

## **Ernst Haeckel and the Genealogy of Scientific Travel Mystique<sup>1</sup>**

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At three o'clock in the morning on September 3, 1786 Johann Wolfgang von Goethe slipped away from his friends in Carlsbad and headed for Italy. It was a journey long put off and a major landmark in the poet's life. Goethe was no casual tourist seeking diversion and a change of scene. He bought the works of Vitruvius and Palladio, and studied the architecture. He looked at paintings, associated with painters, and practiced the art of painting himself. His literary efforts included work on *Faust* and *Egmont*, and the trip itself would provide the materials for his *Italian Journey*.<sup>2</sup>

Goethe also pursued his scientific researches, which he felt were among his most important intellectual activities. At Weimar, where he was an important civil servant, Goethe had cultivated botany among the local intellectuals. But it was a peculiar kind of botany, more inspired by Rousseau than by Linnaeus. Nature was approached from the point of view of something rather like art appreciation. By the time he reached Italy Goethe had begun to formulate his ideas about the metamorphoses of plants. On September 27, 1786 he visited the famous botanical garden of the University of Padova. He came away feeling that he was making progress with his notion that all plants can be derived from a common type, or *Urpflanze*. On April 17 of the following year, in the public gardens at Palermo, he seems to have had an inspiration. The diverse parts of plants, such as leaves and petals, could be envisaged as variations upon a common theme. In effect, the organs are all modified leaves. (In Goethe's own words, there was an "*ursprüngliche Identität aller Pflanzenteile*.")<sup>3</sup>

After his return to Weimar, Goethe remarked that nobody understood his language.<sup>4</sup> Clarifying what he had in mind, even to himself, required a great deal of effort. What he had been looking for, and believed he had found, was the abstract idea of "The Plant." Goethe had invented what he called "morphology" and it was not something limited to botany. In the spring of 1790 Goethe took a second trip to Italy. At the Lido, near Venice, on May 6, he found the skull of a sheep, and had yet another inspiration, that the skull is made up of a series of vertebrae. Thus was born the vertebral theory of the skull, or at least Goethe's version of it.

In those days the town of Jena could be reached by carriage from Weimar in about three hours. Goethe was involved in the administration of its famous university and also participated actively in its intellectual affairs. Jena was a major center of philosophical activity, and it was there that much of the speculation went on that gave rise to what was called *Naturphilosophie*. Initially, at least, Goethe considered himself a follower of Spinoza and Kant, and his early morphological work was carried out in that spirit. He thought that by observation and comparison he could arrive at ideal patterns that supposedly manifested underlying laws of nature. What he called "the metamorphosis" of plants meant that each organ or organism was an imperfect representation of the ideal

plant. Such metamorphosis was what might be called “theme and variations.” At that time, at least, it was not conceived of as an evolutionary relationship. Nor were there any hypothesized mechanisms. Likewise following Kant, Goethe believed that there is moral justification for artistic activity. The scientific study of organic diversity, and the appreciation of natural beauty alike can be justified on that basis. That kind of attitude was quite common among romantic biologists, artists, poets, and travelers.

The search for abstract patterns amidst organic diversity makes sense in terms of idealistic philosophy, and idealism flourished among German philosophers, especially those at Jena. Johann Gottlieb Fichte (1762–1814), who emphasized the subjective aspect of knowledge, taught at Jena from 1794 until 1799, when he was fired for political reasons. So far as natural science goes, however, the crucial figure was the philosopher Friedrich Wilhelm Joseph von Schelling (1775–1854). He taught at Jena from 1798 to 1803 and may be regarded as the true founder of *Naturphilosophie*. Schelling maintained that the world changes progressively as a consequence of the opposition of polar forces such as magnetism and electricity. He conceived of nature and spirit as parts of the same whole. As part of nature the mind itself participates in the same succession of changes that the rest of it does.

When idealism gets mixed with religious mysticism, it becomes easy for the intellectual to conceive of himself as a kind of divine mind reader. If God and Nature are one, then the scientist’s goal is to understand God by studying Nature. Science then becomes an exercise in something like mind-reading. That program was carried to its logical conclusion by Lorenz Oken (1779–1851).<sup>5</sup> He was a professor at Jena from 1807 until 1819, when he too was fired, again because of his political activities. The fact that he was involved in a priority dispute with Goethe about the vertebral theory of the skull evidently had nothing to do with it. Oken was an alchemist and believed in notions about mystical correspondences between microcosm and macrocosm that go back to antiquity.<sup>6</sup> He also was a numerologist and his classifications reflect the mysticism of Pythagoras and his followers.

Alexander von Humboldt (1769–1859) was admitted to the intellectual circles of Jena and Weimar before he departed for his celebrated journey to the Spanish possessions in America (1799–1804).<sup>7</sup> He knew Goethe quite well, but his approach to biology was more physiological than morphological. He was interested in the effects of climate on the distribution of plants, and is considered the founder of scientific meteorology and plant biogeography. Some of his works that were written shortly after his return from the New World were sympathetic with Schelling and other *Naturphilosophen*. Later on, however, he became very critical of *Naturphilosophie* and attacked Schelling’s views in lectures delivered in Berlin in 1827 and 1828. But throughout his career he continued to emphasize the aesthetic aspect of science. Darwin greatly admired Humboldt’s “Personal Narrative,” and its influence on Darwin’s *Journal of Researches* is obvious.<sup>8</sup> Humboldt in turn praised Darwin’s “*Malerisch*” [picturesque] depiction of landscape.<sup>9</sup>

As a child Ernst Haeckel (1834–1919) was ambitious to become a traveler; his favorite book was Robinson Crusoe.<sup>10</sup> At about the age of sixteen, he acquired a copy of Humboldt’s *Ansichten der Natur* [Views of Nature], which is still preserved in the archives at Jena University.<sup>11</sup> According to an autobiographical sketch, this book and Matthias Schleiden’s *Die Pflanze und ihr Leben* [The Plant and its Life] were the main sources of Haeckel’s interest in plant geography and his desire to become a botanical explorer in the tropics.<sup>12</sup> Two years later he began his university studies with the intent, following the wishes of his parents, of taking a medical degree while nonetheless emphasizing botany. Illness prevented him from studying with Schleiden at Jena, but he matriculated at Berlin and later at Würzburg. His undergraduate readings include much Humboldt, Darwin, other scientific travel writers, and Goethe’s autobiography, *Wahrheit und Dichtung* [Poetry and Truth].<sup>13</sup>

