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Introduction

An Age of Transition

May you live in interesting times.

—Ancient Chinese curse

THE VICTORIAN ERA was indeed an interesting time, a time of stark contrasts. It was a time of hope and dismay, of great optimism coupled with anxiety, doubt, and fear. It has been called the “age of science” because of outstanding discoveries in a variety of different fields.¹ The theory of electromagnetism continued the grand unification of the physical sciences, building on the spectacular successes of the scientific revolution. Developments in natural history, geology, embryology, and taxonomy meant that in crafting his theory Charles Darwin could draw on a wealth of information that was unavailable to his predecessors. Victorians packed the lecture hall of the Royal Institute to hear lectures by Michael Faraday on electricity and magnetism and watched Humphrey Davy as he poured water into a model volcano filled with potassium. They listened attentively to John Tyndall’s arguments against the possibility of spontaneous generation from inorganic matter. The enthusiasm they showed for Thomas Huxley’s lectures on man’s relationships to the lower animals caused him to quip to his wife, “By next Friday evening they will all be convinced that they are monkeys.”² The age of science was also a time of unprecedented growth in the marginal sciences. Large numbers of Victorians experienced mesmeric

trances, attended séances, and obtained phrenological evaluations of their character. Rather than the age of science, perhaps the Victorian period should be called the “age of contradictions,” as countless numbers of Victorians became absolutely convinced of the reality of spiritual phenomena. However, these different interests are not contradictory. Rather, they reflect Victorians’ hope that scientific advancements would make it possible to understand the human psyche, which in turn would allow them to come to terms with a rapidly changing society.

Victorian intellectuals themselves characterized the period as the “age of transition.” For the first time in history, a population thought of their own time as an era of change *from* the past *to* the future.³ Beginning in 1832, a series of reform bills were passed that would change the structure of British society, breaking down the rigid social hierarchy that doomed people to remain in the class they were born to. This breakdown of the old conception of status was not due primarily to ideas of democracy, but rather was economically driven. The development of commerce provided many new careers, allowing men to leave the land, dissolving the feudal hold wealthy landowners had on society.

Developments in science and technology fueled the industrial revolution, totally transforming the economic life of England. Instead of a strict system of fixed regulations determined by the rigid social hierarchy, we see the emergence of a *laissez-faire* capitalism. Many people believed that unbridled competition would weed out the less fit and lead to an overall improvement of society. Such ideas provided the backdrop to Charles Darwin’s developing theory that in nature the constant struggle for existence resulted in selection of the most fit. As Herbert Spencer wrote, economic competition resulted in the “survival of the fittest” and Darwin adopted the phrase, realizing that a parallel process was also going on in nature.⁴

Such a dynamic society offered men the possibility of success both financially and socially that never before had existed for members of the middle and lower classes. However, progress did not come without a price. Throughout the Victorian period economic cycles of booms and busts occurred, resulting in large numbers of working-class people periodically meeting and agitating. Expanding business, developments in science, and the growth of democracy were sources of distress as well as satisfaction. From our perspective today, growth in democracy certainly seems like an unbridled good, but for many Victorians, fear of revolution went hand in hand with the idea of democracy. Across the channel, the French were recovering from the excesses of the French Revolution. The spread of both political and radical religious propaganda among the working classes suggested that Britain was not immune to the possibility of revolution.

The Victorian era was an exciting time filled with opportunities—opportunities that were not confined to political and economic spheres. Issues that had supposedly been settled for centuries were now open to vigorous debate. Religious beliefs, ethical theory, and human nature were all topics subjected to critical discussion and scrutiny. Was there a God or not? If so, was he a person or an impersonal force, or an indifferent force? Was there a heaven or hell, both or neither? If there was a true religion, was it theism or Christianity, and within Christianity—Catholicism or Protestantism? Did we have freewill or were we human automatons, and if we had the power of moral choice, what was its basis? Was it a God-given voice of conscience or was it the product of a rational calculating mind that decides what course of action will provide the greatest happiness for the greatest number of people? Was a human being just a more intelligent version of an ape? Public lectures, numerous societies, inexpensive editions of books, periodicals, newspapers, and pamphlets all provided forums for debate and meant that such discussions were not just confined to the intellectual elite. In such an environment of competing theories and beliefs not only were specific doubts raised about particular issues, but also the habit of doubt itself was unconsciously bred. This climate of uncertainty created a vague uneasy feeling, as individuals no longer felt secure in their own beliefs, and this in turn fueled the growth of the marginal sciences. Thus, the marginal sciences provide an important window into Victorian society. More significant for my purposes, they also demonstrate that the boundary between science, marginal science, and nonscience continually shifts as a variety of interrelated but distinct factors come into play. Each of the case studies examines the intersection between a specific body of developing scientific knowledge and the larger society revealing a complex intimate relationship between the two.⁵

