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The Death of an Indian Rhinoceros

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Abstract In 1834, the London Zoological Society purchased a male Indian Rhinoceros, *Rhinoceros unicornis,* at the request of the anatomist, Richard Owen. Fifteen years later, the rhinoceros died from traumatic injuries, and the necropsy performed by Owen led to the very first discovery of parathyroid glands. Around this time, Richard Owen and Charles Darwin vehemently disagreed with one another about the theory of natural selection. Their public feud sparked the public's interest in Darwin and his theory while Owen became less popular despite his many accomplishments in the scientific world. Not until decades after Owen's death was his contribution to the identification of parathyroid glands discovered. Because his discovery is considered pivotal to the history of endocrine surgery, we sought to investigate the circumstances surrounding the rhinoceros' death, its dissection, and Owen's initial discovery.

Introduction

When the London Zoological Society purchased a male rhinoceros in 1834, they had no idea how much his death would ultimately contribute to the field of anatomy (Fig. 1). Before the rhinoceros' acquisition, Richard Owen (Fig. 2), a prominent anatomist, had persuaded the Society that the animal would be a wise investment; little did they know how true this would be [1–3]. On May 24, 1834, the rhinoceros was purchased for 1,000 guineas (approximately $125,000 in today's dollars) and quickly became the most popular exhibit in the zoo [4]. He was housed with the elephants in the Elephant House (Fig. 3). At some point during the rhinoceros' stay in the Elephant House, a large, male elephant in the adjacent paddock inexplicably began to frequently torment the rhinoceros by forcing him to the ground with his large tusks. Four months after the elephant began this harassment, the rhinoceros started vomiting "a bloody and frothy mucous" and died 1 week later on November 19, 1849 [2].

Richard Owen, Hunterian Professor of Comparative Anatomy, was asked by the Zoological Society to perform the necropsy. Owen began a meticulous dissection that would take several months to complete and lead him to an even greater discovery than the rhinoceros' cause of death. As a result of this dissection Owen became the first person to describe the parathyroid glands [5].

Richard Owen

Richard Owen began his medical studies at Edinburgh University in 1824 where he developed his love for anatomy. He took all of the university's courses, as well as outside anatomy classes given by Dr. John Barclay, who greatly influenced Owen's early career. In April 1825, with the encouragement of Dr. Barclay, Owen accepted a position with Dr. John Abernathy, President of the Royal College of Surgeons (RCS) at St. Bartholomew's Hospital in London. He became Abernathy's prosector, preparing all of the anatomic specimens used in Abernathy's lectures [1, 5]. This arrangement was very advantageous for Owen because he obtained experience dissecting without having

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Fig. 1 Stubbs painting of a rhinoceros from *The Rhinoceros from Durer to Stubbs 115–1799,* Vol. 1, London, Philip Wilson Publishers LTD; 1986

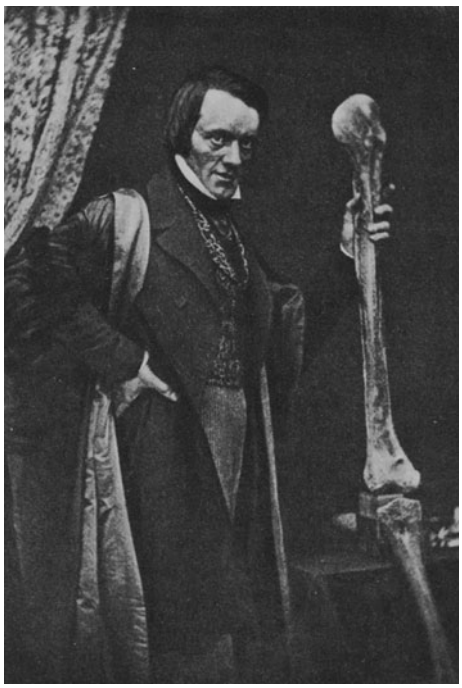

Fig. 2 Sir Richard Owen at age 42 holding a bone of the *Dinornis maximus* from *The Life of Richard Owen*, Vol. 1, London, John Murray; 1894

to purchase the cadavers. Typically, anatomists and prosectors had to pay for their own specimens; these were difficult to obtain before the Anatomy Act of 1832, which expanded the legal supply of cadavers for medical research and education [6].