In a letter to his parents dated February 17, 1854, he tells of spending time in the Würzburg University library reading many books by Humboldt, and he expresses a yearning to accomplish his childhood dream of traveling to the tropics; perhaps, he remarks, he could become a ship's doctor.<sup>14</sup>

In the summer of 1854, Haeckel went on a field trip to Helgoland organized by his teacher Johannes Müller (1801–1858). He found the marine invertebrates so interesting that he switched from botany to zoology. However, he remained determined to conduct research in the tropics. A quick trip to northern Italy and elsewhere only whetted his appetite for travel. Although respectful of his parents' wishes, Haeckel did not want to become a practicing physician. In a letter to them dated January 13, 1856, we find him comparing his own experience as a student at Würzburg with that of Goethe at Strassburg.<sup>15</sup> Such comparison between himself and Goethe crops up again and again in Haeckel's writings. That summer Haeckel was appointed as assistant to Rudolf Virchow, an obvious sign that he showed talent for scientific research and of course suggesting that he had prospects for an academic career.<sup>16</sup> He completed his medical studies, and even obtained a license to practice, but never had a patient. Engaged to be married to his cousin Anna Sethe (1835–1864) in 1858, he departed for a long trip to Italy early the next year.<sup>17</sup>

In Naples, Haeckel (Fig. 1) encountered the poet Hermann Allmers (1821–1902), who was also a painter.<sup>18</sup> Haeckel had a considerable artistic talent himself; both an uncle and his son became painters. Allmers encouraged Haeckel's artistic endeavors as they enjoyed the beauty of Ischia and then Capri. In a letter to Anna Sethe, written in Capri and dated August 7, 1859 Haeckel lavishly praised landscape painting as a branch of science.<sup>19</sup> How much of the influence came from Allmers, how much from Humboldt, and how much from Goethe is hard to say, but by that time Haeckel had embraced a thoroughly aesthetic and poetical approach to life in general, including science. According to Haeckel's brief autobiography, the trip to Italy also tended to undermine his religious beliefs.<sup>20</sup> Among other things it brought him into closer contact with the realities of life in a Roman Catholic country. Haeckel had been brought up in the liberal protestant tradition of Schleiermacher. As a student he was exposed to a great deal of materialistic philosophy, which interested him very much but did not cause him to abandon his faith.

Haeckel returned to Germany in April of 1860, equipped with materials on the systematics of the Radiolaria, a group of protozoans. That summer he read the German translation of *The Origin of Species* and became one of Darwin's staunchest supporters. The Radiolaria were the basis for his habilitation at Jena on March 4, 1861.<sup>21</sup> They also served as material for his evolutionary publications.<sup>22</sup> On his thirtieth birthday, February 16, 1864, his wife died. Haeckel was crushed by the bereavement, and it was this event that caused him to abandon Christianity and to find an alternative, which he called "monism." Epistemologically, his monism affirmed the unity of all knowl-

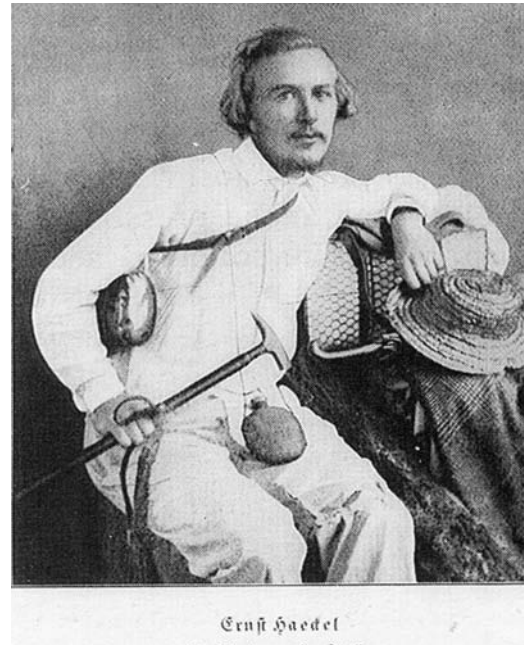


FIGURE 1. Haeckel as a traveler in Italy.

edge. Metaphysically, it was opposed to dualistic notions, including the distinction between living and non-living material and that between mind and matter. For him, all matter was alive; in other words, he was a hylozoist. And it possessed at least rudiments of “soul”; in other words, he embraced panpsychism. God and nature were one and the same thing: in other words, Haeckel was a pantheist. His monism allowed him to be a kind of materialist without being, strictly speaking, an atheist. Even though Haeckel was opposed to mysticism and the supernatural, his views were very similar in many respects to those of traditional *Naturphilosophie*, and important elements were derived from alchemy, via Oken. To give just one example, his hylozoism justified the belief that matter readily organizes itself into cells and their precursors — Oken’s *Urschleim* [primordial slime] provided an easy way to explain the origin of life.