In chapter 2, the story of the sea serpent shows that the line between fact and fantasy is not as clear as many scientists would have us believe. The discovery of fossil plesiosaurs and ichthyosaurs not only suggested a scientific basis for the sea monsters of ancient myth and legend, but also made plausible the possibility that the ancient creatures had survived to the present. Debates over the existence of sea serpents could be found in popular magazines as well as respected scientific journals. However, the sea serpent became a locus for boundary disputes as geology and paleontology struggled for scientific legitimacy. If the sea serpent were to be taken seriously, then its existence would have to be compatible with the prevailing views of earth history. But these views were in flux as a result of recent fossil finds and the serpent's existence or nonexistence was used to promote a particular point of view of earth history.

Yet sea serpent investigations remained marginalized for numerous reasons. One way that the emerging class of professional paleontologists

and geologists could gain scientific authority was by making distinctions between amateurs and professionals. Amateurs made most of the serpent sightings, but the distinction between who was a professional and who was an amateur concerning matters of natural history was in part what was being contested. Another important aspect of the serpent story was defining what counted as evidence. The serpent literature reflected the language of the courts, drawing on eyewitness accounts and affidavits. In codifying what was regarded as scientific proof, sightings must eventually be backed up by actual specimens, which were never found. The collecting, marketing, and exhibiting of fossils played a critical role in both the popularization and professionalization of geology.⁶ Furthermore, the existence of a relic surviving from the distant past became more and more untenable as a consensus view emerged concerning the history of life. The story of the sea serpent also illustrates that science has been as successful as it has by choosing carefully what questions it will investigate. Geologists and paleontologists decided it was not worthwhile to use their time and limited financial resources to search for a creature that might not even exist when a wealth of existing fossil and stratigraphical data awaited interpretation.

Chapter 3 examines the rise and fall of phrenology, continuing an exploration of many of the same issues that were raised in chapter 2. However, the history of phrenology is far more complex. Rather than revolving around essentially one scientific fact or theory: the existence of sea serpents, phrenology entailed an entire body of knowledge concerning the nature of mind and brain and the application of that knowledge. In addition, class, religion, and the threat of materialism played a significant role in how phrenology was received.

Franz Gall argued that the brain was the organ of the mind and should be studied accordingly. The investigation of mind had been the province of philosophers who claimed that the only way to understand the mind was through introspection. Gall challenged that assumption, pioneering techniques in neuroanatomy that have been invaluable. His naturalistic approach contributed to the separation of psychology from philosophy and paved the way for an evolutionary approach to the study of mind and behavior.⁷ The phrenological connection to evolutionary theory again illustrates the blurring of boundaries between science and marginal science and the problematic nature of collecting and interpreting evidence.

Today, the importance of Darwin's ideas to biology and psychology remains central, but phrenology is regarded as pseudoscience. Gall at best receives sparse acknowledgment in histories of neurology and psychology. Yet Darwin's theory was relatively quickly accepted in part because Victorians had been exposed much earlier to the general idea of evolutionary change, and specifically to many ideas about the evolution of mind and behavior with the anonymous publication of *Vestiges of the Natural*

History of Creation in 1844.⁸ Passages in Darwin's *The Descent of Man and Selection in Relation to Sex* show a striking similarity to those in *Vestiges*, in which the author Robert Chambers explicitly acknowledged his debt to Gall and phrenological doctrine.⁹ Darwin used virtually the same kinds of evidence as Gall to show that humans were not an exception to his theory. Yet phrenology had a very different fate than evolution, as both of them become inextricably intertwined with the philosophical, religious, political, social, and scientific debates of the time.

One of the most striking aspects of the intellectual history of the nineteenth century was a faith that science could solve virtually all problems. Such an idea had been suggested in the Enlightenment, but never had much of a following. Victorians had great hope that the scientific assumptions and methodology that had been so spectacularly successful in the physical sciences could now be extended to the biological world including the lives of humans. The actions of human beings, like all other natural events, were subject to invariable laws that could be discovered. Advances in medicine would bring an end to physical suffering. Developments in technology promised to bring an end to poverty. The new science of sociology might even eliminate moral evil. Phrenology promised to be a truly scientific explanation of the mind, and with that offered the possibility of improving oneself, and therefore society.

