

Chapter 1: Introduction

(From Richards, *The Tragic Sense of Life*)

In late winter of 1864, Charles Darwin received two folio volumes on radiolarians, a group of one-celled marine organisms that secreted siliceous skeletons of unusual geometry. The author, the young German biologist Ernst Haeckel, had himself drawn the figures for the extraordinary copper-etched illustrations that filled the second volume.¹ The gothic beauty of the plates (see fig. 1) astonished Darwin, but he must also have been drawn to passages that applied his theory to construct the descent relations of these little

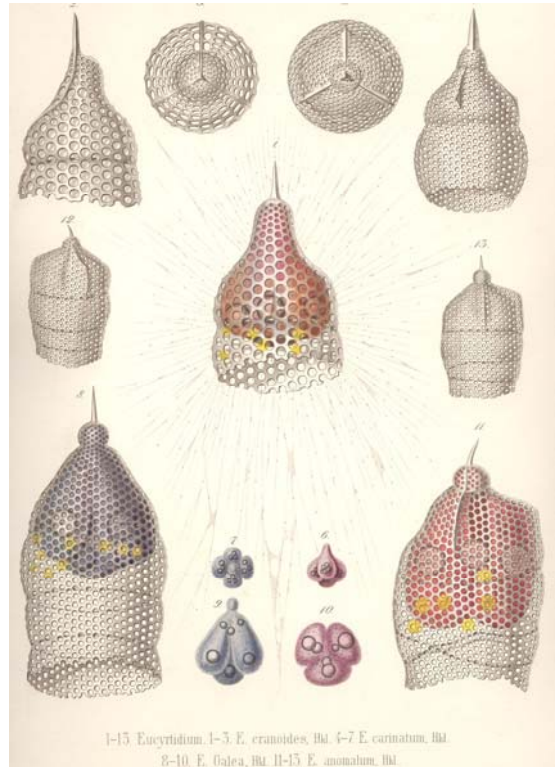


Figure 1: Various species of Eucyrtidium, from Haeckel's *Die Radiolarien*, 1862.

known creatures. He replied to Haeckel that the volumes "were the most magnificent works

which I have ever seen, & I am proud to possess a copy from the author."²

Emboldened by his own initiative in contacting the famous scientist, Haeckel, a few days later, sent Darwin a newspaper clipping that described a meeting of the Society of

¹Ernst Haeckel, *Die Radiolarien. (Rhizopoda Radiaria.) Eine Monographie*, 2 vols. (Berlin: Georg Reimer, 1862).

²Charles Darwin to Ernst Haeckel (3 March 1864), in Correspondence of Ernst Haeckel, in the Haeckel Papers, Institut für Geschichte der Medizin und der Naturwissenschaften, Ernst-Haeckel-Haus, Friedrich-Schiller-Universität, Jena. Hereafter I will refer to this as "Haeckel Correspondence, Haeckel-Haus, Jena." The letter has recently been published in *The Correspondence of Charles Darwin*: vol. 12: 1864, ed. Frederick Burkhardt et al (Cambridge: Cambridge University Press, 2001), p. 61.

German Naturalists and Physicians at Stettin, which occurred during the previous autumn. The article gave an extended and laudatory account of Haeckel's lecture defending Darwin's theory.³ Darwin immediately replied in his second letter: "I am delighted that so distinguished a naturalist should confirm & expound my views; and I can clearly see that you are one of the few who clearly understands Natural Selection."⁴ Darwin recognized in the young Haeckel a biologist of considerable research ability and aesthetic sense, and, moreover, a thinker who obviously appreciated his theory.



Figure 2: Ernst Haeckel (standing) and Nikolai Miklucho in 1867.

Ernst Haeckel (fig. 2) would become the foremost champion of Darwinism not only in Germany but throughout the world. Probably more people prior to the First World War learned of evolutionary theory through his voluminous publications than through any other source. His *Natürliche Schöpfungsgeschichte* (The natural history of creation, 1868) went through twelve German editions (1868-1919) and appeared in two English translations as *The History of Creation*.

Erik Nordenskiöld, in the first decades of the twentieth century, judged it "the chief

³*Stettiner Zeitung* (nr. 439), Sept. 20, 1863. The author began: "The first speaker [Haeckel] stepped up to the podium and delivered to rapt attention a lecture on Darwin's theory of creation. The lecture captivated the auditorium because of its illuminatingly clear presentation and extremely elegant form." The author then gave an extensive précis of the contents of the entire lecture. He concluded by reporting that "a huge applause followed this exciting lecture."

