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What Charles Darwin owed to Joseph Banks

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Abstract: History has remembered Joseph Banks as the explorer-botanist of the first voyage of James Cook. Yet, shortly after his return, he got elected president of the Royal Society and, for over 40 years, he then played in Great Britain an eminent role in reorganizing natural sciences and advocating an “economic botany”. He actively intervened in acclimatization and varietal selection of plants and animals in Great Britain as in the future English colonies. Thus he built an intellectual environment which will promote the emergence of Charles Darwin’s thoughts.

Keywords: Joseph Banks, Charles Darwin, Botany Bay, Transformism, Natural expeditions

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1. Introduction

During my half-century of teaching evolutionary biology, when I was dealing with the history of evolutionary concepts, starting with some of the great ancient precursors of transformism — Pierre Louis Moreau de Maupertuis (1698–1759), Jean-Baptiste de Lamarck (1744–1829), Etienne Geoffroy Saint-Hilaire (1772–1844)... — to the founders of evolutionism — Charles Darwin (1809–1882), Alfred Wallace (1823–1913)... — one question kept cropping up: “Most of the precursors were French. Why are the founders English?” I have to admit that my initial answers were not satisfactory, mainly putting forward the fixism of the students of Georges Cuvier (1769–1832), such as Henri Ducrotay de Blainville (1777–1850), Pierre Flourens (1794–1867) and Henri Milne Edwards (1800–1885) [1, 2], [3, p. 318]. This certainly exposed the institutional climate of the time in France, but said nothing about Great Britain where, whatever one thinks of it, natural selection would have been proposed as the driving force behind evolution even in the hypothetical absence of Darwin, which would have been compensated for, for example, by Alfred Wallace or Henry Bates (1825–1892) [4].

There must therefore have been a particular microcosm across the Channel that suddenly appeared favourable, a microcosm whose patient builder seems to have been one man, Joseph Banks (1743–1820), botanist and President of the Royal Society.

2. Banks' youth

Born into a very wealthy family, Joseph Banks received the best education in 18th century England: Harrow School, Eton and then Oxford University, at the prestigious Christ Church College. At the age of eighteen, on the death of his father, he inherited an immense fortune — which he did not squander. On the contrary, he used it continually for intellectual purposes. For example, finding the standard of botany teaching at Oxford mediocre, he arranged, at his own expense, for Israel Lyons (1739–1775), a botanist and mathematician from Cambridge, to give a series of lectures at his college [5].

A few years later, in 1764, he met the Swedish naturalist Daniel Solander (1733–1782), an “apostle” of Carl von Linné (1707–1778) and, for the past year, assistant librarian at the British Museum [6]. They were never to leave each other's side [7]. On his first expedition, to Newfoundland and Labrador (April 1766–January 1767), Banks asked Solander to accompany him to classify the collections that gave rise to numerous drawings by Sydney Parkinson (1745–1771) [8]. During this trip, Banks was elected Fellow of the Royal Society (FRS). Everything was in place for an incredible career.

3. Cook's first voyage

Since the Newtonian revolution, astronomy has been the leading discipline in Europe. Astronomers calculated and predicted that Venus would transit in front of the Sun on 3 June 1769. By comparing measurements of this transit taken from several distant points on Earth, it was possible to calculate the precise distance from Earth to the Sun. However, the next transit did not occur until 9 December 1874! The Royal Society arranged for a Royal Navy ship, commanded by Lieutenant James Cook (1728–1779), to set sail quickly to take a measurement in the Pacific Ocean. This would be in Tahiti, recently discovered in 1767 by Samuel Wallis (1728–1795). Cook's secondary task was to verify the existence of *Terra Australis Incognita*, the hypothetical southern continent [9].

On 26 August 1768, *HMS Endeavour* set sail from Plymouth. She was a coal ship carrying 94 men — 71 sailors, 12 riflemen and 11 civilians — including Banks, who embarked at his own expense. He took 9 men with him, including the faithful Solander and Parkinson, as well as his secretary, the Finnish naturalist, artist and watchmaker Herman Spöring (1733–1771) and another landscape artist, Alexander Buchan (?–1769). Thanks to his personal fortune, Banks was able to join a team dedicated to astronomy as a naturalist — the 11th civilian was the astronomer Charles Green (1735–1771) [10].

Once the transit of Venus had been observed [11], Cook left Tahiti in search of *Terra Australis*. This made him the second European navigator, after the Dutchman Abel Tasman (1603–1659), to land in New Zealand,

which he mapped as well as he could. He then headed for Tasmania and Australia, where he followed the east coast. It was then, on 28 April 1770, that he discovered an astonishing bay that was to become legendary.

