

## Gerhard Heilmann and the artist's eye in science, 1912-1927

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### **Abstract**

Gerhard Heilmann's 'The origin of birds' from 1926 is a remarkable book. Written by an illustrator-cum-amateur-biologist, it gained worldwide authority almost immediately upon publication. It is demonstrated that Heilmann's skills as an artist, and his ability to use illustration to support his argument, were crucial in gaining this status. Furthermore, turning away from the dramatic confrontational model of palaeontological illustration helped Heilmann's cause and made his monograph the leading word on the subject for well over forty years.



One of the hottest topics in the field of palaeontology since the 1960s has been the origin and development of birds. In any discussion of this topic, some reference is usually made to Gerhard Heilmann's book 'The origin of birds', which was considered to be the final word on the subject from its publication and first reviews in 1926 until John Ostrom's work in the late 1960s shelved it again. I will attempt to explain which factors contributed to the prestige of Heilmann's work in this area, by looking both at its context in the wider frame of vertebrate palaeontology as a science, and its inherent characteristics.

In the early 20<sup>th</sup> century, the field of vertebrate palaeontology, such as it was, was heavily dominated by scientists from England and most of all from the United States. This had very much to do with the fact that among the sciences palaeontology was (and still is) generally considered to be an 'extra'. It was not a science essential to cultural, industrial and technological progress, and therefore not the first choice when it came to distributing funds and grants. Therefore, it thrived most in those countries that possessed a widespread patronage system, and also those that had a good amount of money to spend. Additionally, Great Britain had a long-standing tradition in this discipline, and the North American subcontinent possessed one of the richest sources of fossils.

In continental Europe, the situation was radically different. Much of palaeontological research depended on the private initiative of a few scientists, most of whom were located in Germany. As the feeling of competition between nations grew at the eve of the First World War, German palaeontologists even knew how to generate considerable amounts of money from their government, which they used to subsidise large-scale expeditions to the German colonies in Africa, many of which yielded a rich array of fossils. However, this situation turned out to be only temporary. Generally, money and therefore professional palaeontology, remained rare. Outside of Germany, the situation was even worse, with only France contributing some state funds to palaeontological research.

This did not mean that there was no interest for palaeontology, however. Ever since the publication of Charles Darwin's 'On the origin of species by means of natural selection' in 1859, public interest in matters surrounding the life of the past had been thriving. Again, mainly in England and the United States, but without question also in western and central Europe. People like Ernst Haeckel in Germany and Alexander Vavilov in Russia tried to impose their particular brand of eastern or central European intellectual culture on evolutionary theory, which was all too often seen as being overly individualist and competitive, in other words, too much specifically British.

The discovery in 1860 of the fossil of *Archaeopteryx lithographica* (Von Meyer, 1860), a transitional



Figure 1. Gerhard Heilmann, Self-portrait (1902).

creature possessing features of reptiles as well as birds, instantly demonstrated the significance that palaeontology could bring to the then very current debate about the nature of evolution. Thomas Henry Huxley, one of Charles Darwin's main supporters, constructed a theory whereby birds would have to descend from dinosaurs, creating a pivotal role for *Archaeopteryx*. *Archaeopteryx*' public status increased correspondingly, and the hapless pre-bird became the subject of literature, art and (much) public debate. By the beginning of the 20<sup>th</sup> century, however, the discussion had subsided somewhat, but it had also fragmented into a number of opposing views, each one proposing another origin for *Archaeopteryx* and birds. The need for a more synthetic approach was generally appreciated.<sup>1</sup>

This came from unexpected quarters. Gerhard Heilmann (1861-1946, figure 1), a Danish artist, published a number of articles in the 'Dansk Ornithologisk Forenings Tidsskrift' ['Journal of the Danish Ornithological Society'] between 1912 and 1916, in which he attempted to provide such a synthesis. As Gerhard Heilmann remembered later, his interest in natural history was first raised when Christian Lütken's 'Dyreriget: en haand-og laerebog' ['The animal kingdom: a manual and learning book'] was introduced into the Heilmann household.<sup>2</sup> That household was a decidedly traditional Danish countryside collection, and Heilmann later recounted the horrors of being subjected to what he termed 'religious indoctrination', something which seems to have bred a formidable amount of resentment within him and led to later writings opposing religion.<sup>3</sup>

This may well have been the major motivation for his later exploits in natural history and evolutionary theory. By all accounts, Gerhard Heilmann possessed a decidedly quarrelsome character, which regularly used to bring him into conflict with various forms of authority, and fostered a long-term break between him and his family (Carsten Heilmann, pers. comm.).