⁴Charles Darwin to Ernst Haeckel (9 March 1864), Haeckel Correspondence, Haeckel-Haus, Jena; *Correspondence of Charles Darwin*, 12: 63.

source of the world's knowledge of Darwinism."⁵ The crumbling detritus of this synthetic work can still be found scattered along the shelves of most used bookstores. *Die Welträthsel* (The world puzzle, 1899), which placed evolutionary ideas in a broader philosophical and social context, sold over 40,000 copies in the first year of its publication and well over ten times that during the next thirty year—and this only in the German editions.⁶ (By contrast, during the three decades between 1859 and 1890, Darwin's *Origin of Species* sold only some thirty-nine thousand copies in the six English editions.)⁷ By 1912, *Die Welträthsel* had been translated, according to Haeckel's own meticulous tabulations, into twenty-four languages, including Armenian, Chinese, Hebrew, Sanskrit, and Esperanto.⁸ The young Mohandas Gandhi had requested permission to render it into Gujarati; he believed it the scientific antidote to the deadly wars of religion plaguing India.⁹ Haeckel achieved many other popular successes, and, as well, produced more than twenty large, technical monographs on various aspects of systematic biology and evolutionary history. His studies of radiolarians, medusas, sponges, and siphonophores remain standard references today. These works not only informed a public, they drew to Haeckel's small university in Jena the largest share of

⁵Erik Nordenskiöld, *The History of Biology* (New York: Tudor Publishing, [1920-1924] 1936), p. 515.

⁶See the introduction to a modern edition of Haeckel's *Die Welträttsel*, ed. Olof Klohr (Berlin: Akademie Verlag, 1961), pp. vii-viii. See also, Erika Krausse, "Wege zum Bestseller, Haeckels Werk im Lichte der Verlegerkorrespondenz: Die Korrespondenz mit Emil Strauss," *Der Brief als wissenschaftshistorische Quelle*, ed. Erika Krausse (Berlin: Verlag für Wissenschaft und Bildung, 2005), pp. 145-70 (publication details in pp. 165-66).

⁷See the introduction to *The Origin of Species by Charles Darwin: a Variorum Text*, ed. Morse Peckham (Philadelphia: University of Pennsylvania Press, 1959), p. 24.

⁸Haeckel's charting is in an unnumbered document in the Haeckel Papers, Haeckel-Haus, Jena.

⁹Joseph McCabe to Ernst Haeckel (7 July 1908), Haeckel Correspondence, Haeckel-Haus, Jena.

Europe's great biologists of the next generation, among whom were the "golden" brothers Richard and Oscar Hertwig, Anton Dohrn, Hermann Fol, Eduard Strasburger, W. O. Kovalevsky, Nikolai Miklucho-Maclay, Arnold Lang, Richard Semon, Wilhelm Roux, and Hans Driesch. Haeckel's influence stretched far into succeeding generations of biologists. Richard Goldschmidt, the great German developmental biologist who migrated to Berkeley under the treacherous shadow of the Nazis in the 1930s, later recalled the revelatory impact reading Haeckel had made on his adolescent self:

I found Haeckel's history of creation one day and read it with burning eyes and soul. It seemed that all problems of heaven and earth were solved simply and convincingly; there was an answer to every question which troubled the young mind. Evolution was the key to everything and could replace all the beliefs and creeds which one was discarding. There were no creation, no God, no heaven and hell, only evolution and the wonderful law of recapitulation which demonstrated the fact of evolution to the most stubborn believer in creation.¹⁰

Haeckel gave currency to the idea of the "missing link" between apes and man; and in the early 1890s, Eugene Dubois, inspired by Haeckel's ideas, actually found its remains where the great evolutionist had predicted, in the Dutch East Indies.¹¹ Haeckel

¹⁰Richard Goldschmidt, *Portraits from Memory: Recollections of a Zoologist* (Seattle: University of Washington Press, 1956), p. 35.