One year after his appointment, on August 18, 1826, Owen became a member of the RCS, and Abernathy appointed him as assistant curator of the Hunterian Collections. The Hunterian Collections encompassed both plants and animals and contained 3,970 specimens and preparations of comparative anatomy, pathology, and natural history [7]. His responsibilities entailed cataloguing the Hunterian Collections and installing them in their permanent location in the basement of the RCS. This position also gave Owen the opportunity to dissect animals that had been under the care of the Zoological Society of London. He would later become both prosector for the Zoo and a member of the Zoo Board. However, he later resigned from the Board, protesting Thomas Huxley's membership. Thomas Huxley, a fervent evolutionist and Owen's bitter enemy, had decried Owen's transcendental beliefs on creation for decades [1]. Although, as Zoo prosector, Owen is most famous for his dissection of the rhinoceros, his contributions to zoology began with the dissection of an orangutan and continued with the dissections of a giraffe, an ape, a chimpanzee, and several marsupials, all of which had died at the Zoo [8].

In 1833, he became the Hunterian Professor for the RCS and was responsible for an annual series of 24 lectures from which several well-known papers, including "On the Anatomy of the Indian Rhinoceros," were delivered. Due to this prestigious position, Owen often was asked to examine specimens provided by others. In 1836, Charles Darwin brought fossils that he had discovered on his famous HMS Beagle voyage for Owen to characterize [1]. As Owen analyzed many of Darwin's samples from the Beagle voyage, he began to draw conclusions regarding the development of species. Darwin, too, started forming his own ideas, and unfortunately, his interpretations were quite divergent from Owen's. While Darwin formulated the concept of natural selection, calling it "preservation of favourable [sic] variations and the rejection of injurious variations," Owen maintained his belief in the Divine hand as Creator, believing that natural selection was unchristian and belittling to his belief in human uniqueness [1].

During this same time period, Owen also established a classification for mammals, created a new class, Dinosauria, and developed the archetype for vertebrates. He believed that the structure of vertebrates could be reduced to one type, the archetype, with unlimited modifications for each mammal [1]. With regard to this archetype, Owen stated, "As I do not know the secondary cause by which it may have pleased the Creator to introduce organized [sic] species into this planet, I have never expressed orally or in print an opinion on the subject." He then goes onto say, "Transmutation of species in the ascending course is one of six possible secondary causes of species apprehended by me, and the least probable of the six" [1]. As evidenced by these quotes, Owen's arguments were difficult to comprehend. On the one hand he argued that the diversity of nature was divinely guided; on the other he stated that there had to be a plausible ecological explanation for changes in

Fig. 3 London Zoological Gardens in 1842 from *Old London*, Vol. 1, London, The Ariel Press; 1968

the development of species. In this way he managed to stay within the rigid confines of his faith and still satisfy his intellectual quest for understanding the science.

One of Owen's major accomplishments included the classification of fossils from extinct species, which he called Dinosauria. He was credited with identifying the mammoth, the ground sloth, and the moa—an extinct species of the genus Dinornis [9]. He further categorized six distinct species within this genus, including the ostrich and emu, and yet he did not comment on the obvious modification of the species resulting in wingless birds. Despite these discoveries, he still believed that there was no evolution of the species from the large Dinosauria to the modern animals that they resembled. Instead, he believed that the modern animals and Dinosauria coexisted until the planet could no longer support the larger animals [1].

In his later years, Owen developed and ran the Natural History Museum before retiring to a quiet life with his family at Sheen Lodge, which had been given to him in 1852 by Queen Victoria. He was knighted on June 5, 1884 and became Sir Richard Owen, an honor that Darwin would never receive [5].