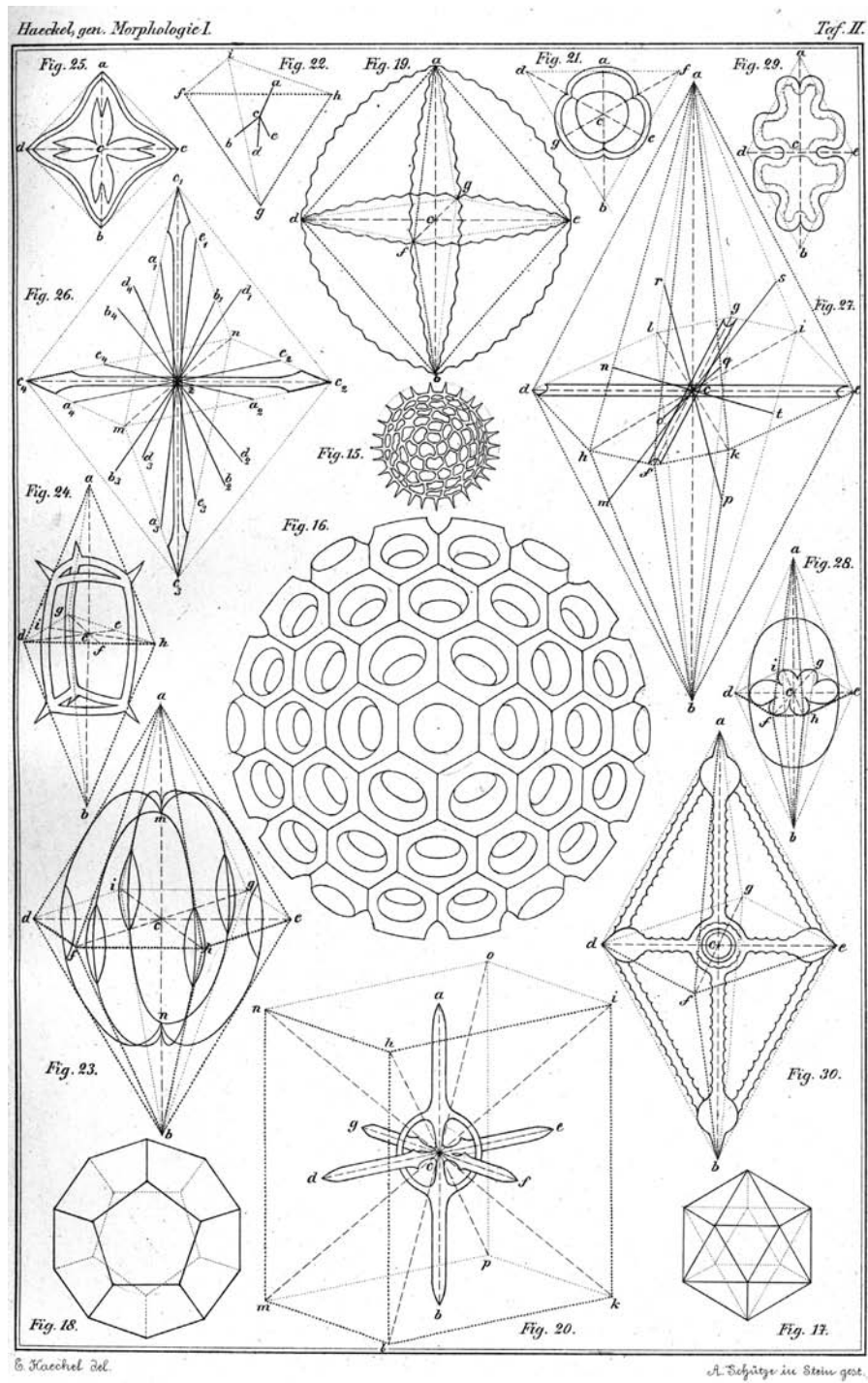
Haeckel’s main philosophical and scientific manifesto was his *Generelle Morphologie* [General Morphology].<sup>23</sup> This book is often cited as the source for Haeckel’s ideas about ontogeny recapitulating phylogeny. But Haeckel’s ideas about such matters were derivative of those of Darwin and Fritz Müller, and what makes the book really interesting is his effort to combine Darwinism with *Naturphilosophie*. The *Generelle Morphologie* was too long to have been widely read, and partly for that reason Haeckel reiterated and updated much of what he had said in works intended for a broader audience, notably his *Natürliche Schöpfungsgeschichte* [The Natural History of Creation]<sup>24</sup> and *Anthropogenie* [The Evolution of Man]<sup>25</sup>. Haeckel’s views on his predecessors are particularly illuminating. He maintains that Goethe was an evolutionist, and that the *Urpflanze* was a common ancestor. Neither of these interpretations is correct. He also says, again erroneously, that Oken was an evolutionist. Apparently, he thought that his predecessors’ belief in the unity of God and Nature justified such historical claims.

One striking feature of his book of 1866 was the emphasis upon patterns of symmetry (Fig. 2), something that shows through quite clearly in his illustrations in general. The artistic license that Haeckel often took with his illustrations, which were sometimes grossly misleading, has been the topic for a fair amount of commentary.<sup>26</sup> We need to consider the philosophical context to see his actions in their proper perspective. It makes a certain amount of sense from the standpoint of idealistic *Naturphilosophie* for the observer to see beyond superficial appearances and intuit an ideal order that is more real than any particular specimen or landscape. Therefore, depicting organisms as more symmetrical than they really are, or bringing out what seemed conceptually important at the expense of realism, is not something that Haeckel himself would have considered misrepresenting the facts (Fig. 2).

Haeckel’s view that a trained artist can see more than an ordinary observer was something he shared with von Humboldt, and, indeed, he probably derived that notion from him.<sup>27</sup> Haeckel notes, and he is quite correct, that photographs of vegetation do not give a good representation of the vegetation itself. Photographic technology has come a long way in the century since he said that, but scientists continue to draw and paint the organisms that they study, and to make use of the talents of professional illustrators. When Haeckel traveled, he spent much of his time painting, and later taking photographs. That was common practice among travelers, scientific and otherwise, but his watercolors have often appeared in print.

In order to study the animals that interested him in the living state, Haeckel traveled extensively, mainly to the Mediterranean, but also as far as the Canary Islands and the Red Sea. However, it was only late in his career that he managed to realize his youthful ambition of visiting the tropics. On October 8, 1881, he departed from Jena for Trieste, and one month later reached Bombay. After some touring, he went on to Colombo (November 21), where he got acquainted with the local scenery and vegetation and with the lives and customs of the natives. He enjoyed a side-trip to the botanic garden at Peradenia, where he was entertained by the Director, Dr. Henry Trimen



FIGURE 2. Plate from Haeckel's *Generelle Morphologie* (1866) showing patterns of symmetry.

