



Breeding & Barnacles
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5 October 2020

I have been fascinated by Darwin since I was a child and have now been studying him seriously for almost 30 years. As a result, I have (and I appreciate that this is entirely my fault) become rather bored with several supposedly funny Darwin stories that get told over and over again. However, I'm going to tell a couple of them again and try to explain why they get repeated; whether or not we find them amusing, they give us several important insights into the world that made Charles Darwin. This first lecture will focus on Darwin himself, trying to give a flavour of the way he thought and the influences that contributed to some of his main ideas. In later lectures, I will branch out into the ways Darwin's ideas were received and how they spread around the world. Darwin's ideas matter, but not because Darwin himself is particularly important. (It could be argued – plausibly in my view – that he's just another dead, white guy about whom we already know more than enough.) The reason he is still worth discussing is that the many different ways in which his ideas have been interpreted and applied have shaped the world we live in. And they seem certain to shape its future.

Marry, or not?

I want to start with Darwin, newly returned from his voyage aboard HMS *Beagle*, trying to decide whether or not to get married. As some of you may already know, he produced a list of the pros and cons, which – like so many Darwin documents – is now stored in the University of Cambridge Library.¹

Under the heading “This is the question”, Darwin set out – in a properly methodical, scientific fashion – two columns “Marry” and “Not Marry”. The benefits of *not* marrying would include the “Freedom to go where one liked”, “choice of Society & little of it” and the “Conversation of clever men at clubs”. He might also avoid being “forced to visit relatives”, and to save himself “the expense & anxiety of children”, which would mean “less money for books &c”. Indeed, if he had “many children” he might even find he was “forced to gain one's bread”. And what would happen if “perhaps my wife went [*sic*] like London”? “then the sentence is banishment & degradation into indolent, idle fool”. Yet despite these worries, Darwin found plenty of things to list on the “Marry” side of the equation. He hoped he would enjoy being a father, and it would be pleasant to have a “Home, & someone to take care of house”, especially if complete with the “Charms of music & female chit-chat” (noting, perhaps in an effort to persuade himself, that “These things good for one's health”). Even more importantly, a wife would be a “Constant companion, (& friend in old age) who will feel interested in one, — object to be beloved & played with. —better than a dog anyhow”. He concluded his list with:

¹ The full list is online at: <http://darwin-online.org.uk/content/frameset?viewtype=side&itemID=CUL-DAR210.8.2&pageseq=1>

“My God, it is intolerable to think of spending ones whole life, like a neuter bee, working, working, & nothing after all. — No, no won’t do. — Imagine living all one’s day solitarily in smoky dirty London House. — Only picture to yourself a nice soft wife on a sofa with good fire, & books & music perhaps — Compare this vision with the dingy reality of Great Marlborough St.

Marry — Marry — Marry Q.E.D.”

Darwin took his own advice. He proposed to his cousin, Emma Wedgwood, on 11th November 1838. As he noted in his journal, it was “The day of days!” because she had accepted him.

Darwin’s notes were perhaps rather tongue in cheek, and we shouldn’t read too much into what was little more than a doodle. Nevertheless, they suggest some very conventional Victorian values. They reflect, for example, the idea of ‘separate spheres’, that a woman’s domain was home and children – where she would be responsible for the whole family’s physical health, and their emotional and spiritual wellbeing. Men were expected to work outside the home and provide for their families, and were thus excused from domestic duties (even when – as in Charles Darwin’s case – he didn’t actually go out to work).

Charles’ father was a wealthy doctor, while Emma was the daughter of Josiah Wedgwood II, son of the famous pottery manufacturer, Josiah Wedgwood I. (The first Josiah had been a major pioneer of factory production, so Charles and Emma’s wealth flowed directly from the innovations known as the Industrial Revolution.) Between them, Charles and Emma inherited more than enough money to ensure the Charles would never be ‘forced to gain his bread’. Nevertheless, there was a very obvious contrast in Darwin’s mind between the home (“Charms of music & female chit-chat” and “a nice soft wife on a sofa with good fire”) and the world of scientific work (including the “Conversation of clever men at clubs”). There was no hint in Darwin’s notes that he was in search of an intellectual equal, a highly educated woman with scientific interests with whom he could collaborate. Admittedly, such women were hard to find in Victorian Britain (because women were barred from higher education and many scientific societies), but they could be found if you looked hard enough – Darwin never looked.

