



Figure 4.1 Richard Owen (left) and Thomas Huxley examining a water baby. Drawing by Linley Sambourne from a 1916 edition of Charles Kingsley's novel for children, *Water Babies*, originally published in 1863. It includes a spoof of the hippocampus minor controversy.

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THE HIPPOCAMPUS MINOR AND MAN'S PLACE IN NATURE:  
A CASE STUDY IN THE SOCIAL CONSTRUCTION  
OF NEUROANATOMY

In midnineteenth-century Britain, the possibility of evolution and particularly the evolution of humans from apes was vigorously contested. Among the leading antievolutionists was the celebrated anatomist and paleontologist Richard Owen, and among the leading defenders of evolution was T. H. Huxley (figure 4.1). The central dispute between them on human evolution was whether or not man's brain was fundamentally unique.

This chapter considers the background of this controversy, the origin and fate of the term hippocampus minor, why this structure became central to the question of human evolution, and how Huxley used it to support both Darwinism and the political ascendancy of Darwinians. The account illustrates both the extraordinary persistence of ideas in biology and the role of the political and social matrix in the study of the brain.

EVOLUTION AND VICTORIAN POLITICS

For several decades before the publication of the *Origin of Species* in 1859, debate raged in Britain over the possibility of the transmutation of species and, especially, of an ape origin for humans. At the beginning of the century J.B. Lamarck elaborated the first coherent theory of evolution and unambiguously

included humans. He thought that evolution involved continuous upward progress, an inevitable transformation of lower into upper forms of life. His “progressivism,” as well as his materialism and his belief in the inheritance of acquired characteristics, made Lamarck very appealing to the London and Edinburgh radicals of the day. They took his idea that biological evolution implies progress and improvement and applied it to society to demand social evolution and social progress. Some of the transformations they advocated were the end of aristocratic and established church privilege, introduction of universal suffrage, reform of medical care and medical education (many were physicians), education for women, and similar radical reformist notions. Correspondingly, the conservative Oxbridge scientist-clergymen who dominated early Victorian science saw Lamarck as a direct threat to the established order of Church and State.<sup>1</sup>

Evolutionary ideas and their radical political and theological implications became more widespread with the publication in 1844 of *Vestiges of the Natural History of Creation* by Robert Chambers, a scientific amateur who published anonymously because of the very real threats of blasphemy laws and economic and political persecution.<sup>2</sup> *Vestiges* argued for both cosmic and biological evolution, and adopted Lamarck’s idea that evolution implied improvement. Chambers’s arguments for biological evolution included the location of simpler fossils in older strata, the fundamentally similar anatomical organization of all groups of animals, and tendencies of embryos to go through stages similar to their putative ancestors. The book was a sensational best-seller, with some 24,000 copies sold in the next ten years compared with 9,500 for Darwin’s *Origin* over a similar period. That Chambers was a successful publisher, expert in marketing popular science, undoubtedly helped.<sup>3</sup>

The scientific establishment reacted rather violently to *Vestiges*. Adam Sedgwick, professor of geology at Cambridge, president of the Geological Society, and a future president of the British Association for the Advancement of Science, wrote a 500-page plus review of this “beastly book” to place “an iron heel upon the head of the filthy abortion and put an end to its crawlings” in which he made clear that the problem was not merely scientific:

The world cannot bear to be turned upside down . . . I can see nothing but ruin and confusion in such a creed. . . . If current in society it will undermine the whole moral and social fabric and inevitably will bring discord and deal mischief in its train . . .

In a letter to Charles Lyell he went further:

if the book be true . . . religion is a lie; human law is a mass of folly, and a base injustice; morality is moonshine; our labours for the black people of Africa were the works of madmen . . .

The Rev. Sedgwick seems to have been particularly incensed that a book for the general public (and therefore for women too) dealt with such topics as pregnancy and abortion, and he cautioned that<sup>4</sup>:

our glorious maidens and matrons . . . not soil their fingers with the dirty knife of an anatomist neither may they poison the strings of joyous thought and modest feeling by listening to the seductions of this author . . .

T. H. Huxley, later to be the great battler for evolution, was almost as brutal, his review using such terms as "foolish fantasies," "pretentious nonsense," and "work of fiction."<sup>5</sup>

Despite the establishment attacks on it, *Vestiges* was a popular success, so much so that Disraeli parodied its fashion in middle-class salons in his 1847 novel *Tancred*.<sup>6</sup> Chambers gave ammunition to the radicals and socialists, who used the book's ideas of biological progress to demand social progress.<sup>7</sup> Chambers certainly made many factual errors and uncritical speculations, yet, as Mayr wrote, "it was he who saw the forest where all the great British scientists of his period (except Darwin) only saw the trees." Chambers's book helped make both the scientific and lay world ready for the far more coherent and compelling arguments in the *Origin*, a debt that Darwin later acknowledged. Furthermore,



it influenced A.R. Wallace, codiscoverer of natural selection. It may also have had a significant effect on Darwin himself, as Darwin's son Francis later reported that his father's copy was well read and annotated.<sup>8</sup>

Lamarck's and Chambers's explicit and graphic descriptions of the transformation of ape into human piqued popular interest in the apes and monkeys. Victorian imperialism was now bringing to Britain in increasing numbers. Chimpanzees were dressed in human clothes at the London Zoo, and anthropomorphic prints of them implied the proximity that these authors made explicit.<sup>9</sup> This "beastialization" of man implicitly supported the idea of evolution, which in turn implied materialism and social transformation, thereby threatening the established church and state. The leading figure to combat this threat was Professor (later Sir) Richard Owen, and he was superbly placed to do so.

#### OWEN SEPARATES MAN FROM THE APES

Owen had been elected to the Royal Society by the age of thirty, was Hunterian Professor at the Royal College of Surgeons, and became superintendent of the Natural History Department of the British Museum, which gave him a monopoly on dissecting animals that died in the London Zoo. He was easily England's leading paleontologist and anatomist, the "British Cuvier." He also became socially well connected; he received a London residence from the queen, dined with Prince Albert and the Prince of Wales, and lectured to the Royal Children on zoology. Nor was his political conservatism only theoretical: when the Chartists (advocating universal male suffrage, equal electoral districts, the end of property qualifications for members of parliament, and similar reforms) were thought to threaten London with their militant marches and violent demonstrations, he joined the militia of urban gentry to defend, quite literally, the status quo.<sup>10</sup>

In the years before the publication of the *Origin*, Owen wrote a series of papers comparing the muscles and bones of apes with those of humans. He stressed the differences between them and used these differences to argue for

their independent origin and the impossibility of the transmutation of one into the other. One major line of argument was that the anatomical details of the leg and foot of the orang-utan were quite incompatible with the animal standing erect and walking like a human. Lamarck's simple-minded notion of an ape climbing down from a tree and becoming a man was clearly wrong. Another theme concerned the similarities of the heads and faces of humans and chimpanzees. Prior to Owen's work, infant but not mature chimpanzees had been described; infant chimps have faces and heads very similar to those of human children (a phenomenon now known as neoteny), making a close relationship plausible. Owen obtained the skull of a mature chimp and, describing its bony ridges for holding strong jaw muscles, its protruding jaws, and its threatening canines, contended that it was far more bestial than a baby chimp's and too much so to be a close relative of man.<sup>11</sup>

Then, at the peak of his career, he wrote a paper that within a few years was repudiated by the scientific community and ridiculed in the popular press, and fixed him in the history books for an egregious triplet of errors rather than for his over 600 scientific papers, many of which had made significant contributions. The paper, "On the Characters, Principles of Division and Primary Groups of the Class Mammalia," was read at a meeting of the Linnean Society and again as the Rede lecture at Cambridge University, on the occasion of Owen receiving the first honorary degree ever given by that university.<sup>12</sup> The startling part of this paper was a new classification of mammals that stressed the gap between human and ape. Its timing was probably spurred by Owen's realization that Darwin was about to publish his book on transmutation.

In the eighteenth century, Linnaeus had put men, apes, monkeys, and lemurs (and bats) into a single order, Primates, and this grouping, minus bats, had been accepted by most zoologists. Owen now rejected this dominant tradition and placed humans apart from all other primates and indeed from all other mammals in a separate subclass, the Archencephala ("ruling brain"). He did so on three anatomical criteria, all of them concerning the brain. Presumably, he chose brain structures because of the human's mental uniqueness and superiority. Furthermore, to strengthen his theory of the lack of continuity

between man and animals, he maintained that these three structures were actually found exclusively in humans, rather than merely being larger or different than in animals. He sought a truly qualitative difference between man and beast and he wanted it based on anatomical science.