Heilmann studied technology and later medicine at the polytechnic academy of Roskilde from 1877 until he decided in 1883, against the express wishes of his family, that his talents were more suited for artistic occupation and he became an apprentice painter under the guidance of Frans Schwartz and later P.S. Krøyer. From 1890 to 1902 he was employed as a painter at the royal Porcelain Works in Copenhagen, but he found time to make extensive travels through Europe: in 1893 to Italy by way of Berlin and Dresden, and in 1898 to Dresden and Switzerland.<sup>4</sup>

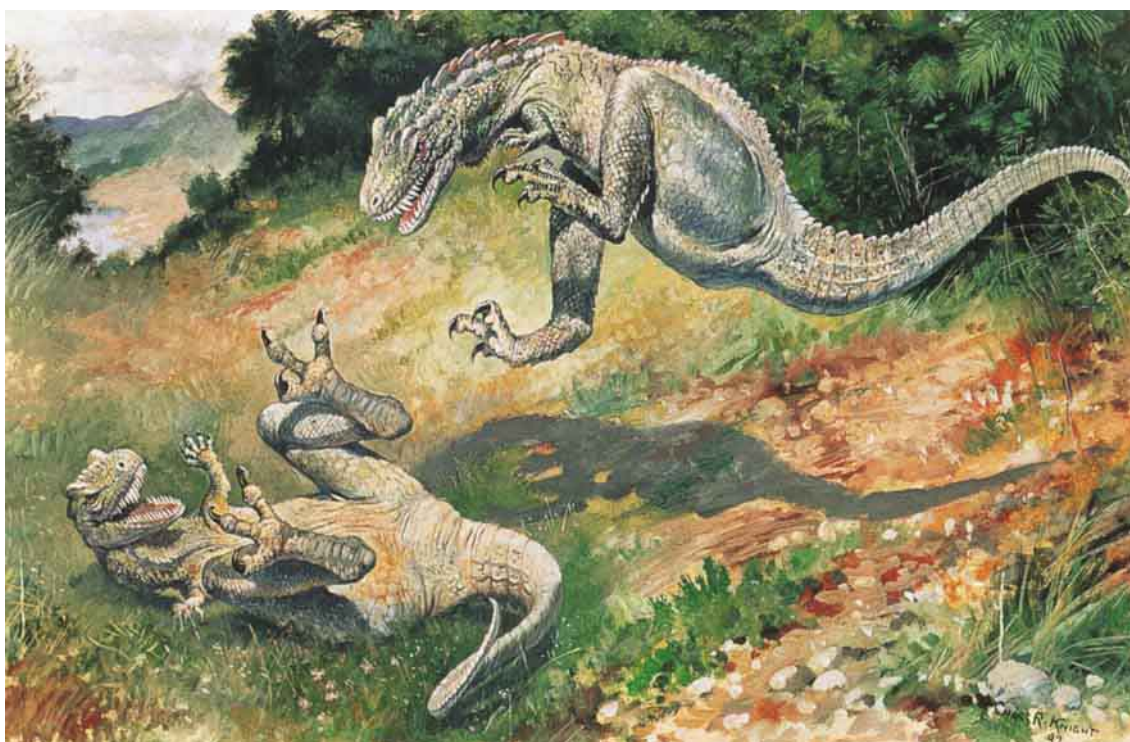


Figure 2. Charles Knight's 'Dryptosaurus fighting' (1896). From Mitchell (1998).

<sup>1</sup> For discussions about the history of *Archaeopteryx*, see Desmond (1976), Shipman (1998) and particularly Chambers (2002).

<sup>2</sup> 'Socialdemokraten', Oct. 24, 1940, p. 8. The full reference: Lütken (1893).

<sup>3</sup> *Ibidem*; cf. Heilmann (1940, 1944).

<sup>4</sup> See Palm (1989).