3.1. *Botany Bay*

Initially named Stingaree Bay by the sailors who spotted a considerable number of rays in the transparent waters, it became Botany Bay after the naturalists disembarked. Banks, Solander, Spöring—but also Cook—discovered an unknown landscape. The trees here did not have the same shape as in Europe, but were shrubs with several stems growing from the base, like a giant bush called a mallee [12]. Then, collecting flowering plants, Solander made the now classic observation that they fell into two groups. Some, such as the fuchsia-shaped heather (*Epacris longiflora*, Ericaceae), easily found their place in the Linnaean classification, but others were surprises, such as *Banksia integrifolia* (Proteaceae), whose genus name was dedicated to Banks in 1782 by Carl von Linné the Younger (1741–1783), and whose family name was coined in 1789 by Antoine-Laurent de Jussieu (1748–1836) to account for the very different shapes of the species that make it up. Fascinated by birds such as the meliphagous pollinators, these naturalists discovered surprising animals such as the bear-like wombat (*Vombatus ursinus*) and the Norfolk phalanger (*Petaurus norfolcensis*), which can glide up to a few dozen metres [13].

But while the *Endeavour* stayed in Tahiti for three months, Cook spent only one week in this naturalist's paradise [14]. The return journey was difficult. On 11 June the ship hit the Great Barrier Reef. Cook managed to avoid shipwreck and ran aground at the mouth of the Endeavour River, not far from present-day Cooktown, to repair the hull [15]. On the return journey, the urgent need for supplies meant a stopover in Batavia (now Jakarta). Thirty-eight men died of malaria there, including Spöring, Parkinson and Green. Finally, on 13 July 1771, the *Endeavour* anchored in Plymouth.

3.2. *The triumphant return*

The *Endeavour's* reception was astonishing. Everyone wanted to know about the circumnavigation. The public were more fascinated by anthropology than botany. Obviously Banks knew how to shine in the London salons far better than Cook. A picture by John Hamilton Mortimer (1740–1779), painted in 1771, bears witness to this. Banks is the only one seated. Behind him is Solander and in front of Cook are John Hawkeworth (1715–1773), who was to edit his logbook, and John Montagu (1718–1792), 4th Earl of Sandwich and First Lord of the Admiralty, who always supported him. Given the unprecedented success of this mission, Cook was asked to return as soon as possible to settle once and for all the problem of the existence of *Terra Australis Incognita*—which he did in 1772. Banks wanted to set sail again, but he made a fatal mistake—probably the only one of his prestigious career: he wanted to command! So we read in the *Gazeter and New Daily Advertiser* of 26 August 1771 [16, p. 149]: “Mr Banks is to have two ships from government to pursue his discoveries in the South Seas, and will sail on his second voyage next March”. How could he not have known that the Admiralty would never allow one of its ships to come under the authority of a civilian? So he did not embark and was replaced by the German naturalists Johann Forster (1729–1798) and his son Georg (1754–1794). Disappointed, he decided to use the team he had assembled—including Solander, of course—for another expedition. It was to be to Iceland [17]. He set sail on 12 July 1772, the same day as Cook. All this did not prevent him from shining again on the return of Cook's second voyage in 1775. A 1776 painting by William Parry (1743–1791) shows Omai, the Tahitian whom Cook brought back to London, accompanied only by Banks and Solander.

4. The longest presidency of the Royal Society

Now famous, Banks was elected President of the Royal Society on 30 November 1778, even though he had not yet published a single article. He was to occupy this chair for the rest of his life, for 41 years! He

became an adviser and then a confidant of King George III (1738–1820)—probably the first monarch to study science—whom he met at least once a week. This privileged position gave him the freedom to act like a minister of research, which he did by reorganising many areas [18]. First and foremost, he turned the English sciences and the Royal Society, still under the titular figure of Isaac Newton (1642–1727), upside down by encouraging the development of the natural and applied sciences, which he achieved with the collaboration of the physicist and chemist Henry Cavendish (1731–1810). Despite what is sometimes written, this reorganisation was not to the detriment of physics and mathematics [19]. Evidence of this can be seen in the thousand or so articles published in the *Philosophical Transactions* during his presidency, 72 % of which did not deal with biology.

4.1. *The development of natural sciences*

Banks' genius lay in seizing opportunities as they arose—and his association with the royal family was to be a major source of these. With the active help of William Cavendish (1748–1811), 5th Duke of Devonshire, he convinced the King to buy the gardens of Kew, probably around 1776. William Aiton (1731–1793), director since 1759, retained his position and actively developed the botanical collections [20]. When Carl von Linné the Younger (1741–1783) died, he encouraged his friend, the wealthy botanist James Edward Smith (1759–1828), to buy the entire collection of Carl von Linné (1707–1778), i.e. his library, all his manuscripts, herbariums and specimens. Five years later, Smith founded the Linnean Society of London, which was to play a key role in the development of the natural sciences. It was also under his impetus that William Smith (1769–1839) was able to complete the geological map of England, Wales and part of Scotland, and that the Geological Society was founded in 1807 [21]. Naturally, the Royal Gardens of Kew were to receive a large number of seeds, bulbs, herbaceous plants, trees, etc. All this was not merely for the development of knowledge, but also for “economic botany”, to use Banks' expression [22, p. 227]. It has to be said that he did a marvellous job of it.

