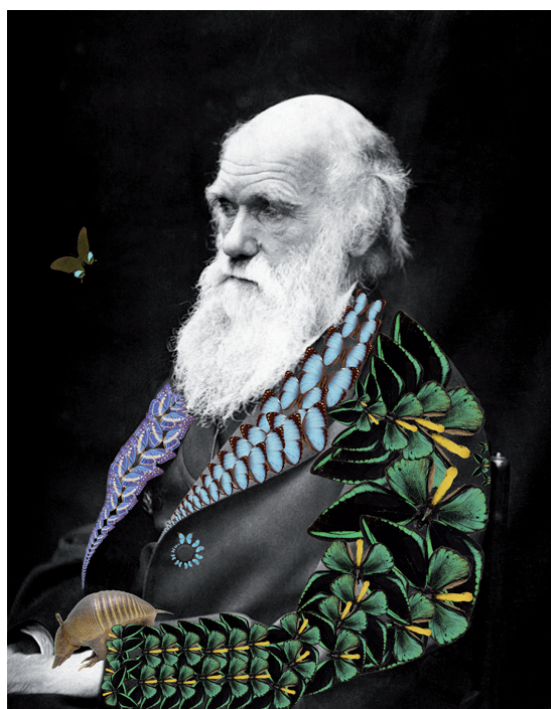


Ana Leonor Pereira
João Rui Pita
Pedro Ricardo Fonseca
(eds.)

Darwin, Evolution, Evolutionisms

I
IMPRESSA DA UNIVERSIDADE DE COIMBRA
COIMBRA UNIVERSITY PRESS
U



Palmira Fontes da Costa

Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Centro Interuniversitário de História das Ciências e da Tecnologia

THE MEANING OF MONSTROSITIES IN
CHARLES DARWIN'S UNDERSTANDING
OF THE ORIGIN OF SPECIES

Beings who clearly deviated from their species in one or more traits have been a subject of great interest and debate by physicians and natural philosophers since at least the 16th century.¹ Yet, by the early 19th century, the mechanism of their origin and their meaning for the understanding of the natural world was still controversial. Nevertheless, monsters obviously showed that new traits could appear among members of a species and sometimes in a very extreme manner. Moreover, although the majority of monstrous animals died at an early age and some had problems in terms of reproduction, various works had also shown the inheritance through various generations of some forms of monstrosity. Their appearance was therefore relevant for understanding variability in the natural world.

In his seminal work, *On the Origin of Species by Means of Natural Selection* (1859) Charles Darwin (1809-1882) introduced the theory that populations evolve over the course of generations through a process of natural selection, and presented a body of evidence showing that the diversity of life arose through a branching pattern of evolution and common descent. His theory required the ubiquity of change in nature and the centrality of variation among individuals of the same species throughout the history of the natural world. What kind of role, if any, did Darwin attribute to the appearance of monstrosities in explaining the variation of nature and ultimately the origin of new species?

During Darwin's life the understanding of animal and vegetable monstrosities underwent profound changes and teratology emerged as a new branch of scientific knowledge. What was the impact of these new studies on Darwin's thought? This paper addresses this question by focusing not only on some of Darwin's works but also on his notebooks on the transmutation of species and personal correspondence. I will argue that Darwin's frequent references to this topic in his personal notebooks and letters should not be neglected and is useful for a better understanding of the development of his ideas on the problem of the origin of new species.

¹ See Daston, L. and Park, K. *Wonders and the Order of Nature, 1150-1750*. New York: Zone Books, 1998; Fontes da Costa, P. *The Singular and the Making of Knowledge at the Royal Society of London in the Eighteenth Century*. Newcastle: Cambridge Scholars Publishing, 2009

Monstrosities and the laws of variation

It seems to have been John Henslow (1796-1861) who first alerted Darwin to the importance of monstrosities. In a letter to his great mentor and former teacher of Botany at the University of Cambridge, dated 3rd July 1840, Darwin remembered how Henslow's lectures had called his attention to the fact that "monsters were sometimes curious".² Together with the letter, he sent Henslow an orange with the shape of cow horns from the family orchard at Down House.

