

# Charles Wells &

## The Dueling 'Vertiginous Philosophers'

BY CHRISTOPHER ZALEWSKI

In a somewhat obscure and dismissed essay titled “Essays upon Single Vision with Two Eyes: Together with Experiments and Observations on Several Other Subjects in Optics,” Charles Wells published what is now known to be the first account detailing the association between vertigo and eye movement—what we now refer to as nystagmus.

# Erasmus Darwin

## Preamble

The following historical summary could not have been possible without two literary works from Nicholas Wade and Benjamin Tatler: *Destined for Distinguished Oblivion: The Scientific Writings of William Charles Wells* (Wade, 2003) and *The Moving Tablet of the Eye: The Origins of Modern Eye Movement Research* (Wade and Tatler, 2005).

This article is a synopsis of many literary sources, but I wanted to highlight these works because much of this synopsis was possible due to the authors' extensive research of the events that surrounded Charles Wells's scientific life.

The title of this summary is also a play on words from a work by one of my favorite authors, Sam Kean, and his book discussing the historical perspective on human neurology, titled *The Tale of the Dueling Neurosurgeons: The History of the Human Brain as Revealed by True Stories of Trauma, Madness, and Recovery*. I thought the dueling tale of Darwin versus Wells was incredibly reminiscent of Sam Kean's perspective on the history of medical science.

If you're ever in the mood for a terrific read, all of these sources would certainly have my recommendation.



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### An Unsung Hero

Although Charles Robert Darwin (1809–1882) is recognized universally as the father of evolution and natural selection, largely due to his 1859 work *On the Origin of Species*, public acknowledgment is seldom given to Alfred Russel Wallace (1823–1913). Wallace was instrumental in the independent conceptualization and propagation of the original framework for the theory of natural selection in his papers titled “On the Law Which Has Regulated the Introduction of New Species” (1855) and “On the Tendencies of Varieties to Depart Indefinitely from the Original Type” (1858). The later paper was sent directly to Darwin by Wallace himself a

year before the publication of Darwin’s seminal work, *On the Origin of Species*.

History is full of such misdirection and obscurities. Scientific and philosophical contributions are sometimes largely displaced or, worse yet, inappropriately credited. Scientific discoveries made by recondite unsung heroes who largely have gone unacknowledged are more frequent than one might think. The history of scientific discovery is laced with unheralded heroes who often have been left to fade away between the cracks and creases of the parchment that nearly made them famous.

Alternatively, history has always dedicated cenotaph positions for those celebrated minds that rise to the top and are recognized for their momentous achievements. Erasmus Darwin, the grandfather of Charles Darwin, is one example. The name Darwin is nearly bigger than history itself—a name that, perhaps, every elementary school child quickly becomes familiar with in basic science class.

There are other such larger-than-life scientists: Watson and Crick, Louis Pasteur, Alfred Nobel, Albert Einstein, and Edwin Hubble, to name just a few. Such well-known scientific minds overshadow lesser-known scientists who are often obscured in the literature. As a result, unsung contributors in science fall short of the recognition they often deserve, among them Pierre Paul Émile Roux, François Englert, Rosalind Franklin, and, of course, William Charles Wells (1757–1817).

### William Charles Wells

Who is William Charles Wells, you ask? William Charles Wells, or simply Charles Wells, was just such an unsung scientist—with whom the story surrounding the discovery of the vestibular sixth sense begins. This is his story.

Interestingly, the overshadowing of Alfred Russel Wallace by Charles Darwin was not the first time that controversy surrounded the crediting of a Darwin for introducing and revolutionizing a groundbreaking scientific theory. Some 63 years earlier, in 1794, Erasmus Darwin (1731–1802), in collaboration with Robert Waring Darwin (1766–1848), the father of Charles Darwin, published a section titled “Of Vertigo” in *Zoonomia; or The Laws of Organic Life* (Vol. I).

This work, single-handedly, all but erased Charles Wells’s sentinel work on the discovery of the relationship between vertigo and nystagmus. *Zoonomia*’s classic written account of life, medicine, and early theories of evolution, including rudimentary ideas of vertigo and dizziness, is the reason that initial descriptions of vertigo are, first and foremost, often attributed to Erasmus Darwin.