The first fundamental difference he claimed was that only in the human does the "posterior lobe" (i.e., the posterior of the cerebrum) extend beyond the cerebellum. He supported this with illustrations contrasting the brain of a chimpanzee with that of a Negro. The comparison of a Negro brain with an ape brain was common in the nineteenth and extended well into the twentieth century. The rationale was that as the "lowest" race with "therefore" the least developed brains, blacks were the most appropriate comparison with animals. This view was nearly universal among nineteenth-century scientists, even those such as Darwin who were ardent abolitionists.<sup>13</sup> The most often illustrated nonwhite brain was that of the famous "Hottentot Venus" (Saartjie Baartman), who was exhibited in London and Paris and described in detail by many of the leading anatomists of the day, including Paul Broca and Georges Cuvier, both when she was alive and after her death and dissection.<sup>14</sup>

The second difference proposed by Owen was that only humans have a posterior horn or cornu in their lateral ventricles. The third and most important difference was that only humans have a hippocampus minor. These extraordinary claims were supported by no citations to the literature, no brain sections, and no illustrations other than those just mentioned. Near the end of the paper, just in case the reader overlooked the importance of the missing hippocampus minor and the other supposed deprivations of the animal brain, Owen wrote: "Thus, [man] fulfills his destiny as the supreme master of this earth and of the lower creation." When Darwin read Owen's paper he commented, "I cannot swallow Man . . . [so] . . . distinct from a Chimpanzee . . . I wonder what a Chimpanzee wd say to this?"<sup>15</sup>

In the following section I describe what the hippocampus minor actually is, since the term has disappeared from contemporary neuroanatomy. Next I discuss Huxley's challenge to Owen's new classification of man and how he used the hippocampus minor to repudiate Owen and irreparably damage

his scientific credibility, thereby facilitating the acceptance of Darwin's ideas. After I consider the origins of Owen's criteria for humanness, I address some consequences and implications of the debate.

#### THE HIPPOCAMPUS MINOR

The hippocampus minor is a ridge in the floor of the posterior horn of the lateral ventricle caused by the deep inward penetration of the calcarine fissure. The original term for the hippocampus minor was *calcar avis*, and this is the one that is used today. It is not easily visible in coronal, sagittal, or horizontal sections but is clearly discernable on blunt dissection, exposing the posterior horn from above (figure 4.2). Where did this physically unimpressive and, to the contemporary neuroscientist, unimportant, structure get its names?

In a top-down dissection through the human brain, the hippocampus is a particularly prominent feature on the floor of the lateral ventricle. It received its modern name from Aranzi (Arantius), a student of Vesalius in 1564, because its features reminded him of the sea horse, or hippocampus. Another somewhat less prominent structure, also visible in this approach, is a ridge on the floor of the posterior horn of the ventricle. As it resembles the spur on a bird's leg, this ridge was named *calcar avis*, from the Latin for cock's spur. In systemizing brain nomenclature in 1786, Vicq d'Azyr renamed these two ventricular structures. The *calcar avis* was named the hippocampus minor, and the hippocampus became the hippocampus major. Things got a bit bizarre for a while when Meyer in 1779 erroneously used the word *hippopotamus* instead of *hippocampus*, which was maintained by several authors until Burdach straightened things out in 1829.<sup>16</sup>

The terms *calcar avis* and *hippocampus minor* continued to be used interchangeably until the later part of the nineteenth century, when the latter term disappeared, having been officially expunged in the 1895 edition of *Nomina Anatomica*. This disappearance may have been related to the ridicule and controversy that swirled around the term in the debates we are about to relate. At this time *hippopotamus* again was substituted for *hippocampus*, but

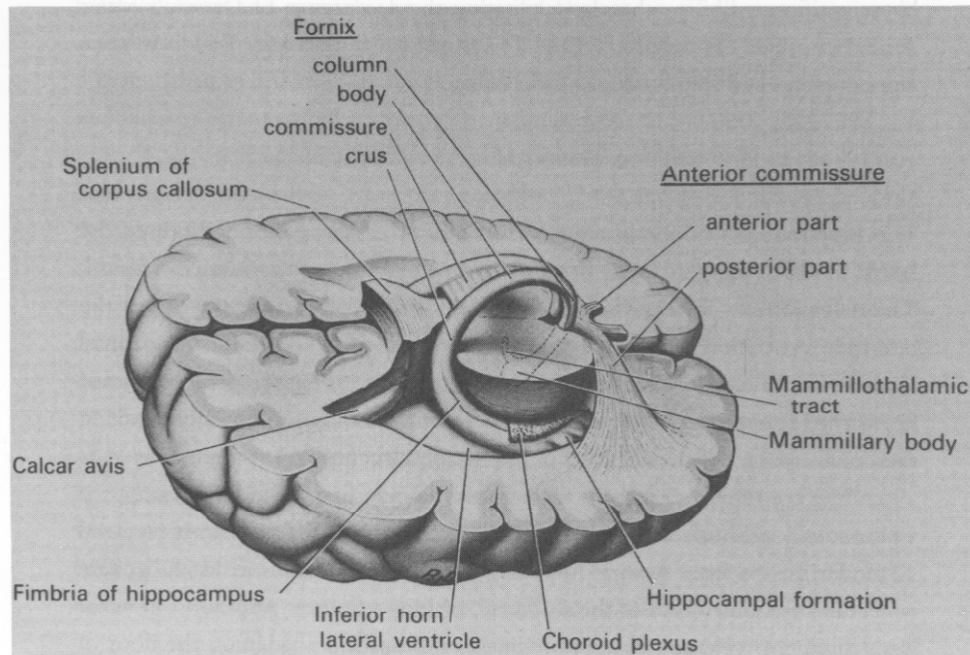


Figure 4.2 Modern drawing of a human brain dissection showing the hippocampal formation and the calcar avis in the floor of the lateral ventricle (from Carpenter and Sutin, 1983, with permission).

in jest, as in Charles Kingsley's *Water Babies*,<sup>17</sup> as we will see. The contrasting designation hippocampus major for what is now called the hippocampus lingered for a few more years, and then also fell out of use. Whereas the hippocampus minor was virtually absent from anatomy textbooks by the turn of the century, it survived in those more conservative sources, dictionaries (e.g., *Webster's New International Dictionary*, 2nd ed., 1957), and encyclopedias (e.g., *Encyclopedia Britannica*, 13th ed., 1926).

Before returning to the fate of Owen's proposals for the hippocampus minor it may be helpful to summarize the state of contemporary knowledge of brain function. The year 1858 can be viewed as a time after the fertilization but before the birth of modern neuroscience. The phrenological movement

initiated by Gall and Spurzheim at the turn of the nineteenth century had popularized the idea of the cerebrum as a collection of organs with different psychological functions, and focused attention on the functions of the cerebral cortex. Gall's errors of equating skull features with brain morphology had been realized in the scientific community, and the search for correlations between the site of cerebral damage and symptom had begun in humans and animals. Flourens's experimental work on pigeons and other animals in the 1820s had simultaneously demolished the extreme localization of phrenology and made the idea of more limited localization of function readily acceptable.<sup>18</sup> However, at the time of Owen's paper, no convincing evidence existed for the specific functions of any portion of the mammalian cerebrum; the hippocampus minor was no more a terra incognita than any other area.

In the years immediately after Owen's paper, three crucial events occurred in the understanding of brain function. The first was Broca's demonstration in 1861 of an area critical for speech in the left frontal lobe. It was the first generally accepted localization of psychological function in the human brain and it was viewed at the time as a vindication of Gall. The second was Fritsch and Hitzig's production of specific movements by electrical stimulation of discrete motor centers of the cortex in 1870. The third was the discovery of the sensory areas of the cortex, which followed soon thereafter.<sup>19</sup>

#### T. H. HUXLEY AS YOUNG BULLDOG

Thomas Henry Huxley was twenty-one years Owen's junior and was hostile to the older scientist almost from the beginning of his scientific career. In 1850 Huxley had just returned from a four-year voyage aboard the *H.M.S. Rattlesnake*. Unlike Darwin's status on the *Beagle* as gentleman naturalist, Huxley had been a lowly assistant surgeon, and what research he did was on his own time. It was good enough, particularly that on coelenterates, that he was elected to the Royal Society in 1851. Yet, for several years after returning, he was without a job or research funds (but with a fiancée waiting in Australia).<sup>20</sup>

In this period, Owen supported Huxley's candidacy for the Royal Society and wrote several letters of recommendation for him for various teaching or

research posts. At the end of 1852, Huxley wrote Owen for yet another letter of recommendation, this time to the Navy. When Owen failed to answer in the next ten days, Huxley wrote again, and still did not receive an answer. Four days later the men happened to meet and Huxley described the confrontation in a letter in a way that nicely epitomizes the personalities of the junior and senior scientists<sup>21</sup>:

Of course I was in a considerable rage. . . . I was going to walk past, but he stopped me, and in the blandest and most gracious manner said, "I have received your note. I shall *grant* it." The phrase and the implied condescension were quite "touching," so much that if I stopped for a moment longer I must knock him into the gutter. I therefore bowed and walked off.

Owen sent the recommendation a few days later and the Navy gave Huxley funds to complete publication of his research from the voyage. Yet during this time Huxley repeatedly attacked Owen, but only privately, writing, for example, that "Owen is both feared and hated" and that "he [Huxley] felt it necessary always to be on guard against him [Owen]." He even thought that Owen was blocking publication of his papers and taking his grant money, both charges apparently without justification. He wrote to his sister in 1852<sup>22</sup>:

Let him [Owen] beware. . . . On my subjects I am his master and am quite ready to fight. . . . And although he has a bitter pen . . . I can match him . . .