¹¹Haeckel speculated that the transition from ape to man via "pithecanthropus alalus" (ape-man without speech) took place in the area of Borneo, Sumatra, and Java. Inspired by Haeckel, Eugene Dubois searched these regions while stationed there as a physician in the French Army. Amazingly, in 1890 and 1891, he discovered in Java the remains of what became known as *Homo erectus*, certainly the best candidate for the missing link. See Eugene Dubois, *Pithecanthropus erectus, eine menschenähnliche Übergangsform aus Java* (Batavia: Landesdruckerei, 1894); and "Pithecanthropus Erectus--A form from the Ancestral Stock of Mankind," *Annual Report, Smithsonian Institution* (1898): 445-59.

invented ecology, identified thousands of new animal species, established an entire kingdom of creatures, the Protista, worked out the complicated reproductive cycles of many marine invertebrates, and performed experiments and devised theories in embryology that set the stage for the ground-breaking research by his students Roux and Driesch. His "biogenetic law"—that ontogeny recapitulates phylogeny—dominated biological research for some fifty years, serving as a powerful research tool that joined new areas into a common field for the application of evolutionary theory. The "law," rendered in sepia tone, can still be found bracing contemporary textbooks in embryology (see fig. 3).¹²

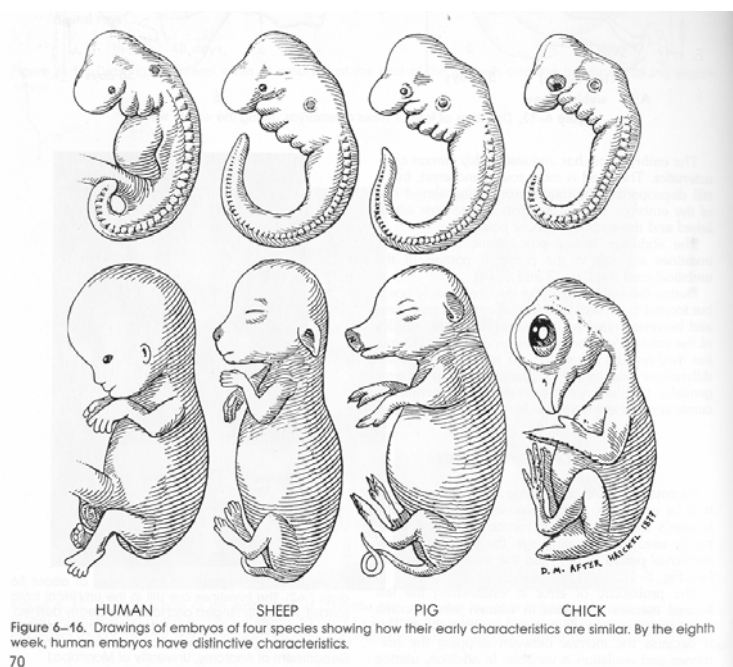


Figure 3: Illustration of the biogenetic law (after Haeckel) from Moore, *Before we are Born: Basic Embryology and Birth Defects*, 1989.

Haeckel, however, has not been well loved—or, more to the point, well understood—by historians of science. E. S. Russell, whose judgment may usually be trusted, regarded Haeckel's principal theoretical work, *Generelle Morphologie der Organismen*, as "representative not so much of Darwinian as of

¹²Figure 3 comes from a standard medical school textbook, Keith L Moore, *Before We are Born: Basic Embryology and Birth Defects*, 3rd ed. (Philadelphia: W. B. Saunders Co., 1989), p. 70. Richardson and Keuck have listed about a dozen text books from the 1980s to the present that have used Haeckel's embryo illustrations. See Michael Richardson and Gerhard Keuck, "Haeckel's ABC of Evolution and Developmen," *Biological Review* 77 (2002): 493-528; the list is on p. 515.

pre-Darwinian thought." "It was," he declared, "a medley of dogmatic materialism, idealistic morphology, and evolutionary theory"¹³ Gavin De Beer, a leading embryologist of the first half of the twentieth century, blames Haeckel for putting embryology in "a mental strait-jacket which has had lamentable effects on biological progress."¹⁴ Peter Bowler endorses these evaluations, and further judges that the biogenetic law "illustrates the non-Darwinian character of Haeckel's evolutionism."¹⁵ Bowler believes Haeckel's theory of evolution ideologically posited a linear and progressive trajectory toward man. Haeckel, he assumes, did not take seriously Darwin's conception of branching descent. Daniel Gasman has argued that Haeckel's "social Darwinism became one of the most important formative causes for the rise of the Nazi movement."¹⁶ Stephen Jay Gould concurs, maintaining that Haeckel's biological theories, supported by an "irrational mysticism" and a penchant for casting all into inevitable laws, "contributed to the rise of Nazism." Like Bowler, Gould holds that the biogenetic law essentially distinguishes Haeckel's thought from Darwin's.¹⁷ Adrian

¹³E. S. Russell, *Form and Function: a Contribution to the History of Animal Morphology* (Chicago: University of Chicago Press, 1982 [1916]), pp. 247-48.