However, as history would eventually prove, Wells’s published work on vertigo and nystagmus would remain resilient, if nothing else. And, although his name may not have been given a cenotaph position within the hallowed halls of medicine and philosophy, his writings have ultimately proven otherwise. Oddly enough, in the end, we just may have Erasmus Darwin, himself, to thank for Charles Wells’s scientific recognition. If not for Erasmus Darwin’s public criticism of Charles Wells’s theory on vertigo, Wells’s 144-page essay containing thoughts on nystagmus and vertigo may have slipped entirely into the cracks and creases of vision research forever.

Without a doubt, Erasmus Darwin’s contributions to medicine, nature, and life are highly acknowledged as belonging among the pinnacles of human physiology and thought. His four editions of the two-volume *Zoonomia* have been recognized as comprehensive and foundational works from which theories of modern medicine and philosophy have burgeoned—including Charles Darwin’s theory of natural selection. However, his recognition for theories on dizziness and vertigo in *Zoonomia* likely obfuscated, and even all but dismissed, a previous literary work published a mere two years earlier by Charles Wells, an essay that (correctly) refuted the contemporary belief surrounding the sensation of vertigo.

## Visual Vertigo

At the turn of the eighteenth century, Erasmus Darwin published views on vertigo and dizziness continued to propagate the well-accepted notion of the time: that post-rotational vertigo and dizziness

were merely a disturbance of abnormal visual function (read “processing” here).

The idea of “visual vertigo” was first proffered by Thomas Willis (1621–1675) in 1661 in his publication titled “De Anima Brutorum quae hominis vitals ac sensitiva exercitationes duae” (The Beasts and the Man’s Life: Two Exercises). Here, Willis first suggested that vertigo came solely from a disturbance of visual function largely due to animal spirits in the central nervous system.

Later, Julien Offray de la Mettrie (1709–1751) corroborated this notion in his work titled “Traité du vertige,” but modified the origin of post-rotational vertigo to be physiologic rather than of animal or humorous spirits. This idea of post-rotational visual vertigo was further supported by William Porterfield (1696–1771) in 1737, further affirming that visual vertigo was specifically not associated with eye movements (i.e., nystagmus), but rather occurred from an aberrant visual neural processing of images.

The concept of “phantom” neural visual processing was not too difficult for Porterfield to articulate and believe, as he also provided the first physician-written

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account of phantom-leg syndrome (his leg was amputated in his youth).

The suspected origin of visual vertigo (specifically, an abnormality referencing the way visual information was processed) was held in unwavering belief for another 65 to 70 years. It was not until 1792 that a young researcher suggested that the sensation of vertigo was due to eye movement that could easily be elicited following head (body) rotation.

In a somewhat obscure and dismissed essay titled “Essays upon Single Vision with Two Eyes: Together with Experiments and Observations on Several Other Subjects in Optics,” Charles Wells published what is now known to be the first account detailing the association between vertigo and eye movement—what we now refer to as nystagmus. In this report, Wells eloquently described both the fast and slow phase of eye movement during nystagmus. Although he did not specify what internal organs were responsible for the production of this nystagmus, Wells, through the use of after-images, was the first to provide irrefutable evidence systematically linking the pattern of eye movements to the direction of perceived vertigo.

Interestingly, Charles Wells published this essay in 1792, two years prior to the publication of Erasmus Darwin’s first edition of *Zoonomia; or The Laws of Organic Life* (Vol. I), where he and Robert Darwin detailed the characteristics of vertigo and continued to support Porterfield’s earlier, and erroneous, notion that visual

vertigo was not associated with eye movements. Yet, Wells’s work, a landmark discovery in the field of vestibular science, went largely unnoticed. So much so, that Charles Wells, himself, would consequently drift into historical oblivion, along with his discovery.\*

## The Sixth Sense: Motion Perception

One hundred and thirty-one years after Thomas Willis first introduced the idea of visual vertigo, and a little more than two centuries after Aristotle introduced the five senses, the notion that there could possibly be a sixth sense, one of motion perception, was brought to scientific light.

But who was rightfully due the scientific discovery? Although Charles Wells’s sophisticated experiments on post-rotational vertigo and nystagmus were seemingly irrefutable, they were also essentially unknown, and seemingly, almost deliberately unrecognized, even if they were briefly cited. This was likely due to the fact that Erasmus Darwin’s world-renowned *Zoonomia* was essentially medical and philosophical law at the time.

Additionally, since the majority of scientific writings at the time were in German, Erasmus Darwin clearly had the upper hand, as *Zoonomia* was quickly translated into German, while Charles Wells’s “Essays upon Single Vision with Two Eyes” was published only in English. Moreover, Wells’s essay appeared in vision literature, a far

cry from that of neurology, or vestibular research—if such a classification existed then.