Various scholars have pointed out that Henslow was fundamental in Darwin's scientific education and career. He not only provided Darwin with the best education in natural history of the period and with the opportunity to travel on the *Beagle*, but he also called his attention to a new subject: the centrality of intra-species variation in the understanding of the natural world, a problem that later became fundamental to Darwin's programme of research and ultimately to the publication of his work *The Origin of Species* (1859) as well as to other related books that he published afterwards.³

In his studies of intra-species comparisons, Henslow often attached two or more pressed plants of the same species to a single sheet of paper, clearly showing any differences between the individuals. Many of his specimens now held at the Botanical Garden of the University of Cambridge, which he directed for several years, also show "monstrosities", that is, unusually shaped specimens where some feature or features deviated from the typical form. It is very likely that Darwin saw some of these specimens.

Darwin included only a few references to monstrosities in *The Origin of Species*.⁴ He defines monstrosities as a "considerable deviation of structure in one part, either injurious to or not useful to the species, and not generally propagated".⁵ This definition is significant since, by stressing the general non-inheritance of monstrosities, it rules out their importance in the process of transformation of species. Darwin also remarks on "the reappearance of minute dangling horns in hornless breeds of cattle, more especially, according to Youatt, in young animals, – and the state of the whole flower in the cauliflower" and notes that "we often see rudiments of various parts in monsters". However, he doubts "whether any of these cases throw light on the origin of rudimentary organs in a state of nature".⁶

A different picture emerges if we look at Darwin's notebooks on the transmutation of species and his personal letters. During the voyage of the *Beagle* Darwin recorded his observations in a series of field notebooks. After returning to England, he also began to use them to record theoretical speculations. Darwin's notebooks on the transmutation of species reveal in detail his research and gradual illumination of the species question. Interestingly, they have several references to monstrosities. Some of them are just notes on news of monstrous births in various parts of the world that

² Darwin Correspondence Project, Letter 573 — Darwin, C. R. to Henslow, J. S., 3 July [1840].

³ David Kohn, Gina Murrell, John Parker, Mark Whitehorn, "What Henslow taught Darwin", *Nature* 436 (2005) 643-645.

⁴ Darwin, *On the Origin of Species*, 1859, pp. 8, 11, 14, 131, 155, 443.

⁵ *Ibid.*, p. 44.

⁶ *Ibid.*, p. 45

he had noticed in the published literature of the period. Such is the case of a “Female pig apt to produce monsters in the Isle of France” or a “Madagascar oxen with an hump”, both from *The Edinburgh Journal of Natural History*.⁷ Also from another journal, *L’institut* (1838, p.414), Darwin records that the author, Mr. Guyon, points out the existence of more monstrosities in Africa than in Europe.⁸

Darwin’s notebooks show also that he was especially interested in the possible relevance of monstrosities for the appearance of variety in nature. He knew from various authors that, just like mules, “dreadful monsters [are] abortive”.⁹ However, he also notes in one of his notebooks, how some monstrous traits such as those that appear in six-fingered people are hereditary.¹⁰

One of the first English authors who had dealt with the problem of the origin of monsters and proposed an hereditary principle for at least some kinds of monstrosities was John Hunter (1728-1793). In his essay “On Monsters”, Hunter recognized that there must be a principle of monstrosity and whether it “be coeval with the first arrangement, or arise in the progress of expansion, is not easily determined in many [instances of monstrosity]; but it is certainly not the case in all; for many take place at a late period, and would seem to be owing to accident, or to some immediate impression; but still there must be a susceptibility for such, which susceptibility must be original”.¹¹ Moreover, Hunter acknowledged that some monsters had an ‘hereditary principle’ and that, once formed, they had the ‘principle of propagating their monstrosity’.¹² He also discussed whether particular species were subject to peculiar monstrosities.¹³ Hunter’s essay was only published posthumously in 1861, but Darwin’s notebooks on the transmutation of species show that he knew the work through Richard Owen (1804-1892).¹⁴

The notebooks reveal also that Darwin had read the most recent works on teratology. He describes Etienne Geoffroy Saint-Hilaire’s *Philosophie Anatomique*, dealing more specifically with monsters, as “worth reading” and, in a letter to Hooker, refers to the fact that he has “just finished three huge volumes by Isidore St Hilaire on animal monsters, and a nasty curious subject it is”.¹⁵ The work of these authors become

⁷ Notebook B: [Transmutation of species], CUL — DAR 121, page sequence 192.