¹⁴G. R. De Beer, *Embryos and Ancestors* (Oxford: Clarendon Press, 1940), p. 97.

¹⁵Peter Bowler, *The Non-Darwinian Revolution* (Baltimore: Johns Hopkins, 1988), p. 83-84. I have argued, on the contrary, that the recapitulational thesis forms the heart of Darwin's own theory of evolution. See Robert J. Richards, *The Meaning of Evolution: the Morphological Construction and Ideological Reconstruction of Darwin's Theory* (Chicago: University of Chicago Press, 1992), pp. 91-166. See also the exchange: Peter Bowler, "A Bridge Too Far," *Biology and Philosophy* 8 (1993): 98-102; and Robert J. Richards, "Ideology and the History of Science," *Biology and Philosophy* 8 (1993): 103-108.

¹⁶Daniel Gasman, *The Scientific Origins of National Socialism* (New York: Science History Publications, 1971), p. xxii. See also, Daniel Gasman, *Haeckel's Monism and the Birth of Fascist Ideology* (New York: Peter Lang, 1998).

¹⁷Stephen Jay Gould, *Ontogeny and Phylogeny* (Cambridge: Harvard University Press, 1977), pp. 77-81.

Desmond and James Moore divine the causes of Haeckel's mode of thinking in "his evangelical upbringing and admiration for Goethe's pantheistic philosophy [which] had led him to a mystical Nature-worship at the University of Würzburg."¹⁸ German historians of recent times have treated Haeckel hardly more sympathetically. Jürgen Sandmann considers Haeckel and other Darwinists of the period to have broken with the humanitarian tradition by their biologizing of ethics.¹⁹ Peter Zigman, Jutta Kolkenbrock-Netz, and Gerd Rehkämper—just to name a few other German historians and philosophers who have analyzed Haeckel's various theories and arguments—these scholars have rendered judgments comparable to their American and English counterparts.²⁰

Could this be the same scientist whom Darwin believed to be "one of the few who clearly understands Natural Selection"? The same individual whom Max Verworn eulogized as "not only the last great hero from the classical era of Darwinism, but one of the greatest research naturalists of all times and as well a great and honorable man"?²¹

¹⁸Adrian Desmond and James Moore, *Darwin: the Life of a Tormented Evolutionist* (New York: Norton, 1991), pp. 538-39.

¹⁹Jürgen Sandmann, *Der Bruch mit der humanitären Tradition: Die Biologisierung der Ethik beim Ernst Haeckel und anderen Darwinisten seiner Zeit* (Stuttgart: Gustav Fischer Verlag, 1990). See also his "Ernst Haeckels Entwicklungslehre als Teil seiner biologischen Weltanschauung," in Eve-Marie Engels (ed.), *Die Rezeption von Evolutionstheorien im 19. Jahrhundert* (Frankfurt a. M.: Suhrkamp, 1995).

²⁰See Peter Zigman, "Ernst Haeckel und Rudolf Virchow: Der Streit um den Charakter der Wissenschaft in der Auseinandersetzung um den Darwinismus," *Medizin Historisches Journal* 35 (2000), 263-302; Jutta Kolkenbrock-Netz, "Wissenschaft als nationaler Mythos: Anmerkungen zur Haeckel-Virchow-Kontroverse auf der 50. Jahresversammlung deutscher Naturforscher und Ärzte in München (1877)," Jürgen Link and Wulf Wülfing (eds.), *Nationale Mythen und Symbole in der zweiten Hälfte des 19. Jahrhunderts* (Stuttgart: Kolett-Cotta, 1991), pp. 212-36.; and Gerd Rehkämper, "Zur frühen Rezeption von Darwins Selektionstheorie und deren Folgen für die vergleichende Morphologie heute," *Sudhoffs Archiv* 81 (1997): 171-92.

