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ROBERT J. RICHARDS

ERNST HAECKEL

A DREAM TRANSFORMED

Ernst Haeckel (1834–1919) was Darwin’s foremost champion, not only in Germany but throughout the world.¹ More people at the turn of the century learned of evolutionary theory from his pen than from any other source, including Darwin’s own writings. His book *Die Welträtsel* (Riddles of the world, 1899) sold more than four hundred thousand copies before the First World War, and was translated into most of the known and many of the unknown languages of the world, including Esperanto. The great historian of biology Erik Nordenskiöld writing in the first decades of the twentieth century, judged that Haeckel’s *Natürliche Schöpfungsgeschichte* (Natural history of creation, 1868), which went through twelve editions during his lifetime, was the world’s introduction to Darwinian evolutionary theory.²

In addition to being an extraordinary research scientist, Haeckel was an artist of considerable accomplishment. He filled his twenty or so technical monographs and several popular books with his own illustrations, which furnished much of the persuasive power of his monographs. Darwin’s *Origin of Species* included only one generic line drawing. Haeckel’s illustrations, however, would ignite a controversy among professional biologists and religious objectors that still smolders even today. If one sought the source of the long-standing enmity between evolutionary thinkers and the religiously orthodox, one could start and finish with Ernst Haeckel. Unlike Darwin, he relentlessly attacked what he took as religious superstition, especially when religion became mixed with biology. His attitude was reciprocated by the Church.

Haeckel’s heterodox reputation did not, however, dampen the enthusiasm of his students. He drew to his small university outpost in Jena, in the center of the German lands, some of the best biologists of the next generation, including the brothers Oskar (1849–1922) and Richard Hertwig (1850–1937), Wilhelm Roux (1850–1924), and Hans Driesch (1867–1941), all of whom made their marks by the turn of the century.

Haeckel’s legacy is palpable even today. He introduced into biology many concepts that remain viable, including the idea that the nucleus of the cell contains the hereditary material, as well as the concepts of phylogeny, ontogeny, and ecology. He was among the first to use the graphic device of the evolutionary tree and made it a fixture of evolutionary explanation. That device,



Figure 2.1. Ernst Haeckel (*seated*) and his assistant Nikolai Miklucho on the way to the Canary Islands in 1866. Haeckel had just visited Darwin in the village of Downe. Courtesy of Ernst-Haeckel-Haus, Jena.

along with Haeckel's emphasis on phylogenetic development, shifted the orientation of evolutionary studies dramatically, especially as newly discovered species had to be fitted into proliferating branches of the tree of life. It is likely that more newly discovered organisms have his name attached than that of any other biologist.³ Haeckel popularized the idea of the missing link between man and the apes, and his protégé Eugene Dubois (1858–1940) found its remains in Java—that is, the first fossils of *Homo erectus*.

We owe to Haeckel the currency of the biogenetic law that ontogeny reca-

pitulates phylogeny. The principle states that the embryo goes through the same morphological stages as the phylum went through in its evolutionary descent. The human embryo, for instance, begins life as a one-celled creature, just as we suppose life began in the sea as a single reproducing cell; then the embryo takes on the form of an invertebrate, then something like a fish, then a primitive mammal, a primate, and finally a distinctive human form. Though Darwin quite early on had embraced the recapitulation hypothesis, he was emboldened by the confirmation his friend offered. Haeckel's theory of the mind-brain relationship had a measured impact on Darwin's own views about the evolution of human beings.

Haeckel's innovations in evolutionary theory completely altered the texture of the discipline, from his use of tree diagrams to his introduction of novel concepts and his elevation of the principle of recapitulation as both crucial evidence for evolution and as a proximate cause of phylogenetic continuity. He laid the empirical foundations of evolutionary transitions and introduced experimental procedures to secure those foundations (see below). But if one sought the lasting impact of this revolutionary thinker, it would be found in a more abstract contribution that has had extensive concrete effects on cultural life up to the present time: he argued with telling consequence that human beings were completely natural animals. Darwin only suggested this and usually side-stepped the issue. Haeckel made it his central argument, especially as against theologically minded scientists and spiritually engrossed philosophers. Haeckel almost single-handedly excavated one of the deepest fissures of our contemporary intellectual life. And all because he had a dream.

