Theory Biosci. (2002) 121: 247–251

http://www.urbanfischer.de/journals/theorybiosc

Editorial: Haeckel and Modern Biology

Michael K. Richardson, Jonathan E. Jeffery

Institute of Evolutionary and Ecological Sciences, Leiden, The Netherlands

Address for correspondence: Prof. Dr. Michael K. Richardson, Institute of Evolutionary and Ecological Sciences, Leiden University, Kaiserstraat 63, 2311 GP Leiden, The Netherlands

Received: May 22, 2002; accepted: June 21, 2002

The symposium *Haeckel and Modern Biology* was held at the Sixth International Congress of Vertebrate Morphology in 2001 in Jena, Eastern Germany. It brought together historians and biologists to consider the work of Ernst Haeckel and its relevance to modern biology. Jena was an appropriate setting because Haeckel spent much of his academic career as a professor in its University.

Haeckel's fame rests on his work as a naturalist, systematist, theoretician, philosopher and popular science writer (Bölsche 1906; Uschmann 1954; Heberer 1968; Kraußе 1984; Weindling 1989; Richards 1992; Nyhart 1995). In this introduction, I suggest some reasons why this work is still relevant to modern science[1], and outline some of the issues discussed by the speakers.

Biologists still make use of Haeckel's important and magnificently-illustrated monographs on marine organisms (e. g. Haeckel 1862; 1872; 1877; 1881; 1888). Not only are the illustrations and descriptions in these works important, but some of the taxonomic categories Haeckel employed for certain groups of sponges, medusa and radiolaria are still in use.

Haeckel developed theories in the field of evolutionary developmental biology, such as the *Gastraea Theory* and *Biogenetic Law*. These theories gained a new relevance, years after Haeckel's death, when their scientific value was reassessed by several influential writers (including de Beer, 1930; Gould, 1977).

Another reason why Haeckel is of interest to modern biologists is that he was the first to outline a phylogenetic tree covering the whole animal kingdom. He did this by adapting the methods of the old comparative anatomy to promote a new evolutionary morphology.

[1] In this article, I have not followed the order in which the talks were presented at the symposium.

1431-7613/02/121/03–247/$ 15.00/0

Haeckel's work has implications beyond biology. He was frequently in conflict with the church, and religious Creationists opposed his championing of evolutionary theory (reviewed in Gursch 1981). The evolution *versus* creation debate is still a matter of great interest to scientists, especially in the United States. Allegations that Haeckel faked his embryo drawings are a conspicuous feature of this debate. Finally, Haeckel's work influenced political and cultural developments in Europe in the first half of the twentieth century (for examples, see Gasman 1971). It therefore represents an interesting case-study in the relationship between science and society.

It is unfortunate that we had no speaker to discuss the value of Haeckel's scientific monographs to modern science. A search of the bibliographic databases reveals that the Haeckel's systematic studies are still cited in the biological literature. A reappraisal of this technical zoological work is long overdue because most critiques of Haeckel's scientific work have concentrated on the Biogenetic Law (reviewed by Gould 1977).

In this symposium, Jonathan Jeffery showed how Haeckel's work is relevant to modern efforts to develop a phylogenetic embryology. He noted that the Biogenetic Law can be seen as a statement about sequence heterochrony, and this is a foundation for modern comparative methodologies such as event-pairing (Smith 2001; Richardson and Keuck 2002). A significant point is that Haeckel viewed changes in developmental sequence (caenogenesis) as falsifying phylogeny reconstruction. Modern cladists, by contrast, regard caenogenesis as informative (Richardson and Keuck 2002).

Haeckel outlined his theories on evolution and development in technical and academic works (e. g. Haeckel 1866; 1875), and brought them to a larger audience through his successful popular science books (including Haeckel 1868; 1874a).

Haeckel has often been accused of falsifying drawings of embryos[2] in order to support his arguments (reviewed by Gursch 1981). In his talk, Robert Richards discussed this controversy, pointing out that it has a long history[3]. He noted that the chairman of the symposium, Michael Richardson, has also publicly criticised inaccuracies in Haeckel's embryo drawings (discussed by Gould 2000).

