

# DEINSEA



## 'Many bad attacks of sickness' – Did Charles Darwin suffer from chronic borreliosis?

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### ABSTRACT

Few personal medical histories have been so intensively studied as that of Charles Darwin (1809-1882). Interest in Darwin's health started in the 19th Century, and has led to an impressive body of literature. However, none of these publications came to a definitive conclusion as to the nature of Darwin's disease. Some of the complaints and symptoms described by Darwin may be compatible with the diagnosis of chronic (neuro)borreliosis: neurological, psychiatric symptoms and symptoms of dysautonomia (most signs of excessive sympathetic nervous system activity, atypical panic disorder, vertigo, depersonalization, palpitations, breathlessness, trembling and shaking of muscles, faint sensations, and tinnitus); gastrointestinal complaints (especially vomiting, flatulence). This could possibly be caused by the cyclic vomiting syndrome as part of panic disorder; and intermittent cutaneous rash, most probably based on autonomic instability, also as part of chronic borreliosis. Based on descriptions of Darwin's symptoms as found in his diaries, notebooks and letters, we conclude that Darwin suffered from a complex condition with multisystem symptoms, in which chronic (neuro)borreliosis may have played an important role, possibly in combination with another illness such as lactose intolerance, and complicated by a hypochondriac predisposition. The possible role of chronic (neuro)borreliosis in Darwin's condition has not been published before, but is worth to consider.

**Keywords** Lyme-borreliosis, Lyme disease, panic disorder, *Ixodes*, *Borrelia*

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### INTRODUCTION

Few personal medical histories have been so intensively studied as that of Charles Darwin (1809-1882) (Fig. 1). Interest in Darwin's health started in the 19th Century, and has led to an impressive body of literature. However, none of these publications came to a definitive conclusion as to the nature of

Darwin's disease. The bicentennial of his birth in 2009 caused a renewed interest in Darwin's life, including his problematical health, and saw a profusion of new, translated or re-edited books. A well-timed and rewritten second edition of the late Ralph Colp's book *To Be an Invalid. The Illness of Charles Darwin* (Colp 1977) appeared in 2008 under the crisp title *Dar-*

*win's Illness* (Colp 2008). In his foreword to Colp (2008), Darwin's biographer James Moore wrote: "*Darwin's Illness* may not be the end, but it is unquestionably the vital starting point for all future reflection on the health of history's most famous sick scientist" (Moore 2008). It is in this framework that we come to a reappraisal of Darwin's condition.

Noteworthy in the many published articles is the focus on a single diagnosis. To mention just a few of the publications, Adler (1959) and Bernstein (1984) proposed South American trypanosomiasis (Chagas' disease), Young (1997) assumed systemic lupus erythematosus, Barloon & Noyes (1997) assumed panic disorder, Sauer (2000) concluded that Darwin suffered from recurrent, cyclic eczema (atopic eczema), and Campbell & Matthews (2005, 2015) came to a diagnosis of inheritable lactose intolerance. In a thorough analysis of Darwin's illness by Finsterer & Hayman (2014) and Hayman (2013) and Hayman *et al.* (2017), it was hypothesized that Darwin's illness was caused by a multisystem mitochondrial disorder, including MELAS syndrome. Arguments include the facts that cyclic vomiting syndrome could be a manifestation of a mitochondrial disorder and Darwin's family history could be compatible with a hereditary disease. Just like Lyme disease, mitochondrial disorders could also explain the wide range of Darwin's illness, involving many organ systems. Although mitochondrial disorders cover many of Darwin's clinical features, mitochondrial disorders with late onset multi-organ clinical manifestation are still extremely rare. The most pretentiously titled paper (Orrego & Quintana 2007), criticizing all previous diagnoses and entitled *Darwin's Illness: a Final Diagnosis*, concluded that Darwin suffered from Crohn's disease. The titles of many papers are indeed rather explicit and conclusive: Darwin suffered from x or y; and the impact subsequently enhanced by firm press coverage of the published conclusions (Anonymous 2005). An overview of all published diagnoses or suggestions is given by Campbell & Matthews (2005) and Colp (1977, 2008), to which we here refer.