HAECKEL'S DREAM

While working on his medical dissertation, the young Haeckel had a dream. It was of a "true German child of the forest, with blue eyes and blond hair and a lively natural intelligence, a clear understanding, and a budding imagination."⁴ That dream was embodied in Anna Sethe (1835–1864), his first cousin. Haeckel had met her only occasionally at family gatherings; but in 1857, when she and her mother moved to the outskirts of Berlin, where Haeckel was working on his dissertation, they became inseparable. Their growing love turned into an engagement, though one with an indefinite promise of marriage, delayed until Haeckel had the security of a job. In letters that recounted his waking dream, the poetically inclined medical student would recall to Anna recent excursions, for example, one in which they made their way through the forest to a mountain stream, where they lay down on a mossy bank:

And your sighing breath, your warm cheek on mine announced to me at every blissful second that sweet unspeakable happiness that I held in my arms, close and sure, so that I might never lose it. Then we lay on my good old plaid, placed on the natural bed of the forest, upholstered with dry beech leaves . . . O, Anna, those were moments I will never, never forget, moments of the greatest human happiness . . . One forgets heaven and heart, past and future, and lives purely and completely in the present. Here Faust himself could exclaim, “Tarry a while, you are so beautiful,” so he might secure the moment which sadly only too quickly dissolves.⁵

Though Haeckel desperately wanted to marry his cousin, the practice of medicine would not be the financial route, since he could not abide the thought of dealing with patients. He received an invitation for habilitation research from Carl Gegenbaur (1826–1903) at Jena, who had been an acquaintance at medical school in Würzburg. He and Gegenbaur were to have traveled together to southern Italy, but when his mentor was advanced to ordinarius professor (roughly full professor in the American system), obligations kept the older naturalist at the university. Haeckel decided to travel alone. He had no secure idea for a research subject; he simply hoped some marine organism would capture his imagination. But he also saw in this travel an opportunity to indulge his growing passion for artistic development—and his talent as a painter had begun to bloom. Thus, the Italian journey would also be one of *Bildung*, of cultural and artistic formation.

At the end of January 1859, Haeckel left Berlin, traveling down the Italian boot, lingering in Florence and Rome, where he took in the museums and art galleries, but finally arriving in Naples at the end of March to begin serious work on his research. In the morning, after a swim in the bay, he would inspect the catches the fishermen brought ashore from this marine Eldorado. But in that wealth he could not find his way, and grew increasingly unhappy, a tale of frustration that he detailed in his many letters to Anna. In June, no longer able to stomach the city, he packed up his sketch pads and paints, and escaped to the island of Ischia, just across the bay. There he fell in with another German, the poet and painter Hermann Allmers (1821–1902), who would become his lifelong friend. They tramped through the island, visiting the ruins of past civilizations while glorying in the natural beauty of the landscape. They indulged each other’s interests, Allmers inquiring about botany and marine biology, while Haeckel gave himself over to “the misty distances of a dreamy poetry.” Haeckel wrote Anna that his new friend “struck a responsive chord in me, has awakened feeling and effort that I believed had already completely died; and in a sense, he has given me back to myself.”⁶ In August,

Haeckel and his new friend set sail for Capri, where they would indulge in the bohemian life of hiking through the countryside, bathing in small lakes, and painting. Haeckel felt the temptation to abandon his academic pursuits and to give himself over completely to his artistic desires—except that he kept returning in imagination to that dream, a life with Anna, which steeled him to achieve his professional goal.

The urge to abandon an academic career was born, partly at least, out of frustration in finding the right kind of organism to study amid the mountains of beautiful and astounding animals that fishermen had brought up from the waters of the bay: siphonophores, petropods, heteropods, medusae, sponges, and more—some whole families of creatures never before classified or described. Haeckel finally hit on one group of animals, virtually infinite in profusion yet remaining almost unknown to the biologist—the radiolarians. These one-celled animals are the size of a pinhead and secrete an exoskeleton of silica. About 20% of the muck lying at the bottom of the oceans consists of their skeletons. Their species are distinguished by the unusual geometries the skeletons exhibit. Haeckel became entranced by their beauty, and in the illustrations for his prize-winning monograph, their images grow to the size of the sun compared to the Earth of these very small creatures. When Darwin received the gift of Haeckel's two-volume *Die Radiolarien*, he declared them to be “the most magnificent works which I have ever seen.”⁷

Haeckel returned to Berlin in April 1860 and began the writing of his habilitation, the German equivalent of a second thesis. He finished the work in 1861 and had it rendered into Latin, still the required language for this kind of academic exercise. He continued his study of the radiolarians, ultimately turning his research into the book that Darwin so much admired, a giant two volumes on the classification and description of the many species, genera, families, and orders of those organisms he had newly discovered and those few already known. The first volume of 570 pages was accompanied by an atlas of thirty-five copper-etched plates, some brilliantly colored to show the inner cellular capsule surrounded by the skeletal frame. Haeckel said he attempted a natural system, rather than a Linnaean artificial system, because of the extraordinary book he had read while preparing his specimens, *Über die Entstehung der Arten im Thier- und Pflanzen-Reich durch natürliche Züchtung* by the English naturalist Charles Darwin.⁸ What especially excited the young disciple was the opportunity the translator, Georg Bronn, had brought to the fore. Bronn had added an appendix to his translation of the *Origin of Species*, in which he argued that the Englishman had offered a theory merely of the possibility of descent. Haeckel thought his own research demonstrated the reality of descent, at least in the case of the radiolarians.