²¹Max Verworn, "Ernst Haeckel," *Zeitschrift für allgemeine Physiologie* 19 (1921): i-xi; quotation from

Ernst Haeckel was a man of parts. It is not surprising that assessments of him should collide. I believe, however, that Darwin and Verworn, his colleagues, exhibited a more reliable sense of the man. This is not to suggest, though, that other of his contemporaries would not have agreed with the evaluations by the historians I have cited. The philosophers, especially the neo-Kantians, were particularly enraged. Erich Adickes at Kiel dismissed *Die Welträtsel* as “pseudo-philosophy.”²² The great Berlin philosopher Friedrich Paulsen erupted in molten anger at the book and released a flood of searing invective that would have smothered the relatively cooler judgments of the historians mentioned above. He wrote:

I have read this book with burning shame, with shame over the condition of general education and philosophic education of our people. That such a book was possible, that it could be written, printed, bought, read, wondered at, believed in by a people that produced a Kant, a Goethe, a Schopenhauer—that is painfully sad.²³

The zoologist Ludwig Rüttimeyer stumbled across one of Haeckel's more crucial lapses of judgment and instigated a charge of scientific dishonesty that would hound him for decades.²⁴ And, of course, Haeckel's continued baiting of the preachers and

p. i. Verworn was a student of Haeckel and later Professor of physiology at Göttingen, director of the Physiological Institute at Bonn, and editor of *Zeitschrift für allgemeine Physiologie*.

²²Erich Adickes, “The Philosophical Literature of Germany in the Years 1899 and 1900,” *The Philosophical Review* 10 (1901): 386-416; see especially 404-407.

²³Friedrich Paulsen, *Philosophia militans: Gegen Klerikalismus und Naturalismus* (Berlin: Reuther & Reichard, 1901), p. 187.

²⁴Ludwig Rüttimeyer, reviews of “E. Haeckel, ‘Ueber die Entstehung und den Stammbaum des Menschengeschlechts’” and “E. Haeckel, ‘Natürliche Schöpfungsgeschichte,’” *Archiv für Anthropologie* 3

theologians evoked from them an enraged howl of warning about "the depth of degradation and despair into which the teaching of Haeckel will plunge mankind."²⁵ Haeckel's evolutionary convictions fused together by the deep fires of his combative passions kept the human questions of evolution continually burning before the public, European and American, through last half of the nineteenth century and well into the next. The controverted implications of evolutionary theory for human life—for man's nature, for ethics, and for religion—might not have the same urgency they still hold today had Haeckel not written.

The measure of Haeckel is usually taken, I believe, using a one-dimensional scale. His acute scientific intelligence moved through many areas of inquiry—morphology, paleontology, embryology, anatomy, systematics, marine biology, and his newly defined fields of ecology and chorology (biogeography)²⁶—and to all of these he made important contributions. But more significantly, through a deft construction of evolutionary processes, he reshaped these several disciplines into an integrated whole, which arched up as a sign of the times and a portent for the advancement of biological science. He anchored this evolutionary synthesis in novel and powerful

(1868): 301-302. I will discuss the charges below.

²⁵R. F. Horton, "Ernst Haeckel's 'Riddle of the Universe,'" *The Christian World Pulpit* 63 (10 June 1903): 353-356; quotation from p. 353.

²⁶Haeckel was notorious for formulating jaw-breaking terms to define new or reconceived areas of research—"phylogeny," "ontogeny," and "ecology," being those that have stuck the tightest to contemporary theory. He defined ecology as "the entire science of the relationships of the organism to its surrounding external world, wherein we understand all 'existence-relationships' in the wider sense." Chorology was the "entire science of spatial dispersion of organisms, of their geographical and topographical spread over the earth's surface." Haeckel conceived chorology as part biogeography, part the morphology of populations (much in the manner of Alexander von Humboldt). See Ernst Haeckel, *Generelle Morphologie der Organismen*, 2 vols. (Berlin: Reimer, 1868): 2: 286-87.

demonstrations of the simple truth of the descent and modification of species. Haeckel supplied exactly what the critics of Darwin demanded, namely a way to transform a *possible* history of life into the *actual* history of life on this planet. Certainly he merited Darwin's accolade, and was, I believe, the English scientist's authentic intellectual heir. But Haeckel, needless to say, was not Darwin. His accomplishments must be understood as occupying a different scientific, social, and psychological terrain, through which passed a singular intellectual current that flowed powerfully even into the second half of the nineteenth century, namely, Romanticism.²⁷