Young physicians quickly recognized the potential of phrenology for increasing their prestige and authority and were the leaders of the phrenological movement in its early days. However, the old guard of the medical establishment along with the philosophers were not about to give up their authority easily and did everything they could to discredit it. But it would be wrong to conclude that phrenology never succeeded in becoming part of the scientific mainstream because of political maneuvering on the part of the university and medical establishment. Although Gall's basic premises were praised, the evidence for his theory of cerebral localization was torn to shreds. The advocates of phrenology were not interested in doing detailed anatomical work to further Gall's basic ideas and by the second half of the nineteenth century phrenology had lost virtually all of its reputable support.

However, the lure of phrenology was simply too strong and it took on a life of its own as countless societies sprung up. Its advocates believed that phrenology was the key to solving virtually all of society's ills and it allied itself with the various reform movements of the time. Phrenology at different times in its history was a mixture of theory and practice that represented a marginal science well on its way to becoming part of the scientific mainstream, but also degenerated into practices that were nothing short of quackery. At the same time it became a popular and powerful social movement that had many positive aspects to it and in that regard should be considered nonsense rather than marginal or pseudoscience.

Chapters 4 and 5 examine the many different factors that contributed to the widespread interest in spiritualism in all classes of society. Spiritualism in many ways epitomizes the often-conflicting tendencies that characterized Victorian society, particularly in regard to their attitude toward science and religion. Spiritualism spoke to the growing crisis in faith that permeated all classes of society. Victorians found their faith being challenged on a variety of fronts and the decline of Christianity with the threat of atheism caused anxiety on a variety of levels. Many people thought a loss of faith would result in a collapse of morality. By giving authority to the commandments and creating a fear of doing wrong, organized religion provided the sanction of moral obligation. Religious belief was necessary for both moral and social purposes. Therefore, if large numbers of people lost their faith, society would disintegrate. While challenges to religion were being raised at all levels of society, people were particularly worried about the spread of unbelief in the lower classes and was explicitly linked to a fear of revolution. This perceived connection between religious belief and respect for the law was clearly illustrated by various reviews of Darwin's *The Descent of Man* appearing in the most important newspapers. In arguing for a totally naturalistic account of humankind's origins, Darwin was condemned for "revealing his zoological anti-Christian conclusions to the general public at a moment when the sky of Paris was red with the incendiary flames of the Commune."¹⁰

Atheism was more common among members of the working class than any other group of people for a variety of reasons. First, Thomas Paine and other early freethinkers explicitly expressed religious skepticism in their radical writings. Second, the Church of England generally identified with and supported Tory and aristocratic principles and a conservative reading of the Bible that contributed further to prejudice against the church from the working classes. Finally, the suffering that the working classes endured seemed incompatible with the existence of a just and merciful God. One only had to turn to the serial installments of Charles Dickens's *Oliver Twist* in *Bentley's Miscellany* to realize that for many members of society life consisted of squalor and grinding poverty. The prevailing social order was under siege.

In addition to political and economic changes that led to a decline in the faithful, intellectual challenges from both within theology and outside of it made it increasingly problematic to accept a literal interpretation of the Bible. Although the Copernican revolution resulted in humans realizing that the earth and, therefore, humans were no longer the center of the universe, humans could still believe that they were spiritually unique and significant. Humans alone of God's creatures were moral beings, masters of a world that had apparently been designed by the Creator to support them. Humans represented the peak in the "Great Chain of Being" that

united all things into a natural hierarchy. Surely no purely natural process could have led to the orderly system of life, especially to have created a thinking, reasoning, but most important a spiritual, moral being. Thus, while Copernicanism profoundly challenged man's place in the universe, his position as a unique spiritual being was left intact.