Finally, in 1854 Huxley secured a position teaching natural history at the Government School of Mines. He kept it for another thirty years, eventually turning down chairs at Oxford and Harvard, among other places. By this time the school had become the Royal School of Science and would eventually become Imperial College. No longer needing job references from Owen, Huxley's attacks on his senior became more public. Huxley's scientific critiques of Owen in the late 1850s included ones on the subjects of parthenogenesis,

on the presence of an anus in a group of brachiopods, on Owen's classification of Invertebrates, and on his comparative anatomy textbook. With Owen in the chair, Huxley's Croonian lecture to the Royal Society in 1859 was a violent critique of Owen's theory that the skull is composed of fused vertebrae. This was part of Owen's theory of archetypes, that there was a basic pattern to which all vertebrates conformed. This theory largely derived from the idealistic morphology of Naturphilosophie, whose origin was the Platonic Romanticism of Goethe and Schiller. Contemporary skull nomenclature stems from this effort of Owen.<sup>23</sup>

The final personal breach between Huxley and Owen came in 1857 when Owen gave a successful series of lectures on paleontology at the Government School of Mines.<sup>24</sup> They were attended by various luminaries such as the Duke of Argyll (then Postmaster General and later president of the Royal Society), Sir Charles Lyell, and David Livingston. In this connection Owen listed himself in a medical directory as "Professor of Comparative Anatomy and Paleontology" in the School of Mines. Huxley was infuriated at this intrusion into his territory and complained to the editor of the directory:

Mr. Owen holds no appointment whatever at the Govt. School of Mines, and as I am the Professor of General Natural History (which includes Comparative Anatomy and Paleontology) in that Institution you will observe that the statement . . . is calculated to do me injury.

To a friend, Huxley wrote<sup>25</sup>:

I have now done with him, personally. I would as soon acknowledge a man who had attempted to obtain my money on false pretenses.

Although scientific controversy tended to be much more openly nasty in Victorian England than it is today, the Owen-Huxley antagonism was extreme even by standards of the time, and it had far from peaked at the time of this



territorial dispute. Huxley's youthful arrogance, hot temper, and anticlericism, and Owen's stubbornness, superciliousness, and religiosity served to exaggerate their scientific differences. The fact that both came from lower middle-class backgrounds, and Owen eagerly sought and Huxley tended to resist social ascent, probably further exacerbated their differences. Of course, in a few decades the amateur naturalist-clergyman Oxbridge establishment would give way to the professional scientist establishment with the Right Honorable Huxley and his friends in the X Club at its very center.<sup>26</sup>

By the end of the 1850s, under Darwin's tutorial, Huxley was gradually accepting the idea of transmutation and what it implied about the origin of humankind; his prepublication reading of the *Origin* finally made him a total convert to the idea of evolution. Like most of Darwin's contemporaries, however, he never really accepted and probably never grasped Darwin's core contribution, the concept of natural selection operating on random variation.<sup>27</sup>

#### THE OXFORD MEETING OF THE BRITISH ASSOCIATION, 1860

The British Association for the Advancement of Science was the largest scientific organization in Britain and its annual meetings were the most public. Its meetings were reported and commented on in the press, even in the popular dailies. The serious weeklies, particularly the *Athenaeum*, usually carried detailed reports of the major papers presented. In anticipation of the 1858 annual meeting in Leeds, Huxley had written "The interesting question arises, shall I have a row with the great O. there?" Two years later he got what was obviously his wish.

The 1860 meeting in Oxford of this "parliament of science" was the first after the publication of the *Origin of Species* and, as a result, interest in it was high among the lay and scientific public. By this time the *Origin* had been discussed in detail in virtually all the serious press. Reviews covered the spectrum from slashing attacks by Owen (thinly anonymously) in the *Edinburgh*

*Review* and by Samuel Wilberforce, Bishop of Oxford, in the *Quarterly Review* to the undiluted enthusiasm of T. H. Huxley in both the very respectable *Times* (anonymously) and the radical *Westminster Review*. Darwin called Owen's assessments "extremely malignant," Wilberforce's "uncommonly clever," and Huxley's "brilliant." As had become his custom for virtually all public scientific meetings because of his chronic illness, Darwin himself did not attend, but eagerly awaited news particularly from his closest colleagues, botanist J. D. Hooker and Huxley.<sup>28</sup>

On Thursday, June 28, the opening day of the meeting, after a paper entitled, "On the Final Causes of the Sexuality of Plants with Particular Reference to Mr. Darwin's Work," the chair called on Huxley for his comments. According to a report in the *Athenaeum*, the leading contemporary intellectual weekly, Huxley declined to comment because:

he felt a general audience in which sentiment would unduly interfere with intellect, was not the public before which such a discussion should be carried out.

Owen then asked for the floor to present facts "by which the public could come to some conclusions . . . of the truth of Mr. Darwin's theory." He then repeated his argument that the brain of the gorilla was more different from that of man than from that of the lowest primate particularly because only man had a posterior lobe, a posterior horn, and a hippocampus minor. Hence, the descent of humans from apes, a crucial implication of Darwin's ideas, was impossible.

Then Huxley rose and "denied altogether that the difference between the brain of the gorilla and man was so great," making a "direct and unqualified contradiction" of Owen. In support of his position, Huxley cited previous studies and promised to defend his arguments in detail elsewhere.<sup>29</sup> He did so, as we will see, repeatedly over the next three years.

The next day Huxley was planning to leave the meeting because Bishop Wilberforce was rumored to be planning to “smash Darwin,” and Huxley was afraid that the “promised debate would be merely an appeal to prejudice in a mixed audience before which the scientific arguments of the Bishop’s opponents would be at the utmost disadvantage.” The Bishop had a first-class degree in mathematics, which supposedly made him an authority on science. Owen was staying with Wilberforce, prepping him for the debate, just as he had helped him with a very negative review of the *Origin*. That afternoon Huxley ran into Robert Chambers, who by now was generally believed to be the author of *Vestiges*, the revolutionary tract on evolution. On hearing that Huxley was planning to leave, Chambers “vehemently” urged him not to “desert them.” Huxley recalled replying, “Oh! If you are going to take it that way I’ll come.”<sup>30</sup>

The next day the lecture room was packed, and when Dr. Draper from New York finished his lecture, “The Intellectual Development of Europe Considered with Reference to the Views of Mr. Darwin and Others that the Progression of Organisms Is Determined by Law,” the Bishop of Oxford rose and spoke for “full half an hour . . . ridiculing Darwin badly and Huxley savagely,” and in general repeating arguments from his review of the *Origin*. Then turning to Huxley, and referring to the clash two days earlier between Owen and Huxley over brain anatomy and the relatedness of man and ape, “he begged to know was it through his grandfather or his grandmother that he claimed descent from a monkey?” Huxley supposedly turned to his neighbor saying, “The Lord has delivered him into mine hands.”

Huxley rose, calmly, in his memory, but “white with anger” according to others, and defended Darwin’s theory as “the best explanation of the origin of species which had yet been offered.” He concluded with the most famous repartee in the history of science, that:

he was not ashamed to have a monkey for his ancestor; but he would be ashamed to be connected with a man who used great gifts to obscure the truth.

Some accounts were stronger ending:

I should feel it a shame to have sprung from one who prostituted the gifts of culture and eloquence to the service of prejudice and of falsehood.

According to one report:

as the point became clear there was a great burst of applause, one lady fainted and had to be carried out, I for one jumped out of my seat, no one who was present can ever forget the impression it made.

Other speakers followed, including FitzRoy, now Admiral, formerly Captain of the *Beagle*, regretting the publication of Darwin's book, and John Lubbock, pioneering ethologist, accepting the Darwinian hypothesis as the best available. Speaking last and at length, J. D. Hooker gave a detailed refutation of Wilberforce and defense of Darwin using his expertise as a botanist and biogeographer.

Years later, particularly after accounts of these events were published by Huxley and Darwin's sons, the exchange between Huxley and Wilberforce took on a exaggerated mythic existence as the "Great Battle in the War between Science and Religion," the most famous nineteenth-century battle after Waterloo, in which Huxley committed "forensic murder" and Wilberforce "involuntary martyrdom." At the time, however, each man believed himself the victor. Furthermore, Hooker thought he, rather than Huxley, had demolished Wilberforce. The audience seems to have been divided among these three views; the *Athenaeum* summarized it all as "uncommonly lively." Jensen critically reviewed the contemporary reports, the recollections of the participants, and the large and ever growing secondary literature on this so-called debate.<sup>31</sup>

THE "BULLDOG" AND "GLADIATOR-GENERAL FOR  
SCIENCE" ATTACKS<sup>32</sup>

Huxley had been waiting and preparing for his attack on Owen at the British Association meeting for some time. As soon as he read Owen's new classifica-

tion scheme separating humans from other primates on the basis of brain structure, he began systematically to dissect monkey brains. He soon realized the magnitude of Owen's errors and saw his opportunity to "nail . . . [Owen] . . . that mendacious humbug . . . like a kite to the barn door." He said nothing publicly until his contradiction in the opening session of the 1860 Oxford meeting. After that, as promised, he began to attack Owen's claims in print and with a vengeance. He used his new journal, *Natural History Review*, as a major platform. He had just founded it as a pro-Darwin and anticlerical ("episcopophagous") organ.<sup>33</sup>

The opening of Huxley's campaign came in 1861 in the first issue.<sup>34</sup> There he attacked the three claims of Owen, that only man's cerebrum covered the cerebellum (the posterior lobe), that only man had a posterior horn in his lateral ventricle, and that only man had a hippocampus minor. He did so with a barrage of citations, quotations, and personal communications from leading anatomists in Britain and abroad. Huxley was interested in doing more than proving Owen wrong. He wanted to prove him dishonest as well. Thus, he put great emphasis on quoting three particular sources that Owen must have known about, and stated that in failing to mention them he was "guilty of willful and deliberate falsehood."