Haeckel received an invitation from Gegenbaur to become his assistant at Jena and to serve there as Privatdozent (a lecturer paid by students) and he readily accepted. During his teaching and research duties, he worked feverishly on his radiolarian book. With its publication in spring of 1862, he was offered an advancement to the permanent position of extraordinary professor in the medical faculty. He immediately wrote Anna to boast of his elevation to the “Archducal-Saxonish-Weimarish-Colburgish-Altenburgish-Meiningenish Extraordinary Professor.”⁹ The advancement solidified his financial situation, though an added contribution from his father did help. Now the dream could become reality—a life with the “loveliest, and purest maiden soul.” Anna promised “everything that science cannot give.”¹⁰ Haeckel and Anna were married in Berlin on 18 August 1862.

From the time Haeckel first read the *Origin of Species*, his devotion to the Darwinian theory almost rivaled his affection for Anna—so much so that she had taken to referring to him as “her German Darwin-husband.”¹¹ Through his publications and lecturing, Haeckel’s support for Darwin became better known to the public, and he was invited to lecture on Darwinian theory at the first plenary session of the Society of German Natural Scientists and Physicians, which met in the Prussian city of Stettin during September 1863.¹² As judged by the reporter from the *Stettiner Zeitung*, Haeckel’s “exciting lecture” met with “a huge applause.”¹³

Anna had accompanied her husband to Stettin and undoubtedly gloried in the adulation he received. When they returned to Jena, he plunged into further study and application of Darwinian theory. He wrote Allmers just before Christmas that “I am now convinced that a great future lies before this theory and that it will slowly but surely loose us from the bonds of a great and far-reaching prejudice. For this reason, I shall dedicate my whole life and efforts to it.”¹⁴

In his pursuit of Darwinian theory, Haeckel expected to continue receiving the loving support of Anna. But shortly after writing Allmers, in late January of 1864, Anna suffered a severe attack of pleurisy, which lasted through the first part of February. She recovered, but then in mid-February she again became ill with severe abdominal pains. In the evening of February fifteenth, the pains became acute. The next day, Haeckel’s thirtieth birthday and the day he received word that his radiolarian book had been awarded a significant prize, his beloved wife of eighteen months died. Haeckel became mad with grief, falling unconscious and remaining in bed for some eight days in partial delirium. The dream of this “German Darwin-husband” had evanesced in an acrid vapor. His parents thought he might commit suicide and

arranged to have him travel to Nice to attempt some kind of recovery. From the southern coast of France, he wrote them a searing letter:

The last eight days have passed painfully. The Mediterranean, which I so love, has effected at least a part of the healing cure for which I hoped. I have become much quieter and begin to find myself in an unchanging pain, though I don't know how I shall bear it in the long run. . . . You conclude . . . that man is intended for a higher, godlike development, while I hold that from so deficient and contradictory a creation as man, a personal progressive development after death is not probable; more likely is a progressive development of the species on the whole, as Darwinian theory already has proposed it. . . . Mephisto has it right: "Everything that arises and has value comes to nothing."¹⁵

Thereafter on his birthday, Haeckel harbored thoughts of suicide. In 1899, he wrote a dear friend, an Anna reincarnated, "Thursday, 16 February, is my sixty-fifth birthday, for me the saddest anniversary of the year, since on this same day in 1864, I lost my most beloved and irreplaceable first wife. On this sad day, I am lost."¹⁶ After thirty-five years, the memory of great happiness oppressed by great sorrow had remained vivid.

While recovering along the shore of the Mediterranean, Haeckel chanced to notice in a tidal pool a medusa—a jellyfish—the tendrils of which reminded him of Anna's golden braids. He named it in memory of his wife, *Mitrocoma Annae*—Anna's headband. Next to the illustration that would later appear in *Das System der Medusen* (1879), Haeckel wrote, "I name this species, the princess of the Eucopiden, as a memorial to my unforgettable dear wife, Anna Sethe. If I have succeeded, during my earthly pilgrimage in accomplishing something for natural science and humanity, I owe the greatest part to the ennobling influence of this gifted wife, who was torn from me through sudden death in 1864."¹⁷ Haeckel wrote this while married to his apparently forgettable second wife, Agnes. The living dream of Anna and happiness were supplanted by Darwinian theory and a strident determination to combat biological orthodoxy and religious superstition—at least the pattern of evidence, which I relate in the remaining part of this essay, suggests this transformation.