Perhaps the most striking thing about Darwin’s list is that he seemed to assume that the decision to marry was entirely his; there’s no sense that he had any idea (or cared particularly) about *Emma’s* desires and interests. Once married, he would – he accepted – need to compromise and take into account Emma’s decisions (even if that meant “banishment” from London to live as an “indolent, idle fool” in the suburbs or country). As we shall see in later lectures, the idea that courtship involved one sex choosing, while the other being the passive object of choice, would remain a part of his scientific thinking.

Darwin’s marriage notes give us a clear sense of his expectations of marriage. His expectations were common for their time, not least because they assumed an apparently natural division between male and female roles. The majority of his contemporaries, male and female, would doubtless have agreed with his assumption that men’s and women’s natures equipped them for different social roles, just as their bodies equipped them for different biological roles. Common assumptions in Victorian Britain, but perhaps the most important of Darwin’s long-term legacies are the ways in which the prestige of his name and ideas would reinforce people’s ideas about what was natural. What makes Darwin’s legacy potentially problematic is that his list doesn’t simply suggest that there were supposedly natural *differences* between men and women; it clearly assumes that women were inferior to men – less intelligent, less capable of making decisions and less able to take action. His list was a private document (it’s likely that almost nobody read it during his lifetime), but – as we shall see in later lectures – Darwin’s assumption of inequality between men and women was just one of several forms of human inequality which he (and most

of his contemporaries) simply accepted. Such inequalities were generally not something Victorian men of science hoped to change; they were treated as *facts* which science was expected to explain. For Darwin – and most of his contemporaries – the idea that gender inequality was the product of unjust social institutions, which could be ended, never entered their minds.

After they were married on 29 January 1839. Charles and Emma lived together on Gower Street, London (where University College, London now has lecture theatres). But as the family grew, and Charles' health continued to be bad, the family left London in September 1842 and moved to Down House, in the village of Downe in Kent. They spent the rest of Charles' life here, seldom travelling very far (and, in Charles' case, never leaving Britain again). However, despite his worries about "banishment" from London, Darwin was far from isolated. The railways brought him easy access to London and its scientific societies, but as the years went by, he increasingly preferred to have scientific London visit him. Over the following decades, a range of visitors (all carefully managed by Emma) – from old friends to royal celebrities – arrived in the village to meet the increasingly distinguished Darwin.

Judicious investment in railway shares was also one of the ways Darwin increased his wealth, another reminder of how closely he was tied to the booming economy of the world's first industrialised, capitalist economy. The railways (and other novel technologies, such as the telegraph and steamships) all helped to power a global postal service, which Darwin used to build up a network of correspondents that spanned the whole world. Many of those he wrote to were part of one of the European empires: administrators, traders, missionaries, colonial governors and convict supervisors. Darwin's own voyage had been made possible by Britain's desire to expand its trading opportunities with the newly independent nations of South America. The *Beagle* was a British naval vessel, charged with making more accurate maps and charts that would allow Britain's navies (military and mercantile) to navigate these unfamiliar waters safely – and profitably. Although Darwin travelled as a gentlemanly companion to the ship's captain (and was free to spend long periods ashore, accompanied by a personal servant), it's worth remembering that his father's wealth could never have paid for Darwin to have his own ship. Without the British empire, Darwin would probably have never become a naturalist. And back in Britain he relied on imperial networks for the endless flow of specimens and information from which he produced his many books.

