INTRODUCTION

VICTORIAN SCIENCE AND IMAGERY

Nancy Rose Marshall

What happens when we look at an artwork in terms of the ways its depicted subject, its medium, its method of production, or its formal elements correspond with the dominant scientific discourses of the period in which it was produced? This volume suggests that considering how objects from such conventionally separated categories as "empirical research" and "creative works of art" might share epistemological conditions offers fruitful interpretive possibilities. At a crucial moment in the development of the modern world, British and American visual culture helped to produce science, while science in turn newly informed art. Remarkably, in 1875 it was possible for an English scientist to maintain that "science and art . . . act and re-act upon each other with an almost exchangeable importance. Science is theoretical art; art practical science."[1] The art historians in this collection help us see the extent to which nineteenth-century "science" and "art" were not in fact separate fields but instead mutually constitutive.

A focus on the close kinship between the two fields in the nineteenth century is timely and topical, as it may help disrupt the subsequent reification of the idea of two antagonistic cultures, an image that became entrenched by the middle of the twentieth century.[2] Interpretive models emphasizing the ways that cultural knowledge emerges across a wide range of spheres might, in fact, offer us some salient wisdom in facing our current global crises; it will take both imagination and empirical data to solve the issues involved in climate change, for instance.

Foundational to our project is the acknowledgement that art and science are not tightly compartmentalized, separate spheres but rather loosely framed practices and knowledges that emerge from shared

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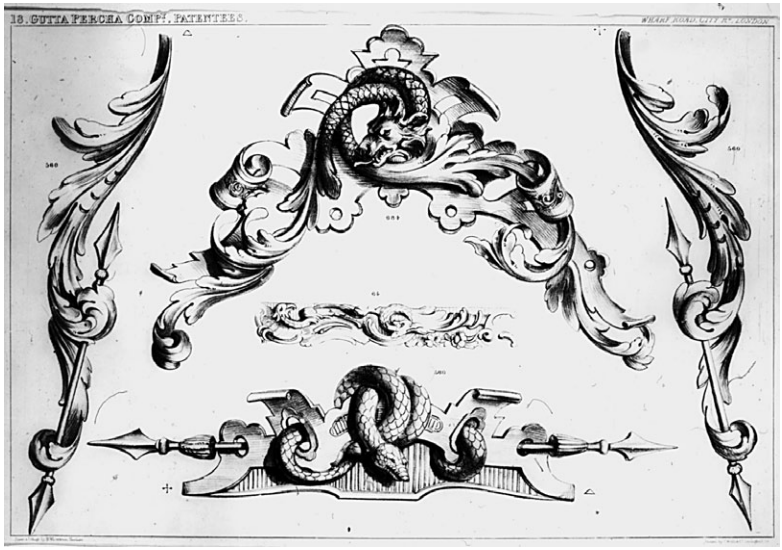

Fig. I.1. Hawkins's ornamental serpent designs reveal his close study of natural history. Benjamin Waterhouse Hawkins, *Decorative Motif in the Form of a Serpent.* Reprinted from *Gutta Percha Company's Pattern Book of Ornaments for the Use of the Trade* (London: Gutta Percha Works, 1850).

beliefs circulating in a society.[3] As Gowan Dawson and Sally Shuttleworth remind us, the same "metaphors, themes, images, and ideological orientations" inform poetry and science; in other words, like science, art and literature are both social products that manifest from and in turn produce the epistemological possibilities at play in any given moment in history.[4] Science does not remain objective, timeless, universal, and stateless while art gets to be imaginative, subjective, and culturally constituted; science is not the straight man to art's funky and unpredictable comedian. In the helpful characterization of Caroline A. Jones and Peter Galison, "neither practice has unique absolute purchase on 'reality,' and neither is as alienated from history as its rhetoric may imply."[5]

The story of one individual serves to illustrate the inseparability of artistic and scientific identities in the Victorian period. Around 1850, naturalist Charles Darwin wrote to Benjamin Waterhouse Hawkins, who had illustrated fish and reptiles for two volumes of *The Zoology of the Voyage of HMS Beagle* (1838–43): "Dear Sir, I have much pleasure in sending my testimony to your skill as an artist . . . , and in several departments in Natural History."[6] The unproblematic promotion of the same man as both scientist and artist suggests the compatibility of these roles in the Victorian period. A fellow of the Linnean and the Geological