So far, none of the thus far published diagnoses seems entirely conclusive, for which reason research continues. First, we wish to introduce the possibility that Darwin suffered of a chronic infection with spirochetes of the genus *Borrelia*, leading to a chronic form of borreliosis (Lyme disease) as an explanation of Darwin's pathological condition. Secondly, his hypochondriac constitution could have played a role in the aggravation of the symptoms.

### DARWIN'S OWN OBSERVATIONS

Charles Darwin himself often wrote about his health in many of his letters to friends and colleagues, such as Joseph Hooker, William Darwin Fox, and Charles Lyell. Also, his diaries and notebooks are filled with medical observations and complaints about his health, which can be divided in three main categories:

- Dysautonomic, neurological and psychiatric complaints;
- Gastrointestinal complaints;
- Cutaneous complaints.

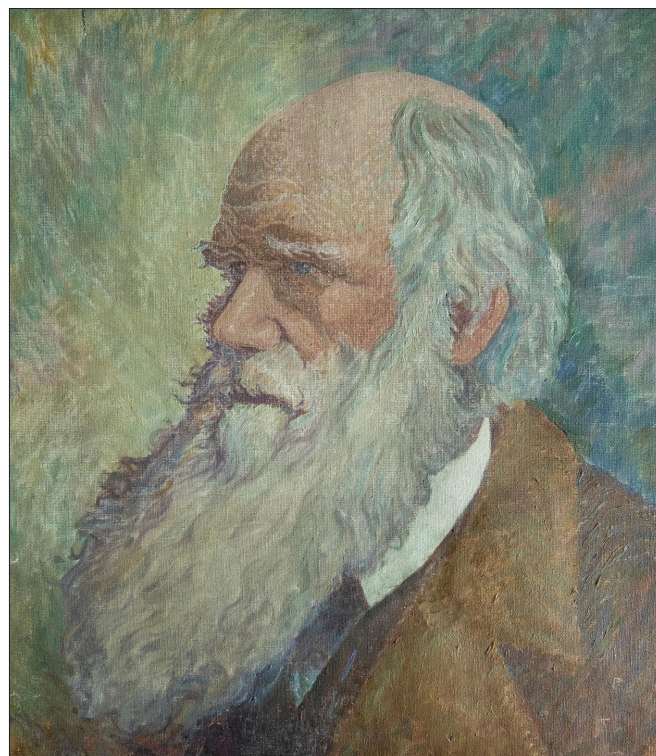


Figure 1 Charles Darwin. Oil on canvas (42 x 32 cm), unknown artist, circa 1925; collection E.J.O. Kompanje. (Otto van Duijn)

### Dysautonomic, neurological and psychiatric complaints

Darwin complaining about his condition, writing in one of his notebooks in 1848: "from July to end of year, unusually unwell, with swimming of head depression, trembling & many bad attacks of sickness." (Fig. 2). In his numerous writings, Charles Darwin described several symptoms of these "many bad attacks of sickness". To cite just a few examples: "Involuntary twitching of the muscle, fainting feelings, black spots before the eyes" (Darwin 1849a); "I have not been very well of late with uncomfortable palpitations of the heart" (Darwin 1837); "Air fatigues, (...) bring on head symptoms" (Colp 1977); "(...) head swimming, hands trembling (...)" (Darwin 1849b); "treading on air and vision" (Darwin 1865). He also feared that he was "rapidly dying" (Darwin 1849a).

Many of Darwin's own observations concern symptoms of dysautonomia as commonly experienced by patients having a panic attack as a symptom of panic disorder (APA 2013). Panic disorder criteria as stated in *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; APA 2013) are: "air fatigue" (breathlessness or the inability to take a deep breath or sigh, sensations of shortness of breath or smothering); "treading on air and vision" (derealisation, depersonalization); "fear of dying"; "faint sensations" (feeling dizzy, unsteady, lightheaded, or faint); "involuntary twitching of the muscle" (trembling and shaking of muscles); "uncomfortable palpitations of the heart" (palpitations, accelerated heart rate); "head swimming" (vertigo, dizziness); "hands trembling"; "numbness" (paresthesias), "ringing in the ear" (tinnitus).