Both by intellectual persuasion and temperament Haeckel was a Romantic. His ideas pulsed to the rhythms orchestrated particularly by Johann Wolfgang von Goethe, Alexander von Humboldt, and Matthias Schleiden. They, and other similarly disposed figures from the first half of the century, inspired Haeckel in the construction of his evolutionary morphology. They had proposed that archetypal unities ramified through the wild diversity of the plant and animal kingdoms. Such Urtypes focused consideration on the whole of the creature in order to explain the features of its individual parts. When the theory of the archetype became historicized in evolutionary theory it yielded the biogenetic law, the lever by which Haeckel attempted to lift biological science to a new plane of understanding. The Romantic thinkers to whom Haeckel owed much regarded nature as displaying the attributes of the God now in hiding; for them, and Haeckel as well, it was *Deus sive natura*—God and nature were

²⁷For a discussion of the ways the Romantic movement shaped biological thought in the first half of the nineteenth century, see See Robert J. Richards, *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe* (Chicago: University of Chicago Press, 2002).

one. This metaphysical persuasion required that the sterile mechanisms described by low-grade Newtonians be replaced by a fecund nature from whose creative depths greatly disparate forms could arise. Nature, under their conception, feigned no indifference to moral concerns or to beauty. Darwin himself, as I have tried to show elsewhere, shared this Romantic conception of nature.²⁸ These earlier Romantic scientists insisted that the understanding of organic forms, whether manifested in the individual or population, required not only theoretic evaluation but aesthetic consideration as well. The artistic features of organic forms had to be included in the proper assessment of their development and function; and for this purpose, Haeckel's talent with the artist's brush served him no less than his dexterity with the scientist's microscope. And just as Goethe sought the concrete realization of his theory of types in an aesthetically imagined primitive plant, the *Urpflanze*, so Haeckel pictured a polymorphous organism—a perverse sponge artfully conceived—that seemed to bring an ideal evolutionary theory into actual history.

Haeckel's Romanticism reached down to the inmost feelings of his being. So to comprehend his scientific achievement, we must also probe his character. The strategy of causally linking the theories and ideas of a scientist not only to other theories and ideas supplied by predecessors and contemporaries but to the hooks of character, the grappling rings of personality—this strategy is born of a historiographic conviction. I believe that historical understanding is causal understanding. And we achieve that understanding by determining, in the first place, what previous or co-terminus scientific theories or ideas caused the conceptions of concern. In this book I wish to explain why

²⁸ibid., epilogue.

Haeckel adopted Darwinian theory and why that theory came to have, in Haeckel's rendering, the special features it did. In this instance, I believe we account for Haeckel's initial acceptance of evolution, in large part, by uncovering his contact with the theory, his actual reading of Darwin's *Origin of Species*. But, of course, many other German biologists read Darwin in the 1860s but did not come away evolutionists, quite the contrary. We must, therefore, further situate his reading in the context of other ideas and intimate personal experiences that allowed Darwin's message to become, in Haeckel's case, virtually a religious conviction. Haeckel first read the *Origin of Species* immediately after research on a class of animals that provided evidence that bespoke species transmutation; but, again, such evidence would bear fruit only in a mind prepared by certain other fertile conceptions—in Haeckel's case prominently among them were those Romantic notions I have mentioned, as well as the traditions of morphology in which he was schooled. Ideas will have causal efficacy because of their logical and semantic character. But, once again, this can hardly be enough. Logic and meaningful fit of ideas have potency only if invested with it by the person. To adapt Novalis's adage, logic and semantics bake no bread. Only when the fire is struck from below, in the depths of personality, will logic and causal relations of ideas become solidified. The relations of ideas are human relations. Ideas that are logically or semantically fit to be cause and effect of one another must yet be brought into proximity and charged with causal energy through hopes and fears, desires and sufferings. Without the infusions of personality, ideas floating through the mind of a scientist will remain limp and anemic, poor effete creatures that evanesce away. So the study of Haeckel's scientific ideas, their origin and trajectory, must be grounded in his character

formation—in his *Bildung*, the Romantics would say—and in the enlarged passions of the man, in a deep need to find the truth about the world, especially a truth that would mitigate the overwhelming tragedy that touched virtually all of his work in evolutionary theory.