Following the *Beagle* voyage, Darwin settled down to a quiet married life, relying on correspondence to gather facts. He wrote thousands of letters as he gathered facts to support his still-unpublished theory. The specimens he had collected on his voyage were distributed to various British specialists, who identified and classified them, sometimes producing unexpected insights that provided important evidence for Darwin's developing ideas about evolution.

Among the *Beagle* specimens was a curious barnacle that Darwin could not identify. Nor could he find a willing expert to take on the barnacles for him. So Darwin decided to classify his odd little barnacle, a project he initially expected would take only a few months, and would perhaps provide a bit of relief from the long labour of producing his 'Big Book' on species. In reality, the barnacles took him almost a decade (1846–1854) and resulted in four substantial books that reclassified and reassessed all known species of barnacle, living and fossil.

Barnacles

Barnacles bring me to another, oft-repeated story. One of Darwin's children was visiting a friend's house, and – noting the absence of an off-limits study like his father's – asked "but where does

your daddy do his barnacles?”² There is something distinctly comical about the image of Darwin’s children assuming their father’s weird obsessions were shared by every father, but the story also illuminates several other points about Darwin and his world.

The story is another reminder of “separate spheres” – one of Emma’s many jobs was to stop the children (and anyone else) disturbing Darwin while he was at work. More importantly, the story is a reminder that Darwin grew up in a world without recognised scientific credentials; his life spanned the period of gentlemanly natural history right through to the rise of a recognisable groups of full-time, paid men of science. (They would not become known as ‘scientists’ until well into the twentieth century.) For most of the nineteenth century, someone who wished to participate in the scientific world needed to prove their expertise and win the approval of those who were already acknowledged experts. Travelling and publishing a record of one’s travels was a common – and important – first step, but most of the technical descriptions of the *Beagle* specimens had not been done by Darwin himself. And Darwin worried that when he finally published his ideas about species they would be dismissed as the work of someone with inadequate knowledge of the topic. That fate has befallen the author of the main Victorian best-seller on evolution, *The Vestiges of the Natural History of Creation* (1844), which had created an extraordinary sensation in the 1840s, while Darwin was working away privately on his ideas. The *Vestiges* was anonymous, which added to the publicity, but most of the scientific reviewers were convinced that – whoever the unknown author might be – they clearly didn’t have enough first-hand experience to be considered an expert. (One of Darwin’s old Cambridge friends, the geologist Adam Sedgwick, argued that the *Vestiges* was so awful that it must be the work of “some woman”.)

What does the *Vestiges* have to do with barnacles? Well, there was an interesting exchange of letters between Darwin and his closest friend, Joseph Dalton Hooker in 1845 (the year after the *Vestiges* appeared), in which they discussed another rather speculative tract about species (“*De l’Espèce dans les Corps Organises*”, by Frédéric Gérard). Hooker disparaged Gérard’s work because he was “neither a specific naturalist, nor a collector, nor a traveller” and therefore merely “a distorter of facts.” Hooker, like most Victorian naturalists, believed that before anyone was qualified to speculate about grand, philosophical (and potentially controversial) questions – such as evolution – they “must have handled hundreds of species with a view to distinguishing them & that over a great part,—or brought from a great many parts,—of the globe.” Darwin replied, with a note of anguish, “How painfully (to me) true is your remark that no one has hardly a right to examine the question of species who has not minutely described many”.³ Hooker tried to reassure Darwin that he was sufficiently qualified, but one of the reasons Darwin spent eight long years spent poring over barnacles was to demonstrate that he was fully qualified to discuss species. His effort succeeded; the Royal Society of London awarded him their prestigious Royal Medal in 1853, in recognition of his barnacle work.⁴ When the *Origin of Species* appeared, six years later, many

² The story first appeared in the first volume of *More Letters of Charles Darwin* (1903), whose editors (Darwin’s son Francis and A.C. Seward) reflected on how long the barnacles had preoccupied Francis’ father by quoting “a story of Lord Avebury’s” [i.e. the Darwin’s friend and neighbour, the banker and MP, John Lubbock] who claimed that “one of Mr. Darwin’s children is said to have asked, in regard to a neighbour ‘where does he [i.e. your father] do his barnacles?’ as though not merely his father, but all other men, must be occupied on that group”. Francis Darwin and A.C. Seward, eds., *More Letters of Charles Darwin (Volume I)*, 1st ed., 3 vols., vol. 1 (London: John Murray, 1903), 38.