Furthermore, scientific inquiry seemed to affirm that the universe had a plan, an overall design. Newton had provided the image of a clocklike universe, being put in motion by natural laws. His single law of universal gravitation explained the orbiting of the planets and why a stone falls to the earth, but natural law was merely another way of referring to God's law. Discovering these natural laws guided thinking throughout the eighteenth and nineteenth centuries. That all events were linked together by uninterrupted cause and effect was one of the most fundamental ideas to emerge in the modern age. Indeed, scientists' faith in the universality of physical law gave analogical support for the moralist's faith in the universality of moral law. In addition, the hand of God could be seen everywhere in the laws of nature. Thus, the founders of modern science did not regard their findings as undermining traditional Christian belief. Rather, they were unveiling the means by which God fashioned His magnificent creation.¹¹

Nevertheless, the new cosmology and new scientific outlook ultimately weakened traditional Christianity. Our place in the universe was being compromised with another string of developments that were occurring over a long period of time, finally culminating in Darwin's theory of evolution. In the Enlightenment, the desire to explain the universe in mechanical, materialistic terms came to the forefront. God had so exquisitely designed the universe that there was no need for Him to intervene in the form of miracles. Furthermore, miracles were contrary to what scientific findings were revealing about the regularity of nature. As natural philosophers continued their search for God's laws, the role of God faded into the background. It became increasingly less important to reconcile new findings with the Bible. The most dramatic example of this incompatibility was the discovery of fossils and the challenge they presented to the story of Genesis.

Several attempts had been made to reconcile Genesis with geology. A great deal of first-rate research in paleontology was done specifically to garner evidence in support of natural theology. However, the fossil record clearly showed that living beings had been created at widely separated intervals, not in seven continuous days. Fossils were problematic for other reasons as well. First, finding sea creatures embedded in particular strata implied that areas that were dry at one time were under water. Thus, the earth was not fixed and static, but continually changing. Second, remains were being found that did not resemble any known living organism. What were these creatures; what had happened to them? Would God have created creatures only

to let them die out? It was far better to admit that the Bible contained dated and false science than try to preserve its literal meaning by harmonizing it with the latest theories in Scriptural Geology, which were always in retreat as more and more scientific knowledge came in. Findings in science should be used to help interpret the Bible rather than be twisted to be compatible with it.

In 1802 a book appeared that later was to have a profound influence on the young Charles Darwin—William Paley’s *Natural Theology*. Written by an Anglican priest, the treatise was a powerful response to the threat of atheism posed by the Enlightenment thinkers. Nature gave overwhelming evidence for the unity of God that was seen in the “uniformity of plan observable in the universe.”¹² In his famous opening passage, Paley drew an analogy between the workings of nature and the workings of a watch. No one would believe that a watch, with its exquisite design, the detailed workings of its springs and gears all intricately fitted together, could have come about by a natural process. The existence of the watch implied the existence of a watchmaker. However, even the simplest organism was far more complex than the most complex watch. Thus, organisms, like the watch, could not have come about by a purely natural process, but rather must be the product of a Divine watchmaker. The core of Paley’s argument centered on adaptation. Example after example illustrated the remarkable adaptation of organisms to their environment, with every part of every organism designed for its function. The eye was an exquisite organ designed for sight. The human epiglottis was so perfectly designed that no alderman had ever choked at his feast. Even some species of insects were designed to look like dung to protect them from being eaten. The handiwork and divine benevolence of the Master Craftsman could be seen everywhere. God protected and looked after all his creatures, great and small.

Natural theology initially provided a powerful antidote to the findings in science that were undermining a belief in a Creator, but eventually the observations were interpreted in very different ways. Thomas Paine took the fundamental idea of the natural theologians and pushed it to its ultimate conclusion. In *The Age of Reason*, written in three parts between 1794 and 1802, he argued that the Bible had been written by men, but Nature was the handiwork of God. The Bible had been corrupted by errors in copying and translation, while Nature had an indestructible perfection. The Bible portrayed a God that was passionate and, therefore, changeable and at times vindictive, but Nature revealed Him as immutable and benevolent. Biblical revelation had come late and was supposedly revealed to one nation only, but the revelation from Nature had always been available. God communicated with humankind through magic, but Nature communicated through ordinary senses. Thus, “the theology that is now studied . . . is the study of

human opinions and of human fancies concerning God.” Christianity was guilty of abandoning “the original and beautiful system of theology, like a beautiful innocent, to distress and reproach, to make room for the hag of superstition.” But “natural philosophy is the study of the power and wisdom of God in his works, and is the true theology.”¹³