(December 4–6) and then had a look at Kandy and also visited Trimen's predecessor Thwaites. Leaving Colombo on December 9, for Point de Galle, he set up a makeshift laboratory at nearby Belligemma (December 12) where he spent six weeks (until January 19). It was a picturesque location where he was able to study the mostly planktonic marine invertebrates, which had long been his main topic of research. He also made a collection of specimens of plants and animals to be sent back to Jena. Haeckel describes the difficulties of working in the tropics: marine animals got too warm and died, and insects devoured his collections. According to his account, he was able to put in a twelve-hour working day, collecting in the morning, working in the laboratory from 12 to 4, followed by an excursion of about two hours during which time he would make water-color sketches (Figs. 3–4), take photographs, and collect. After leaving Belligemma, he toured the highlands and was able to see a quite different assemblage of plants (Fig. 5). His ship left Colombo on March 11. His youthful ambition had been fulfilled, and he had materials for the first of his two travel books, *Indische Reisebriefe* [Indian Travel Letters] (Haeckel 1882).<sup>28</sup>

Haeckel got back to Jena at 5 o'clock in the afternoon on April 21, 1882. En route, in Trieste, he learned that Darwin had died (on April 19). Evidently, he felt the loss very deeply. He published a preliminary account of his travels in a popular periodical, and began to negotiate for its publication as a book, but he ran into difficulties because the publishers did not want as many illustrations as he did. Even so, it was published in 1882, and there was a second edition in 1884. In September of 1882, he delivered an address to the *Versammlung deutscher Naturforscher und Aerzte*, entitled "Die Naturanschauung von Goethe, Darwin und Lamarck." [The World View of Goethe, Darwin and Lamarck.]<sup>29</sup> Although his earlier publications had contained such material, Haeckel was increasingly going public with his philosophical views. At Altenberg on October 9, 1892, he delivered an *ex tempore* address entitled "Der Monismus als Band zwischen Religion und Naturwissenschaft".<sup>30</sup> It created a sensation and was translated into English as "The Profession of Faith of a Man of Science."<sup>31</sup> It laid out the essentials of his monistic religion and claimed, as fellow pantheists, both Laplace and Darwin. (There is evidence that Darwin had been successively an orthodox member of the Established Church, something of a deist, and perhaps an agnostic; but the pantheism was evidently the product of Haeckel's imagination.)

Haeckel's book *Die Welträtsel* [The Mystery of the Universe] was published in 1899.<sup>32</sup> It was a great popular success; according to a letter to a colleague, it had sold 10,000 copies by the middle of August.<sup>33</sup> The book created a scandal, for it was an effort to turn Haeckel's monism into something that could replace the existing religions. He was anything but diplomatic in his criticisms of the existing faiths, especially Roman Catholicism. To Haeckel it made a great deal of sense that social and cultural evolution were extensions of organic evolution. Progress meant the increasing dominance of the cerebral hemispheres, and the gradual decline of what he dismissed as superstition. He dealt with the soul much as he had dealt with the body: by describing the gradual elaboration of mental faculties from precursors that had long existed. Haeckel attributed souls to crystals, cells and tissues, not just to organs and whole organisms. Even sex was a physico-chemical affair, with male and female and love and hate having parallels at the atomic level. Haeckel cited Goethe's novel *Die Wahlverwandtschaften* [The Elective Affinities] in support of such analogizing. Haeckel evidently approved of Goethe's effort to modernize alchemy. Also published that year were the first installments of Haeckel's *Kunstformen der Natur* [Art Forms in Nature], which provided illustrations of naturalia chosen as art-objects (Figs. 6–8).<sup>34</sup>

On August 21, 1900 Haeckel left for yet another trip to the tropics, mostly to Java and Sumatra. He reached Singapore on September 26, 1900 and visited the botanical gardens there. Haeckel was provided with hospitality at the famous botanical garden at Buitenzorg and at a smaller research station in Tjibodas. Given the isolation of the places he was visiting, it is hardly surprising that the





FIGURES 3 (above) and 4 (below). Water color paintings by Haeckel while at Belligemma during his travels in Ceylon (Sri Lanka) in 1882. Permission to reproduce courtesy Haeckel House, Jena.