Haeckel returned from France in the summer of 1864 to a home empty of the joy it once knew. He threw himself into his classes, brief diversionary travel, and then began, demonlike, to compose a treatise that would be the definitive application of evolutionary theory. After eighteen-hour days over the period of a year, he delivered to his publisher a large, two-volume work

of more than one thousand pages, with a concluding forest of plates depicting tree diagrams of systematic relationships. His *Generelle Morphologie der Organismen* (1866) sought to explain those relationships through the devices that Darwin had advanced: namely, natural selection and the inheritance of acquired characteristics. Depending on the traits and the situation of the organism, one of these devices might be emphasized more than the other.¹⁸ Through the course of Haeckel's career, he tilted to the Lamarckian notion, but kept natural selection at the ready. Haeckel, though, emphasized another explanatory principle—namely, the principle of recapitulation.¹⁹ He gave an extended definition of the principle in his *Generelle Morphologie*: “The organic individual . . . repeats during the quick and short course of its individual development the most important of those changes in form that its ancestors had gone through during the slow and long course of their paleontological development according to the laws of inheritance and adaptation.”²⁰ As he more succinctly phrased it, “Ontogeny is nothing other than a short recapitulation of phylogeny.”²¹ For Haeckel, the principle was both evidence for evolutionary transmission as well as a causal explanation for the early developmental features of the embryo. He did not assume that recapitulation would be perfect. The more the embryo was subject to environmental forces—for example, when the larvae of insects or marine organisms were exposed to the impact of natural selection—the greater the differences between ancestor and embryo. Thus Haeckel modified the principle of recapitulation with the corollaries of *palingenesis*—when the recapitulation was very close—and *cenogenesis*—when the differences were more extreme.²²

The final two chapters of Haeckel's magnum opus transformed the dream that Anna had realized in living form into something else—a conception of unity in the depths of nature. Chapter 29 was prefaced by Goethe's poem *Prometheus*, in which Prometheus renounced Zeus and chose to cast his lot with suffering humanity. The chapter declared that the only sure path to truth for human beings was through the rational and empirical methods of science, a science that had no room for an anthropomorphic God, an “imaginary, gaseous substance” (*Vorstellungen von gasförmigen Materien*).²³ The last chapter asserted the metaphysical perspective that lay behind the previous thousand pages of technical discussion of evolutionary systematics and morphology. Haeckel advanced a monistic conception of nature as understood by Goethe: “the unity of God with the whole of nature”—it was Spinoza's “Deus sive Natura.” This kind of monism postulated mind and matter as properties of an underlying substance that was neither. In Haeckel's naturalistic theology, “God is the almighty; he is the sole creator, the cause of all things; in other words: God is the universal causal law.”²⁴ Haeckel's version of monistic meta-

physics is exactly of the sort that branded Spinoza with the insignia of atheism. But it also had a different kind of religious meaning. Since the conservation laws of physics held that force and matter could not be destroyed, Anna might be yet preserved in nature. She would not die forever.

The dream of a life with Anna had been transformed into one of a different kind: the pursuit of nature through the scientific instruments of evolutionary theory. Of course, Haeckel had already begun the pursuit while Anna was still a warm presence. But now he undertook it as a religious mission. He informed Darwin of this new urgency. In a letter of 7 July 1864, he wrote of the great tragedy that had “hardened me against the blame as well as the praise of men, so that I am completely untouched by external influence of any sort, and only have one goal in life, namely, to work for your descent theory, to support it, and perfect it.”²⁵ In a subsequent letter in October, he made clear to Darwin that he sought to recover in his work the love that he had lost: “Now in my isolation, which since the death of my wife is so lonesome, this engrossing work is a great consolation, and I toil at it with so great an enthusiasm as if my Anna herself drove me to its completion and had left this task as a memorial.”²⁶

After the exhausting work on his *Generelle Morphologie*, Haeckel and his assistants escaped to the Canary Islands for research. But on the way, they passed through London, and then Haeckel took a train to the village of Downe to meet his master, Charles Darwin. It would be the first of three visits, interspersed with a flow of letters between the two naturalists. Upon his return to Jena in spring of 1867, he renewed an acquaintance with the daughter of a former professor at the university, Agnes Huschke (1842–1915). In desperate hope and daring haste, he asked Agnes to marry him. Almost from the beginning, it became clear to him that this young woman could not replace the unforgettable Anna. Agnes hated the polemics in which her husband engaged, and she became afflicted with the nineteenth-century disease of neurasthenia. Haeckel’s marriage was successful only in the biological sense; they had three children.