The zoo and its animals

In 1826, The Zoological Society of London published its objectives, which included "the advancement of zoology and animal physiology" as well as the promotion of original research to further these goals. The Society created two journals to publish original works written by scientists within the Society: *Proceedings of the Zoological Society of London,* and *Transactions of the Zoological Society of London* [8]. Because of his position as the prosector, Owen wrote many articles for these two journals, including "On the Anatomy of the Indian Rhinoceros" published in 1862.

The Zoological Gardens in Regent's Park were officially opened to the public in 1827; however, its popularity was not immediate. More exotic animals and lower ticket prices finally lured the crowds to what was then later called the Zoo [10]. During the Victorian era, people mingled among the animals that were restrained but not caged (with the exception of the Carnivora House, which housed lions, tigers, and other big cats; Fig. 3). There seemed to be little concern about the dangers of humans being in such close contact with wild animals. Furthermore, not much thought was given to placing various animals with each other in close proximity. The Society was more concerned about animals escaping. Surprisingly, for the majority of the exhibits, the integration of animals resulted in very few adverse events [8]. However, for one large male rhinoceros, the proximity of a bull elephant proved to be fatal.

Most elephants are not aggressive creatures in the wild. They generally coexist peacefully with many animal species because the elephant is a socially complex animal and has the ability to react appropriately in many different situations. However, when elephants are in pursuit of water, they become quite fierce and have the capability of killing almost any animal that stands between them and the water source. In contrast, rhinoceroses are very aggressive, will charge at the slightest provocation and, as a consequence, have no natural predators. Given these two

divergent sets of behaviors, it would be logical to separate rhinoceroses from elephants and other animals when they are in captivity [11, 12].

In the case of the relationship between the elephant and the rhinoceros, there was unexpected aggressive behavior exhibited by the elephant toward the rhinoceros. The rhinoceros was the outsider of the group, having been placed in the Elephant House upon his arrival at the zoo. At some point, the rhinoceros had become submissive to the elephant, going low to the ground when the elephant pushed him with his tusks [2]. Eventually, the elephant succeeded in conquering the rhinoceros, regaining his territory in the Elephant House while the rhinoceros fell sick and eventually died. Only because of this complex interaction between two species was Owen able to examine fully the anatomy of the rhinoceros and make his ultimate discovery of the parathyroid glands.

Owen and the rhinoceros

Upon the rhinoceros' death, Owen became reacquainted with the rhinoceros that he had originally persuaded the Zoological Society to obtain 15 years earlier. The rhinoceros was brought to Owen in November 1849, and because of his status within the scientific world, he was given "The very rare opportunity of investigating the internal structure of the Rhinoceros…." During the course of a few months, Owen performed a meticulous and comprehensive necropsy. His wife wrote, "There is a quantity of rhinoceros on the premises," and the smell was "unrelenting" [1].

It had been noted in the head zookeeper's journal that the rhinoceros had begun to lose his appetite in July 1849, and that 1 week before his death, in November, he began vomiting bloody mucous from his nose and mouth. During the necropsy, Owen discovered that the animal had broken his left seventh rib, which had punctured the adjacent left lung, causing inflammation and extensive adhesions and leading to an accumulation of fluid in the bronchus and trachea [2]. Owen believed that this injury had ultimately caused the rhinoceros' demise. He also discovered *Echinococcus* in the right lung, which had not affected the parenchyma as well as associated parasitic vermicules in the stomach, which he believed had caused the animal's anorexia, but not ultimately his death. Owen also believed that the cracked rib had resulted from repetitive injuries to the ligaments of the costovertebral joints, such as the forceful pressure of elephant tusks on the rhinoceros' back. When the elephant forced the rhinoceros to the ground, strain was placed on the ligaments around the vertebrae causing ossific inflammation, achylosis of the vertebrae, and formation of a bony mass. However, it also is possible that the rhinoceros suffered a "contre-coup" injury when he fell heavily to one side. As a result of the trauma from the rib fracture, the animal could no longer clear the secretions that were building up in the bronchial tree and he slowly suffocated on these secretions during the week before his death [2].