⁸ Notebook D: [Transmutation of species], CUL — DAR 124, page sequence 74.

⁹ Notebook D: [Transmutation of species], CUL — DAR123, page sequence 192.

¹⁰ *Ibid.*

¹¹ John Hunter, “On Monsters”, *Essays and Observations on Natural History, Anatomy, Physiology, and Geology*, ed. By R. Owen, Vol. 1, 239-251, London: John Van Voorst, Paternoster 1861, p. 240.

¹² *Ibid.*, p. 246. John Hunter supported this view with the fact that he had seen three *spinæ bifidae* in the children of one family, two hare-lips in the children of the same parents, as well as other cases.

¹³ *Ibid.*, p. 248.

¹⁴ In one of his notebooks on the transmutation of species, Darwin particularly stressed Hunter’s remark that monsters are formed at an early stage, that is “at the very first formation, for this reason, that all supernumerary parts are joined by their similar parts, viz. a head to a head”, Notebook D: [Transmutation of species], CUL-DAR123, page sequence 55.

¹⁵ Notebook B: [Transmutation of species], CUL-DAR121, page sequence 116; Letter 847 — Darwin, C. R. to Hooker, J. D., 31 Mar [1845]. Darwin is referring to Isidore Geoffroy Saint-Hilaire’s *Anomalies de l’organisation chez l’homme et les animaux au traité de teratologie* (1832–7).

especially valuable in Darwin's elaboration of *The variation of animals and plants under domestication* (1868), a book that attempted to explain the mechanisms of variation and inheritance. Indeed, of all works published in Darwin's lifetime, this is the one where it is possible to find the greatest number of references to monstrosities.¹⁶ Darwin emphasizes the importance of Isidore Geoffroy Saint-Hilaire's law on the affinity of homologous parts and its relevance in explaining the origin of double monsters: "this is perhaps best seen in monsters with two heads, which are united".¹⁷ However, he also notes that lately it has been admitted that:

the production of double monsters is explained in a different way and as being due to the spontaneous divarication of the embryonic mass into two halves. This, however, is effected by different methods. But the belief that double monsters originate from the division of one germ, does not necessarily affect the question of subsequent fusion, or render less true the law of the affinity of homologous parts.¹⁸

Darwin points also to the usefulness of the law of mutual affinity in explaining other cases of monstrosities:

Isidore Geoffroy gives a number of instances of two or more digits, of two whole legs, of two kidneys, and of several teeth becoming symmetrically fused together in a more or less perfect manner. Even the two eyes have been known to unite into a single eye, forming a cyclopean monster, as have the two ears, though naturally standing so far apart. As Geoffroy remarks, these facts illustrate in an admirable manner the normal fusion of various organs which during an early embryonic period are double, but which afterwards always unite into a single median organ. Organs of this nature are generally found in a permanently double condition in other members of the same class. These cases of normal fusion appear to me to afford the strongest support in favour of the present law.¹⁹

He remarks, however, that "Adjoining parts which are not homologous sometimes cohere; but this cohesion appears to result from mere juxtaposition, and not from mutual affinity".²⁰

Darwin also refers to the French naturalist Alfred Moquin-Tandon (1804-1863) who had studied monstrous plants and argued for the tendency in homologous parts to unite during their early development as one of the most striking laws governing the production of monsters. He further emphasises that the law throws clear light not only on the production of monsters but also of many normal structures which have evidently been formed by the union of originally distinct parts.²¹

¹⁶ There are 10 references to monstrosities in volume 1 and 46 references in volume 2.

¹⁷ Darwin, *The variation of animals and plants under domestication*, 2nd volume, p. 352.

¹⁸ *Ibid.*, p. 353.

¹⁹ *Ibid.*, p. 341. Isidore Geoffroy Saint-Hilaire presented his ideas in *Histoire générale et particulière des anomalies de l'organisation chez les animaux ou Traité de teratology*, Paris, 1832-1836.

²⁰ Charles Darwin, *The variation of animals and plants under domestication*, 2nd volume, 1868, p. 341.

²¹ *Ibid.*, p. 342.