4.2. *The development of British agriculture*

Banks soon realised that for botany to be of economic importance, several conditions had to be met: acclimatisation, hybridisation and selection. But he did not stop at plants, as illustrated by his crucial involvement in British sheep farming [22]. Let's put the problem into perspective. The American War of Independence ended in 1783 with many negative economic consequences for Great Britain. The price of wool collapsed because the markets of the American states were closed, and it had been forbidden since 1660 to send raw wool abroad. The economic context had to be reviewed, but Banks wanted to seize the opportunity to improve British sheep flocks. To do so, he turned to the right man for the job, Auguste Broussonet (1761–1807) from Montpellier, whom he had helped to settle in London in 1780.

Broussonet became friends with Solander and Smith, among others, and set about classifying the fish collected during Cook's first voyage. He joined the Royal Society in 1781. However, in August 1782 he returned to Paris and joined the Société d'agriculture de la Généralité de Paris, which became the Société d'agriculture de France in 1790 [23, pp. 67–98]. Two years later, Louis Daubenton (1716–1899) took him on as a substitute at the Collège de France and as an assistant at the École vétérinaire d'Alfort, where he taught rural economics. Daubenton was a sheep specialist, responsible at Alfort and Montbard—the stronghold of Georges Buffon (1707–1788)—for the flocks of Spanish Merinos brought to France in 1766. After much hesitation, he sent a ram and a ewe to Banks on 16 June 1785. Later, on 3 January 1788, Daubenton and Broussonet sent a flock of 80 animals to Kew. In gratitude, Banks gave Broussonet a kangaroo, the first to arrive in France.

Banks began cross-breeding experiments with Southdown, Hereford and Norfolk sheep. He needed other Merinos to continue these experiments, but the French Revolution put an end to discussions with Broussonet. He then turned to Portugal and in 1792 received a herd of 47 animals from Lisbon. The main result of the numerous crosses made in very different regions was crucial: Banks demonstrated that the fineness of the wool did not deteriorate when the environment changed, in other words that it was a hereditary trait. At the

same time, he made it clear that in any selection operation, it was necessary to verify the independence of the trait from the environment and, without having the vocabulary, he clarified the difference between a heritable trait and a hereditary trait [22, p. 222].

4.3. *Acclimatisation in all directions*

The greenhouses at Kew now contained many plants of remarkable beauty, such as *Strelitzia reginae*, the most famous bird of paradise, which William Aiton dedicated to Queen Charlotte of the Grand Duchy of Mecklenburg-Strelitz in 1789. But it was economic botany that captivated Banks. He cultivated New Zealand flax (*Phormium tenax*), botanically unrelated to the European flax (Linaceae) and widely used in Maori basketry, and New Zealand spinach (*Cordyline fruticosa*), also unrelated to European spinach, an amaranthaceae (formerly chenopodiaceae). He also experimented with Canadian wild rice (*Zizania aquatica*), which this time belongs to the same family as our traditional rice [20, 24].

But his most spectacular actions took place in the future English colonies. When he realised that potential acclimatisation in Britain would prove impossible, Banks encouraged it in a place that was favourable for both the plant and the British [25]. For example, he introduced the camphor tree (*Cinnamomum camphora*, lauraceae), originally from China, and the mango tree (*Mangifera indica*, anacardiaceae), originally from India, to Jamaica. From an economic point of view, his most spectacular achievement was the introduction of the tea plant (*Camellia sinensis*, theaceae), originally from China, into India and Ceylon [26, 27]. What agronomic achievements!