Like Paley, Paine was absolutely sure that Nature revealed a benevolent Creator. Nevertheless, relying on Nature for signs of God’s benevolence was problematic. Nature was often cruel. Where was God in the slaughter that went on every day for survival? In the wild, it was eat or be eaten. An example that particularly vexed nineteenth-century theologians was the ichneumon flies. Actually a group of wasps, many species followed a perversely cruel lifestyle. Although they were free-living adults, in the larval stages they were parasites feeding on other animals, usually caterpillars, but sometimes spiders or aphids as well. The adult female pierced the host and deposited her eggs within the caterpillar. When the egg hatched, the larvae started eating from the inside. However, if the caterpillar died, it would immediately start to decay and be of no use to the larvae. Thus, the larvae ate the fat bodies and digestive organs first, keeping the caterpillar alive by preserving intact the essential heart and central nervous system. Finally, it killed its victim leaving behind the caterpillar’s empty shell. Where was God’s benevolence in this grisly tale?

In spite of such problems, however, natural theology offered a powerful alternative for people who were finding it increasingly difficult to continue to believe in the tenets of traditional Christianity. Instead of accepting the “whimsical account of creation—strange story of Eve—the ambiguous idea of a man/god—, and the Christian system of arithmetic, that three are one and one are three,” Paine maintained that the scientific study of the structure of the universe would reveal the true power and wisdom of God.¹⁴ Paine claimed that *The Age of Reason* was a tract in support of Deism, but people perceived it primarily as an attack on all organized religion, not just Christianity. He was attacked as an atheist and died a pauper. Nevertheless, Paine’s ideas resonated with the thinking of a small, but influential group of theologians who were determined to make the findings of science compatible with religious belief in the Deity. Their work became known as the higher criticism.

The convergence of scientific naturalism and historical criticism came to a head with the publication of *Essays and Reviews* in 1860. Just as Galileo had argued two hundred years earlier that science and theology were two separate spheres of knowledge, the authors, a group of liberal Anglican clergy, claimed that the Bible was not in the business of interpreting nature, nor should it be. Galileo believed the Bible could never speak untruth whenever its true meaning was understood, but the Bible could be difficult to understand. Like Galileo, the authors urged that reason and evidence from all

possible sources should be used to interpret and understand the Bible. Mosaic cosmogony was not an authentic utterance of Divine knowledge, but a human one. It was to be used in a special way for educating humankind. At one time the gospel miracles had constituted proof of Christ's divinity, but now they were an embarrassment and a liability. For the faithful, this book was more of a shock than Darwin's *The Origin of Species*, published the year before. Darwinism was threatening for many reasons, but in the religious community it was because it was part of a much wider revolution in attitudes toward the Bible. *Essays and Reviews* was condemned by the bishops of the Anglican Church, with the Archbishop of Canterbury issuing an encyclical against it.

Biblical criticism was alive and well on the continent as well. In Germany, David Frederick Strauss painstakingly analyzed the Gospels, pointing out all their inconsistencies and argued that trying to harmonize them was impossible. For him, many of the healings performed by Christ as well as the Resurrection were not supported by a careful historical approach and were simply untrue. Far better to acknowledge that the accounts of the original incidents had been altered over time, due to differing interpretations and embellished to the point of legend. Strauss argued that to continue to cling to an outmoded literalism would only bring Christianity into disrepute. He hoped to preserve the moral insights of Christian doctrine by making them independent of miracles that a modern educated person could no longer believe.

The idea that nature does nothing in vain was an ancient theme. However, the argument from design both furthered the belief in a Divine creator and undermined Christianity at the same time.¹⁵ Naturalism had great appeal to both religious and nonreligious thinkers alike. Many religious thinkers, in fact, welcomed the developments in science, regarding them as an aid to faith. Natural theology could serve as a mediator between different theological positions by offering independent proof of a God who had also revealed Himself in the person of Christ. Deists also liked the design argument, because the more that could be known of God through rational inference, then the less dependent one would be on revelation and miracles to justify their faith. In addition, many people welcomed the challenges to orthodox religious belief and felt tremendous relief, no longer burdened by the Christian doctrine of original sin.