During the dissection, Owen carefully delineated the structures within the upper airway, including the thyroid. He noted, "The thyroid gland consisted of two elongate, subtriangular lobes extending from the sides of the larynx to the fourth tracheal ring.…The structure of this body is more distinctly lobular than is usually seen; a small compact yellow glandular body was attached to the thyroid at the point where the veins emerge" [2]. Believing that this glandular structure was somehow significant, he preserved it in situ along with the thyroid and larynx (Fig. 4). A paper on the anatomy of the rhinoceros that resulted from this meticulous dissection was presented as a lecture at the Zoological Society on February 12, 1850 (this lecture was subsequently accepted as a journal article in 1852 but the volume in which it was located was not published until

Fig. 4 Owen's dissection of the parathyroid gland (*arrow*) of the Indian rhinoceros. Reproduced with permission from the Royal College of Surgeons of England

1862) [2]. Of all of Owen's accomplishments, the discovery of the parathyroid glands remained obscure for several decades [13, 14]. It was not until A. J. E. Cave, successor to Owen as Professor of Anatomy at the RCS, discovered that Owen's paper was published in 1852—not 1862 as originally thought [15]. Before Cave's discovery, credit had been given to Ivar Sandström, a medical student in Sweden, for first discovering the parathyroid glands. Sandström first observed parathyroid glands in a dog and later confirmed their presence in a rabbit, a cat, and a horse. He eventually located parathyroid glands in human cadavers and wrote an article entitled, "Om en ny Körtel hos Menniskan och åtskilliga Däggdjur" (On a new gland in man and several mammals), published in 1880 [16, 17]. Interestingly, Ivar Sandström was born in 1852, the year Owen's paper had been originally published. In December 1905, S. G. Shattock first mentioned Owen's paper in his own article, "The Parathyroids in Graves Disease" [18]. Almost 50 years later, Cave discovered that in the Zoological Society publications individual papers within a volume had actually been published separately and before the publishing date of that particular volume. Therefore, Owen's paper was published within volume IV of *Transactions of the Zoological Society of London* in 1862 but had originally been published separately in 1852 predating all other descriptions of parathyroid glands, including observations from Remak in 1855 and Virchow in 1863 as well as Ivar Sandström in 1877 [15, 16, 19].

Unfortunately, Owen was only granted the credit that he deserved for the first documented discovery of the parathyroid glands posthumously. Although he did have many other major accomplishments in the natural science world and was richly rewarded by Queen Victoria with land and knighthood, many of his colleagues disliked him. They perceived him as vain, arrogant, envious, and vindictive. Owen often argued publicly with other scientists who respected him for his knowledge and influence but despised him personally. Owen eluded the praise of the scientific community because of these habits as well as his lack of progressive thinking. Hugh Falconer, a paleontologist, hated Owen and told Darwin repeatedly, "You will find him out someday"—a statement that Darwin acknowledged as true. In later years, Darwin called Owen, "One of my chief enemies, the sole one who has annoyed me" [20, 21]. The disdain felt by the scientific arena continued to grow exponentially as Owen began to publicly ridicule Darwin, denouncing his theory of evolution.

Owen and Darwin

In 1859, Charles Darwin published his most famous work: *On the Origin of Species*. Before this publication, Darwin had frequently consulted his mentor, Owen, to discuss paleontological questions, especially those concerning the development of vertebrates. With the publishing date for his book fast approaching, Darwin sent an advance copy to Owen, asking his opinion on the controversial subject matter. Even while openly praising the book and offering his suggestions to Darwin, Owen anonymously wrote a public critique of the book, declaring it "unchristian" [1]. Owen believed that species were fixed and unchangeable because they represented a specific idea in the mind of the Creator. This was in direct opposition to Darwin's beliefs—that species flourished or floundered according to natural selection. Darwin referred to natural selection as "preservation of favourable [sic] variations and the rejection of injurious variations"—a theory that was considered quite radical at the time [22].