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Societies and a member of the Society of Arts, Hawkins also received recommendations from Royal Academicians John Rogers Herbert and the vice-president of the Zoological Society William Yarrell. Hawkins, a clubbable sort with a penchant for dramatically illustrated lectures and a gift for public relations, exemplified the possibilities open to Victorian men in possession of both empirical knowledge and artistic skills. He found work in both Britain and the United States due to the shared currency of artistic and scientific thought between the two countries, as well as to their comparable institutional structures. Combining his understanding of sculptural technique acquired from his academically trained teacher, William Behnes, with his natural history and geological knowledge gleaned largely from self-study, Hawkins's projects exemplify the type of hybrid forms seen elsewhere in this book.[7] Hawkins also deployed art to persuade, either in the service of commerce or to direct public opinion regarding scientific and social debates. In designs for the pattern book of the Gutta Percha Company, which fabricated objects from a recently isolated rubberlike material from Malaysian trees, for example, he drew snakes and other creatures featured in mass-produced moldings and decorative elements (see fig. I.1).

In this way Hawkins promoted through his art a new industrial material brought to England by a botanist and a doctor in 1843 and further refined by English scientists of the Joint Committee for Chemistry, Colonies and Trade.[8] Likewise, when commissioned by the planners of the 1854 Sydenham Crystal Palace Park geology display, who were familiar with his sculptural work from Royal Academy exhibitions, Hawkins realized life-size three-dimensional models of the famous paleontologist Richard Owen's visions, including the megalosaurus (fig. I.2). A boisterous dinner party staged by Hawkins for scientists (including Owen), journalists, and investors in the model of the iguanodon was an inspired promotion for what was essentially the world's first Jurassic Park (although Hawkins's dinosaurs remained inanimate, proliferating cartoons and anecdotes of mobile and nightmarish monsters threatening visitors, who sometimes stole their teeth as souvenirs, suggested otherwise).[9] Renowned for his accomplishments at Sydenham, Hawkins next designed a hadrosaur with Joseph Leidy of Philadelphia's Academy of Natural Sciences and then another dinosaur display for Central Park in New York (where it still lies buried, according to popular accounts).[10] These splendid models, undertaken in concert with men on different continents holding differing opinions about evolution and extinction, assured the visibility of both the debate and the debaters. While Leidy supported Darwin's theory of natural selection leading to evolution, Owen rooted his own mechanism for evolution in divine creation.[11]

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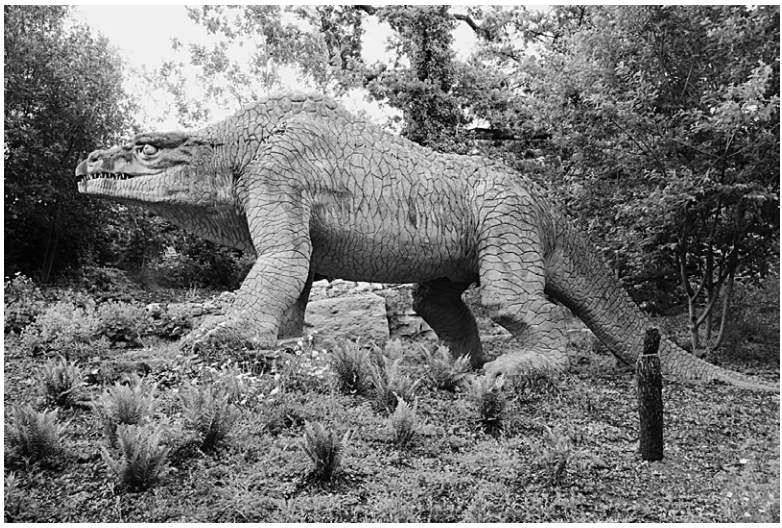

Fig. I.2. Working with paleontologist Richard Owen, Hawkins created the first "Jurassic Park" of life-size dinosaur reconstructions. Benjamin Waterhouse Hawkins, *Megalosaurus.* Concrete, iron, rock, pigment. Sydenham Crystal Palace, London, 1854. Credit: Chris Sampson, Wikimedia Commons.

As a scientist-artist, Hawkins could also design illustrations to express his opinions on the scientific debates of the period. A plate in his 1860 *Comparative Anatomy as Applied to the Purposes of the Artist* (fig. I.3), portraying a white man clasping the hand of a deferential African, simultaneously evoked the iconic "handshake moment" of history painting (suggesting a treaty or agreement) and refuted Darwinian claims about the evolution of man from apes, thereby entering the fray of the acrimonious public dispute between Owen and the biologist Thomas Henry Huxley, "Darwin's bulldog." In the text accompanying the plates, Hawkins emphasized that artists should use these "graphic illustrations . . . to contradict degrading theories in support of the fallacy of the Darwinian Paradox" and his diagram of the various primate species grouped together in harmony was intended to display their fixity rather than their evolution from beast to man.[12] With the central handshake, the Black and white figures appear to accept their positions as no. 2 and no. 1 in Hawkins' hierarchy. In another diagram (fig. I.4), Hawkins represented his interest in the divinely ordained (rather than evolving) hierarchy of man over animal—and of white over black races—by depicting, in skeletal form, a tableau of a standing and a kneeling figure that we can identify only through iconography: The chains and beseeching gesture of the skeleton on the right are part of a large catalogue of abolitionist imagery that worked to