Allegations that Haeckel played fast-and-loose with scientific evidence were widely publicised at the time by religious anti-Darwinians, who used them to argue that evolutionary theory was built on the rotten foundations of dubious science (Braß 1909; Assmuth and Hull 1915). The same allegations are repeated today by anti-Darwinians (Behe 1998).

However, Richards suggested that it may be unfair to accuse Haeckel of dishonesty and falsification. Indeed, one defence of Haeckel's illustrations is that they were legitimately schematised to make them more understand-

---

[2] Especially plates IV and V in Haeckel (1874a)

[3] Due to time constraints, Robert Richards was unable to contribute to this volume.

able to a lay public[4]. Richardson disputed this point, arguing that some of the illustrations raised legitimate concerns about the misrepresentation of scientific data.

A defence of Haeckel's methodology was presented by Olaf Breidbach, director of the Haeckel-Haus in Jena. In his talk, he argued that Haeckel's drawings were idealistic. In this sense, they were meant to interpret the natural world, bringing out qualities not discernible in the superficial appearance of the original specimens (see also Breidbach 1998). Breidbach argued that this was a legitimate scientific practice in Haeckel's time and should not be characterised as fabrication. He elaborated on the methodological basis of Haeckel's morphology, arguing that Haeckel was a typologist. Thus, even with his Biogenetic Law, Haeckel can be seen to reflect a pre-Darwinian concept of morphology.

If the evolution-creation debate was one source of conflict between Haeckel and the church, a related source was Haeckel's Monism. One of the speakers, Abigail Lustig, discussed Monism with reference to Erich Wasmann, a biologist and Jesuit whom Lustig sees as one of Haeckel's principal opponents in this field. While Wasmann and other Christians argued that the physical and spiritual worlds were distinct, Haeckel sought to unite them under the philosophy of Monism. Wasmann, while not denying the possibility that humans evolved from animals, nonetheless supported the idea that humans are qualitatively different from animals because they have a soul.

Haeckel, on the other hand, saw human thought as merely a physiological process. He sought to emphasise the physical similarity of humans and animals, and used the embryo illustrations as supporting evidence. In the 1874 *Anthropogenie* figures, for example, Haeckel (1874a) shows the human embryo as looking little different from a pig or fish embryo. Haeckel therefore used comparative embryology to demote humans from special creation, to mere member of the animal kingdom.

In his talk, Daniel Gasman discussed Haeckel's impact on the ideology of fascism (see also Gasman 1971; Gasman 1998). He argued that Haeckel's mixing of typological arguments with evolution was fatal. It led to a judgement about primitive and advanced forms of life, and this judgement was extended to different races of human beings. As Haeckel worked out his theories in the context of a pseudo-religious system, Monism, he was of considerable influence on nazi ideology. Robert Richards, however, took issue with the concept of Haeckel as proto-nazi.

In summary, the discussion was lively, a wide range of topics was covered, and there was a large and attentive audience. Issues were covered that

[4] Although not all the drawings criticised for inaccuracy were in popular works: see the criticisms levelled by F. M. Balfour (Balfour 1876: 521 nn1) against a figure in Haeckel's *Die Gastrula* (Haeckel 1875)

were of great interest to both historians and biologists, although it has to be admitted that there was rather little consensus on issues such as the meaning of 'faking', or the political implications of Haeckel's work. These issues will no doubt be discussed in future meetings.

References

Assmuth, J. and Hull, E. R. (1915) Haeckel's Frauds and Forgeries. Examiner Press. Bombay.

Balfour, F. M. (1876) The development of the elasmobranch fishes. J. Anat. Physiol. **10**: 517–570.

Behe, M. J. (1998) Untitled. National Review March 9th: 53–54.

Bölsche, W. (1906) Haeckel, His Life and Work [transl by J. McCabe]. T. Fisher Unwin. London.