Therefore, in *The variation of animals and plants under domestication*, Darwin considers monsters as one extreme case of variation in nature and he refers particularly to Etienne Geoffroy Saint-Hillaire's law of mutual affinity to explain their occurrence. According to this explanatory framework, most monstrosities would be due to problems occurring during the early development of the organism, namely to arrested development.²² Darwin is also aware that "many congenital monstrosities are inherited" and that "other malformations are rarely or never inherited".²³ He specifically observes that monstrosities can be a cause of sterility since "great deviations of structure, even when the reproductive organs themselves are not seriously affected, sometimes cause plants to become sterile".²⁴ In addition, he remarks that close interbreeding could lead to monstrosities and that domesticated organisms are much more liable to produce them.²⁵

Despite the various references to monstrosities in *The variation of animals and plants under domestication*, Darwin does not discuss any possible relationship between their appearance in nature and his transformist ideas on the origin of species. What possible reasons were there for his silence on this matter?

Monstrosities and the transformation of species

The notebooks on the transmutation of species reveal that Richard Owen suggested to Darwin that "the production of monsters, which follow certain laws according to species, present an analogy to the production of species".²⁶ Hence, much before writing the *Origin of Species*, Darwin was alerted to the fact that monsters might be a useful model for understanding the appearance of novelty and ultimately of new species in nature.

In the concluding chapter of *The Origin of Species*, Darwin asserts his conviction on gradualism by invoking the old Leibnizian and Linnean aphorism, *natura non facit saltum* (nature does not proceed by leaps):

As natural selection acts solely by accumulating slight, successive, favorable variations, it can produce no great or sudden modifications; it can act only by short and slow steps. Hence, the canon of *Natura non facit saltum* which every fresh addition to our knowledge tends to confirm, is on this theory intelligible.²⁷

Darwin's emphasis on gradualism explains, at least in part, why the possible relationship between the appearance of monstrosities and the transformation of species might have seemed problematic to him. Monstrosities represented the possibility of the existence of extreme changes in nature and, therefore, were not compatible with his

²² Darwin, *Variation of animals under domestication*, p. 57.

²³ *Ibid.*, p. 24.

²⁴ *Ibid.*, p. 166.

²⁵ *Ibid.*, pp. 263; 417-418.

²⁶ Notebook B: [Transmutation of species], CUL — DAR 121, page sequence 163.

²⁷ Darwin, *On the Origin of Species*, p. 471.

gradualist views. This is probably one of the reasons why Darwin only occasionally mentions monstrosities in *The Origin of Species*. However, shortly after the publication of the work, in one of his letters to Charles Lyell, dated February 18th 1860, Darwin frankly admits that he “had been too cautious in not admitting great and sudden variations” in his book.²⁸ This remark was motivated by a recent attack on his work by the botanist William Henry Harvey. On the basis of the study of the plant *Begonia frigida*, Harvey had argued that in some cases new species could have originated through the abnormal development of the existing form.²⁹ In the letter to Lyell, Darwin admits that one of the problems of having had to present his theory in a shorter version than he originally intended, was the absence of relevant matters.³⁰

Indeed, in the fuller manuscript written between 1856 and 1858, usually referred to as the “big species book”, Darwin had included a section on monstrosities.³¹ In this section, he discusses the work of the main contemporary authors on the subject, Étienne Geoffroy Saint-Hilaire and his son Isidore on animal monstrosities and Moquin Tandon on vegetable monstrosities. Darwin remarks that all of these authors have insisted “on the law that monstrosities in one animal resemble normal structures in another”.³² He doubts, however, that “in a state of nature new species arise from changes of structure in old species so great & sudden as to deserve to be called monstrosities”. He notes that, if it “had this been so, we should have had monstrosities closely resembling other species of the same genus or family; as it is comparisons are instituted with distant members of the same great order or even class, appearing as if picked out almost by chance”. In fact, all the cases of monstrosities which resemble normal structures which he could find were not in allied groups. Furthermore, Darwin does not believe, “that structures could arise from any sudden and great change of structure so beautifully adapted as we know them to be, to the extraordinarily complex conditions of existence against which every species has to struggle”.³³ Yet, he admits that possibility in the rarest instances.