HAECKEL’S SUBSEQUENT RESEARCH: THE DARWINIAN DREAM REALIZED

Through the last quarter of the nineteenth century and into the first decades of the twentieth, Haeckel pursued his dream not only of bringing the realms of nature under the aegis of Darwinian theory but also of exorcising the kind of superstitious belief that had haunted so much of natural science. Though Jena remained his home base for the rest of his career, almost every year he was away conducting research or lecturing, returning for several

months to meet his teaching duties and settle in with his family. His first major research venture after Anna's death took him to the Canary Islands and Spain during the fall and winter of 1866–1867. This research resulted in a prize-winning work on siphonophores and three volumes on sponges.²⁷ In the spring of 1873, he traveled to Egypt and down to the Red Sea, which yielded a beautiful study of the region's corals, augmented by several of his paintings of desert scenes.²⁸ He sailed with the “golden brothers” Hertwig in the spring of 1875 to Sardinia and Corsica, where he collected numerous specimens of medusa; and in February 1877 he journeyed to Corfu for more research on jellyfish. During the late summer of 1878, he spent several weeks off the coasts of Normandy and the Isle of Jersey, adding to the materials on radiolarians and medusae. These several excursions resulted in two beautifully illustrated volumes on medusae, his *System der Medusen*.²⁹ In October of 1880, Haeckel left Jena with sixteen large trunks to begin his first journey to the far east (a second to Sumatra and Java would occur in 1900). In mid-November he reached Colombo, the capital of Ceylon (now Sri Lanka), and headed down the coast, where he discovered ever more species of radiolarians and medusae. When he returned to Jena in mid-April of 1881, he began work on a new and extraordinary project: the description of material from the *Challenger* expedition.

The *Challenger* was a British research ship that spent three and a half years (1873–1876) dredging the Atlantic and Pacific oceans, pulling up all manner of marine life and testing the chemical composition of the seas. The materials were sent to experts all over the world to be described and classified, and the subsequent results appeared in fifty large folio volumes. Because of his extraordinary reputation for research, Haeckel was asked to work on radiolarians, medusae, siphonophores, and sponges. His study of radiolarians, which included much of his own material, described more than four thousand species in two large folios of 1803 pages; a third volume of 140 plates completed the study. Those volumes appeared in 1887. His research on medusae produced a preliminary volume in 1881, and two *Challenger* tomes the next year. The years 1888 and 1889 saw the remaining *Challenger* volumes on siphonophores and sponges.³⁰ The commission Haeckel received to describe the *Challenger* materials testifies to his standing as a research scientist in the eyes of his colleagues, as does the continued support given by such stalwarts as Thomas Henry Huxley, August Weisman, Hermann von Helmholtz, and Darwin himself.

Through his many publications, Haeckel contended that the specific areas of marine biological systematics could only be understood in terms of evolutionary theory. In the *Origin of Species*, Darwin had composed “one long ar-

gument.” Haeckel’s research solidified the long argument, planting it firmly on empirical ground of an extent unmatched by any other biologist of the period. But Haeckel not only drew upon his systematic observations of marine life and his ability to conceive of that life as branches of a living evolutionary tree, but he accomplished what virtually no other evolutionary scientist of the nineteenth century was able to do—namely, he introduced experimental procedures into his discipline.

During his stay in the Canary Islands in fall and winter of 1866–1867, just after his visit with Darwin, Haeckel performed a series of experiments on siphonophores (jellyfish-like organisms in the phylum of Cnidaria) that aimed to demonstrate species transitions. He undertook three kinds of experiments. First, he followed the larval development of species from ten different genera of siphonophores, showing their virtual identity at early developmental stages. In light of the biogenetic law, this identity suggested a common ancestral form. Second, during larval development, he altered environmental conditions (e.g., water temperature, water movement, amount of light, salinity, etc.). The effects were surprising: the manipulations not only showed the susceptibility of embryos to changed conditions (thus supporting the inheritance of acquired characters), but the alterations revealed morphologically distant species forms hidden beneath those of the particular species on which he was experimenting. The most significant set of experiments anticipated the work of his two students, Wilhelm Roux and Hans Driesch, in developmental mechanics some twenty years later.