It was unclear as to whether or not Wells's work was poorly represented in the German translation of *Zoonomia* due to inadequate language translation or because Erasmus Darwin, himself, did not fully understand Wells's work—or possibly a combination of both. Perhaps most salient, the word vertigo was not included in the title of Wells's essay. The topic of vertigo was, in fact, one of the "...Several Other Subjects in Optics" mentioned in the title of the 144-page essay, buried between pages 85 and 105. Clearly, traction for scientific recognition and future prosperity was against Wells for a number of reasons.

Charles Wells also struggled against his own exasperations. Despite his kindness and warmth of heart, Wells often displayed ungracious manners and was easily offended, sometimes even during amiable conversation. Wells may not have been the easiest person to get along with and was, at times, irascible. He even described himself as "naturally irritable" in his own memoir.

Whether or not these character traits projected Wells as a rather obstinate and indignant person, it would have been clear that such qualities could certainly have stunted his reputation within the scientific community. One could almost hear such indignation in two rejoinders Wells published in *The Gentleman's Magazine* in September and October of 1794, a mere three to four months after the first volume of *Zoonomia* was published. Wells's quick dispute of Darwin's comments on visual vertigo, if nothing else, was highly detailed, concise, and piercing (and accurate).

## The Debate

In each letter, Wells provided a rather pointed rebuttal that articulated a clear and concise scientific counterargument to each of Darwin's apparent logical statements supporting visual vertigo. Among Wells's points of refutation was the notion that vertigo could occur in complete darkness, that is, in the absence of any visual processing.

It was Wells's use of optical after-images that provided the indisputable scientific evidence supporting a physiologic link between eye movements and vertigo, and thus, debunking the notion of visual vertigo. Although Wells did not provide a theory as to the origin of the production of these eye movements (or vestibular nystagmus, as it is now known), his work did lay the scientific foundation for others to begin considering this question.

Wells's two retorts to Darwin's theory of visual vertigo in *Zoonomia* were highly publicized at the time, as *The Gentleman's Magazine* was well regarded.



# The discovery of the vestibular sixth sense was a uniquely rare event.

However, the magazine was likely not widely read by scientists outside of Britain. Regardless of the magazine's limited readership, Wells's two rejoinders in *The Gentleman's Magazine* gained some scientific attention and traction.

As such, Erasmus Darwin briefly acknowledged Wells's alternative theories on vertigo and nystagmus in his third edition of *Zoonomia*, which was published in 1801—almost 10 years after the initial publication of Wells's "Essays upon Single Vision with Two

Eyes." Unfortunately, Darwin's position on visual vertigo changed little in the third edition.

It was not until Darwin's final fourth edition of *Zoonomia* that Erasmus and Robert Darwin would finally acknowledge, although begrudgingly, Charles Wells's scientific contributions linking eye movement (nystagmus) to the perception of vertigo. Amazingly, however, they continued to largely support the theory of visual vertigo—still dismissing Wells's conclusions.

In retrospect, it is interesting that *The Gentleman's Magazine* and its published feud between Wells and Darwin was likely the primary reason for the eventual and proper crediting of Charles Wells's work on vertigo and nystagmus. The detailed responses by Wells quickly gained attention and allowed for the expansion of his theories—and the devolution of visual vertigo. And, ironically, it was more than simply Erasmus Darwin and Robert Darwin, individually—it was the collective Darwin name that may have brought added public recognition to Charles Wells, paradoxically ultimately crediting Wells for the discovery of the physiologic link between vertigo and nystagmus (which Erasmus Darwin had refuted for so many years).

## The Foundational Work for Vestibular Research

Scientifically speaking, it is Wells's second letter to *The Gentleman's Magazine*, detailing the post-rotation nystagmus response, that possibly offers the best evidence to suggest his work was, and is, the first foundational work for vestibular research. Frequently, two of the most famous vestibular scientists, Jan Evangelista Purkyně (1787–1869) and Jean Pierre Flourens (1794–1867) are credited with this achievement and are often referred to as the fathers of vestibular science.