Based on these mostly dysautonomic symptoms, Barloon & Noyes (1997) suggested that Darwin's symptoms indicate panic disorder with agoraphobia, which seems an attractive and

reasonable hypothesis. Adler (1997) however, stated that the case for agoraphobia is overstated, as "Darwin rode until he was 60 years old, attended many meetings of the British Association, and mixed widely among pigeon fanciers in their numerous London clubs". Colp (1997) commented on the article by Barloon & Noyes (1997) by mentioning that Darwin was "away from home for about 2000 days between 1842 and his death in 1882", making a diagnosis of agoraphobia not very realistic. We have to find another cause than panic disorder with agoraphobia. Cases of atypical panic attacks are described to be neurologic/psychiatric manifestations of chronic (neuro)borreliosis (Pachner *et al.* 1989, Fallon 1994, Sherr 2000, 2001, Westerveld & McCaffrey 2002, Bär *et al.* 2005, Blanc 2007, Hassett *et al.* 2008, Hurley & Taber 2008).

Sherr (2000) described some patients who suffered from atypical panic attacks that turned out to be related to underlying, previously unsuspected Lyme disease. In this context, it is interesting to notice that patients with Lyme disease who suffer from panic attacks/dysautonomia attacks are usually not agoraphobic: "(...) the patients did not develop the panic victim's usual 'fear of the marketplace-fear of making a scene', nor confine themselves to home. Like agoraphobics, however, they did fear being away from avenues of help should the attacks recur. They tended to stay in their neighborhoods or their workplaces and around familiar, helpful people" (Sherr 2000). It is striking that Darwin's wife, Emma, wrote on 10 February 1840 to her aunt that "(...) he always tells me how he feels and never wants to be alone (...)". It is described that since beginning treatment with intensive doses of appropriate antimicrobial medications for their Lyme disease, all patients have become free of panic attacks, which indicates that the panic attacks are in these cases a symptom of Lyme disease rather than a separate psychiatric condition in which antibiotics will not be very helpful (Sherr 2000). Colp (2008) commented that it is unlikely that Darwin suffered from panic disorder as defined in the (then latest) DSM-IV, because the course and symptoms are atypical and incomplete for this disorder. It is noticed that a panic attack as a symptom of Lyme disease is atypical in many aspects.

Another citation: "I use the term 'panic-like', because they have many of the physical symptoms of panic disorder (...). But unlike a typical panic attack that starts and stops within about

From July to end of year, unusually unwell, with swimming of head depression, trembling - many bad attacks of sickness...

Figure 2 "From July to end of year, unusually unwell, with swimming of head depression, trembling & many bad attacks of sickness ..." (from: Darwin's Journal, kept in the Robin Darwin Collection of Darwin's papers and letters, on deposit in the Cambridge University Library; reproduced with permission from <http://darwin-online.org.uk>)

15 minutes, the panic attacks [experienced by] patients with Lyme disease can go on for hours or days. So it is far more like a prolonged, really intense panic attack. That, if anything, is the one feature which distinguishes a possible Lyme-related panic attack from an independent panic attack" (Sherr 2000); "Each patient experienced symptoms that are not usual in panic disorder but are typical of neurological Lyme disease (...). Because these symptoms are atypical of primary panic disorder, they were very helpful in alerting the clinician to suspect an underlying physical illness. In each case, the results of testing revealed positive hallmarks of disseminated Lyme disease (...). Therapeutic hints that these patients' diagnoses may have resulted from complex, infectious causes included the fact that, in each case, panic lasted for hours as opposed to the usual half-hour or less duration expected with typical panic attacks" (Sherr 2000). Although the panic-like disorder may have been more an epiphenomenon with Lyme disease, the lack of family history of these disorders and the normal premorbid history suggest that Lyme disease may have triggered these symptoms (Sherr 2000). Although there is rarely mention of the duration of his 'attacks', Darwin very often mentioned that "he was unwell for some days", "unwell for a week", "I lost time by frequent unwellness", "I have lost five days by my own unwellness", thus pointing to prolonged attacks with subsequent feeling unwell. This could indicate that the attacks are of a longer duration than the short panic attacks of the classic psychiatric form as defined in the DSM.