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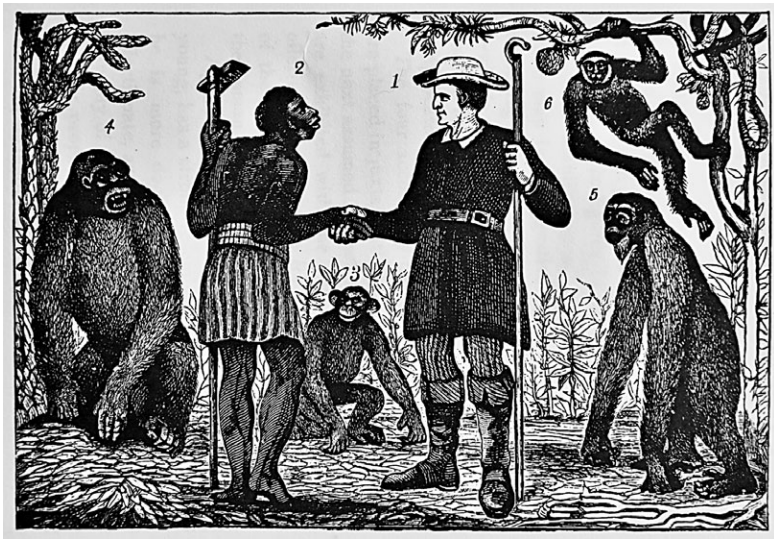

Fig. I.3. By placing the human figures in a numbered array of primates, Hawkins indicated his support for the belief in a divine, rather than evolutionary, natural history hierarchy with white man at its top. *Plate 2*, in Benjamin Waterhouse Hawkins, *Comparative Anatomy as Applied to the Purposes of the Artist*, ed. George Wallis (London: Winsor and Newton, 1860).



Fig. I.4. Based on a long history of Black figures kneeling before white men, including the Wedgwood Slave Medallion, Waterhouse's ostensibly empirical anatomical rendering is in reality heavily charged with racial meanings. Detail, *Plate 1*, in Benjamin Waterhouse Hawkins, *Comparative Anatomy as Applied to the Purposes of the Artist*, ed. George Wallis (London: Winsor and Newton, 1860).

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assert and maintain the superiority of the white man, most influential of which was the medallion crafted by Josiah Wedgwood in 1787 in which the image was inscribed "Am I Not a Man and a Brother?"[13] The fact that racist comparative anatomy was taught to artists is yet another example of the inextricability of the arts and the sciences at this time.

Hawkins's plates, then, demonstrate the complex interweaving of the codes of art and of science in this period. They demonstrate that one man could skillfully deploy art as a weapon in scientific debate, on the one hand, while bringing keen empirical observation to the arts, on the other. Royal Academician Henry Stacy Marks's painting *Science Is Measurement* (plate 1) occasioned unusual scrutiny upon its exhibition at the Royal Academy in 1879, due to just this overt assertion of the relationships between art and science. Portraying a scholar-gentleman in an eighteenth-century periwig and knee-breeches, pencil in mouth and notebook and tape measure in hand, gravely evaluating a skeleton of a stork, the painting was important enough to be selected for Marks's "diploma picture."[14]

Despite the fact that the painting was set about one hundred years prior to its production, the critic for the *Leisure Hour* understood the piece as a paradigmatic and celebratory image of the modern era, proclaiming that it rose to a category of those rare artworks that became "typical representatives of the period of their production." The picture constituted "a doctrine of our more recent times" for making the case that "good could come of measurement applied to organisms, that life and mind and social phenomena could by any possibility be subject to laws, and that these laws could be discovered and made useful to man." Its primary contribution was in its acknowledgement that the biological kingdom had become newly subject to the type of empirical investigation previously reserved for the inanimate world, and that mysteries of organic forms could now be rendered transparent and rational. Everything, art included, now fell under the purview of the coherently calculable: "All art, which is in truth nothing but applied science, depends likewise on measurement."[15]

Marks, though, seems to add a question mark to his positivist title through the puzzled standoff between the stork skeleton and the ornithologist; although the scientist deploys the analytical gaze of the experimental observer, he appears to pause in confusion at what he sees. Moreover, his wig and knee-breeches make the scientist appear quaintly old-fashioned for those not immediately inclined to associate eighteenth-century dress with Enlightenment empiricism. What, in fact, *was* science, if not measurement?[16] For nineteenth-century thinkers and practitioners, and for Marks himself, it was, to a degree, art.