Specifically, it was Wells's succinct summary describing the involuntary post-rotational nystagmus that resulted in the apparent motion of the environment after the cessation of rotation. Most importantly, he pointed out that this apparent rotation of the environment was dependent on the direction of the subject rotation and on the direction of involuntary eye movement that also switched directions in accordance with a change in the direction of head rotation. Wells also detailed

the suppression of after-image eye movement (nystagmus) with concentrated vision, as well as the perception of vertigo and documentation of after-image eye movement in darkness.

Collectively, Wells's observations on vertigo and nystagmus are the first and foremost definitions of those we now know today to be the properties of clinical vestibular nystagmus. It would take an additional 100 years for Róbert Bárány (1876–1936) to apply these properties clinically.

## Vestibular Research at the Turn of the 18th Century

Scientifically linking head rotation to nystagmus (and vertigo) was a novel and revolutionary finding at the time—and looking to the semicircular canals as the anatomic and physiologic origin to explain this relationship may have been a logical step in the scientific process.

At the turn of the eighteenth century, however, an erroneous notion still persisted. Many still believed that the Cretan Labyrinthos, as Aelius Galen had elegantly named the vestibular labyrinth sometime between 129–216 A.D., was responsible for auditory localization. (The hydrodynamic theory of semicircular canal function was still nearly three-quarters of a century from postulation.) The anatomical structure of the labyrinth could easily suggest that the semicircular canals were, indeed, aligned for optimal sound localization.

Unfortunately, at the time of Wells and Darwin, the scientific bridge linking the vestibular labyrinth, head rotation, nystagmus, and vertigo had yet to be built. It is unclear if Wells's work actually had any direct impact on the work of Purkyně and Flourens in making these final connections. It would seem that, despite Wells's work finally receiving some (begrudged) recognition from Darwin, it was still in peril of slipping into historical oblivion.

Purkyně and Flourens were two world-renowned physician-scientists, both performing work in vertigo and motion perception. With others working in this area, such as Ernst Josef Mach (1838–1916), Josef Breuer (1842–1925), and Alexander Crum Brown (1838–1922), the discovery of the link between the vestibular system, vertigo, and eye movements quickly started to advance.

Unfortunately for Wells, his unsung work may not have been very accessible to either Purkyně or Flourens, as neither spoke English in their early careers. Most of the vestibular research at the turn of the century came from either Germany or France, with German often being the language of choice. Darwin’s *Zoonomia* was widely cited and available in German, which was familiar to both Purkyně and Flourens (as they both often cited it). Neither one of them ever referenced Wells’s work on vertigo and nystagmus.

On more than one occasion, Purkyně assigned sole credit to Darwin for his investigation of vertigo and the physiologic background of this phenomenon. This seems to support Purkyně’s unfamiliarity with Wells’s work on vertigo and nystagmus, and this unfamiliarity is only further supported by the fact that Purkyně is often given credit for being the first to publicly make the association between eye movements and rotation.

Most of the work related to vertigo and its physiologic and subjective bases often begins with citations of the work by Purkyně and Flourens, which is clearly evident in Coleman Griffith’s well-known and well-cited book, *An Historical Survey of Vestibular Equilibration*, published in 1922. This is likely why most literature will cite Purkyně and Flourens as the fathers of vestibular science.

Although their work on vestibular physiology is without a doubt seminal, it is now worth considering whether or not the preliminary discovery of the sixth sense aptly belongs with Charles Wells, despite his lack of recognition at the time.

## The Sixth Sense: Confirmed

From the beginning, the characterization of the original Aristotelian five senses was unchallenged for nearly 2,000 years. And, since the discovery of the elusive sixth sense was officially accepted in the beginning of the nineteenth century following Purkyně and Flourens’s sentinel work in 1824, even the most elaborate and complex science has yet to prove the existence of a seventh sense.

Although some argue that there are more than six senses—and these may include a premonition sense, an echolocation sense, or even a supernatural sense—most scientists would agree that providing scientific evidence for the existence of a universally accepted new human sense is a

uniquely rare event—if such an event is even to occur again.

The discovery of the vestibular sixth sense was just such an event—a uniquely rare event. Exactly to whom the discovery of the vestibular sixth sense is credited may likely be debated forever. Fortunately, historical facts generally tend to prevail—and we just may have Erasmus Darwin’s published “feud” with Charles Wells to thank for that. Because of that magazine-based duel, perhaps (just perhaps) Charles Wells can finally receive the proper credit he deserves.

\*The phrase “drifting into historical oblivion” is a play on words, respectfully evoking the title of Nicholas Wade’s book, *Destined for Distinguished Oblivion*. [A](#)

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