We conclude that the dysautonomic, psychiatric and neurological complaints of Darwin can be seen as manifestations of atypical panic attacks.

### Gastrointestinal symptoms

Charles Darwin suffered from a gastrointestinal dysfunction that probably affected only the upper gastrointestinal tract. He complained of "extreme spasmodic daily and nightly flatulence" and that he "suffered from almost incessant vomiting for nine weeks". The vomiting became recurrent and occurred in patterns ('periodic' in 1839-1841; 'once a week' in 1848-1849 and 'daily' in 1863-1864 and 1865; Colp 1977). The gastrointestinal dysfunction was often the result from excitement: "I dread going anywhere, on account of my stomach so easily failing under any excitement" (Darwin 1852); "I never felt my weakness a greater evil (...). I spoke for a few minutes (...) and it brought on twenty-four hours of vomiting" (Darwin 1861).

Gastrointestinal symptoms related to Lyme disease may manifest as gastroesophageal reflux disease, gastrointestinal bloating, nausea, vomiting, flatulence and atypical colitis. Chronic borreliosis can result in severe dysfunctioning of the enteric nervous system and/or the autonomic nervous system supplying the gut. Possible spirochaetal paralysis of the vagal nerve may cause temporary or long-lasting disruption of normal mobility in the small intestine, which can lead to Small Bowel Bacterial Overgrowth (SBBO), which in its turn can lead to abdominal bloating with subsequent flatulence as occurred in the case of Darwin. Cases of persistent vomiting are described in children with neuroborreliosis (Baehr *et al.* 2008).



Orrego & Quintana (2007) concluded that Darwin suffered from Crohn's disease, and that this diagnosis explained his upper abdominal pain, his flatulence and vomiting, as well as his articular and neurological symptoms, his 'extreme fatigue', low fever and especially the chronic, relapsing course of his illness. In response, Sheehan *et al.* (2008) mentioned that vomiting is an exceedingly uncommon symptom of Crohn's disease, and they assume that Darwin's symptoms involve feedbacks and reactions across both brain and gut. Taking in mind the dysfunctioning of the autonomic nervous system and enteric nervous system, resulting from chronic borreliosis, this seems to be reasonable.

Here we introduce another explanation. Cyclic Vomiting Syndrome (CVS) is a disorder characterized by recurrent stereotypic episodes of incapacitating nausea, vomiting and other symptoms, separated by intervals of comparative wellness (Fleischer *et al.* 2005). The disorder is reported from childhood to middle age (Fleischer *et al.* 2005, Namin *et al.* 2007). CVS is triggered by stress, excitement and fatigue. Epigastric and diffuse abdominal pain of variable severity is a major component of the cycles. Symptoms of panic disorder are surprisingly prevalent in adult patients. Fleischer *et al.* (2005) found that 68% in their series had panic attacks during the prodromal and emetic phases of most of their cyclic vomiting episodes, and Namin *et al.* (2007) report that 84% of their patients with CVS were suffering from an anxiety disorder. This observation could form a very plausible explanation for Darwin's cyclic vomiting. The CVS-like symptoms possibly can be caused by autonomic dysfunction resulting from chronic (neuro)borreliosis.

Another explanation for the gastrointestinal complaints was drawn by Campbell & Matthews (2005) when supposing that Darwin had inherited lactose intolerance. Some of his family members also suffered of similar symptoms. Darwin had a sweet 'milky' taste, he was fond of puddings, custards, and white sauces. Also, his complaints reportedly often started some two hours after a meal, which matches the time it takes for food to reach the large intestine. Darwin's many hydrotherapeutic treatments involved drinking large amounts of water, thereby avoiding a large intake of milk. The case for lactose intolerance thus seems strong, but can not explain symptoms other than his sick stomach and intestine, vomiting and flatulence - especially the skin disorders and mental effects. For these we have to look somewhere else.