Heilmann appears to have found little pleasure in porcelain decorating, and from 1902 he only worked as an independent artist, painting, drawing, and illustrating books. Feeling indifferent towards the turbulent artistic developments of his time, Heilmann's exquisite figurative style showed itself to be very suitable for decoration and illustration, and it was in this field that he was mainly active. From 1900 to 1940, he was also responsible for the design of Danish bank notes.

However, Heilmann became most noted for his book illustrations, drawing for Karl Gjellerup's novels 'Minna', 'Sindbads rejser' ['Sinbad's travels'] and 'Mikkels Ræv'. Later, he also illustrated a number of natural history books about birds, most notably E. Lehn Schiøler's work 'Danmarks fugle' ['Denmark's birds', 1925-1931] and 'Danmarks fugleliv', edited by A.L.V. Manniche ['Denmark's birdlife', 3 vols., 1928-1930].

This was not the first sign of Heilmann's interest in birds. From 1912 to 1916, a number of articles from his hand appeared in the 'Dansk Ornithologisk Forenings Tidsskrift' ['Journal of the Danish Ornithological Society']. Their subject was the evolutionary origin of birds. Ever since Thomas Henry Huxley had noted the similarities between the anatomy of the earliest known *Archaeopteryx* specimens and the small bipedal dinosaur *Compsognathus longipes* (Wagner, 1859), the scientific consensus had judged in favour of such a link. Later influential workers, such as Yale's Othniel C. Marsh, had supported this view. However, by the early 20<sup>th</sup> century it was increasingly attacked by prominent scientists, such as Ferenc Nopcsa and Robert Broom. Broom had been working in South Africa on mammal-like reptiles and on Thecodonts, a group of reptiles considered to be the ancestors of dinosaurs and pterosaurs. Never one for exaggerated meticulousness, Broom placed some sweeping arguments against an evolutionary connection between dinosaurs and birds.



Figure 3. Thomas Hawkins' 'The book of great sea-dragons' (1840). From Desmond (1976).

In his articles, Heilmann generally supported Broom's view, but he also gave it a more thorough theoretical foundation. He worked out a theory explaining the evolutionary origin of birds from the Thecodonts from the early Triassic (approximately 220 million years ago). Heilmann advanced from a starting point that owed much to the work of the German scientist Othenio Abel, combining Eimer's law of orthogenesis (which states that evolution is destined to develop in a fixed direction), Cope's law of the unspecialised ancestor (stating that only organisms that are not adapted to specialised ecological niches (e.g., rats rather than ant-eaters) can give birth to further evolutionary developments), and Rosa's law of the increasing reduction of variability. But his most significant theoretical 'hook' turned out to be Dollo's 'Law of irreversibility', which states that evolution is not reversible: structures or functions discarded during the course of evolution do not reappear in the same form in a given line of organisms. One thing Heilmann did not endorse, or in fact pay much attention to,





Figure 4. Charles Knight's 'Triceratops and Tyrannosaurus' (1899). From Mitchell (1998).

was Abel's Neo-Lamarckianism, which had become largely discredited as a mainstream view by this time. It is important to note that most of these laws have now lost their authority.<sup>5</sup>

The main problem revolved around the presence of a furcula (the 'wishbone') in birds and in the '*Urvogel*', *A. lithographica*. In dinosaurs this furcula, a fusion between both clavicles, was unknown. At this point, Dollo's law of irreversibility kicked in. This evolutionary law stated that a complex structure, once lost, can never re-evolve in the same form in a given evolutionary line. Since the ancestors of dinosaurs possessed a clavicle and dinosaurs did not, this seemed to disqualify the latter as ancestors of birds. In fact, Heilmann considered small, predatory dinosaurs to be the ideal ancestors of birds except for this one fact. Since Heilmann's days, ideas on this point have radically changed, both due to a different interpretation of Dollo's law and the discovery of large numbers of clavicle-bearing dinosaurs.



Figure 5 (left). Gerhard Heilmann's 'Archaeopteryxes fighting' (1916). From Heilmann (1916).



Figure 6 (right). Gerhard Heilmann's, Proavis (1912). From Heilmann (1912).

<sup>5</sup> For a general view on the development of evolutionary thought, see Mayr (1982) and Shanahan (2004). More specifically discussing *Archaeopteryx*' case are Desmond (1975), Shipman (1998) and Chambers (2002). For a specific discussion of Dollo's law and its use, see Marshall *et al.* (1994).