The first of these sources was Owen himself in a monograph that was a major factor in establishing the man's anatomical reputation, and that antedated *Vestiges* and Owen's antipathy to transmutation. In it Owen briefly notes that the cerebral hemispheres of the baboon and chimpanzee extend beyond the cerebellum.<sup>35</sup>

The second authority was F. Tiedemann, a distinguished German anatomist from whose 1836 paper in the *Philosophical Transactions* Owen copied, without attribution, the drawing of the Negro brain in his classification paper. Huxley quoted earlier papers by Tiedemann describing, in infrahuman primates, the cerebrum extending beyond the cerebellum and a posterior horn in the lateral ventricle. He was a little misleading here, since in the paper from which Owen obtained the drawing of the Negro brain, illustrations of orang-utan and chimpanzee brains actually show the cerebrum not extending beyond the cerebellum. Huxley also rather quickly passed over Tiedemann's earlier failure

to find a hippocampus minor in any animal other than man.<sup>36</sup> (The point of Tiedemann's 1836 paper, incidentally, was to argue, rather iconoclastically, for the neuroanatomical, intellectual, and moral equality of whites and blacks. To support their anatomical equality, he showed the brain of the "Hottentot Venus" and claimed, unlike several other anatomists, that it is essentially identical to the brains of Europeans. To support his claim of intellectual and moral equality, Tiedemann provided a list of distinguished black clergyman, intellectuals, artists, and political leaders.)

The third source Huxley used to impugn Owen's integrity was a paper by Dutch anatomists J. L. C. Schroeder van der Kolk and W. Vrolik.<sup>37</sup> Again Owen must have seen this paper since that is where he obtained, again without attribution, his illustration of a chimpanzee brain showing its cerebellum uncovered by the cerebrum. In this paper the authors clearly described a posterior horn and a hippocampus minor in the chimpanzee. As to their figure showing the exposed cerebellum, Huxley quoted Gratiolet, the leading brain anatomist of the day, that this specific figure was greatly distorted and misleading because of the way the brain was removed from the skull. Tiedemann's drawings of both the orang-utang and the chimpanzee showed the same distortion.<sup>38</sup> This must have been a common error and not quite the absurdity Huxley claimed. Animals, and certainly rare apes, were not perfused with a fixative for anatomical purposes when they were still alive, as is done today, under anesthesia, for optimal histological fixation. Rather, when they died, usually in a zoo, their brains were removed and placed in a preservative. Under these conditions the kind of distortion that misled Owen and his sources must have been common indeed.

Owen's Linnean (1858) and Rede lectures (1859) on the classification of mammals were identical except for a footnote missing from the latter. In that note Owen said he was unable to shut his eyes to the "all-pervading similitude of structure which makes the determination of the differences between" human and chimpanzee "so difficult." He presumably originally included this comment to stress the importance of his three new cerebral criteria for distinguishing human and ape, but then may have omitted it in the republication because he

realized it undercut his theory. In any case Huxley, here and many times again, reveled in quoting this footnote, which he treated as the ultimate hoisting petard.

At the end of his *Natural History Review* paper, Huxley readily admitted several differences between the human brain and that of the higher apes, such as size, relative proportions of different parts, and the complexity and number of convolutions. These he believed were "of no very great value" because they were the same as those between the brains of the "highest" and "lowest" human races "though more in degree." He then took exception to Tiedemann's view that the brain of a black was no different from that of a European, since this weakened his view of the continuity between human and ape, with the "lower" races of man intermediate. In any case, he concluded, the brains of monkeys "differ far more widely from the brain of an orang than the brain of an orang differs from that of man" and therefore, Owen's dividing the two by cerebral characters was wrong.

As soon as this paper appeared Huxley sent the "Lord Bishop of Oxford" a reprint of it with a short note to "draw attention" to it as a "full justification for contradicting Owen at the Oxford British Association meeting." Wilberforce answered politely.<sup>39</sup> When Darwin read Huxley's paper he congratulated him and called the paper a "complete and awful smasher . . . for Owen." As to Owen, he called Huxley a "humbug" for omitting the footnote on the similarity of man and apes in his Rede lecture to the "orthodox Cambridge dons."<sup>40</sup>

The second issue of the *Natural History Review* contained an article on an orang-utan brain by George Rolleston, who had won the chair of anatomy at Oxford, with Huxley's help over a candidate of Owen's. The article placed great emphasis on showing the cerebrum covering the cerebellum, and both a posterior horn and a hippocampus minor in orang-utan and human. It was illustrated with an elegant three-dimensional engraving of a horizontal dissection of the orang-utan brain showing a rather prominent hippocampus minor. (This same figure appeared again in the same issue, whether by accident or design, attached to an article entitled, "Crania of Ancient Races of Man." The

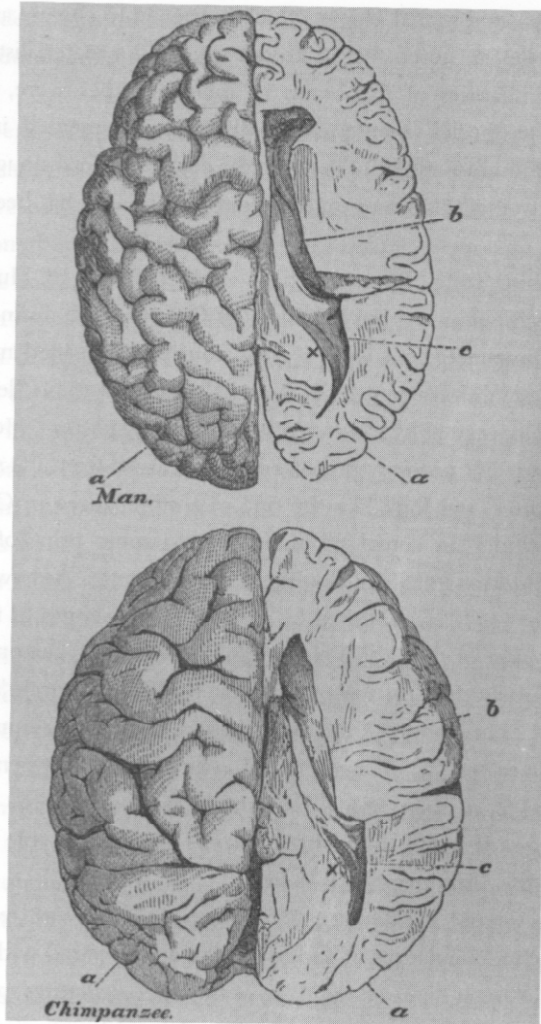
figure was never cited in that article, which happened to contain another attack on Owen.) Rolleston noted that as he did not hold a materialist position, he believed the similarities of the brains of men and apes were, in any case, irrelevant to the species' mental status. (Huxley commented in a letter to Hooker that although Rolleston "had a great deal of Oxford slough [i.e., snake skin] to shed . . . his testimony on that very background has been of especial service."<sup>41</sup>)

In the third issue, John Marshall, another friend of Huxley's, made essentially the same points about the falsity of Owen's three distinctions, in this case for the chimpanzee and with a great flourish of detailed measurements. Presumably to establish his credibility, Marshall assures us to no "leaning toward any of the developmental hypotheses of the origin of species." He too explains that if a brain was not properly preserved and removed from the skull it would be grossly distorted and look like the one of a chimpanzee in Owen's paper. The article includes an actual mounted photographic print of a dissection showing the posterior horn and the hippocampus minor. A drawing based on this photograph was later published by Huxley and is shown in figure 4.3.<sup>42</sup>

The last issue of the year included an article on the anatomy of primate muscles, particularly those of the orang-utan, by W. S. Church.<sup>43</sup> The general theme was that examination of the range of variation among humans, particularly in the "lower" or "wild" races, reveals a smaller gap between the myology of humans and apes than noted by others, such as Owen. The author's dissections suggest that the chimpanzee and the gorilla "are able to point with their finger in the same manner as man."

Owen answered Huxley at a Royal Institution lecture reported in the *Athenaeum*, with a circulation of about 15,000, as compared with the *Review's* of about 1,000. Owen repeated his claim of the three structures specific to man, but hedged a little by saying that apes do not have a hippocampus minor "as defined in human anatomy." The accompanying brain illustrations were entitled "section of a Negro's brain" and "section of animal's brain." Both were otherwise unlabeled and their details unrecognizable and inaccurate. The next week Huxley wrote in to ridicule the inaccurate and unlabeled figures and to





excoriate the reporter for failing to mention the numerous previous scientists who reported that the three critical structures were found in animals, since:

doubtless Prof. Owen, following the course which would be taken by most men of science . . . allowed full weight to the affirmations of these eminent persons . . . and pointed out how they had been so misled as to describe . . . and figure . . . structures which have no existence.