Braß, A. (1909) Das Affen-Problem. Professor Ernst Haeckel und seine „Fälschungen der Wissenschaft" und ihre Verteidigung durch deutsche Anatomen und Zoologen!, 2 Ed. Biologischer Verlag Heinrich Wallmann. Leipzig.

Breidbach, O. (1998) Brief instructions to viewing Haeckel's pictures. In: Art Forms in Nature. Munich. Prestel, pp. 9–18.

de Beer, G. (1930) Embryology and Evolution. Oxford University Press. London.

Gasman, D. (1971) The Scientific Origins of National Socialism; Social Darwinism in Ernst Haeckel and the German Monist League. Macdonald, London.

Gasman, D. (1998) Haeckel's Monism and the Birth of Fascist Ideology. Peter Lang. New York.

Gould, S. J. (1977) Ontogeny and Phylogeny. Belknap Press. Cambridge, MA.

Gould, S. J. (2000) Abscheulich! (Atrocious!). Natural History 42–49.

Gursch, R. (1981) Die Illustrationen Ernst Haeckels zur Abstammungs- und Entwicklungsgeschichte, Diskussion im wissenschaftlichen und nichtwissenschaftlichen Schrifttum. Peter Lang. Frankfurt am Main.

Haeckel, E. (1862) Die Radiolarien. Georg Reimer. Berlin.

Haeckel, E. (1866) Generelle Morphologie der Organismen. Allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformirte Descendenz-Theorie. Georg Reimer. Berlin.

Haeckel, E. (1868) Natürliche Schöpfungsgeschichte, 1st Ed. Georg Reimer. Berlin.

Haeckel, E. (1872) Die Kalkschwämme. Georg Reimer. Berlin.

Haeckel, E. (1874a) Anthropogenie oder Entwickelungsgeschichte des Menschen. Engelmann. Leipzig.

Haeckel, E. (1874b) Die Gastrea-Theorie, die phylogenetische Classification des Thierreichs und die Homologie der Keimblätter. Jen. Zeit. Naturwis. **8**.

Haeckel, E. (1875) Die Gastrula und die Eifurchung der Thiere. Jenaische Zeitschrift für Naturwissenschaft **9**: 402–508.

Haeckel, E. (1877) Report on the Radiolaria collected by HMS Callenger during the years 1873–1876. Challenger Reports Zoology **18**.

Haeckel, E. (1881) Report on the Deep-Sea Medusae dredged by H. M. S. Challenger during the years 1873–1876. Report on the scientific results of the voyage of H. M. S. Challenger, Zoology **12**.

Haeckel, E. (1888) Report on the Siphonophorae collected by H. M. S. Challenger during the years 1873–1876. Report on the scientific results of the voyage of H. M. S. Challenger, Zoology **28**.

Heberer, G. (1968) Der gerechtfertigte Haeckel. Einblicke in seine Schriften aus Anlaß des Erscheinens seines Hauptwerkes "Generelle Morphologie der Organismen" vor 100 Jahren. Gustav Fischer Verlag. Stuttgart.

Krauße, E. (1984) Ernst Haeckel. Teubner. Leipzig.

Nyhart, L. K. (1995) Biology Takes Form: Animal Morphology and the German Universities. University of Chicago Press. Chicago.

Richards, R. J. (1992) The Meaning of Evolution Chicago. University of Chicago Press, pp. 205.
Richardson, M. K. and Keuck, G. (2002) Haeckel's ABC of evolution and development. Biol. Revs. In Press.
Smith, K. K. (2001) Heterochrony revisited: the evolution of developmental sequences. Biol. J. Linn. Soc. **73**: 169–186.
Uschmann, G. (1954) Ernst Haeckel, Forscher, Künstler, Mensch; Eine Biographie. Urania-Verlag. Jena.
Weindling, P. (1989) Ernst Haeckel, Darwinismus and the Secularisation of Nature. In J. R. Moore (ed.). History, Humanity and Evolution: Essays for John C. Greene Cambridge. Cambridge University Press, pp. 311–327.