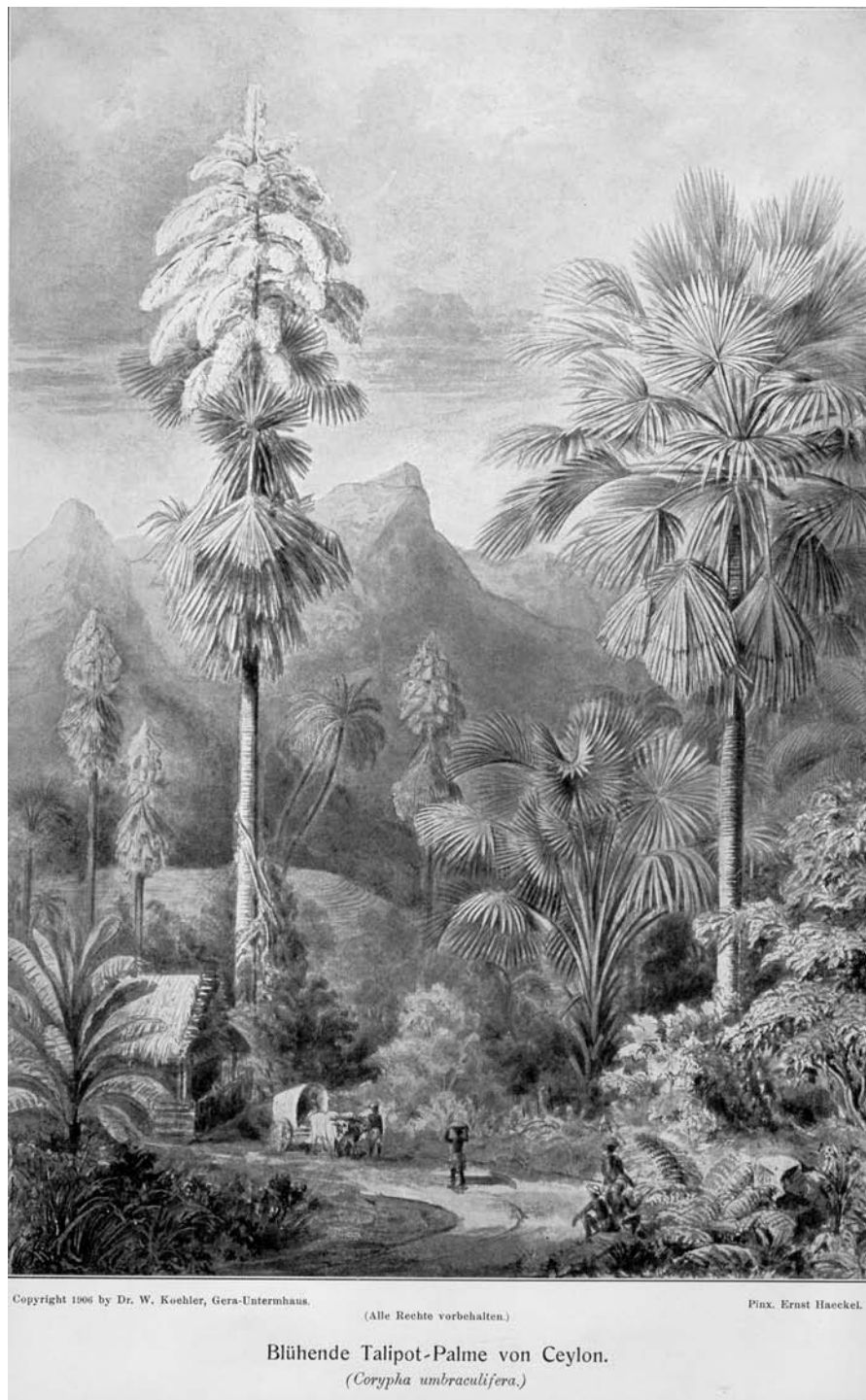
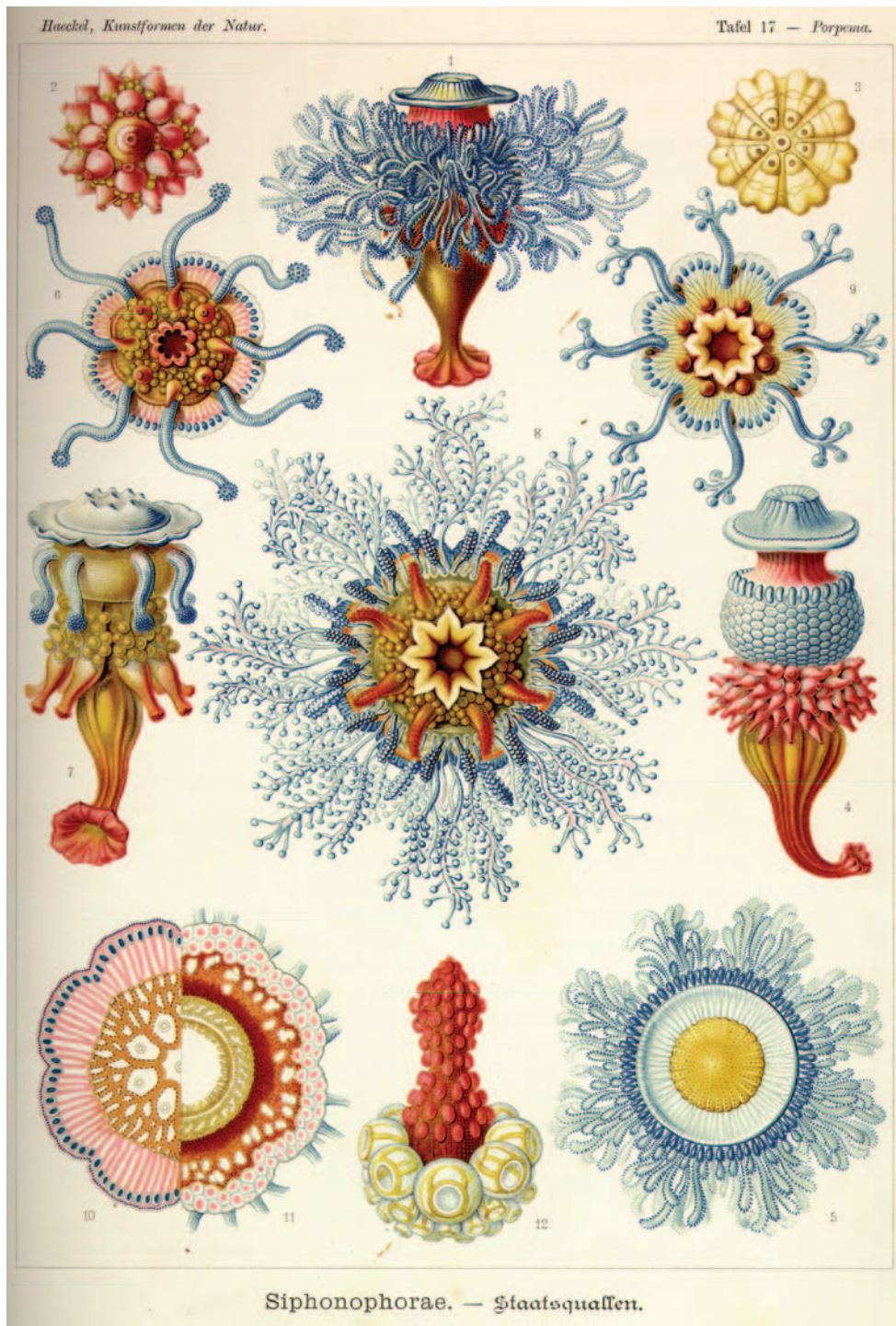


FIGURE 5. Haeckel's painting of palm trees on Ceylon.