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The Nineteenth Century

As we learn from the foundational scholarship of Bernard Lightman, the nineteenth century offers some distinctive contributions to the student of the history of science. A number of significant discoveries in the sciences coincided with an expanding middle class and the rise of commodity production and consumer culture, while a receptive and engaged public eager for entertainment and education in a range of fields drove the proliferation of publications in both science and art. Before scientific knowledge became too arcane for a general audience, journals routinely assumed an educated readership thoroughly absorbed by the cutting-edge debates of the day.[17] The new medium of industrial printing expanded print culture, allowing for cheaper editions of theoretical texts and the spread of debated ideas.[18] Lightman's *Victorian Popularizers of Science* demonstrates that we must look beyond the work of canonical scientific figures of the period to identify and understand the widely varying beliefs of the new middle-class consumers of science, a subject that became both education and entertainment in a remarkably wide range of locations beyond the predictable lecture halls, periodicals, and libraries, including churches, artist's studios, shipyards, and zoos. In an era in which "the lines delineating science from spectacle had not been drawn," scientific display was as likely to be found under the oversight of showmen as in the care of learned dons. To comprehend the complex domains of Victorian science, it is also necessary, as Lightman notes, to explore the discourses and practices of marginalized groups, such as women, people of color, and the working classes, as well as those of alternative sciences such as phrenology or psychical research.[19]

From 1851, the year of the Great Exhibition at the Crystal Palace in London, World's Fairs became important sites for the display and dissemination of new information, and there were countless such locations in London alone, such as the Adelaide Gallery (1832), the Polytechnic Institution (1838), or the Royal Institution (1799).[20] Networks of scientific communication stretched across the Atlantic between individuals and institutions, even as American naturalists fought for acknowledgement as the experts on their own continent.[21] As natural history collections increasingly moved into dedicated spaces, Philadelphia's Academy of Natural Sciences (1812) and the American Natural History Society in New York (1869), followed by London's Natural History Museum in 1881.[22] By 1870 there were 125 scientific societies in Britain and Ireland, including the Royal Astronomical Society (1820), the Institute of Chemistry of Great Britain (1877), and the Geological Society of London (1807).[23] In the United States, the American Association for the Advancement of

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Science was formed in 1848, followed by the National Academy of Sciences in 1863.[24]

Like the world of science, the art world became similarly institutionalized and ordered into hierarchies of educational, exhibition, and sales venues. The American Academy of Fine Arts (1802) and the National Academy of Design (1825) in New York and the Pennsylvania Academy of Fine Arts in Philadelphia (1805) were three of the most prominent organizations in the United States, while British art was dominated by the Royal Academy in London (1768).[25] Public art collections expanded in number, scope, and access, prominent among them being the National Gallery in London (1824), the Boston Museum of Fine Arts (1870), the Metropolitan Museum of Art in New York (1872), and the Pennsylvania Museum and School of Industrial Art (1876).[26]

While art and natural history began to be separated in the Enlightenment, they retained connections not fully severed until the twentieth century, if indeed this rupture was ever fully completed. Many scholars have traced the history of both scientific and art display in tandem with changing cultural norms and shifts in how knowledge was organized, particularly the move from *Kunstkammer* (cabinet of curiosities) to museum.[27] Such a scholarly turn of course follows in the wake of *The Order of Things* (*Les mots et les choses*), in which Michel Foucault proposed the concept of the "episteme," a slippery and shifting amalgam of discourses, constructions, institutions, orderings of knowledge, and ideologies that produce conditions of knowing in a given period. Thinking with Foucault illuminates how in fact the arts and the sciences not only can but should be seen as tightly interconnected and cross-fertilizing—as, to use the words of Jones and Galison, "regimes of knowledge, embedded in, but also constitutive of, the broader cultures they inhabit."[28]

Tony Bennett cites Krzysztof Pomian's argument that the fact that cabinets of curiosities gave way to natural history collections points to changing epistemes; focusing on the exceptional or curious object, one that inspired wonder, was well suited to the medieval and early modern worldview in which the notion of seeking for laws in nature was alien: the unique could therefore be exemplary.[29] During the Enlightenment, however, rational logical order, classification, connection and organization became governing principles, pushing art and natural history asunder while retaining less visible threads of attachment.[30] The rise of the scientific focus on the category or type—as opposed to the unique individual or specimen—accompanied the elevation of "objectivity" into an essential scientific moral quality.[31] At the same time, the mutual relationship between artistic and scientific practices continued in a range of practices, however; as Sally Gregory Kohlstedt has found, for instance,