The problem of the possible existence of sudden variations in nature is again addressed by Darwin in a letter to his close friend, the botanist Joseph Hooker (1817-1911):

As the “Origin” now stands Harvey’s is a good hit against my talking so much of insensibly fine gradations; & certainly it has astonished me that I sh^d be pelted with the fact that I had not allowed abrupt & great enough variations under nature. It would take a good deal more evidence to make me admit that forms have often changed by *salutum*.³⁴

²⁸ Letter from William Henry Harvey, professor of Botany at Trinity College, Dublin, *Gardeners’ Chronicle and Agricultural Gazette*, 18 February 1860, pp. 145-6.

²⁹ *Ibid.*

³⁰ Darwin referred always to his book *On the Origin of Species* as his “abstract”.

³¹ Charles Darwin’s *Natural Selection Being the Second Part of his Big Species Book Written from 1856 to 1858*, edited from manuscript by R. C. Stauffer, University of Wisconsin, Madison, 1999.

³² *Ibid.*, p. 319.

³³ *Ibid.*, p. 319.

³⁴ Darwin Correspondence Project, Letter 2705 — Darwin, C. R. to Hooker, J. D., [20 Feb 1860].

In another letter to Charles Lyell, Darwin mentions the case of a monstrous Gold-fish with analogous fish in state of nature and the case of monstrous eels examined by Louis Agassiz (1807-1873) but he reaffirms that he still feels “excessively doubtful whether such abrupt changes have more than very rarely taken place – changed by *saltum*”.³⁵

The aforementioned letters to Lyell and Hooker are revealing since they present a less categorical view on gradualism than that Darwin had argued for in *The Origin of Species*. In the letters, Darwin does not completely refute the existence of abrupt changes in the history of life. Instead, he admits the possibility that, although very rarely, they might have taken place. It is significant, but not surprising, that Darwin was only open to confessing a breach of uncertainty on his gradual view of the transformation of species in private letters and to two of his closest friends.

The view that sudden, inexplicable change and the production of monstrosities were casual factors in the production of new species had been argued by the Swiss palaeobotanist Oswald Heer (1809-1883). Darwin was aware of Heer’s views and wrote a letter to Asa Grey (1810-1888) in search of reassurance that Heer’s supposition was wrong: “Do you not consider such cases as all the Orchids next thing to a demonstration against Heer’s view of species arising suddenly by monstrosities: it is impossible to imagine so many coadaptations being formed all by a chance blow.”³⁶

It was Camile Dareste (1822-1899) who fully addressed the implications of monsters for transformism. He considered that several races and species had a teratological origin since several anomalies were compatible with life. Dareste worked on the artificial production of monsters. He corresponded with Darwin who praised him for his efforts in understanding the origin of monstrosities:

I thank you for your very kind letter, & for the present of your pamphlet. Whether or not many persons in France are at present interested in your subject of Teratology I feel thoroughly convinced that the time will come when your labour & that of all the few others who have worked on this subject will be highly valued. Therefore I am glad to hear that you intend to publish a book on this subject.³⁷

Later, in his *Descent of Man* (1871), Darwin refers to Dareste’s work on monstrosities as “full of promises for the future”.³⁸

Dareste’s main work, *Recherches sur la production artificielle des monstruosités, ou Essai de tératogénie expérimentale* (1891), was only published after Darwin’s death. It included a tribute to Darwin and the promise that his programme of research on monsters would finally solve the mysteries behind the origin of species:

³⁵ Darwin Correspondence Project, Letter 2707 – Darwin, C. R. to Lyell, Charles, 23 Feb [1860].

³⁶ Darwin Correspondence Project, Letter 4196 – Darwin, C. R. to Gray, Asa, 31 May [1863].

³⁷ Darwin Correspondence Project, Letter 5547 – Darwin, C. R. to Dareste, G. M. C., 23 May 1867. The pamphlet was Dareste, Camille. 1862. Mémoire sur la production artificielle des monstruosités. *Annales des Sciences Naturelles* (Zoologie) 4th ser. 18: 243-76.