FIGURE 6. Plate from Haeckel's *Kunstformen der Natur* (1899) showing coelenterates.

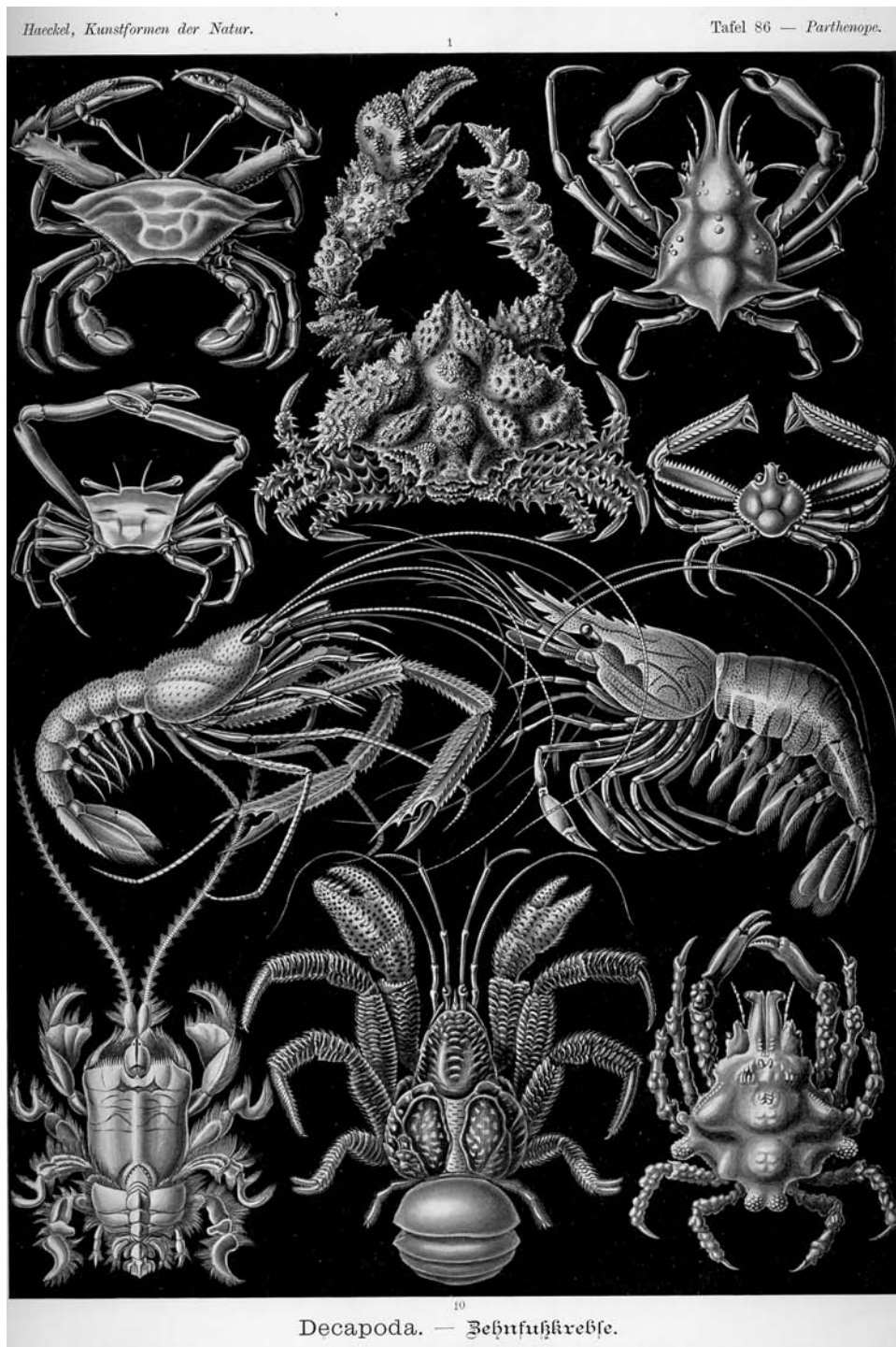


FIGURE 7. Plate from Haeckel's *Kunstformen der Natur* (1899) showing a diversity of crustaceans.



FIGURE 8. Plate from Haeckel's *Kunstformen der Natur* (1899) showing tropical palms and ferns.



local scientists went out of their way to make him feel welcome. He remarks that one of his important goals during the trip was to collect materials for the *Kunstformen der Natur* [Art Forms in Nature]. He spent much of his time photographing as well as sketching. Part of the justification for the trip was to study the marine animals at a location near Padang, on the south coast of Sumatra. Soon after his arrival there, however, he fell and injured his knee and was able to accomplish little scientific work. As in his earlier trip, he traveled extensively observing the countryside and the inhabitants, and otherwise enjoying the life of a scientific tourist. His account of the trip was published under the title *Malaiische Reisebriefe* [Malayan Travel Letters] within a few months after his return in 1901.<sup>35</sup>

Haeckel's two books on his scientific travels are perfectly respectable examples of their genre, as was his posthumously published *Von Teneriffa bis zum Sinai* (1925) (Fig. 9), but they are not considered classics like those of Humboldt, Darwin, or Wallace. Like his letters to his parents and his fiancée, however, they are interesting as autobiography. They are particularly revealing when we attempt to place them within the context of his other works. The trips he took had something of the character of scientific junkets in conjunction with serious efforts to do research in the field and at remote locations. In both of his books he provides anecdotes about what we nowadays call adventure travel. As a scientist he naturally remarks upon much that he saw in the light of the kind of evolutionary theory that he cultivated. Darwin's theory of natural selection gets only minor attention, but he does invoke it as in explaining the green coloration of marine invertebrates in Ceylon. Haeckel had devoted much of his time to the evolution of man, and to the comparative study of the various subunits of our species. His observations on the natives are perceptive, and he does not seem to have the kind of prejudices that one would expect from a racist. Rather he attrib-