Heilmann's articles were collected and published in Danish in 1916 (Heilmann 1916). Ten years later, an English edition appeared after considerable effort on Heilmann's part and that of others<sup>6</sup>, and one year later, in 1927, and American edition was published in New York. Although the Danish edition made little impact, the English translations almost overnight raised Heilmann to the dizzy heights of scientific authority. His 'Origin of birds' remained the final word on the subject until it was overtaken by new discoveries and interpretations in the late 1960s.

It is remarkable that an obscure Danish painter could achieve such status at a single stroke. We can, however, hazard an educated guess at the reasons. The main one will undoubtedly have been the intrinsic quality of Heilmann's work; 'The origin of birds' was a clever synthesis of fashionable ideas about the ancestry of birds and current evolutionary theory, which were compared to one another and then merited. Also, Heilmann employed a host of scientific disciplines on which to build his theories, such as embryology, at that time a new field of experimental biology. Although without question valuable in strengthening the theoretical base of his discourse, however, this evidence was only peripheral to the argument he presented. Most of it was based upon old-style comparative anatomy, the comparison of various body parts of different animals to one another to determine kinship (*cf.* figure 8). This had long been one of the foundations of palaeontological method, but Heilmann carried it several steps further by the sometimes almost obsessive detail and consistency of his researches.



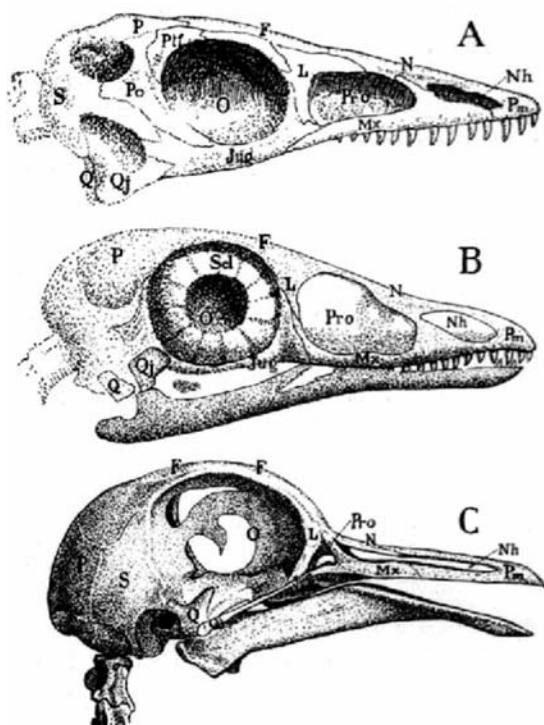
Figure 7. Gerhard Heilmann's 'Archaeopteryxes courting' (1926). From Heilmann (1926).

In this respect, Heilmann's artistic background proved to be vital. As a capable artist, Heilmann could enhance his theory with detailed, high-quality illustrations. Until that time, reconstructive illustration of source materials had played only a minor role in professional palaeontology and detailed illustrations of specimens were rare. Of course, there had been the odd photograph, but a high-quality and high-detail visible comparison of anatomical features, which also allowed the reader to compare the evidence without having to examine the fossil specimens himself (often a practical impossibility), was not so common. Especially in handbooks, many authors preferred to employ illustrators for life reconstructions rather than the depiction of source material. Therefore, the near-photographic quality of Heilmann's illustrations of fossils, and the accuracy of his reconstructions greatly contributed to the attractiveness of 'The origin of birds'. Heilmann was an artist 'of the old school', working almost exclusively with realistic images and ignoring most of the artistic innovations of his time. In fact, pictorial detail in 'The origin of birds' sometimes surpassed the actual factual knowledge of the time: the skulls of *A. lithographica* and *C. longipes*, for instance, were not known in the detail in which they were depicted

<sup>6</sup> See Shufeldt (1914, 1916).

by Heilmann (a fact which was kept from the reader), and his reconstructions consequently created much misunderstanding after the actual anatomical details, which sometimes differed greatly from those supposed by Heilmann, had been described. Heilmann's obscurity as far as the scientific community (especially in the United Kingdom and the United States) was concerned, may have worked in his favour; were everyone to know that this book had been written by Denmark's prime bank note designer, whatever his further credentials, they might have taken a more sceptical view.