Public debates ensued, spurred on by Owen who was guided by religious principles and who was considered to be more prominent in the scientific world. Neither he nor Darwin participated in the debates; rather, they used surrogates to argue their points of view while they silently stood by. Interestingly, Darwin and his supporters tended to use a more positive approach in their defense, whereas Owen used a more negative approach. For example, Owen's representatives would falsely proclaim an idea to be Darwin's and then proceed to prove the idea wrong in hopes of gaining public consensus [20].

In 1860, Owen decided to use the most important scientific meeting of the year as a forum to promote his ideas and to crush Darwin's theories. The annual weeklong meeting sponsored by the British Association for Advancement of Science was attended both by scientists and the public. The Bishop of Oxford, Samuel Wilberforce, had been asked to deliver a speech that argued for creationism. On Saturday June 30, 1860, 700 people attended the debate, and the Bishop, speaking first, delivered his flamboyant speech, exciting the crowd [23]. Thomas Huxley and John Hooker were the spokesmen for Darwin and his ideas. In his fervor, the Bishop was inappropriate when he asked Huxley if it were his grandfather's or grandmother's ancestors who descended from ape. In his rebuttal, Huxley said, "I asserted and I repeat, that a man has no reason to be ashamed of having an ape for his grandfather. If there were an ancestor whom I should feel shame in recalling, it would be a *man*, a man of restless and versatile intellect, who, not content with an equivocal success in his own sphere of activity, plunges into scientific questions with which he has no real acquaintance…" [24]. Because he had insulted the Bishop, the crowd became riotous, calming down only after John Hooker proceeded to deliver his closing comments. Supporting Huxley, Hooker stated that the Bishop was not only ignorant of the ideas contained in Darwin's book, but also of the basic principles

of botanical science. Hooker also discussed his initial disbelief in Darwin's theory and his 15-year quest to study its scientific basis. He came to the realization that inexplicable scientific queries could indeed be explained by Darwin's theory and, therefore, "Conviction has been thus forced upon an unwilling convert" [24]. These closing arguments ultimately won the debate, strongly supporting Darwin and his radical theory.

These debates initially resulted in public outcry, but Victorian sensibilities prevailed and with the help of Darwin's positive approach and the popular press, his book became a success. Because people were not threatened by Darwin's evolutionary theories, they were able to assimilate these ideas into their religious structure without undermining their principles or their faith [20, 21]. Unfortunately, Owen was unable to capitalize on religious doctrine as it applied to his theory of creationism because he was so antagonistic in the eyes of Victorian society. Darwin and his theory prevailed; the people adapted their ideology to incorporate both Darwin's views as well as the Church's doctrines. In contrast, Owen's career stagnated and he eventually faded out of the public eye and the scientific community's view. It would be nearly 50 years before Owen would be recognized posthumously for his discovery of the parathyroid glands and once again brought back into the fold of the scientific community [15, 22].

Conclusions

In 1859, the death of an Indian rhinoceros led to the discovery of parathyroid glands, which in the 1900s were found to have a principal role in calcium metabolism. In cataloguing these small glands, Owen was the first scientist to document their existence in a mammal; eventually, these glands would be identified by others in humans. Despite his myriad dissections and categorization of animals, such as the rhinoceros, he was unwilling to embrace the concepts brought forth by Darwin. Ironically, Owen's discovery of parathyroid glands in the rhinoceros is considered a seminal event in the evolution of parathyroid disease and parathyroid surgery. Because Owen failed to grasp that the world was continually evolving around him while he remained stationary, he could not appreciate that his work actually supported the concept of the evolutionary process. The very principles that he vehemently opposed were embedded in all aspects of life. Without any understanding of the implications of this discovery, Owen unknowingly contributed to the evolution of parathyroid disease management, which is still being refined and improved upon today.

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