³ Darwin Correspondence Project, “Letter no. 915,” accessed on 11 September 2020, <https://www.darwinproject.ac.uk/letter/DCP-LETT-915.xml>

⁴ Darwin Correspondence Project, “Letter no. 1539,” accessed on 12 September 2020, <https://www.darwinproject.ac.uk/letter/DCP-LETT-1539.xml>

people doubted Darwin's theory, but even his most committed opponents had to admit he was qualified to raise it; thanks, in part, to the barnacles, Darwin had become a man who could not be ignored.

However, there was more to barnacles than simply establishing Darwin's credentials among the men of science. The barnacles were part of Darwin's attempts to answer some complex questions about sex and reproduction. One of the many puzzles that Darwin investigated with the help of his barnacles was the origin of sex. Most species have two sexes and reproduce sexually most of the time. Indeed, it seemed to Darwin (and to most of the plant and animal-breeders whose work he studied) that sexual reproduction was nature's preferred method. Among Darwin's many enthusiasms were plants (indeed, I will argue in a later lecture that he was primarily a botanist). Most plants have both male and female parts in the same flower and as a result they can save themselves the tedious – and often hopeless – business of finding a mate. Most flowers can simply self-fertilise and save their energy for producing and scattering their seeds. Yet Darwin found that not only did few plants take advantage of this convenient arrangement, many had structures that made self-fertilisation as difficult as possible. I will leave that puzzle for a later lecture; before it can be considered, we need to ask – as Darwin did – what the point of sex is?

Breeders and naturalists had long been aware that sexually reproducing organisms varied more than those which reproduced asexually. One amoeba is exactly like another, because they reproduce by simple fission – a single cell splitting in two. However, the offspring of sexually reproducing organisms exhibit a mixture of their parents' characters. In the twenty first century, most of us know something about genetics and have some understanding of the various ways in which the genes from organisms are mixed and transmitted. But even in Darwin's day, when most of this was barely understood, it was clear that the variability of organisms provided the raw material for breeders to pick and choose from. Darwin called that process – choosing which cow to breed from, or which crops seeds were worth saving – *artificial* selection. He used it as an analogy for the main mechanism that he believed caused evolution: *natural* selection. Competition between plants and animals would ensure that any variations which offered any kind of advantage to an organism would help that organism to survive, to breed and to pass on the advantageous variation to its offspring. That – in very brief outline – was natural selection.

In what Darwin called the “struggle for existence”, sexually reproducing organisms had an advantage: because they varied more, they evolved faster, which sometimes allowed them to adapt to changing environments more effectively than asexually reproducing organisms. For example, the loss of most of Britain's elm trees in the twentieth century to Dutch Elm disease was partly the result of the fact that elm trees normally reproduce asexually. They send out roots called suckers that grow into new trees, which are genetically identical to the parent tree (in genetic terminology, they are clones). In 2004, geneticists confirmed what had long been suspected: that all Britain's elm trees were clones of a *single* tree.⁵ As a result, they had almost no genetic variability – including in their resistance to the disease – which explains why 25 million of them died in the 1970s, largely denuding Britain of ancient elms. Examples like this show how sex benefits the species; sexual reproduction increases variability which allows the species to adapt, spread to new habitats and survive.

The problem is that, according to Darwin's theory, nothing can evolve ‘for the benefit of the species’. Species are a human concept, a roughly defined group of fairly similar organism. Natural

⁵ Gil, L., Fuentes-Utrilla, P., Soto, Á. et al. “English elm is a 2,000-year-old Roman clone”. *Nature* 431, 1053 (2004). <https://doi-org.ezproxy.sussex.ac.uk/10.1038/4311053a>

selection only affects individuals – one plant, one animal, one bacterium – each competes in various ways with all the other individuals. Those which survive the competition long enough reproduce and pass on the collection of traits – the genes – that helped them survive. Natural selection has no intentions, no goals and no foresight, so there is no possible way in which it could anticipate the long-term needs of a collection of organisms which haven't yet been born. So how could sex have evolved in the first place?