Despite his adherence to traditional forms of art, Heilmann did carry through at least one important innovation in scientific art that not only enhanced the scientific value of his own book, but also cleared the way for others. As Tom Mitchell (1998) demonstrated, palaeontological illustration has always possessed a definite retrograde character, largely due to practical constraints, but also as a consequence of an established tradition. One element of that tradition, the origins of which go back to the middle of the 19<sup>th</sup> century, was that prehistoric animals usually got portrayed in a way seemingly intent on underlining their ferocity and bloodthirsty competitiveness. Fine examples of such hand-to-hand combat are Charles Knight's '*Dryptosaurus* fighting' (figure 2, 1896) or his '*Triceratops* facing *Tyrannosaurus*' (figure 4, 1899). This view was indicative of social ideas of the time. Mitchell draws a comparison between *Triceratops* and *Tyrannosaurus* and the 19<sup>th</sup> century cult of the big hunt, but an equally good case can be made to regard this illustration as a metaphor for (commercial) competition, which often made grateful use of elements of evolutionary thought, and never more so than in the concept of 'social Darwinism'.



**Fig. 3.** Kranium af *Aëtosaurus ferratus* A, en Øgle fra Trias (efter Jaekel), af *Archæopteryx* B (tildels efter Dames), og af en ung Due C (efter Brehm). F Frontale, Jug Jugale, L Lacrymale, Mx Maxillare, N Nasale, Nh Næsehul, O Orbita, P Parietale, Pm Præmaxillare, Po Postorbitale, Pro Præorbitale, Ptf Postfrontale, Q Quadratum, Qj Quadratojugale, S Squamosum, Sct Sklerotikaring. — B er i nat. St.

Figure 8. Gerhard Heilmann's comparisons of thecodont, theropod and avian skulls. Figure 3 from Heilmann (1916).



There is one other aspect of late 19<sup>th</sup> century scientific reconstruction that merits mention in this respect. Compare, for instance, ‘*Dryptosaurus* fighting’ from 1900 (figure 2) to James Ward’s painting ‘Bulls fighting’ (figure 9) from 1800. Mitchell has recently used these to show that the illustrating style of 1900 was in fact a ‘throw-back’ to the romantic style of painting that was in fashion around 1800. However, if we compare these illustrations with those of Thomas Hawkins’ ‘Book of great sea-dragons’ from 1840 (figure 3), another striking feature appears that most of all becomes obvious when looking at English work. In all these pictures we see a certain image of nature, but also of society, reflected. Hawkins’ sea-monsters are what I would call ‘black nature’ in Victorian terms. Victorian morality also came to include nature, where a strict line could be observed between ‘white nature’ and ‘black nature’. Avoiding subtlety, we can define the former as manicured dogs and neatly-mown lawns and the latter as monsters, pterodactyls, and wild things from Africa. In fact, the British had a reasonably successful swing at the wild things from Africa, almost wiping the eastern African plains clear of lions and elephants in a very deliberate attempt to rid the world from these uncontrollable creatures. Also, beings from the fossil past (certainly dinosaurs, who were seen as overgrown lizards) were usually perceived as belonging to this category, which may also account for the unduly gloomy appearance of the first dinosaur reconstructions in London’s Crystal Park in the middle of the 19<sup>th</sup> century. Also, in illustrations we often see *single* hand-to-hand combat (Charles Knight, 1900), a reflection of the strong sense of personal and social competition present in Victorian society, and of the typical Anglo-American public view of evolution.



Figure 9. James Ward’s ‘Bulls fighting’ (1800). From Mitchell (1998).

By 1912, the view of prehistoric animals as remnants of the previous divine creations had long ceased to be scientific common opinion. However, reconstructions, especially those in handbooks and works of popular science, often recall outdated concepts. When Heilmann wrote and illustrated his articles, he allowed his *Archaeopteryxes*, *Proaves* (Heilmann’s hypothetical pre-bird) and other animals to go for one another’s throat. Just as the late 19<sup>th</sup> century illustrations are pervaded with concepts from commercial enterprise, Heilmann’s bloodthirsty birds and pre-birds can be seen in the light of the ‘*Wille zur Krieg*’, the desire for war which was such an essential part of European public opinion immediately preceding the First World War (figures 5, 6).