### Cutaneous complaints

Darwin suffered from a recurring skin disorder on his lips and hands. In his 1849-1855 diary he wrote that he had skin symptoms, which he called either 'eruption', 'rash' or 'erythema' and 'a eruption' about the mouth'. He wrote to his friend William Darwin Fox: "The only disagreeable part as yet to me, has been the excessive irritation of skin which comes on every evening over seven o'clock". Hooker recollected in 1899: "(...) an attack of violent eczema in the head during which he was hardly recognizable". According to Hooker (1899), the attacks are with a "(...) sudden beginning, brief duration, and sudden end (...)". The 'eczema' cleared when Darwin stopped talking about a controversial subject.

Young (1997) put forward that Darwin's lip eruption was a form of 'discoïd lupus' and that the lesions of his hands and face were manifestations of systemic lupus erythematosus, but these lesions were atypical for this disorder. Sauer (2000) thought Darwin was suffering from a dermatitis or atopic eczema. Colp (2008) stated that these attacks of 'violent eczema' were psychosomatic symptoms. In addition to the above mentioned dysautonomic, neurological, psychiatric and gastrointestinal complaints, chronic dermatoborreliosis should be considered in the case of Darwin, but this is doubtful, because the skin symptoms in Darwin waxed and waned. Acrodermatitis chronica atrophicans (ACA) is the characteristic cutaneous manifestation of late Lyme disease in Europe, where it is the second most common form of dermatoborreliosis. ACA is usually located on the extensor surfaces of the distal extremities. ACA has been described to occur in the face in exceptional cases (Müllegger 2004).

ACA does not resolve spontaneously, but gradually progresses to an atrophic phase. We have been unable to find descriptions in the letters, notebooks and diaries of Darwin pointing to a chronic and progressive borreliosis-related skin disorder like ACA. The most frequent extracutaneous manifestation of ACA is peripheral neuropathy. Darwin described symptoms like numbness of the hands, but this is more likely the result of dysautonomia (atypical panic disorder), than of ACA-related peripheral neuropathy.

Another plausible possibility is that the dermatologic complaints of Darwin are related to the above-mentioned (atypical) panic disorder. Sansone & Malik (2001) published a case of a patient suffering from an intermittent rash, which was triggered by various emotional precipitants, as was commonly observed in Darwin's case. It is supposed that the rash is a sign of autonomic instability or allergic-type vasomotor reaction occurring during a panic attack (Roth *et al.* 1998, Schmidt-Traub & Bamber 1992).

We suggest that the cutaneous complaints of Darwin are not related to the known cutaneous presentations of chronic borreliosis, like ACA or morphea, or another, non-Lyme-related, dermatological condition or manifestation of another systemic disease, but is related to a less known dermatologic presentation of panic disorder, which in turn is in our opinion a rare symptom of chronic borreliosis related dysautonomia. The sudden 'wax and wane' character of the rash/eczema, which was under influence of emotions and stress, points strongly in this direction.

### Hypochondriasis

In addition, Darwin must have been a hypochondriac of some degree. Darwin himself was quite aware that his condition could have had something to do with hypochondriasis, at least he was told so by 'many friends', as can be concluded from a letter he wrote to Sir Joseph Hooker on March 31, 1845: "You are very kind in your enquiries about my health; I have nothing to say about it, being always much the same, some days better and some worse. I believe I have not had one whole day, or rather night, without my stomach having been greatly disordered, during the last three years, and most days great prostration of strength: thank you for your kindness; many of my friends, I believe, think me a hypochondriac" (F. Darwin, 1869). This

awareness is also noticed by psychiatrists when they treated Lyme-patients with symptoms of panic disorder: "Nearly every one of unsuspected Lyme sufferers comes to me believing their symptoms are the result of stress, hypochondriasis, or personal weakness" (Sherr 2000, 2001).

### Chagas disease

Although many arguments can be stated against this diagnosis, Chagas disease is still one of the most popular explanations of Darwin's disease. This hypothesis is mainly based on the fact that Darwin documented a bite of an insect in Argentina that could possibly be the vector of Chagas disease (Adler 1959). However, exposure to a tick carrying *Borrelia* in Great Britain is much more plausible than exposure to Chagas disease during his travel in South America. Also, the clinical course with relatively mild fluctuation symptoms, partly already present before arrival in South America is more compatible with chronic borreliosis than with chronic Chagas disease.