In the following issue Owen blamed "the Artist" for the poor figures, but attested to the accuracy of the account otherwise. For a more accurate figure he referred the reader to his original paper, that is, to the distorted figure lifted from Schroeder van der Kolk and Vrolik.<sup>44</sup>

Owen's next detailed answer came in the *Annals and Magazine of Natural History* (circulation about 2,000). He republished both the Dutch chimpanzee figure (in spite of the comments of Gratiolet, Marshall, and Huxley) and Tiedemann's human brain figure that had been in his original paper, but he added drawings of the lateral ventricle in both species. The chimpanzee's ventricle had no hippocampus minor labeled on it, and Owen failed to mention that its source indicated one existed in this species. This time he cited the sources of his figures and pointed out that neither the Dutch nor German workers could have been influenced by their views on evolution since both had published before the *Origin* and even before *Vestiges*. He ended the paper by simply restating his three original claims for a difference between the brains of humans and all other creatures.<sup>45</sup>

Figure 4.3 "Drawings of the cerebral hemispheres of a Man and of a Chimpanzee of the same length, in order to show the relative proportions of the parts: the former taken from a specimen, which Mr. Flower, Conservator of the Museum of the Royal College of Surgeons, was good enough to dissect for me; the latter, from the photograph in Mr. Marshall's paper (Marshall, 1861) . . . a, posterior lobe; b, lateral ventricle; c, posterior cornu; x, the hippocampus minor" (Huxley, 1863).

Later that year Huxley weighed in with his own empirical paper "On the Brain of *Ateles paniscus*," the South American spider monkey, in the *Proceedings of the Zoological Society*. As with the other primate anatomy papers spurred by the controversy, the emphasis was on refuting Owen's three points, particularly on the hippocampus minor. The paper contained a set of carefully drawn human and simian coronal brain sections, as well as a horizontal dissection of the lateral ventricle, all designed to show prominently the hippocampus minor. In the course of his detailed study of this structure, Huxley corrected a major error in previous descriptions of human and other primate brains and effected a lasting change in sulcal terminology.

Before him, the major sulcus on the medial surface of the hemisphere was termed the hippocampal fissure and was supposed to extend from the corpus callosum to almost the posterior pole. In the course of studying sections through the hippocampus minor, Huxley realized that this hippocampal fissure consisted of two separate sulci, a posterior and anterior one. The indentation of the posterior one into the lateral ventricle formed the hippocampus minor, so he named it the calcarine sulcus after *calcar avis*. He named the anterior part the dentate sulcus, since it corresponded to the fascia dentata. "Calcarine sulcus," of course, entered into the permanent canon, but the term hippocampal fissure or sulcus was maintained for the anterior part (except by Huxley's followers), perhaps because the term dentate gyrus was already widespread.<sup>46</sup>

Huxley had only begun his campaign. In 1862 the onslaught against Owen spread to that most prestigious venue of them all, the *Philosophical Transactions of the Royal Society*. There another protégé of Huxley's, William Henry Flower, later Sir, after stating that he had no views on transmutation or the origin of man, proceeded to refute Owen's human-ape distinctions. He provided a detailed review of the earlier literature and then carefully presented the results of his own dissections of sixteen different primate species, including the orang-utan, several species of Old and New World monkeys, and several prosimians. Flower not only found a hippocampus minor in all these primates, but went on to claim that the hippocampus minor is largest in proportion to the mass of cerebral substance in the marmoset, next in monkeys, then apes,

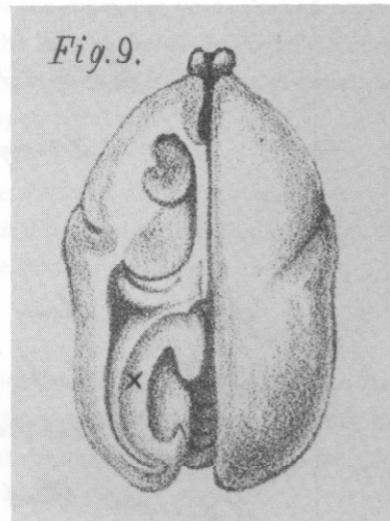
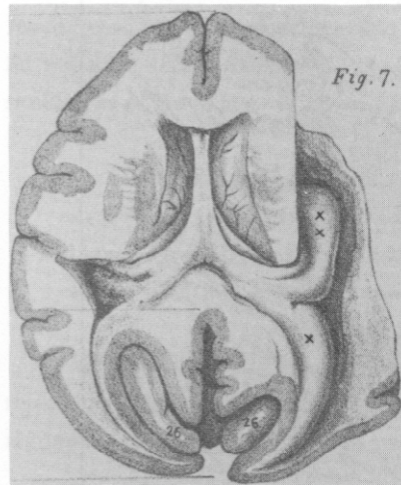


Figure 4.4 Horizontal views of the cerebrum of a vervet (left) and a marmoset (right). "On the right side [of the vervet] the middle and posterior cornu are completely opened, so as to exhibit the relative size and situation of the two hippocampi. In exposing the hippocampus minor to this extent, the limits of the cornu . . . have not been exceeded; but as the walls are more or less adherent this must be regarded partly as a dissection. On the left side the walls of the cornu remain undisturbed, part of the brain only having been cut away to expose the commencement of the hippocampus major . . ." x, hippocampus major; xx, hippocampus minor (Flower, 1862).

and least in humans. Drawings of two of his dissections are shown in figure 4.4; the hippocampus minor in both, particularly the marmoset, certainly appears prominent, if not rather exaggerated.

In addition to his being a close friend of Flower, Huxley's hand in the paper is shown explicitly in two ways. First, the nomenclature that Flower used included terms just introduced by Huxley. Second, Huxley was one of the anonymous reviewers for Flower's paper and commented in his review "this important paper should be published" (figure 4.5). The other reviewer was John Marshall, another member of Huxley's anti-Owen team of neuroanatomists.<sup>47</sup>



1862.  
 The High School of <sup>Homes</sup>  
 Lower  
 Wm. & ~~Wm.~~ 41 1862  
 by  
 Huxley

Before making my Report upon  
 Mr. Homes paper "On the position  
 of the cerebrum in the Quadrumina"  
 it is right that I should state  
 that the question therein  
 discussed has been the subject  
 of controversy: that I have taken  
 an active part in that  
 controversy: & that Mr. Homes  
 memoir contains a complete  
 confirmation of the statements  
 I have made

♦ ♦ ♦  
 Thomas H. Huxley

Huxley continued the campaign in the following year's *Natural History Review* with a long unsigned review of the leading French zoologist Geoffroy St. Hillaire's 1856 *Histoire Naturelle Generale*, quoting St. Hillaire at length on similarities of the brains of humans and apes, particularly<sup>48</sup>:

for those of our readers who have followed the controversy respecting the brains of Apes and Man if that can be dignified by the name of a controversy where all the facts are on one side and mere empty assertion on the other.

When Schroeder van der Kolk and Vrolik discovered that Owen had repeatedly used the chimpanzee figure from their 1849 paper to justify his arguments they "resolved . . . to prevent the public from being misled." An

Figure 4.5 The beginning of Huxley's referee report on Flower's paper (1962), submitted to *Philosophical Transactions of the Royal Society*, which took Huxley's side in the controversy. The entire report (RR 4.97, Royal Society Archives) is as follows: "The Gov. School of Mines, Jernyn St. August 4, 1862. Before making my report upon Mr. Flower's paper 'On the posterior lobe of the cerebrum in the Quadrumana', it is right that I should state that the questions therein discussed have been the subjects of controversy: that I have taken an active part in that controversy: that Mr. Flower's memoir contains a complete confirmation of the statements I have made. This much premised in order that the Committee of Papers may form their own judgement as to the extent to which my opinion is likely to be prejudiced, I may say, that both as regards manner and matter, Mr. Flower's memoir appears to me to be eminently worthy of a place in the *Philosophical Transactions*. Wisely avoiding even the appearance of entering into controversial discussions Mr. Flower has detailed with much clearness & precision of expression, a number of careful dissections—most of which have been made upon animals whose brains we possess, at present no sufficient account. The results of Mr. Flower's dissections of the Lemurine brains more particularly, are quite new & of very great importance. If it can be done without inconvenience I should recommend in the plates all the brains be drawn to the same absolute underlying length, as the variation in proportions become in this way far more obvious—Furthermore, as M. Gratiolet has already maintained the view that the Lemurs form a distinct subspecies—a reference should be added to this effect—to that part of Mr. Flower's paper which deals with this question. [signed] Thomas H. Huxley."

orang-utan had just died in the Amsterdam Zoo, so they dissected its brain. They reported at an 1862 meeting of the Dutch Royal Academy of Science that, in fact, this animal had an extensive posterior lobe covering the cerebellum as well as a posterior horn and a hippocampus minor. The attending audience, they wrote, recognized all three structures. The authors admitted the inadequacy of their original figure due to the way they had removed the brain from the cranium, and they disavowed any position on transmutation, but suggested that Owen had “gotten lost” and “fell into a trap” by his desire to combat Darwin. Huxley promptly reprinted the entire article, still in French, in his *Review*.<sup>49</sup>

That year and the next, the confrontations between Owen and Huxley continued in person and in print. For example, when Owen defended his position at the 1862 British Association meeting in Cambridge, his talk was reported in detail in the *Medical Times and Gazette* along with objections by Huxley and by his allies Rolleston and Flower, followed by Owen’s rebuttal.<sup>50</sup> The next two issues contained further rounds between the combatants.

#### THE HIPPOCAMPUS MINOR GOES POP

While Owen and Huxley were fighting at meetings and in the scientific journals, the popular press was featuring and, usually, satirizing the hippocampus minor debate. One example is the anonymous poem from *Punch* shown in figure 4.6. It was written by Sir Philip Egerton, a paleontologist and member of parliament. After accurately epitomizing *Vestiges*, Darwin, and some recent archeological discoveries, the author focused in on Huxley and Owen’s contest. In that year alone *Punch* had about a half dozen satirical pieces about the debate or its participants (figure 4.7).