³⁸ Darwin, *The Descent of Man*, p. 388. Darwin refers also to Dareste in *The variation of animals and plants under domestication*, Vol. 2, pp. 289, 331, 340

Je serais heureux si les considerations que je viens de developper pouvaient engager les jeunes savants qui debutant dans l' etude de la zoologie a me suivre dans une voi qui, j' en serai certain, les conduira à d' importantes découvertes (...) Un des maitres les plus illustres de la science actuelle a dit dans un de ces derniers ouvrages que mes experiences son plaines de promeces pour l' avenir (Darwin, *De la descendance de l' homme*, p. 388). Ces paroles de M. Darwin m' encouragent a continuer les etudes auxquelles j' ai voué ma vie, etudes qui me ont déjà permis de etablir les lois de la formation des monsters, et qui me permettront, je l' espere, de reunir quelques donnes pour la solution de un des plus grans problems que puisse proposer notre intelligence, celui de l' origine des espèces.³⁹

Concluding Remarks

It is in Darwin's work *The variation of animals and plants under domestication* that we can find more references to monstrosities as an extreme case of variability in nature. This work reveals that he knew of the recent findings in teratology. Nevertheless, in his published works, the English naturalist does not make any direct reference to the possible relation between the appearance of monstrosities and the origin of new species. Yet, a different picture emerges if we consider Darwin's notebooks on the transmutation of species and his personal correspondence. These documents show that Darwin was conscious of this possible relationship. One of the possible reasons for avoiding the issue in his published works, as I have pointed out, might have been the challenge that it posed to his gradualist view of change. In addition, throughout his life Darwin was very cautious about theoretical speculations. He probably thought that he needed much more evidence to be convinced of the possible relationship between monstrosities and the appearance of new species. Nevertheless, we have also seen that in his encouragement of Dareste's work, Darwin was open to new paths in the understanding of the natural world even if they might contradict some of his treasured suppositions.

Bibliography

Manuscripts at Cambridge University Library (<http://darwin-online.org.uk>)

Darwin Correspondence Project:

Letter 573 — Darwin, C. R. to Henslow, J. S., 3 July [1840].

Letter 2705 — Darwin, C. R. to Hooker, J. D., [20 Feb 1860].

Letter 2707 — Darwin, C. R. to Lyell, Charles, 23 Feb [1860].

³⁹ Camille Dareste, *Recherches sur la production artificielle des monstruosités, ou Essai de tératogénie expérimentale*, 1891, p. 41.

Letter 4196 — Darwin, C. R. to Gray, Asa, 31 May [1863].

Letter 5547 — Darwin, C. R. to Dareste, G. M. C., 23 May 1867

Notebook B: [Transmutation of species], CUL — DAR 121.

Notebook D: [Transmutation of species], CUL — DAR 123 and CUL-DAR124.

Published works

DARESTE, Camille, *Recherches sur la production artificielle des monstruosités, ou Essai de tératogénie expérimentale*. Paris: C. Reinwald et C^eÉditeurs, 1891.

DARWIN, Charles, *Natural Selection Being the Second Part of his Big Species Book Written from 1856 to 1858*, edited from manuscript by R. C. Stauffer, University of Wisconsin, Madison, 1999.

DARWIN, Charles, *The variation of animals and plants under domestication*, 2nd volume, London: John Murray, 1868.

DARWIN, Charles, *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. London: John Murray, 1859.

DARWIN, Francis (ed). *The life and letters of Charles Darwin, including an autobiographical chapter*. vol. 2. London: John Murray, 1887.

FONTES DA COSTA, P. *The Singular and the Making of Knowledge at the Royal Society of London in the Eighteenth Century*. Newcastle: Cambridge Scholars Publishing, 2009

HUNTER, John, “On Monsters”, *Essays and Observations on Natural History, Anatomy, Physiology, and Geology*, ed. By R. Owen, Vol. 1, 239-251, London: John Van Voorst, Paternoster, 1861.

KOHN, David, Gina Murrell, John Parker, Mark Whitehorn, “What Henslow taught Darwin”, *Nature* 436 (2005) 643-645.

MOQUIN-TANDON, Alfred. *Éléments de Tératologie Végétal.*, P.-J. Loss, Libraire-Éditeur: Paris, 1841.

SAINT-HILLAIRE, Etienne Geoffroy, *Philosophie anatomique, des monstruosités humaines*, Paris, 1822.

SAINT-HILLAIRE, Isidore Geoffroy, *Histoire générale et particulière des anomalies de l'organisation chez les animaux ou Traité de tératologie*, Paris, 3 vols., 1832-1836.