4.4. *Exploring the world*

In this context, Banks encouraged voyages of scientific exploration. While Carl Linnaeus' 17 "apostles" had been sent around the world to discover and record flora and fauna, Banks systematised these expeditions so that, more importantly, the British would be the first Europeans to discover potential riches. In Africa, he sent Mungo Park (1771–1806) up the Niger and James Bruce (1730–1794) to discover the Blue and White Niles [28]. It was at his instigation that George Vancouver (1757–1798), Cook's former midshipman on *HMS Resolution* and then *HMS Discovery*, set off in search of the Northwest Passage. For Allan Cunningham (1791–1839) it would be Brazil, then Australia, the continent of Matthew Flinders (1774–1814). In 1798, Flinders sailed around Tasmania on *HMS Reliance* with the naturalist George Bass (1771–1803). Then, from 1801 to 1806, *HMS Investigator* circumnavigated Australia with the botanist Robert Brown (1773–1858). At Encounter Bay, on 8 April 1802, she met *Le Géographe*, commanded by Nicolas Baudin (1754–1803). At the time, it was not clear whether Australia would be English or French [29], [30, pp. 238–245]. Finally, we must not forget the infamous *HMS Bounty* expedition, whose commander, William Bligh (1754–1817), had been Cook's boatswain on *HMS Resolution*. Bligh's mission was to introduce the breadfruit tree (*Artocarpus altilis*), a moraceous plant from Oceania, to the Caribbean. But why? It was the American War of Independence and the slaves in the Caribbean had to be fed, as nothing could be brought from the nearest continent.

Let us conclude with the most political of Banks' operations. At his suggestion, in 1787, 732 convicts were sent by the First Fleet commanded by Arthur Phillip (1738–1814) to Botany Bay, which, despite its myth, was not a good anchorage [31]. Phillip sailed on to a bay further north, Port Jackson, where he founded Sydney. From then on, Australia was truly English, despite the visit of *L'Astrolabe* and *La Boussole* in 1788, commissioned by Jean-François de Lapérouse (1741–1788) [32, pp. 395–397].

Thus, after being an explorer, Banks turned out to be an organiser of different areas, that of English science and, at the same time, that of the future colonies that he would transform, both from a human and an agronomic point of view.

5. The emergence of Darwin's thought

How was Darwin led to descent with modification and natural selection? Darwin was 11 years old when Banks died. His grandfather, Erasmus Darwin (1731–1802), whose *Zoonomy, or Laws of Organic Life* (1794) reflected transformist thinking, was a friend of Banks, whom he met at the Royal Society.

5.1. *Five years aboard the Beagle*

First and foremost, there was his five-year voyage aboard *HMS Beagle* (27 December 1831–2 October 1836). Like Banks, he was born into a wealthy family and embarked at his own expense. While this was an innovation on Cook's first voyage, it had become customary a few decades later, and the Admiralty had no problem accepting that Captain Robert Fitz-Roy (1805–1865) set out to find a young naturalist to accompany him. On the *Beagle*, Darwin read the *Principles of Geology* by Charles Lyell (1797–1875), published between 1830 and 1833, in which he discovered uniformitarianism, i.e. that the earth had been shaped continuously, slowly but for a very long time, by the same forces as today, as the subtitle of the work makes clear: "an attempt to explain the changes in the Earth's surface by causes operating at the present time". Would there be such a Lyell without the Geological Map of England and the Geological Society?

5.2. *Selection*

When Darwin returned from his expedition around the world, he took an interest in domestication, the work of breeders, whose work was now well codified under the impetus of Banks. The very existence of artificial selection, that of breeders, demonstrates that the ability to be selected is a natural reality of the living world. The process of domestication makes it possible to highlight, over a short period of time, a production that takes place over a long period of time in nature, and which humans cannot witness [33].

Thus, it was with reference to artificial selection that Darwin forged the concept of natural selection [34, 35]. But would there have been so many competent breeders in Britain without Banks?

5.3. *Supporters*

Darwin received unfailing support from the botanist William Hooker (1779–1832), Director of the Royal Gardens at Kew from 1841 to 1865, and from his son Joseph Hooker (1814–1879), who embarked as botanist on *HMS Erebus*, under the command of James Clark Ross (1800–1862), and succeeded his father at Kew. It is clear that the gardens of Kew were the place of choice for competent botanists, just as the King's gardens were in Paris. It can be summed up as follows: without Kew, there is no Hooker.

5.4. *The atmosphere at that time*

The disruption of natural science undertaken by Banks gave rise to many questions. Thus, before embarking together in May 1848 for the Amazon, Henry Bates wrote to Alfred Wallace [36]: "Local specimens are no longer sufficient for my study. They add nothing new. I should like to examine a whole family, chiefly from the point of view of the theory of the origin of species." So research into the origin of species was never Darwin's exclusive preserve; it was part of the zeitgeist.

Let's review the key points of Darwin's learning and thinking: his work as a naturalist in the field, starting out on the *Beagle*; his discovery of the importance of geological time; constant exchanges with English breeders; constant exchanges with professional zoologists and botanists. All this led to the intuition that life had a history on Earth, and that classification should be a search for common ancestors. Biology thus became a historical science, and natural selection one of the driving forces behind evolution. In fact, Darwin developed a scientific way of thinking whose premises are all to be found in the consequences of Banks' inspirations.

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