Both Owen and Huxley and the hippocampus minor were featured in Charles Kingsley’s children’s fantasy *Water Babies*, originally published in 1863 and still in print and a favorite in Britain (see figure 4.1). At one point its child protagonist is puzzled at the strange things that are said at British Association

## MONKEYANA.



Am I satyr or man?  
Pray tell me who can,  
And settle my place in the scale.  
A man in ape's shape,  
An anthropoid ape,  
Or monkey deprived of his tail?

The *Vestiges* taught, "  
That all came from naught  
By "development," so called, "progressive;"  
That insects and worms  
Assume higher forms  
By modification excessive.

Then DARWIN set forth.  
In a book of much worth,  
The importance of "Nature's selection;"  
How the struggle for life  
Is a laudable strife,  
And results in "specific distinction."

Then HUXLEY and OWEN,  
With rivalry glowing,  
With pen and ink rush to the scratch;  
'Tis Brain *versus* Brain,  
Till one of them's slain;  
By Jove! it will be a good match!

Says OWEN, you can see  
The brain of Chimpanzee  
Is always exceedingly small,  
With the hindermost "horn"  
Of extremity shorn,  
And no "Hippocampus" at all.

The Professor then tells 'em  
That man's "cerebellum,"  
From a vertical point you can't see;  
That each "convolution"  
Contains a solution,  
Of "Archencephalic" degree.

Then apes have no nose,  
And thumbs for great toes,  
And a pelvis both narrow and slight;  
They can't stand upright,  
Unless to show fight,  
With "Du CHAILLU," that chivalrous knight!

Next HUXLEY replies, "  
That OWEN he lies,  
And garbles his Latin quotation;  
That his facts are not new,  
His mistakes not a few,  
Detrimental to his reputation.

"To twice slay the slain,"  
By dint of the Brain,  
(Thus HUXLEY concludes his review)  
Is but labour in vain,  
Unproductive of gain,  
And so I shall bid you "Adieu!"

Zoological Gardens, May, 1861.

GORILLA

Figure 4.6 Part of a page from *Punch*, May 18, 1861. Several additional stanzas dealing with recent archeological discoveries are not shown. "Gorilla" here is the pseudonym for Sir Philip Egerton.



meetings. He had thought that the differences between him and an ape were such things as:

being able to speak, and make machines, and know right from wrong, and say your prayers . . . rather than having . . . a hippopotamus major in your brain. He understands that . . . if a hippopotamus major is ever discovered in one single ape's brain, nothing will save your great-great-great-great-great-great-great-great-great-greater-greatest-grandmother from having been an ape too.

In an anonymous and well-informed eight-page squib entitled "A Report of a Sad Case Recently Tried before the Lord Mayor, Owen versus Huxley . . ." (figure 4.8), Owen and Huxley are dragged into court for brawling in the streets and disturbing the peace. The fight continues in court with much shouting of "posterior cornu," "hippocampus minor," and so on, as

*Huxley:* Well, as I was saying, Owen and me is in the same trade; and we both cuts up monkeys, and I finds something in the brains of them. Hallo! says I, here's a hippocampus. No, there ain't says Owen. Look here says I. I can't see it he says and he sets to werriting and haggling about it, and goes and tells everybody, as what I finds ain't there, and what he finds is . . .

At the end of the trial, the Lord Mayor declines to punish either because "no punishment could reform offenders so incorrigible." He does suggest to Owen that rather than being bitter at being compared with an ape he might act less like one and more like a man. He suggests to Huxley that he is less interested in the truth than in destroying his rival.

Another anonymous pamphlet that year, entitled "Speech of Lord Dundreary . . . on the Great Hippocampus Questions," was also by Kingsley. The authors of these parodies not only knew every detail of the controversy but the personalities of the combatants and their friends intimately.

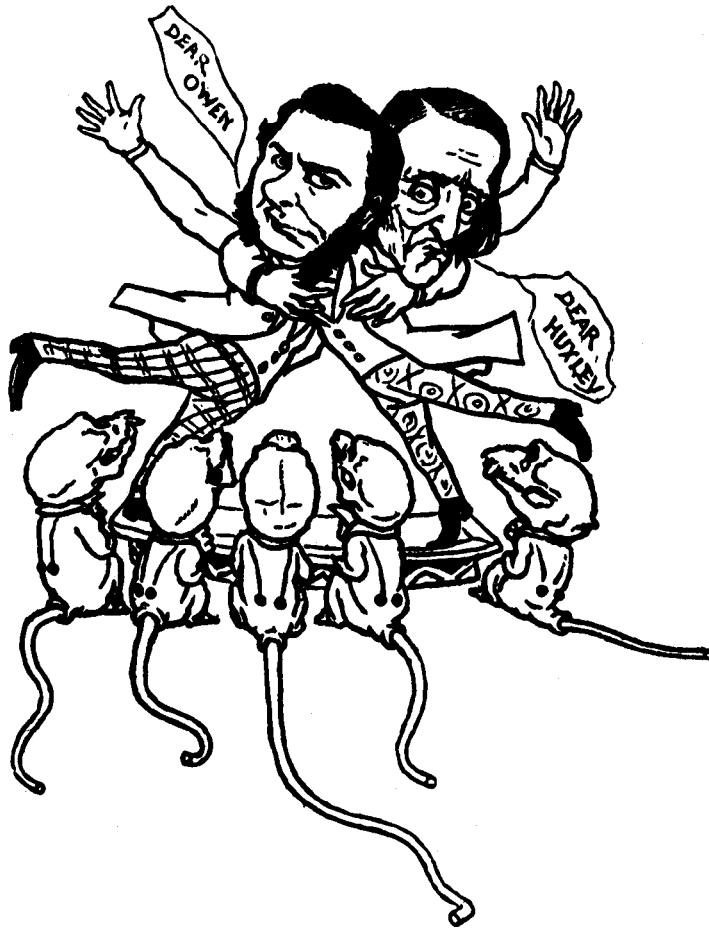


Figure 4.7 Owen and Huxley dancing a jig before the 1865 British Association Meeting. *Punch*, Sept. 23, 1865.

# A Report

or

## A SAD CASE,

Recently tried before the Lord Mayor,

## OWEN *versus* HUXLEY,

*In which will be found fully given the*

*Merits of the great Recent*

## BONE CASE

---

LONDON.

1863.

G

*EVIDENCE AS TO MAN'S PLACE IN NATURE*

The School of Mines, Huxley's principal appointment for most of his life, sponsored an evening series of lectures for working men ("vouched for by their employers," although Karl Marx managed to attend). Huxley participated with great enthusiasm, writing that the working men:

are as attentive and intelligent as the best audience I ever lectured to. In fact they *are* the best audience I ever had . . . I am sick of the dilettante middle classes.

As early as 1860 he began to devote these lectures to evolution and particularly to the evolution of man, a topic that Darwin avoided in public for another twenty years. On March 22, 1861, he wrote to his wife, "My working men stick by me wonderfully, the house being fuller than ever last night. By next Friday evening they will all be convinced that they are monkeys . . ." <sup>51</sup> Soon Huxley expanded these lectures into a book telling Sir Charles Lyell,

I mean to give the whole history of the [Owen] business . . . so that the paraphrase of Sir Ph. Egerton's line "To which Huxley replies that Owen he lies," shall be unmistakable. [See figure 4.6.]

The book, designed for a lay audience, was *Evidence as to Man's Place in Nature*. Darwin loved it, exclaiming: "Hurrah the monkey book has come." It was enormously successful, selling out at once and quickly going through several more printings. <sup>52</sup>

The first part, "On the Natural History of the Man-like Apes," is largely a review of travelers' accounts of various apes, stressing their humanlike intel-

Figure 4.8 Title page of an eight-page squib anonymously published and written by G. Pycroft. In it Owen and Huxley are dragged into court for brawling in the streets over the hippocampus minor and related matters.

ligence, emotions, and social life. It thus lays the basis for Darwin and Romanes's florid anthropomorphizing in defense of psychological continuity between humans and animals. When this tendency to attribute high mental functions to animals was reduced by C. Lloyd Morgan's law of parsimony, Occam's razor for students of animal behavior, this continuity argument became the basis of modern behavioristic psychology.<sup>53</sup>

The second part, "On the Relations of Man to the Lower Animals," is the heart of the book. It begins with arguments from embryology and cell theory for the fundamental unity of all animals, including, of course, humans. Then the bones, skull, and teeth of humans and apes are discussed, with the conclusion that "the lower Apes and the Gorilla . . . differ more than the Gorilla and the Man." Next, and it almost seems like the *raison d'être* for the whole book, we come to an account of the fundamental similarity of the brain of apes and humans, particularly the possession by both of a posterior lobe, a posterior horn, and a hippocampus minor. The account is a twelve-page, step-by-step argument, but perhaps it had to be since the audience addressed had never heard of a brain ventricle, let alone the hippocampus minor. At the end of the chapter, Huxley points out that the close similarity of human and ape that he has just demonstrated proves the validity of Linnaeus's original Primate order, and ends by stating, in a rather offhand manner, that Darwin's theory provides an explanation of the origin of man from ape.

