLAND: Well, just to be agreeable, I can paint over all these objectionable bridges. There, you see?

⁸ That is, the diagram in the *Origin*, constructed to illustrate his principle of divergence. In contrast to almost all other 19th century trees of life, it bore no names of species or groups, only letters that he used to discuss general processes. Darwin did sketch a number of other trees in his private notes, as shown by David Archibald in his excellent *Aristotle's Ladder, Darwin's Trees* (Columbia University Press 2014).

Eliminating those lines of affinity still leaves the relative positions of my groups intact, just as an explorer's map doesn't report the paths he travelled, only the mountains and rivers he observed. Now you must agree that the remaining details accord very well with your theory. I've still got my cartouches, and my boundary lines indicating sub-families, families, tribes and orders. I will rename this new chart 'The Darwinian View of Bird Relationships'.

DARWIN: You have hidden your lines of affinity but they have left their imprint. I think they caused you to situate your groups rather too firmly in relation to one another. Naturalists who compose a taxonomic monograph generally admit that while we may satisfy ourselves as to which families belong in an order, and which genera belong in a family, and which species in a genus, the order in which we list them on the page often must be arbitrary. We would like to arrange them in a series from advanced to simple, perfect to imperfect, high to low, even though such terms elude definition, but honest taxonomists usually confess defeat.

STRICKLAND: It's a common complaint that our tool, printed words on a page, forces a linear series. Whether we use the same order as our most respected predecessor, or list the species in a genus alphabetically, we know this is merely for convenience. Arranging the names on a surface, as Waterhouse and I did, gives us more freedom to represent nature's own arrangement.

DARWIN: You are assuming nature was arranged. Here, look at all your charming finches, tanagers, and buntings. What man could really sort them out, or say anything more than that they are connected by numerous similarities and small differences? I am sure they all diverged, long ago, from a common ancestor, but their changes had no relation to the divergence experienced by their distant cousins, the nuthatches. Your map-making project forces you to decide which nuthatch is closer to which finch, instead of being satisfied to say the two families are related. I fear that the idea of a map tempted you to locate forms at various distances, as if amount of resemblance could be distilled down to one number.

STRICKLAND: Well, well, Mr. Darwin, I thought you said you knew nothing about birds.

DARWIN: Only the names of the major groups, and a haphazard array of species, such as any field collector has to acquire.

STRICKLAND: Earlier you admired the colouring by which I made the subfamily and family groups stand out, so I hope we can agree my chart gives us a vivid portrait of nature.

DARWIN: I learned early on to be wary of metaphors. Now you say your map is a portrait.

STRICKLAND: And what's the harm in that?

DARWIN: Forgive me, but I do worry. Whenever I indulged in such literary flourishes in my book, I tried to make sure that no reader could mistake what it was that the figure of speech stood for. A portrait? When I said 'we see the face of nature bright with gladness' I was confident no one would think I meant that nature has two eyes, a nose, and a mouth⁹. I consider it a great virtue in my theory

that terms like affinity, relationship, or community of type, which had only metaphorical meanings in natural history, now take on meanings that are concrete¹⁰. The mysterious old term 'plan of creation' now appears vacuous¹¹.

STRICKLAND: Creation certainly has a plan; that is beyond doubt, surely, even if it's hard for us to discover it.

DARWIN: I am afraid we may drown in this sea of metaphors. I know what you mean if you speak of men creating some wonderful object, whether a small Wedgewood vase or a large ship. In speaking of the earth and its varied inhabitants, however, words like 'creation' and 'plan' have no literal meaning for me. My young friend Huxley, with whom I have had interesting but exasperating arguments about classification, ridiculed Owen for his archetypes, calling them metaphysical nonsense, yet Huxley kept using the word plan, to my great frustration.

STRICKLAND: I didn't know the man, but he has my vote. Whatever is the matter with saying the natural system reveals a plan?

DARWIN: In English it's a word with two meanings. Usually a plan is something intended beforehand, like an architect's drawing which he hands to the builder. Sometimes we ask for a floor plan, meaning any diagram showing what is there, but because the verb implies forethought, I think using the word for nature implies that its pattern was designed.

STRICKLAND: I cannot imagine the beauty and complexity of the living world that you and I were so privileged to enjoy coming into existence by accident.

DARWIN: It seems to be a law of life that offspring resemble their parents, but it's also a fact that differences do occur, so if some variations happen to be useful, they will be preserved and will spread. Multiplying the effects of such small events over millions of years, the consequence must be divergence, and extinction, and organisms mostly well-adapted to their circumstances, though not always perfectly.

STRICKLAND: Forgive me for changing the subject, but it has just come back to me that you said I was killed by a train. Are you sure that was the case? My final moments of life are clear in my memory. In 1853 I was in my mid-forties and in the peak of health. I was collecting fossils from the cliff of a railway cutting when I heard and saw an oncoming train, but I had plenty of time and easily stepped out of its way. Of course, since my existence here is so delightful, the cause of my death has never troubled me, but I'm a bit curious, because I have always imagined I must have been struck by a bolt of lightning.

DARWIN: I read with horror the newspaper reports; there was no lightning. The railway had two tracks, and when you stepped aside to avoid one train, fate put you directly in front of another.

¹⁰ Writing to Waterhouse in 1843, Darwin had said, 'I shall be curious to hear what your object is in a Natural Classification, with every term clearly defined & no metaphorical words like "relationship" used, or at least if used, explained.' (*Correspondence* 2: 378) Darwin predicted that after his ideas are accepted, 'The terms used by naturalists of affinity, relationship, community of type, paternity, morphology, adaptive characters, rudimentary and aborted organs, &c., will cease to be metaphorical, and will have a plain signification.' (*Origin of Species*, 1859, p. 485.)

¹¹ 'But many naturalist think that something more is meant by the Natural System; they believe that it reveals the plan of the Creator; but unless it be specified whether order in time or space, or what else is meant by the plan of the Creator, it seems to me that nothing is thus added to our knowledge.' (Darwin, *Origin of Species*, 1859, p. 413.)

⁹ 'We behold the face of nature bright with gladness...' (Darwin, *Origin of Species*, 1859, p. 62.).

STRICKLAND: It matters not a whit, for none of us spends more than a short time in the flesh. What does matter to me, and very greatly, is whether, if you manage to convince me of your theory, I would have to relinquish my understanding of nature's Creator. My faith is inexpressibly precious to me.

DARWIN: I am afraid you would indeed be forced to revise your understanding, for all the evidence points to life evolving in no predetermined direction. Yet I believe this view is far grander and more marvellous than the old one. It

makes the idea of a deity resembling ourselves, who shaped creation with his hands, seem childish; it leads us to acknowledge that our brains are not fit instruments for comprehending the Being responsible for the universe, even if we knew for certain that He exists. While I lived, I was not sure of that, but now, here with you, there can be no doubt.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.endeavour.2015.03.001>.