Natural theology was also compatible with a metaphysical conception of the universe that was finding increasing support as a result of findings about the evolution of the universe and life on earth, where evolution in this context simply means change. By 1850, the evidence from paleontology suggested that the history of life showed a great progressive development, from amoebas to fish to reptiles to birds to mammals, finally culminating in the coming of humankind. The *Vestiges of the Natural*

History of Creation specifically argued that species changed in accordance with a law of organic development resulting in increasingly higher and more complex organisms. Natural theology argued that the order and complexity of the world, particularly as exemplified by living organisms, could not have come about by purely naturalistic means, but was the result of an intelligent designer. Chambers used the argument from design, but couched it in evolutionary terms. *Vestiges* even suggested that species superior to us have not yet evolved. Evolution within species would continue and humankind might continue toward higher and nobler developments. In contrast to a faith in science where progress depended on the applications of scientific methods to societal problems, this was a faith in progress as a law of the universe.¹⁶ Such a process would occur worldwide, independently of human efforts. In 1859 Darwin reinforced this idea writing in *The Origin* that the process of natural selection resulted in organisms becoming increasingly well adapted to their environment, which also led to an overall improvement.¹⁷ For those so inclined this suggested that a Divine Craftsman was overseeing the history of life.

Nevertheless, Darwin had turned Paley's argument on its head. For Paley, the relationship between structure and function that resulted in the remarkable adaptations of organisms was powerful evidence for supernatural design. For Darwin, however, adaptation became a natural process by which organisms adjust to a changing environment. There was no need for an intelligent designer. Scientific findings in many other areas also suggested that we live in a materialistic world, devoid of spiritual meaning. In this godless world many Victorians turned to the "pseudosciences" for solace. This pejorative label usually appeared in hindsight or was employed as a way to discredit a particular line of inquiry that seemed threatening to the status quo. However, in the Victorian era the pseudosciences, or what I prefer as a more accurate description, the marginal sciences represented an attempt to come to terms with the most critical problems in science, philosophy, and religion. Although many Victorians were willing to give up specific Christian doctrine such as the literal interpretation of the Bible, very few people were prepared to become atheists. Recent findings in physics and chemistry such as the discovery of electromagnetism gave hope that it might finally be possible to scientifically demonstrate the existence of the spirit world.

Chapter 4 explores the rise of the modern-day spiritualist movement and examines in detail William Crookes's investigation of two prominent mediums, Douglas Daniel Home and Florence Cook along with the fully materialized spirit of "Katie King." Crookes, a chemist and physicist, was highly skeptical of spiritualist claims and promised to use his outstanding experimental skills in a rigorous examination of spiritualism. However, as in the previous case studies, Crookes's involvement with spiritualism is a

multilayered story that reveals many factors shaped his investigation, and also points out the less savory aspects of the spiritualist movement. In the public arena spiritualism became a haven for hucksters and quacks who preyed on individuals grief stricken by the loss of loved ones as well as exploiting the deep-seated desire among Victorians to reconcile the findings of science with religion. Although Crookes became thoroughly disenchanted with spiritualism, he remained convinced that some undiscovered psychic force existed, and he was not alone in that regard.

Spiritualism attracted serious interest among a small, but significant group of scientists, particularly physicists who wanted to understand psychic phenomena. Nevertheless, spiritualist investigations never became part of mainstream science, but it was not just because most of the phenomenon were exposed as fraudulent. The Society for Psychical Research investigated all kinds of unusual mental phenomena and produced high quality reports. However, they were largely unsuccessful in connecting with more orthodox branches of psychological research. Spiritualist phenomena were illusive, and erratic. Some of the most distinguished physicists of the day argued that physical laws were uniform and universal. They reiterated the importance of repeatability to good experimental design and claimed that spiritualism violated the basic principles of good scientific practice. Their views prevailed in defining not only what counted as good scientific practice, but also in limiting the kinds of topics deemed legitimate in their quest for the professionalization of science. However, not all scientists were convinced that spiritualist phenomena were outside the purview of scientific investigation. An undiscovered force could potentially explain psychic phenomena without recourse to spirit agents. In addition, demonstrating that mind was not just an epiphenomenon of the brain was critical to spiritualists and psychic researchers in their argument against materialism.

Many spiritualists also found Darwin's theory very attractive, interpreting it in such a way as to meet their spiritual needs. Chapter 5 explores the intersection of spiritualism with evolutionary theory, focusing on the career of Alfred Russel Wallace. For traditional Christians evolutionary theory was problematic. If humans had evolved from a lower form, what were the implications for the immortality of the soul and the uniqueness of human beings? However, most British spiritualists including Christian spiritualists with their limited knowledge of biology happily embraced evolutionary theory because for them it confirmed their belief that higher forms would continue to evolve in the spiritual realm after physical death.