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natural history illustrations fed into arrangements of specimens, which in turn sometimes were copied by artists.[32]

As science developed, an emphasis on categories of rational classification led to the rise of new disciplines; the Victorian period saw the burgeoning of psychology, chemistry, physics, and many other fields. The term *scientist* was itself a nineteenth-century word, deployed first in 1834 by William Whewell, and it remained a fluid term until later in the century.[33] Dramatic advances drove confidence about the potential ordering and taming of the world through the sheer power and scope of reason, and the list of momentous and transformative discoveries occurring over a very short period of time is formidable. The universe became vaster but more crowded through advances allowing for astronomical observation and calculation, which in turn produced theories such as Whewell's nebular hypothesis imagining the creation of the planets and stars. Simultaneously, our environment grew ever more populated by the invisibly tiny: forty-nine new elements were discovered in the nineteenth century, and the development of the model of the atom as the smallest particle in the universe by John Dalton (1808) was modified at the end of the century by J. J. Thomson's discernment of a subatomic particle, the electron, in 1896.[34] From the mid-eighteenth century chemists proved the idea of the conservation of mass, the principle that nothing could be created or destroyed, followed by the formulation of the law of the conservation of energy.[35] Meanwhile, changing the face of medicine were John Snow's and Louis Pasteur's proof of the germ theory (1850s) for the transmission of disease, along with the deployment of chloroform during surgery (1847) and Joseph Lister's successes with antisepsis (1867).[36]

Even more paradigm-shattering were Charles Darwin's proposals regarding evolution and natural and sexual selection, which radically reoriented many fields, from theology to zoology to sociology, and participated in the gradual relocation of humankind away from its long-accepted position at the center of the universe. People increasingly belonged to the realm of the animal; biology had now "boldly entered the precincts of man's own and special order," as Andrew Wilson, a Scottish follower of Darwin, asserted in 1883.[37] In the wake of German scientists' contributions to the visualization of the workings of the cell and its components in the middle of the century, there blossomed a newly acute sense of the kindred relationship between all living things, based on the concept of protoplasm. Producing such visions as Huxley's fantasy of the transubstantiation of a man into a lobster, an imaginative investment in the exciting idea that there was one common substance shared by all organic creatures refashioned the order of the world.[38] Even plants could become cousins: as Wilson remarked, "the last decade

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of science has certainly tended to raise the plant as a living, and moreover as a sympathetic and active being."[39]

In light of—and contributing to—the radical changes in structures of belief, traditional attitudes began to crumble. Nature was increasingly perceived as a comprehensible united system rather than an amorphous force inimical to human beings.[40] A view of scientific progress as a gradual mastery of the world also both allowed for and was part of the development of technologies of power deployed to subordinate and discipline all that fell under the category of "nature," relative to the human sphere of "culture." The normalization of values that instrumentalized the natural world in turn served and was served by the growing system of industrial capitalism, reminding us that any definition of nature is itself a product of culture with its own history.[41] Propelled by their growing economies, expanding empires indelibly marked the globe, generating encounters between peoples, species, plants, cultures, and knowledges, which in turn required cataloguing and recording. Indeed, the centralized concentration of raw materials brought together from the far reaches of the earth formed important laboratories. As Julia Voss has concluded, for example, it was Darwin's experience with the extraordinary accumulation of specimens in the British Museum that set him on the path to grasping the mechanisms behind the infinite variety of life.[42]

At the same time that imperial institutions and practices certainly contributed to knowledge, then, the dark side of empire and colonization produced systematic oppression and exploitation of people, animals, and lands, as Rachael DeLue tells us in her essay in this volume—as well as, of course, scientific racism. Art, too, must be situated in all of these contexts.

Victorian Science and Art

The two fields under consideration in this volume are, then, profoundly interconnected. Most obviously, perhaps—certainly to Marks's depicted naturalist—artists and scientists both invested heavily in the faculty of sight.[43] The scientific gaze was an ostensibly objective form of looking increasingly shared by artists who, especially after the forcefully expressed artistic directives of the prominent cultural critic John Ruskin, began to practice close observation of the natural world. Ruskin advocated seeing rather than analyzing: "Do not think, by learning the nature or structure of a thing, that you can learn to draw it," he instructed, continuing, "To draw a man, a flower or a mountain" can be accomplished "only by looking at them; not by cutting them to pieces."[44] Countless scholars have observed the connection between vision, knowledge, and empiricism.[45]

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