In the following chapters, then, I will trace the unfolding of Haeckel's thought, especially its Romantic connections, as it reaches up to the great synthesis of his early career, his *Generelle Morphologie der Organismen* (1866). This work, born in despair, formed the trunk whence sprang the many branches of his later science. In order to appreciate the resolving power of Haeckel's theory, I will treat in some detail his great monographs on various marine organisms that appeared in the decade and a half surrounding his *Generelle Morphologie*. These monographs, while still known to the relevant specialist in marine biology, remain only forbidding waters to most others. Yet these volumes reveal his remarkable abilities as a research scientist and display the singular discoveries by which Darwinian theory achieved concrete realization. Indeed, Haeckel's empirical accomplishments in his vast studies of marine fauna provide counterweight to the presumption of many contemporary historians that his evolutionary theory fled sound science to reside in a speculative dream land. Haeckel's research, richly detailed and technically sophisticated even to modern eyes, it must be admitted, reached back through theoretical and aesthetical attachments to the works of Goethe, Humboldt, Schleiden, and the Romantic morphologists. Yet this only indicates, as I will argue, that Romanticism had features attractive and fecund enough to seduce thoroughly modern science.

Haeckel did not remain hidden behind the researcher's microscope. Because of

great personal tragedy, he took on Darwinian theory as a kind of theological doctrine, recasting it as the foundation for his “religion of monism.” He preached this doctrine from a number of venues—the popular book, the vituperative essay, the revivalist lecture. These works brought him the admiration of a liberal, emancipated public during the first part of the twentieth century and allowed him to cultivate relationships with such political, intellectual, and artistic luminaries as Edward Aveling (consort of Karl Marx’s daughter and translator of *Das Kapital*), David Friedrich Strauss (theologian and author of the *Life of Jesus*), Ernst Mach (positivist and physicist at Vienna), and Isodora Duncan (free-lover and dancer, see fig. 4).

After his extraordinary empirical accomplishments of the 1860s and 1870s, Haeckel fought one battle after another, right through the First World War, against the enemies of his



Romantic evolutionism, that is, his passionately applied

Figure 4: Haeckel walking with a barefoot Isodora Duncan, who wrote "These fugitive recollections of Bayreuth, with the best wishes for the new year" (1904).

Darwinism. The heated controversies in which Haeckel became engaged reflect, from a particular perspective, the course of evolutionary theory from the second half of the nineteenth century through the first part of the twentieth. These controversies concerned internal disputes of evolutionists among themselves as well as external

conflicts with the enemies of evolution, at least Haeckel's anti-religious brand of evolution. The politics of evolution even spilled over into Haeckel's efforts to enlist scientists to ward off the coming Great War. I will sketch these battles and thereby offer one portrait of the course of evolution during the period. I will also attempt to develop several themes of more historiographic concern, namely: the rhetorical structure of disputes in science, the role of graphic representation in the explanation and demonstration of particular theories, and the justification for making ethical evaluations of historical figures.

Haeckel's greatest sin in the eyes of many historians and philosophers is that he was not Darwin. But not even Darwin was Darwin, at least as he is usually depicted in contrast to Haeckel. This study will, I hope, make it more difficult to dismiss Haeckel's scientific accomplishments as anti-Darwinian and to denigrate his character as meretricious. I also hope that this book will expose those Romantic roots of evolutionary theory that have made it bloom with such diverting and seductive ideas.

The Tragic Source of Contingency in Evolutionary Theory

Had Darwin or Haeckel not lived, I believe that in due course a theory like Darwin's would have been formulated—Alfred Russel Wallace, after all, came very close to beating Darwin to the punch, though it may have been a punch not many people would have felt, initially at least. But in Germany prior to 1859, there were several biologists of prominence who had advanced one or another version of a theory of descent with modification; for several, the great modifier was not natural selection but God. The fossil evidence, the biogeographical evidence, the anatomical evidence, the

embryological evidence, the practical evidence from breeders—during the first half of the century, all of these avenues had opened up and led to the same destination. Moreover, though many different devices had been proposed to explain transmutation, the analytic clarity of the principle of natural selection and the persuasive model of artificial selection could be expected, even without the *Origin of Species*, to reveal the power of the selective device, elevating it to become a leading contender for the position of chief causal source of species alteration. It is certainly not unreasonable to suppose, absent Darwin, that both of these ideas—descent with modification and natural selection—would have rather quickly become dominant in biological science during the latter part of the century. Why would they become dominant? Well, because, as the best evidence we have shows, they conform to features of the natural world.²⁹ How else to explain the rapid spread of evolutionary theory in radically different social cultures, political dispensations, and religious orientations in the last part of the nineteenth century—from Europeans to Asians, from social conservatives to liberal Marxists, from militant atheists to Jesuits?