Wallace independently came up with the theory of natural selection and in many ways was more of a selectionist than Darwin. He understood only too well the implications of evolutionary theory and that it chal-

lenged the most basic tenets of spiritualism. Yet he managed to reconcile his belief in evolution by natural selection with an absolute faith in spiritualism. He did not think natural selection was wrong, only incomplete, claiming that neither natural selection nor a general theory of evolution could give an adequate account of consciousness and a variety of other human traits. He made no reference to spiritualist ideas, basing his objections on grounds of utility only.

Wallace raised a number of serious issues surrounding human evolution that needed to be addressed and the Darwinian camp responded. Although Thomas Huxley had argued passionately that the probable lowly ancestry of humankind did not detract from their unique status in the panoply of life in *Man's Place in Nature* in 1863, his defense of Darwin did not address one of Wallace's key objections. Wallace had argued that there would be no need for humans living in their primitive state to have a big brain and particularly a high sense of morality. In *The Descent of Man* Darwin explained how the evolution of the moral sense could have come about. Thus Wallace's objections helped further the discussion over human origins. A variety of experiences shaped his mature views including his extended period of living with native peoples, which made him more open to spiritualism and contributed to his doubts concerning natural selection as a complete explanation for the emergence of humans in the history of life.

Wallace's career, like Crookes's, illustrates that it would be a mistake to consider their investigations into spiritualism separately from their more mainstream scientific research. Both men were not arguing in favor of the supernatural, but rather of extending the boundaries of what should be considered science. Many spiritualists and not a few scientists had a vision of a "new science," which would unify spirit and matter, mind and body. If such a vision could be achieved, it would reconcile the growing gulf between science and faith.

These chapters illustrate again and again that the scientific community did not speak in one unified authoritative voice concerning what was considered legitimate scientific knowledge. "Issues of place, practice, and audience have been central to the construction of scientific authority and orthodoxy."¹⁸ Chapter 6 explores some of the negotiations surrounding evolutionary theory by examining the ideas of Thomas Huxley, and in doing so elucidates why evolution did not share the same fate as the previous case studies. Like phrenology, evolutionary ideas pre-Darwin had found their greatest support among the dissidents and radicals of the London medical schools.¹⁹ Just like the ideas promulgated in *Vestiges of the Natural History of Creation*, including its phrenological content, evolution was attacked on both scientific and religious grounds. It should be pointed out that phrenology was not initially attacked because it was stupid, but rather that it was

a materialistic doctrine. But unlike phrenology, evolution did not remain marginalized. The scientific naturalists eventually gained control of the universities and also largely succeeded in defining scientific methodology and what were legitimate topics of scientific investigation.

Huxley played a leading role in defending evolutionary theory against religious attacks. He also used Darwin's theory to promote the scientific and professional status of biology. However, Huxley was skeptical of the two basic tenets of Darwin's theory, natural selection and gradualism. Huxley's doubts are the basis for exploring some of the scientific objections to Darwin's theory. They also provide a window to view the emerging structure of what becomes defined as good scientific practice and suggest why unlike the previous examples, evolutionary theory emerged as a powerful and unifying theory for the life sciences.

Based on the evidence from embryology and comparative anatomy of both living and extinct organisms, and the pattern of the fossil record, Huxley thought species were fixed. Organisms appeared to be grouped into distinct types with no transitions between them. However, Darwin's interpretation resulted in Huxley recognizing that the evidence was also compatible with species descent from a common ancestor. Nevertheless, he still maintained that the fossil record did not support the idea of gradual change. Saltation allowed Huxley to keep his belief in the idea of distinct types, explain the gaps in the fossil record and accept evolution. As more and more transitional fossils were discovered and new findings from development suggested the common ancestry of all organisms, Huxley eventually accepted the idea of slow gradual change. However, he continued to view natural selection as a hypothesis rather than a proven theory or fact.

While Huxley thought natural selection played an important role in the history of life, he maintained that the evidence did not yet exist that demonstrated it had the power to create good physiological species incapable of interbreeding, and not merely well marked varieties. He agreed with Darwin that it could be difficult to determine what was a variety and what was a species. He recognized that breeding experiments often gave inconclusive results. Darwin in turn also recognized that if he could demonstrate that hybrid sterility was actually selected for, his theory would be in a much stronger position. Because of Huxley's objections, Darwin performed a series of experiments that he might not have and eventually strengthened his original position that hybrid sterility was not specifically selected for, but was an incidental byproduct of other selection. Huxley remained unconvinced.