In this third set of experiments, Haeckel used a fine needle to separate the cells of two-day-old embryos into two, three, or four groups of cells, and then watched the further development of these groups into separate embryos. In six cases, development got to the sixth day; in three of those, development proceeded to the eighth day; two reached the tenth day; and one went to day fifteen. The embryos were morphologically complete, though smaller than normal embryos. Though he didn’t explicitly draw this conclusion, his experiments nonetheless showed that cells of embryos at early cleavage stages were totipotent—they had the capacity to develop into all the parts of the organism. Only in the late 1880s, did Roux and Driesch produce comparable experiments, which led to the enterprise of developmental mechanics.³¹

Haeckel’s empirical work in establishing evolutionary theory—and the fame it brought—served as a tactical advantage: it gave him the authority and leverage for launching bristling attacks against the ingressions of anthropomorphic religion into science. Haeckel’s religion was that of Spinoza and Goethe, that is, *Deus sive Natura*. In October of 1892, he gave a lecture explicating his brand of religion: *Der Monismus als Band zwischen Religion und*

Wissenschaft (Monism as the bond between religion and science). The lecture and subsequent publication, which would reach a seventeenth edition just before Haeckel's death in 1919, became the foundation for his even more successful *Die Welträthsel* seven years later. Both argued for a universe of atoms swimming through waves of ether and governed by attractive and repulsive forces. From the inorganic up through levels of biological organization, no unbridgeable barriers arose blocking evolutionary transformations. In this monistic universe, the properties of matter and mind ran together as united in an underlying substance, even down to the simplest atom. One might thus speak of the human soul and the central nervous system in one breath. A reviewer of the English translation of *Die Welträthsel* for the *New York Times* summed up the book as follows: "One of the objects of Dr. Haeckel—is it would not be unfair to say the chief object—is to prove that the immortality of the human soul and the existence of a Creator, designer, and ruler of the universe are simply impossible."³² While Haeckel's monistic system provided a philosophical foundation for then-current physics and biology and a counter to anthropomorphic religion, it had a more personal support.

CONCLUSION: LIFE IN NATURE

In the *System der Medusen*, in which he pictured a yellow-tinted *Mitrocoma Anna*, the medusa that reminded him of his first wife, Haeckel included another newly discovered medusa sent to him from South Africa by his cousin Wilhelm Bleek, also a cousin of Anna Sethe. He named it *Desmonema Annasethe*. It came to him in a soldered tin preserved in spirits of wine. By the time it arrived, it was a mess, crumpled and denatured of most of its color. Haeckel represented it in monochromatic brown—it's still preserved in the natural history museum in Jena as a ghostly white, mostly a translucent tangle lying at the bottom of a glass container. That poor creature underwent a transformation during the succeeding years of Haeckel's career, just as Anna had in his memory, becoming ever more lovely over time. In 1899 through 1904, Haeckel began issuing fascicles of an art book he was composing, his *Kunstformen der Natur* (Art-forms of nature, 1904).³³ He employed many of the illustrations from his monographs, now represented in new settings and with vibrant, lithographic colors. The wan *Mitrocoma Anna* found no place in the art book, while the original illustration of *Desmonema Annasethe* had been dramatically and beautifully transformed for a new appearance (fig. 2): "The species name of this extraordinary Discomedusa—one of the loveliest and most interesting of all the medusa—immortalizes [*verewigt*] the memory of Anna Sethe, the highly gifted, extremely sensitive wife of the