Darwin was pondering puzzles like these even before he set sail on the *Beagle*. He had a lifelong fascination with the myriad ways that organisms procreate; some seemed to rely entirely on sex to reproduce, others managed with only an occasional coupling, while a few managed without sex at all. If, as Darwin assumed, every living thing had evolved from an earlier lifeform, the earliest possible organism must have been very simple. Probably something like amoebas, which multiplied by simple fission. If sex evolved, it must have done so gradually as a result of an immensely long series of random variations, a few of which increased the variability of the organism's variation, a trait that would be selected (because organisms which possessed it had a better chance of surviving). The fossil record produced few insights into the process because the soft parts of organisms almost never fossilise, so Darwin looked for living organisms that might provide plausible analogies for various evolutionary stages. Among the ones he had collected on his travels were barnacles, which fascinated him because most barnacles, like flowers, are hermaphrodites, they have both male and female reproductive organs. It seemed to Darwin that hermaphroditism must have been an inevitable early step on the long evolutionary road from asexual origins to two separate sexes. That possibility was supported by the fact that some barnacle species have separate sexes. So, Darwin wondered whether barnacles might give him some insight into the possible stages by which separate sexes had evolved in the past.

Among the *Beagle* specimens was an intriguing species, which he initially named *Arthrobalanus*, one of the creatures that had first piqued his interest in barnacles. The *Arthrobalanus* males were so tiny that they lived inside the females' shells, almost like parasites. The male of the species was little more than a tube of sperm, relying on the female for protection and nourishment. Staggered by this discovery, Darwin wondered whether such species – those that had what he called 'complemental males' – might perhaps be intermediates between the common hermaphroditic barnacles and the ones that had wholly separate sexes. They suggested a route by which separate sexes could have evolved.

Eight years spent on barnacles might seem absurd. The Victorian novelist Edward Bulwer Lytton (responsible, among other things for the immortal phrase "it was a dark and stormy night") certainly thought so: he included a character in his 1858 novel *What will he do with it* called Professor Long, "who had written two huge volumes on Limpets" – clearly a satirical vision of Darwin himself.⁶ However, the barnacle books allowed Darwin to demonstrate his expertise in taxonomy (classification), one of the most fundamental, technical branches of natural history. The books also began to demonstrate how natural selection would transform the study of nature. Although Darwin was not yet ready to go public with his theory, it already informed his work. As he told Hooker in a letter, he would never have understood what the complemental barnacle males were, not understood their significance, "had not my species theory convinced me, that an hermaphrodite species must pass into a bisexual species by insensibly small stages". Darwin wryly observed that Hooker might "perhaps wish my Barnacles & Species theory al Diabolo [to the

⁶ Nora Barlow, ed. *The Autobiography of Charles Darwin*, 1st ed. (London: Collins, 1958), 117.

devil] together. But I don't care what you say, my species theory is all gospel".⁷ Darwin's discovery added important evidence to his wider theories, but even more importantly it convinced Darwin himself that his theory was valid, since it helped him solve important puzzles. Far from being a distraction from his more theoretical work, the barnacles were crucial to it.