### Borreliosis in Great Britain during Darwin's life

A crucial aspect of our suggestion that Darwin suffered of chronic borreliosis is the question whether or not borreliosis was endemic in Great Britain during the first half of the 19th century. Darwin travelled around England and Wales, collecting insects, shooting birds, picking up stones and thus being exposed to ticks. He spent two years in Scotland while studying medicine (from October 1825 to April 1827) and using any opportunity available to stroll around in nature; he subsequently moved to Cambridge for nearly four years (October 1827 - spring 1831) to study theology and collect more specimens. After the voyage with the Beagle, Darwin spent two months in Shrewsbury and three months in Cambridge, before moving to London and more away from the countryside in 1837. There must thus have been ample time during the first three decades of his life to get infected by ticks.

Tick-borne skin affections were described for the first time in Europe in the late nineteenth and early twentieth centuries (Buchwald 1883, Herxheimer & Hartmann 1902). Lyme disease and its cause were only recognized in 1976 in Lyme, Connecticut, USA (Edlow 2003). However, its symptoms were known and have been described from Britain long before the actual discovery of the agent. Summerton (1995) described cases of Lyme disease in the eighteenth century on the island of Jura, Hebrides. This record and its conclusion are based on a detailed description of an engorged tick, and the fact that many of the islanders had developed arthritic symptoms that are a major diagnostic feature.

The British tick fauna has a similar diversity as from the European mainland. Van Bronswijk *et al.* (1979) report fifteen tick species (Ixodidae and Argasidae) from Belgium, the Netherlands and Luxemburg. The British Isles possess 23 species of ticks (Martyn 1988), which similarity indicates that the British tick fauna is of an old age, most probably predating the flooding of the North Sea at the beginning of the Holocene (the flooding

occurred around 12.000 - 9.000 years ago).

The diversity of *Borrelia* species is also high, both in Britain and on the European mainland. In both realms three related species are present (*B. burgdorferi*, *B. afzelii* and *B. garinii*; Cull *et al.* 2018). Even though (sea)birds play an important role as a reservoir of *Borrelia* and in the spread of the spirochetes across the northern hemisphere (Duneau *et al.* 2008, Dubska *et al.* 2009), we think it safe to assume that *Borrelia* has been endemic in the British Isles since pre-Holocene times when Britain was still part of the European continent. Especially pheasants (*Phasianus colchicus*) are important as a reservoir of the disease (Gern *et al.* 1998, Kurtenbach *et al.* 1998, Dubska *et al.* 2009); Darwin had ample contacts with this species during most of his lifetime.

### CONCLUSION

Lyme disease was present in the British Isles in the late eighteenth and early nineteenth centuries, and we hypothesize that Darwin could have become infected by ticks during one of his many wanderings in the British countryside, either before or shortly after the voyage with the Beagle. Known symptoms of chronic (neuro)borreliosis that are found in Darwin's condition are:

- Neurological, psychiatric symptoms and symptoms of dysautonomia (most signs of excessive sympathetic nervous system activity, atypical panic disorder, vertigo, depersonalization, palpitations, breathlessness, trembling and shaking of muscles, faint sensations, and tinnitus).
- Gastrointestinal complaints (especially vomiting and flatulence). This was caused by the cyclic vomiting syndrome as part of autonomic dysfunction.
- Intermittent cutaneous rash, most probably based on autonomic instability, also as part of chronic borreliosis.

Although mitochondrial disorders cover many of Darwin's clinical features, mitochondrial disorders with late onset multi-organ clinical manifestation are still extremely rarely diagnosed. Given the much higher prevalence of Lyme disease, nowadays and most probably also in the 19<sup>th</sup> century, we consider Lyme disease to be a more plausible diagnosis of Darwin's illness. We therefore conclude that Darwin suffered from a complex condition with multisystem symptoms, in which chronic (neuro)borreliosis could have played an important role, possibly in combination with another illness such as lactose intolerance, and complicated by a hypochondriac predisposition. The possible role of chronic (neuro)borreliosis in Darwin's condition has not been published before, but is worth to consider.

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