Interposed between the second and third parts are six pages of fine print providing, "a succinct History of the Controversy respecting the Cerebral Structure of Man and the Apes," that is, how Owen "suppressed" and denied the truth about the hippocampus minor, posterior horn, and posterior lobe, and how this was now a matter of "personal veracity." The final portion of *Man's Place*, "On Some Fossil Remains of Man," deals with the evidence for a fossil link between ape and human, which Huxley admitted was very meager indeed.

At the time, judging by a sample of the reviews, Huxley's book was regarded chiefly as a polemic against Owen, favorably by Huxley's partisans who were in the majority by now, and unfavorably by Owen's allies. Darwin, natural selection, and even evolution, as distinct from the human's systematic

status, are not major issues in these reviews and indeed they are not major concerns in the book. Probably the most influential evaluation was that of Sir Charles Lyell, Britain's leading geologist and one of its most eminent scientists. Through nine editions his *Principles of Geology* rejected the idea of evolution. Now in *Antiquity of Man* he evenhandedly discussed the pros and cons of Darwin's theory, disappointing Darwin, but actually moving a very long way closer to him. He also reviewed the hippocampus minor debate in detail. Lyell came down totally and unambiguously on Huxley's side, which must have effectively ended the discussion in the scientific community.<sup>54</sup>

Owen, no surprise, attempted to refute Lyell and continued to defend his classification scheme against its critics. He even found a new support for the importance of the hippocampus minor: that it was absent, or virtually so, in an "idiot."<sup>55</sup>

Owen's final statements on the controversy are in *On the Anatomy of Vertebrates*. There his brain figures are accurate, and in a long footnote he finally admits, citing himself as well as the earlier literature, that in apes "all the homologous parts of the human cerebral organ exist." However, this admission, he believes, does not invalidate or even threaten his classification of man in a separate subclass because the critical structures, the posterior lobe, the posterior horn, and the hippocampus minor, exist in apes only "... under modified form and low grades of development." As to Huxley and his neuroanatomical allies, their attacks on his classificatory scheme were "puerile," "ridiculous," and "disgraceful."<sup>56</sup>

Owen's original aim was to define the uniqueness of humankind, to find an objective way of differentiating humans from animals that was (a) qualitative and not merely quantitative, (b) solidly grounded in anatomical science rather than theology or speculation, and (c) based on the brain, the origin of the most striking differences between humans and animals. His downfall was not this goal but his hubris in stubbornly defending his errors in trying to reach it. The tragedy was classic: Owen fell from the pinnacle of British science to be remembered, when at all, for his obstinate errors in this debate, rather than for his real contributions.

## THE SOURCES OF OWEN'S THREE CRITERIA

Where did Owen get his three benchmarks whose repudiation by Huxley destroyed his credibility as a critic of Darwin and evolution? One source for his idea that the posterior extent of the cerebrum in humans was a powerful indicator of their elevated taxonomic status was probably a figure in Fletcher's *Rudiments of Physiology*. This figure shows a series of dorsal views of the brain, drawn to the same size, starting with cuttlefish [sic], then eel, turtle, bird, marmot, and "up" through otter, to orang-utan, to the human.<sup>57</sup> A line is drawn at the posterior border of the cerebrum (or its supposed homolog) to show that moving "upward" in the animal scale the cerebrum moves posteriorly until, in the human, it covers the rest of the brain, the cerebellum being the last structure to disappear from view. Fletcher's idea of these systematic changes correlating with increasing complexity was used by Chambers as a major argument for evolution in *Vestiges* and therefore must have been well known to Owen, at least through this source (Owen had originally been quite sympathetic to *Vestiges*<sup>58</sup>). As mentioned previously, this idea that the cerebellum was exposed even in the highest nonhuman primates was supported by published drawings of "distorted" ape brains.<sup>59</sup>

Owen's choice of structures in the lateral ventricles for his other two ways of distinguishing humans and animals appears to be a persistence of the importance Galen gave the ventricles centuries earlier. The ventricles played a central role in his physiological system, a set of theoretical views that dominated Western medicine for over 1,400 years and was influential into the nineteenth century. Galen thought the ventricles were the primary site of production of psychic pneuma, which he believed was a critical mediator of cerebral function and the medium of transmission in sensory and motor nerves. The early church fathers, particularly Nemesius, Bishop of Emesia (fourth century), radically altered Galen's conceptions of the structure and function of the ventricles, transforming the ventricles into three more "perfect" spheres. Galen had localized sensory and motor functions in the solid portions of the cerebrum, the former anteriorly and the latter posteriorly. The church fathers, however, were

looking for a less mundane site for the interaction of the body and soul and chose for this purpose the "empty" spaces in the brain that Galen described, the ventricles. They then took the Aristotelian faculties of the mind, sensation, cognition, and memory, and located them in the anterior, middle, and posterior ventricles, respectively (see figure 1.7). Drawings of this ventricular localization of mental function hardly changed for over a thousand years except for the expressions on the faces.

When systematic brain dissection began again in the Renaissance the brains were usually dissected from the top down, often in situ. The ventricles were carefully depicted and labeled because of their importance in Galenic theory. The most famous of these early horizontal dissections was that of Vesalius in his revolutionary work, *On the Fabric of the Human Body*, published in 1543 (see figure 1.10). Horizontal views in which the ventricular features are prominent continued to be a common way of depicting the internal structure of the human brain into the nineteenth century (see figure 1.15). Thus, ventricular structures were carefully depicted and named, whereas the cortex was often drawn in a schematic fashion, since, until Gall and phrenology, it was usually thought to be unimportant. The theoretical importance of the ventricles persisted presumably because no better theory of brain function emerged, and better theories, not better facts, are required to overturn a theory. Given this tradition it is not all that surprising that Owen, looking for important and "higher" parts of the human brain, looked into the ventricles. See chapter 1 for further discussion of ventricular theory.

#### MAN'S PLACE IN NATURE IN HISTORY

A second edition of Huxley's *Man's Place in Nature* was published in 1896. A number of things had changed since the first edition. The general idea of evolution, including that of humans, was now accepted by most of the scientific community. Darwin's *The Descent of Man* had been published offering detailed mechanisms for the evolution of the human body, mind, and morals. It contained an appendix by Huxley on the similarities and differences between



human and ape brains. The hippocampus minor is mentioned only in passing, but never Owen. Sir Richard had died in 1892 and in the ultimate confirmation of the saying, "history is written by the victors," his grandson asked Huxley for an account of Owen's "Position in the History of Anatomical Science" to include in the book he was writing on the life of Owen.<sup>60</sup> Huxley gave him sixty pages that did not refer to any of their bitter disputes and were full of phrases such as "unabated industry," "wide knowledge," "great service," "splendid record," and "sagacious interpretations." By this time Huxley was the Right Honorable (a privy counselor) and had been president of the Royal, Ethnological, Geological, and Palaeontographical Societies, the British Association, and the National Association of Science Teachers, as well as university president and dean.

More generally, the social and political scene had changed. The Reform Act of 1867 giving the urban working class the vote eliminated the threat of revolution, or perhaps the decline of this threat made the Act possible, and the end of religious tests had opened the doors of Oxford and Cambridge to dissenters and Jews as students and faculty. Both developments tended to reduce the political charge of evolutionary ideas. The dominance of the Oxbridge clergyman-naturalist had given way to that of the professional scientist of which Huxley was the archetype. As much as personality clashes or scientific differences, the conflict between Owen and Huxley represented this transfer of power. Although they came from similar middle-class, nonuniversity backgrounds, Owen early attached himself to the medical, religious, and political establishment. In contrast, Huxley fought to professionalize science and free it from the dominance of clergy and gentry, although he carefully kept his distance from the political radicals of the time.<sup>61</sup> In defeating Owen and his backers, Huxley and his friends had become the Establishment, and in doing so, the hippocampus minor was Huxley's most successful weapon.

The new edition of *Man's Place* reflected changes in the status of evolutionary theory and of Huxley himself. The title had become more assertive, dropping "Evidence as to" and becoming simply *Man's Place in Nature*. The

section "Succinct History" of Owen's supposed perfidy was eliminated entirely and Owen hardly mentioned at all.

Today this book is usually viewed as a triumph of evolutionary thought rather than an attack on Owen or a defense of Linnaeus, and its relevance to the hippocampus minor has been totally lost. Huxley is admired for charging in where Darwin feared to tread for another eight years. Homer Smith, physiologist and historian of science, called it "the first . . . [and still] . . . definitive statement of the naturalistic interpretation [of man] . . .," Sir Arthur Keith, pioneering anthropologist, claimed it "laid the basis for a true science of anthropology" and "can only be compared to Harvey's *Movement of the Heart and Blood*." Ashley Montagu, in an introduction to a paperback edition, called it a "great classic of science" and "among the most inspiring."<sup>62</sup>

THE PLACE OF THE HIPPOCAMPUS MINOR IN MAN'S SEARCH  
FOR MEANING

Richard Owen identified the hippocampus minor and its associated structures as the touchstone of humanness. Other choices for this function from brain anatomy have included the size of the frontal lobes, brain laterality, and the position of the lunate sulcus. Perhaps the earliest was that of Herophilus, the Alexandrian anatomist in the second century BCE who attributed man's greater intelligence to his more complex cerebellum, or so Galen, in ridiculing this view, tells us.<sup>63</sup>

Thomas Huxley chose language in *Man's Place* as the criterion of humanity, and some of its contemporary reviewers pointed out that in doing so he was playing the same game he attacked when Owen played it.<sup>64</sup> Human language continues to be a popular candidate for a hippocampus minor, although whether the uniqueness of language lies in its unbounded vocabulary, infinite set of sentences of arbitrary size and complexity, ability to code distant time and place, self-reference, or ability to lie is unclear.