Breeding

At precisely the time when Darwin was considering marriage, he read Alexander Walker's newly published book *Intermarriage* (1838), which bore the subtitle: "How and why beauty, health, and intellect result from certain marriages, and deformity, disease, and insanity from others". As he read, Darwin would have noted Walker's claim that he would be explaining "the functions and capacities which each parent, in every pair, bestows on children, in conformity with certain natural laws, and by an account of corresponding effects in the breeding of animals". The idea that natural laws governed the breeding of both humans and animals would surely have caught Darwin's eye; soon after he got married, he decided to test ideas like Walker's by making detailed observations of plant-breeding. I will return to this topic in a later lecture, but Darwin's experiments showed the cross-bred plants produced a greater profusion of healthier seeds than those which were in-bred. That suggested why even hermaphroditic flowers seemed to avoid regular self-fertilisation, instead relying on the wind or insects to transfer their pollen to a different plant. Darwin experiments suggested that any mechanism that promoted cross-breeding would have been spread by natural selection. Presumably similar factors were at play among animals, which helped explained how asexual animals might have evolved through hermaphroditic stages into fully separate sexes.

However, Darwin's interest in these topics was not merely academic. Walker claimed that in-breeding could cause "deformity, disease and insanity". Over the years that followed his marriage, Darwin worried that his decision to marry his cousin had weakened their children, who seemed rather sickly. In 1842, he and Emma watched their third child, Mary, die just a few weeks after her birth; nine years later, their beloved daughter Annie died, just ten years old; and, their last child, Charles Waring, lived for less than two years. Darwin's garden was not merely a refuge from these sad losses, it was also where he tried to understand their causes; he spent years crossing plants with each other, trying to understand the precise effects of inbreeding. Natural selection was, for Darwin, far more than a purely scientific theory; it also connected the largest philosophical questions about the nature of life on earth with the most intimate issues imaginable. And ever since Darwin, all kinds of people would find similar links in his writings, between the big scientific questions and the most personal ones, which is one reason so many of us are still thinking about Darwin.

Suggestions for further reading

The two best biographies of Darwin remain: Adrian Desmond and James Moore *Darwin* (1991) and Janet Browne's magisterial two-volume study (*Charles Darwin: Voyaging*, 1995; and, *Charles Darwin: The Power of Place*, 2002). Desmond and Moore's book is shorter and emphasises the social and political circumstances of Darwin's life, while Browne's offers a very rich and subtle

⁷ Darwin to J. D. Hooker, 10 May 1848 (Darwin Correspondence Project, "Letter no. 1174," accessed on 12 September 2020, <https://www.darwinproject.ac.uk/letter/DCP-LETT-1174.xml>)

reading of Darwin's private life. If you have the time and the patience, the two books complement each other perfectly.

Barlow, Nora, ed. *The Autobiography of Charles Darwin*. 1st ed. London: Collins, 1958.

Buchanan, R. D. and J. Bradley (2017). "Darwin's Delay': A Reassessment of the Evidence". *Isis* 108(3): 529–552.

Darwin, Francis, and A.C. Seward, eds. *More Letters of Charles Darwin (Volume I)*. 1st ed. 3 vols. Vol. 1. London: John Murray, 1903.

Secord, J. A. (2000). *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation*. (Chicago, University of Chicago Press).

Stott, Rebecca (2003). *Darwin and the Barnacle*. London, Faber and Faber.

Two websites provide invaluable resources for anyone who is interested in Darwin:

- The Darwin Correspondence Project [<https://www.darwinproject.ac.uk/>] is an online database of Darwin's letters, with a rich array of supporting documents and resources.
- Darwin Online [<http://darwin-online.org.uk/>] hosts accurate online editions of almost everything Darwin published, accompanied by reviews and lots of other relevant material.

Finally, several sections of this transcript are adapted from my own publications; you will find more details of the sources I used there. See:

Endersby, Jim (2003). "Darwin on generation, pangenesis and sexual selection" (*Cambridge Companion to Darwin*. Edited by M. J. S. Hodge and G. Radick. Cambridge, Cambridge University Press: 69–91).

Endersby, Jim (2007). *A Guinea Pig's History of Biology: the plants and animals who taught us the facts of life*. London, William Heinemann.

Endersby, Jim (2009). Editor's Introduction, to Darwin *On the Origin of Species by Means of Natural Selection: or the preservation of favoured races in the struggle for life* (Cambridge, Cambridge University Press: xi–lxv).

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