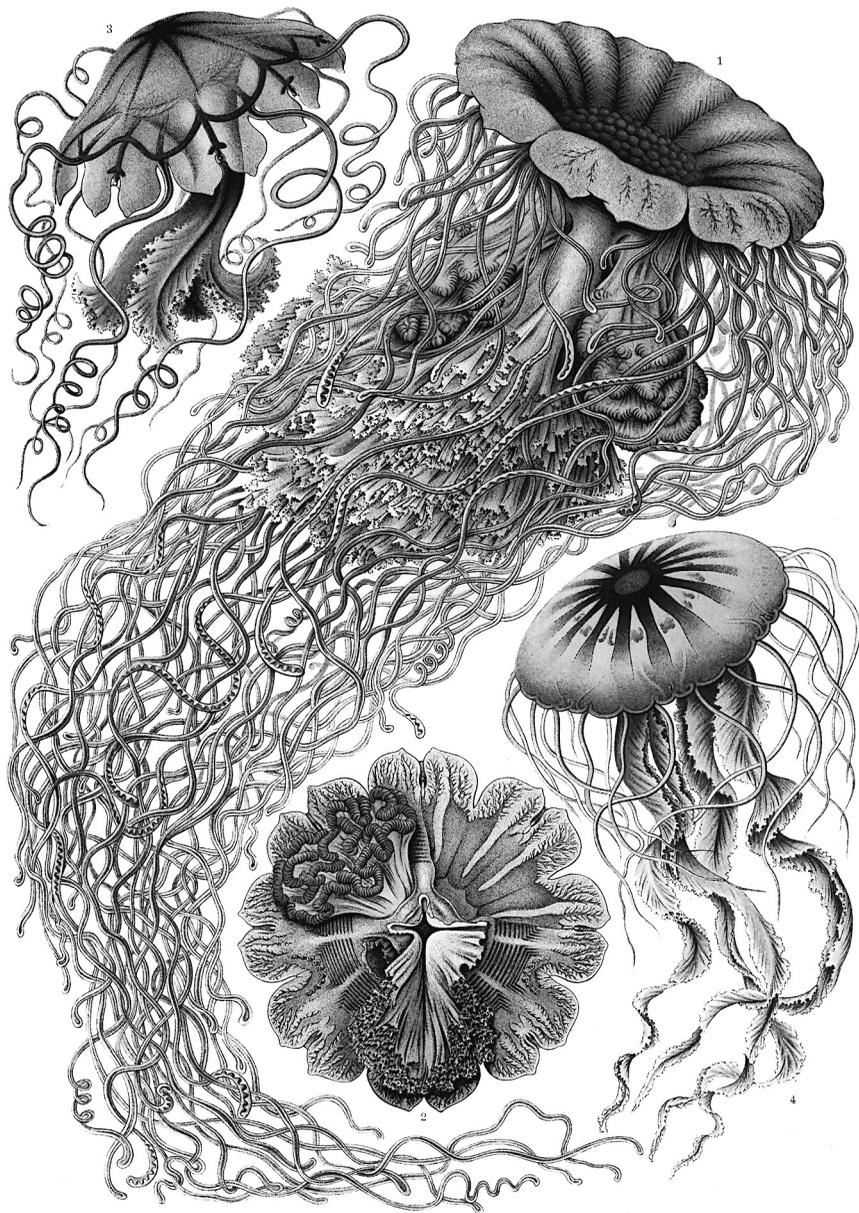


Figure 2.2. *Discomedusa Desmonema Annasethe*. From Haeckel's *Kunstformen der Natur* (1904).

author of this work, to whom he owes the happiest years of his life.”³⁴ In his artistic imagination, the original dream of a German girl had been magically altered into a creature still living in the seas. Love had fled and hid her face among sea-creatures. Nature had not proved completely foreign to human aspiration and hope.

FURTHER READING

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NOTES

1. This essay is based on my book *The Tragic Sense of Life: Ernst Haeckel and the Struggle over Evolutionary Thought* (Chicago: University of Chicago Press, 2008).
2. Erik Nordenskiöld, *The History of Biology: A Survey*, trans. Leonard Eyte, 2nd ed. (1920–24; repr., New York: Tudor, 1935), 515.
3. For example, of the 684 registered radiolarian species discovered from before Haeckel's time to the present, Haeckel identified more than 22%. From the nineteenth century to the present, Haeckel described more of the recognized genera in the subclass Calcaronea (calcinated sponges) than any other researcher. His discoveries ranged over many classes of organisms.
4. Haeckel to a friend (14 September 1858), in *Himmelhoch Jauchzend: Erinnerungen und Briefe der Liebe*, ed. Heinrich Schmidt (Dresden: Carl Reissner, 1927), 67.
5. Haeckel to Anna Sethe (26 September 1858), in Schmidt, *Himmelhoch Jauchzend*, 72–73.
6. Haeckel to Anna Sethe (25 June 1859), in Schmidt, *Himmelhoch Jauchzend*, 69.
7. Charles Darwin to Haeckel (3 March 1864), in *The Correspondence of Charles Darwin*, vol. 12, 1864, ed. Frederick Burkhardt et al. (Cambridge: Cambridge University Press, 2001), p. 61.
8. Charles Darwin, *Über die Entstehung der Arten im Thier- und Pflanzen Reich durch natürliche Züchtung; oder Erhaltung der vervollkommnesten Rassen in Kampfe um's Daseyn*, trans. Georg Bronn (Stuttgart: Schweizerbart'sche, 1860).
9. Haeckel to Anna Sethe (17 June 1862), in Schmidt, *Himmelhoch Jauchzend*, 281.
10. Haeckel to Anna Sethe (7 June 1861), in Schmidt, *Himmelhoch Jauchzend*, 187.