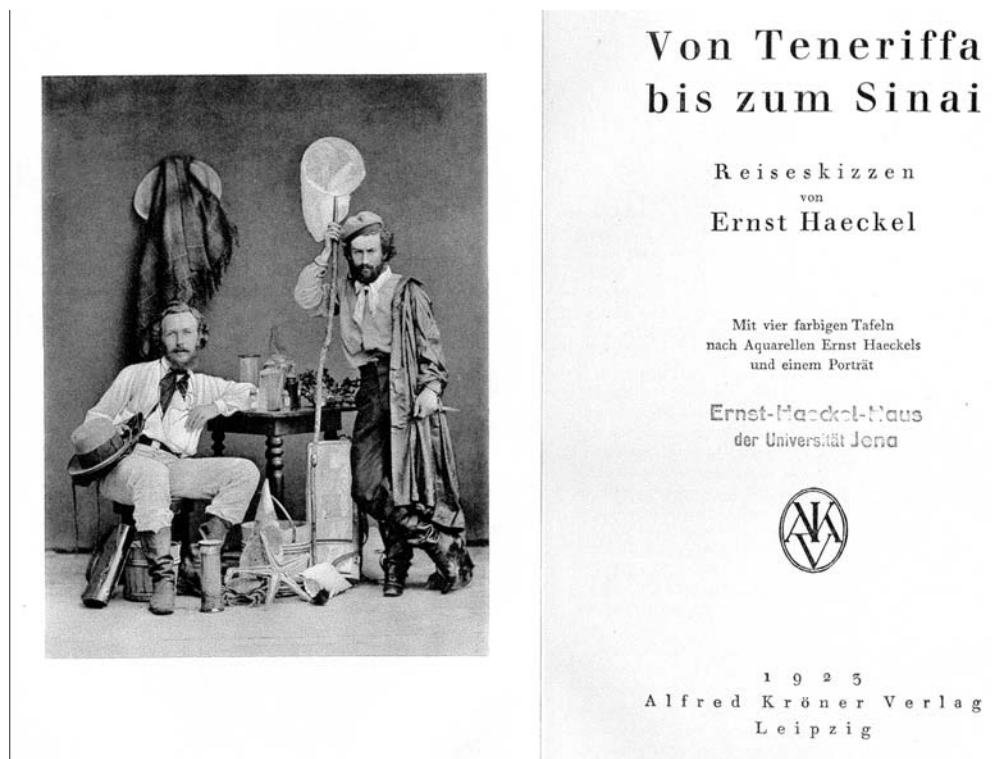


FIGURE 9. Title page and frontispiece of Haeckel's posthumously published *Von Teneriffa bis zum Sinai* (1923).

utes human diversity to adaptation to local circumstances. His account of Java recounts his rather cursory observations on non-human primates. As with his examination of the archaic arthropod *Limulus* undertaken while in Ceylon, nothing of scientific value resulted, but that was not the point. Rather he wanted to see the things that interested him through his own eyes.

What he wanted to see most of all was the vegetation. That is not quite the same thing as the plants, but he wanted to see those too. He describes the “physiognomy” of the tropical forests, with their noble trees, vines and creepers. He rhapsodizes about the aesthetic impact that the vegetation made upon him. In more detail than most readers would probably feel necessary, he enumerates the various plants that he observed, and often comments on their beauty. It is rather like some one’s account of art galleries visited and paintings and sculpture observed. In that respect Haeckel’s trips to the tropics are more than just suggestive of Goethe’s trips to Italy. Given the identity of God and Nature in which both of them believed, they were participating in the same tradition.

Like the novel, the travel book is a literary genre, and the scientific travel book is a particularly good example of that genre. Travel becomes a ritual and a symbolic act, satisfying our deepest spiritual needs. Like a knight errant, the young scientist sallies forth in search of adventure and self-fulfillment and comes back transformed by the experience. The journey symbolizes our passage through the various stages of our lives. At the same time it symbolizes the process of discovery, whether of the inner or the outer world, and often both simultaneously. When the voyager’s goal is scientific discovery, both the voyage and the voyager’s account of it come to stand for aspirations that are common to all mankind. Small wonder that an account of a journey round the world has become an icon of its author’s accomplishment. It stands to reason that accounts of scientific travel will appeal to the young, for breaking loose from the established order and gaining a larger vision of the world is part of the normal conduct of life. The ideal scientific traveler is well prepared for the voyage, but young enough to derive the full benefits of the experience. The older traveler may derive somewhat different benefit. If the youthful ambitions were thwarted, satisfying them later on means the journey, albeit deferred, has been completed.

#### ACKNOWLEDGMENTS

Mant thanks to Olaf Breidbach and Uwe Hoßfeld for help with the illustrations, which are published with the permission of the Ernst-Haeckel-Haus, Jena.

## NOTES

<sup>1</sup> As befits the subject matter, this is an essay on literary history. The English word “mystique” has been borrowed from the French language, and apparently has no good equivalent in Italian. A dictionary definition is as follows: “A complex of quasi-mystical attitudes and feelings surrounding some person, institution, activity, etc.”

<sup>2</sup> J. W. Goethe, *Italian Journey*, translated by W. H. Auden and Elizabeth Mayer (San Francisco: North Point Press, 1982). See also *The Autobiography of Johann Wolfgang von Goethe*, translated by John Oxenford (2 vols., Chicago: University of Chicago Press); Nicholas Boyle, *Goethe: the Poet and the Age*, Volume 1 the *Poetry of Desire* (1749–1790) (Oxford: Oxford University Press)

<sup>3</sup> Dietze and Golz p.257. Italics in the original.

<sup>4</sup> P. 62 of Kuhn. “niemand verstand meine Sprache.”

<sup>5</sup> Olaf Breidbach and Michael T. Ghiselin, “Lorenz Oken and *Naturphilosophie* in Jena, Paris, and London,” *History and Philosophy of the Life Sciences*, 2002, 24:285–291.