Huxley's disagreement with Darwin highlights what is the fundamental question of my study. How is evidence interpreted and evaluated, and what kinds of factors influence that judgment? Geologists based on

very fragmented evidence posited an elaborate scenario concerning the history of life. In the early part of the nineteenth century was the quality of their evidence and their interpretation of it that different from that of some of the scientists who were investigating the phenomena observed at séances? Darwin used the same kinds of evidence to support the evolution of the moral sense as Gall did in support of phrenology. Yet spiritualism and phrenology were eventually discredited. Huxley's concerns over natural selection help elucidate how these judgments were made. He did not disagree with the interpretation of the experimental results, but rather over what constituted proof of a hypothesis.

Huxley was following William Herschel, maintaining that theories should be based on direct empirical evidence. In making his case for natural selection, Darwin was following William Whewell, claiming that if a theory had wide explanatory power than it should be accepted. In *The Origin*, however, Darwin had made use of both types of arguments, both empirical and the idea of consilience. Huxley also recognized the importance of consilience claiming that no theory except for evolution could explain so many "facts" of the natural world. Yet he maintained that natural selection had to be experimentally demonstrated to move it from hypothesis to theory. Darwin felt that Huxley was placing an essentially impossible demand on his theory. This discussion also highlights that the distinction between the two different approaches is not absolute. The influence a theory ultimately wields depends on how well it makes sense of empirical data. Both are essential aspects of good scientific methodology.

Huxley avidly defended Darwin's theory in spite of his disagreements with it because he recognized that it was extremely powerful as a means to further the understanding of the natural world. Initially, he did not think either transmutation or natural selection had been proven, but these ideas could be tested. Evolution did not suffer the same fate as the other case studies in this book, not because it turned out to be correct, but rather because its advocates not only promoted, but actually practiced for the most part the scientific methodology that they espoused. The quality and quantity of evidence in favor of evolution was simply much higher than in the previous case studies. One of the hallmarks of a good scientific theory is that it should continue to generate hypotheses that can be tested. Evolutionary theory has proved to be exceeding robust in this regard. The very issues that Huxley was concerned with, such as the role of development and the gaps in the fossil record, have continued to be revisited. Disagreements and disputes among evolutionists are the marks of a good scientific theory. Nevertheless, evolution is not immune from the same kinds of problems that have plagued the marginal sciences.

The final chapter examines the culture of science and why it has been so successful in providing reliable knowledge of the natural world.

Philosophers have long been grappling with how to differentiate science from other types of knowledge, but none of their explanations have been entirely satisfactory.²⁰ Henry Bauer has suggested that the notion of a filter represents a more accurate description of how scientific knowledge accumulates and is particularly applicable to my case studies.²¹ In early stages of an investigation knowledge is highly unreliable, coming from many different sources, but various filtering processes winnow the possibilities of what will eventually become accepted as scientific knowledge. In a later stage, part of the filtering process is the actual creation of boundaries. However, the crucial aspect of the filtering process that determines what eventually becomes reliable scientific information in the long term is that science is fundamentally a cooperative enterprise. Theories and “facts” must survive a period of testing and experimenting. Darwin’s theory survived this period in a way that the other case studies did not, while at the same time remaining controversial.

Examining two present-day controversies that connect to the case studies illustrates that the boundaries in science are ever changing as scientists continue to expand into areas that were once the domain of religion and philosophy and as new areas of investigation continue to vie for scientific legitimacy. The first explores the role that fossils continue to play as possible links between myth and science. The second examines evolutionary psychology, which claims to provide a definitive scientific explanation of human nature, just as phrenology did in times past. Both of these investigations have spawned contentious debates. As with the early stages of the case studies in the book, it is unclear what their eventual status will be. Since human beings with all their foibles, biases as well as their keen intellect produce scientific knowledge, such knowledge will never be totally objective. However, it is precisely these attributes that contribute to the multiplicity and productivity of scientific ideas. In the short term, in what Bauer refers to as frontier science, many factors come into play that determine what kinds of questions are asked, what counts as evidence, and how evidence is interpreted. However, science in the long term is self-correcting. Scientific method is important and evidence does matter. As all these case studies demonstrate, scientists provide us with an ever changing, but increasingly accurate view of the material world.