So I reject the so-called “contingency thesis” proposed by several sociologists and historians of science.³⁰ The thesis itself cannot, I think, even be coherently expressed. The notion seems to be something like this: major features of science—the experimental method, for instance—need not have come to characterize a successful

²⁹There are certain Kantian problems with the concept of “the natural world” that need not be explored at this juncture.

³⁰Ian Hacking discusses the various formulations and implications of the contingency thesis in his *The Social Construction of What?* ([Cambridge: Harvard University Press], especially pp. 63-99). While he thinks the thesis not exactly clear, he admits some limited agreement.

modern science; rather those features resulted simply from a collocation of chance historical events that introduced and sustained them; the development of an equally effective modern science could have occurred without the techniques of empirical experiment.³¹ In this instance, the thesis cannot be coherently expressed because by “modern science” we mean that interconnected set of laws established by experimental procedures. No doubt, it might possibly have occurred that the Black Death was more lethal to European populations than was historically the case and that virtually the entire intellectual community was obliterated. One could imagine—though with some difficulty—that the saved remnants reverted to doctrinaire superstition that became fanatically entrenched, so that its system came to dominate what subsequently passed for intellectual thought. But simply said, that would not be science. It makes no sense to say that modern science could have developed quite nicely without modern (experimental) science. I don’t think the thesis could be rationally expressed if one focused on modern biology and held that it only contingently featured evolutionary theory. As Dobzhansky famously observed, nothing in biology makes sense except by reason of evolution. Thus again, without this major feature—evolutionary theory—one could not have the development of “modern biology.”

³¹This is the general thesis that Shapin and Schaffer worked out in their historical analysis of the controversy between Thomas Hobbes, whom they take to reject experimental methods to establish the fundamental elements of science, and Robert Boyle, whom they represent as advancing those methods. See Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump* (Princeton: Princeton University Press, 1985). They say: “... we want to show that there was nothing self-evident or inevitable about the series of historical judgments in that context [of the Hobbes-Boyle debate] which yielded a natural philosophical consensus in favour of the experimental programme. Given other circumstances bearing upon that philosophical community, Hobbes’s views might have found a different reception” (p. 13). Shapin and Shaffer further contend that the victory of Boylean experimentalism in the history of early modern science was inextricably intertwined with his political and religious ideology—a quite contingent matter—and that this connection was a principal factor in the success of his programme (pp. 80-109).

Well, these may seem like the niggling semantic objections of a paleo-positivist. I do believe, nonetheless, they go quite deep. Yet, for my purposes in this history, it is not crucial that the reader accept these analytical objections to the contingency thesis. Indeed, I want to argue for an attenuated version of the thesis, a version that, I think, can be coherently stated. This version considers certain non-essential aspects of modern evolutionary theory, namely its materialistic and anti-religious features. These, I believe, are contingent cultural traits of the modern theory. As I have attempted to show elsewhere, many of the early proponents of Darwinian theory were both spiritualists—that is, they accepted a non-materialistic metaphysics—and believers—that is, they integrated their scientific views with a definite, or sometimes an indefinite, theology.³² Asa Gray, William James, and Conwy Lloyd Morgan are just a few prominent examples of advocates of evolutionary theory but who rejected a stony, desiccated materialism. Yet during the late nineteenth and through the twentieth centuries, the cultural representation of the evolutionary doctrine more and more took on a different cast: evolutionary theory became popularly understood as materialistic and a-theistic, if not atheistic. I believe this cultural understanding is principally due to the tremendous impact and polarizing influence of Ernst Haeckel. Had Haeckel not lived, I think evolutionary theory would have turned a less strident face to the general public. At least, the antagonism with religion would not have been so severe. It was Haeckel's formulations that, as I will try to show, created the texture of modern evolutionary theory as a cultural product. My thesis is even more specific, namely: that had Haeckel not

³²See my *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (Chicago: University of Chicago Press, 1987), pp. 331-408.

suffered the tragic event that caused him to dismiss orthodox religion as unmitigated superstition and to advance a militant monistic philosophy, his own version of Darwinian theory would have lost its distinctively aggressive features, and that these features would not have bled over into the general cultural perception of the doctrine. In the following, I will attempt to show that modern evolutionary theory has the cultural face that it does because of Haeckel's tragic sense of life.