<sup>6</sup> Michael T. Ghiselin, “The Founders of Morphology as Alchemists,” in *Cultures and Institutions of Natural History: Essays in the History and Philosophy of Science*, ed. Michael T. Ghiselin and Alan E. Leviton (San Francisco: California Academy of Sciences) pp. 39-49.

<sup>7</sup> L. Kelner, *Alexander von Humboldt* (London: Oxford University Press, 1963).

<sup>8</sup> Michael T. Ghiselin, *The Triumph of the Darwinian Method* (Berkeley: University of California Press, 1969), p. 9; and Philip R. Sloan, “‘The Sense of Sublimity’: Darwin on Nature and Divinity,” *Osiris*, 2001, 16:251-269. Too much can be made of such influences, however, as explained in Breidbach and Ghiselin n. 5.

<sup>9</sup> Alexander von Humboldt, *Ansichten der Natur, mit wissenschaftlichen Erläuterungen* (Stuttgart und Tübingen: J.G. Cotta'scher Verlag, ed. 3, 2 vols., 1849), vol. 1, p. 174.

<sup>10</sup> Heinrich Schmidt, ed., *Ernst Haeckel, Entwicklungsgeschichte einer Jugend* (Leipzig: Verlag von K.F. Koehler, 1921); Georg Uschmann, *Ernst Haeckel, Forscher, Künstler, Mensch, Briefe* (Leipzig: Urania-Verlag, 1958).

<sup>11</sup> Humboldt, *Ansichten der Natur*; the volume is lightly annotated by Heackel.

<sup>12</sup> Ernst Haeckel, “Eine autobiographische Skizze,” in *Ernst Haeckel, gemeinverständliche Werke*, Herausgegeben von Heinrich Schmidt (Leipzig: Alfred Kröner Verlag, 1924), 1:ix–xxvi, p. x.

<sup>13</sup> Schmidt, p. 59.

<sup>14</sup> Schmidt, pp. 98-102.

<sup>15</sup> Schmidt, p. 175.

<sup>16</sup> Schmidt, p. 183.

<sup>17</sup> Ernst Haeckel, Ed. Heinrich Schmidt, *Italienfahrt: Briefe an die Braut 1859/1860* (Leipzig: Verlag von K. F. Koehler, 1921).

<sup>18</sup> Uschmann, p. 38 and letters therein.

<sup>19</sup> Haeckel, *Italienfahrt*, pp.85–86; Uschmann, pp. 42–43.

<sup>20</sup> Haeckel, ref. 12 above.

<sup>21</sup> Ernst Haeckel, *De Rhizopodum Finibus et Ordinibus. Pro Venia Legendi in Litterarum Universitate Jenensi. Di III Men. Mart 1861* (Berlin: Georg Reimer, 1861).

<sup>22</sup> Ernst Haeckel, *Die Radiolarien* (Berlin: Georg Reimer, 1862)

<sup>23</sup> Ernst Haeckel, *Generelle Morphologie der Organismen. Allgemeine Grundzüge der organischen Formen-Wissenschaft, mecanisch begründet durch die von Charles Darwin reformirte Descendenz-Theorie* (Berlin, Georg Reimer, 1866) 2 vols.

<sup>24</sup> Ernst Haeckel, *Natürliche Schöpfungsgeschichte. Gemeinverständliche wissenschaftliche Vorträge über die Entwicklungslehre im allgemeinen und diejenige von Darwin, Goethe und Lamarck in Besondern, über die Anwendung derselben auf den Ursprung des Menschen und andere damit zusammenhängende Grundfragen der Naturwissenschaft* (Berlin: Georg Reimer, 1868) and later editions.

<sup>25</sup> Ernst Haeckel, *Anthropogenie oder Entwicklungsgeschichte des Menschen. Gemeinverständliche wissenschaftliche Vorträge über die grundzüge der menschlichen Kiemes- und Stammesgeschichte* (Berlin: Georg Reimer, 1868) and later editions.

<sup>26</sup> Léon Szyfman, Les Prétendus Falsifications d’Ernst Haeckel et son Triomphe sur ses Diffamateurs *Bulletin Biologique de la France et de la Belgique*, 1979, 113:375–406.

<sup>27</sup> Ernst Haeckel, *Aus Insulinde: Malaische Reisebriefe*, in *Ernst Haeckel, gemeinverständliche Werke*, Herausgegeben von Heinrich Schmidt, (Leipzig: Alfred Kröner Verlag, 1924 [1901]), 6: 414; Humboldt, *Ansichten*, vol. 2, pp. 237–240.



<sup>28</sup> Ernst Haeckel, in *Ernst Haeckel, gemeinverständliche Werke*, Herausgegeben von Heinrich Schmidt, (Leipzig: Alfred Kröner Verlag, 1924 [1882]), vol. 6.

<sup>29</sup> Ernst Haeckel, *Die Naturanschauung von Darwin, Goethe und Lamarck*, (Jena: Gustaf Fischer Verlag, 1882).

<sup>30</sup> Ernst Haeckel, *Der Monismus als Band Zwischen Religion und Wissenschaft. Glaubensbekenntnis eines Naturforschers, vorgetragen am 8. Oktober 1892 in Altenburg* (Bonn: Verlag von Emil Strauss, 1891).

<sup>31</sup> Ernst Haeckel, *The Confession of Faith of a Man of Science* (London: Adam and Charles Black, 1894).

<sup>32</sup> Ernst Haeckel, *Die Welträtsel. Gemeinverständliche Studien über monistische Philosophie* (Bonn: Verlag von Emil Strauss, 1899); also *Ernst Haeckel, gemeinverständliche Werke*, vol. 3.

<sup>33</sup> Walther May, *Ernst Haeckel Versuch einer Chronik seines Lebens und Wirkens*. (Leipzig, Verlag von Ambrosus Barth, 1909), p. 150.

<sup>34</sup> Ernst Haeckel, *Kunstformen der Natur* (Leipzig: Bibliographisches Institut, 1899).

<sup>35</sup> Ernst Haeckel, Aus Insulinde n. 27 above.