11. Haeckel to Charles Darwin (10 August 1864), in *The Correspondence of Charles Darwin*, 24 vols. to date (Cambridge: Cambridge University Press, 1985–), 12: 298–300.
12. Ernst Haeckel, “Ueber die Entwicklungstheorie Darwins,” in *Amtliche Bericht über die acht und dreißigste Versammlung Deutscher Naturforscher und Ärzte in Stettin* (Stettin: Hessenland’s Buchdruckerei, 1864), 17–30.
13. *Stettiner Zeitung*, no. 439 (20 September 1863).
14. Haeckel to Allmers (15 December 1863), in *Ernst Haeckel: Sein Leben, Denken und Wirken*, ed. Victor Franz, 2 vols. (Jena: Wilhelm Gronau und W. Agricola, 1943–44), 2:36.
15. Haeckel to his parents (21 March 1864), in Schmidt, *Himmelhoch Jauchzend*, 318–19.
16. Haeckel to Frieda von Uslar-Gleichen (14 February 1899), in *Das ungelöste Welt-rätsel: Frida von Uslar-Gleichen und Ernst Haeckel. Briefe und Tagebücher 1898–1900*, ed. Norbert Elsner, 3 vols. (Berlin: Wallstein, 2000), 1:128.
17. Ernst Haeckel, *Das System der Medusen*, 2 vols. (Jena: Gustav Fischer, 1879), 1:526–27.
18. Darwin, it is well recognized, held a belief in the inheritance of acquired characteristics from the beginning of his career to the end. In *On the Origin of Species* (London: Murray, 1859), he affirms this quasi-Lamarckian theory (134): “I think there can be little doubt that use in our domestic animals strengthens and enlarges certain parts, and disuse diminishes them; and that such modifications are inherited.”
19. Bowler states that “recapitulation theory thus illustrates the non-Darwinian character of Haeckel’s evolutionism.” See Peter Bowler, *The Non-Darwinian Revolution* (Baltimore: Johns Hopkins University Press, 1988), 84. Other historians who have thought Darwin did not endorse the recapitulation hypothesis are E. S. Russell, Stephen Jay Gould, Dov Ospovat, and Ernst Mayr. However, on page 1 of Darwin’s first transportation notebook, *Notebook B*, he enunciates the principle, and he restates it in *On the Origin of Species* (London: Murray, 1859): “As the embryonic state of each species and group of species partially shows us the structure of their less modified ancient progenitors, we can clearly see why ancient and extinct forms of life should resemble the embryos of their descendants,—our existing species” (449). By “their less modified ancient progenitors,” Darwin meant the adult ancestors of the current species, something he is explicit about in the sixth edition of the *Origin*. See my discussion in *The Meaning of Evolution* (Chicago: University of Chicago Press, 1992), 152–66.
20. Ernst Haeckel, *Generelle Morphologie der Organismen*, 2 vols. (Berlin: Georg Reimer, 1866), 2:300.
21. Haeckel, *Generelle Morphologie*, 2:7.
22. Haeckel introduced this terminology in “Die Gastrula und die Eifurchung der Thiere,” *Jenaische Zeitschrift für Naturwissenschaft* 9 (1875): 409.
23. Haeckel, *Generelle Morphologie*, 2:442n.
24. Haeckel, *Generelle Morphologie*, 2:451.
25. Haeckel to Darwin (10 August 1864), in *Correspondence of Charles Darwin*, 12:298–300.
26. Haeckel to Darwin (26 October 1864), in *Correspondence of Charles Darwin*.

27. Ernst Haeckel, *Zur Entwicklungsgeschichte der Siphonophoren* (Utrecht: C. Van der Post, 1869); and *Die Kalkschwämme*, 3 vols. (Berlin: Georg Reimer, 1872).
28. Ernst Haeckel, *Arabische Korallen* (Berlin: Georg Reimer, 1876).
29. Ernst Haeckel, *Das System der Medusen*, 2 vols. (Jena: Gustav Fischer, 1879).
30. Ernst Haeckel, *Die Tiefsee-Medusen der Challenger-Reise* (Jena: Gustav Fischer, 1881); and the following volumes from *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the Years 1873–1867* (London: Her Majesty's Stationery Office): vol. 14 (2 parts), *Report on the Deep-Sea Medusae Dredged by H.M.S. Challenger* (1882); vol. 18 (3 parts), *Report on Radiolaria* (1887); vol. 28, *Report on the Siphonophorae Collected by H.M.S. Challenger* (1888); and vol. 32 *Report on the Deep-Sea Keratosa Collected by H. M. S. Challenger* (1889).
31. I have discussed Haeckel's experiments and those of Roux and Driesch in *The Tragic Sense of Life*, 185–95.
32. "A Little Riddle of the Universe," *New York Times*, 27 July 1901.
33. Ernst Haeckel, *Kunstformen der Natur* (Leipzig: Bibliographisches Institut, 1904).
34. Haeckel, *Kunstformen der Natur*, text to plate 8.