For his ordering of organisms, Linnaeus preferred sexual characteristics, at least for plants, and when he could get them, for animals (e.g., mammae).

Perhaps inspired by him, variety of coital positions, desire for privacy during intercourse, and orgasm in females have all been offered as distinguishing features of *Homo sapiens* (and counterindicated), as has the ratio of the size of the erect penis and of the female breasts to body weight.<sup>65</sup> DNA was a transient hope, but the difference between human and chimpanzee (about 1.6%) is rather anxiety provoking.

One basic human characteristic does seem to be the need to establish differences between ourselves and our closest relatives; for that purpose, the hippocampus minor may be as good a criterion as any other.<sup>66</sup>

## NOTES

1. Lamarck, 1809; Mayr, 1982; Desmond, 1989.
2. The fear and reality of persecution for unorthodox views in Victorian biology was virtually ignored until Gruber (1974) showed it to be the major cause of Darwin's delay in publishing. Gruber's insights may have been related to his own political persecution during the McCarthy era in the United States. Desmond and Moore (1992) also make fear of persecution an important theme in Darwin's life.
3. Chambers is treated in detail by Secord (1989), Desmond (1992), Ruse (1979), and Mayr (1982). The first (1844) edition of *Vestiges* was reprinted (1969) by Leicester University Press. Chambers published ten more editions, many of which were responsive to the detailed criticisms of his reviewers. The twelfth (1884) posthumous edition finally named its author, common knowledge by then.
4. Sedgwick, 1850. The quotations were found by Young (1970a), Mayr (1982), and Desmond (1992).
5. Huxley, 1854. Huxley later called this "the only review I ever had qualms of conscience about, on the grounds of needless savagery," (L. Huxley, 1900).
6. Disraeli, 1847.
7. Desmond, 1992; Young, 1970a, 1973.
8. Mayr, 1982; Darwin, 1909; Wallace, 1905; F. Darwin, 1887.
9. Ritvo, 1987.
10. Owen (1894). Upper crust social events are scattered throughout these two volumes by Owen's grandson, but there is very little about the course of Owen's rich scientific life and correspondence.

11. E.g., Owen, 1853, 1855.
12. Owen, 1858, 1859.
13. Indeed, as demonstrated by Gould (1981), their measurements of crania and brains tended to confirm their prior beliefs. An interesting exception was Wallace (1891), who stated in *Natural Selection* that the "brain of the lowest savage . . . is little inferior to that of the highest types of man"; and in *My Life*, (1905), "The more I see of uncivilized people, the better I think of human nature and the essential differences between civilized and savage men seem to disappear." Wallace's tolerant and relatively nonracist attitude may have been the result of having lived among Pacific Islanders for eight years and traveled under their care on long voyages over the open seas. In contrast, Darwin and Huxley made their observations about the primitive minds of the lower races largely from the decks of *H.M.S. Beagle* and *H.M.S. Rattlesnake*. Wallace's views of the full development of the brain and in some cases the moral sense among "savages" led him to reject totally natural selection as a basis for humans' intellectual and moral development (Wallace, 1891). He appealed to "some higher intelligence" as an alternative. The fact that such religious mysticism was now out of fashion, plus his involvement in various spiritualist activities such as table rapping, obscured Wallace's observations and insights of how cultural evolution was replacing biological evolution in the development of human civilization (Eiseley, 1961). Otherwise, perhaps a "social Wallacism" might have developed.
14. Gould, 1981; Tiedemann, 1836; Topinard, 1878. Schiebinger's (1993) detailed discussion of Baartman has a valuable set of references to the primary and secondary literature. The results of Cuvier's dissection of Baartman's genitals are in the Musee de l'Homme in Paris (Gould, 1982, a gem). Huxley (1861a) commented that she "had the honor of being anatomized by Cuvier."
15. Burkhardt and Smith, 1985, vol. VI.
16. Lewis, 1923; Meyer, 1971.
17. Kingsley, 1863.
18. See chapter 1; Young, 1970b.
19. The state of knowledge of the brain in the nineteenth century is dealt with in more detail in chapter 1; Young, 1970b; Boring, 1950.
20. Mitchell, 1901; L. Huxley, 1900; Desmond, 1984.
21. Letter to his friend and predecessor at the School of Mines, Edward Forbes (Desmond, 1984).
22. Letter to W. Macleay, an entomologist he had met in Sydney, describing the British scientific scene (L. Huxley, 1900; Desmond, 1984).

23. Bibby (1959) has a synoptic curriculum vitae of Huxley. Some of the scientific attacks: by Huxley on Owen, "Observations upon the Anatomy and Physiology of Salpa and Pyrosoma" (1851); "Contributions to the Anatomy of Brachiopoda" (1854–1855); "Lectures on General Natural History" (1856a); "Owen and R. Jones on Comparative Anatomy" (1856b); "Vestiges of the Natural History of Creation" (1854); and "On the Theory of the Vertebrate Skull" (1859). Owen's treatise was *The Archetype and Homologies of the Vertebrate Skeleton*, London (1848). For naturphilosophie and its influence on Owen, see Nordenskiöld (1928) and MacLeod (1965).
24. Owen, 1894.
25. Huxley's letter to the Medical Directory is quoted in DiGregorio (1984); Huxley's letter to a friend (F. Dyster) is quoted in Desmond (1984). The record seems to show that Owen was appointed lecturer at the School of Mines for these lectures; and Huxley's title there was also lecturer, not professor. Both individuals at the time probably considered they were entitled to call themselves professor since Owen had just held a chair at the Royal College of Surgeons and Huxley had a temporary one at the Royal Institute.
26. The X Club was a dining club of Huxley and about eight of his friends devoted to "science, pure and free, untrammelled by religious dogma." It included botanist J. D. Hooker, physicist J. Tyndall, ethologist J. Lubbock, and philosopher Herbert Spencer. It gradually accrued enormous power in British science. Its influence ranged from membership, medals, and offices in the Royal Society and on journal editorial boards to the standards for science teachers and school science curricula. See Barton (1990), Desmond (1984), and Jensen (1991) including its rich notes.
27. Burkhardt and Smith, 1985, vol. VII; L. Huxley, 1900; Mayr, 1982; Ruse, 1979.
28. L. Huxley, 1900; Ellegard, 1958; F. Darwin, 1887.
29. *Athenaeum*, July 7, 1860; L. Huxley, 1900.
30. L. Huxley, 1900.
31. *Athenaeum*, July 14, 1860; L. Huxley, 1900; F. Darwin, 1887, 1903; Jensen, 1991 who provides the sources for all the contemporary or quasi-contemporary quotations cited here; see also Gould (1986). Comparison with Waterloo is Moore's (1979); "murder and martyrdom" is Irvine's (1955).
32. Both were Huxley's self-descriptions (L. Huxley, 1900).
33. Huxley, 1896; L. Huxley, 1900; Desmond, 1984. Characteristically, Darwin told Huxley that the *Review* was a waste of time and he should get on with his own original research instead (F. Darwin, 1903).

34. Huxley, 1861a; Desmond, 1984.
35. Owen, 1835.
36. Tiedemann, 1821, 1827, 1836.
37. Schroeder van der Kolk and Vrolik (1849).
38. Tiedemann, 1821, 1827, 1836.
39. Blinderman, 1957.
40. F. Darwin, 1903.
41. Rolleston, 1861; L. Huxley, 1900.
42. Marshall, 1861; Huxley, 1863.
43. Church, 1861.
44. These exchanges are in the *Athenaeum* between Mar. 23, 1861 and Apr. 13, 1861. The circulation figures are from Ellegard (1958).
45. Owen, 1861.
46. Huxley, 1861b; Meyer, 1971.
47. Flower, 1862. The reviews are available in the *Archives of the Royal Society*, RR.96-7 (Huxley's reviews) and RR.4.95,98 (Marshall's reviews).
48. [Huxley], 1862.
49. Lyell, 1863; Schroeder van der Kolk and Vrolik, 1862.
50. October 11, 1962.
51. Bibby, 1959; L. Huxley, 1900.
52. L. Huxley, 1900; F. Darwin, 1903; Blinderman, 1971; Desmond and Moore, 1992.
53. Darwin, 1871; Romanes, 1882; Morgan, 1894; Boring, 1950; Boakes, 1984.
54. Blake, 1863; DiGregorio, 1984; Lyell, 1863; F. Darwin, 1903.
55. Owen, 1863a, b.
56. Owen, 1866.
57. Fletcher, 1835; Secord, 1989.
58. MacLeod, 1965; Richards, 1987.
59. Schroeder van der Kolk and Vrolik, 1849; Tiedemann, 1836.
60. Owen, 1894.
61. Desmond, 1984.
62. Smith, 1955; Keith, 1925; Montagu, 1959.
63. Galen, 1968.
64. E.g., [Anonymous], 1863.
65. Diamond, 1992.

#### CHAPTER 4

66. The Darwin industry grinds on. Since this chapter was written, three major biographies of the principals have appeared: Brown (1995) on Darwin, Desmond (1994) on Huxley, and Rupke (1994) on Owen. Rupke's sympathetic treatment of Owen maintains that Owen's desire for a Natural History museum over the opposition of Huxley was a major source of their quarrels about evolution.