When we look to Heilmann’s ‘Fuglenes afstamning’ from 1916, these elements are still clearly present. There are two *Archaeopteryxes*, going at one another’s throat (figure 5). Compare this to the colour picture from the English edition of 1926 (figure 7). Here we see another pair of *Archaeopteryxes*, but considerably pacified. The one which we can take to be the male is decoratively coloured, and the whole image is aesthetically much more pleasing than the former. Another example is given by the hypothetical pre-bird *Proavis*, illustrated in 1916 (figure 6). Again, we see aggression, an example of hand-to-hand combat in an aggressive prehistoric world. In the 1926 we again find pacification and no element of aggression. What it boils down to is this: Heilmann makes a conscious effort to de-dramatise palaeontological illustration, removing as much as possible any social consideration superimposed on the image of the fossil world. All through the English edition, the



illustrations have become precise, anatomical studies of the animals in question, of course reflecting certain insights into their life and behaviour, but of a clearly non-confrontational nature. This emphasis on illustrative precision naturally enhances the scientific merits of Heilmann's work, since attention, instead of at the 'emotion' of the illustration, is directed towards its factual anatomical and interpretative content. The removal of both aggressiveness and competitiveness from the pictures furthermore relinquishes the specific Anglo-Saxon social projection of evolution, and gives it a more universal appearance.

The text of 'The origin of birds' is sometimes in strange contrast with the tendency described above. Unlike the pictures, the texts of the 1926 edition had undergone only minor revision since the original publication. In two instances, Heilmann allowed himself to describe the life of his subject matter in prose, the first time of *Archaeopteryx*, the second time of his hypothetical *Proavis*. The first description is rather uneventful, but the second still rather bloodthirsty, with a score of two *Proaves* out of three left dead. That Heilmann's prose is rather less restrained than his illustrations becomes even more clear when he chastises the English zoologist Ray Lankester for declaring that birds must be derived from ornithopod dinosaurs (1926: 142-143): "Before proceeding, we take out one of the books accompanying us on our expedition. The title is "Extinct Animals" (London 1909), and, on opening it we happen to catch sight of a rather astonishing passage, p. 202: "In fact it is now certain that reptiles similar to the *Iguanodon* were the stock from which birds have been derived, the front limb having become probably first a swimming flipper or paddle, and then later an organ for beating the air and raising the creature out of the water for a brief flight. From such a beginning came the feather-bearing wing of modern birds". Dear me! How evident! We exclaim. The origin and evolution of the entire class of birds presented in a nutshell, and not the slightest doubt as to the correctness of the conclusion: "In fact it is now certain". Hands off! All further investigations superfluous; we may just as well pack up again." [References and citations in original].

The text unfortunately also reveals Heilmann's shortcomings as a scientific author: he may be a consistent thinker, he is by no means an original one. Heilmann steadfastly adheres to Dollo's 'Law of irreversibility' as a guiding principle for his discourse. By applying this principle, Heilmann effectively sorts out the evolutionary origin of birds, and is left with the least offensive alternative in the basal archosaurs or 'Thecodonts', *i.e.* the ancestors of the dinosaurs. However, when we look at the number of pages devoted to each group, there is a strange discrepancy between the value he attributes to the Thecodonts as possible bird ancestors and the number of pages devoted to them. Theropods, on the other hand, are treated at length, only to be disqualified rather unexpectedly and suddenly because of their (then supposed) lack of a furcula (which, according to Dollo's law, should be present in both birds and theropods). Moreover, his contention that certain features of Thecodonts are identical to those of *Archaeopteryx* and not to those of carnivorous dinosaurs is contradicted by his own illustrations (*e.g.* figure 8). Here, the conflict between doctrine and graphical evidence is decided in favour of the former, which creates a strange disharmony in 'The origin of birds'. Heilmann doubtless spoke better through his pictures than through his words.

What caused Heilmann to bring these changes to his illustrations? Some may remark that the aggression in the 1916 edition is a reflection of the general '*Wille zum Krieg*' (and the war itself) so clearly prevalent in the European culture of the time (Eksteins, 1982). However, we have clearly traced these tendencies back to much earlier times. Rather the other way around, we ought to consider the possibility that the relative peacefulness of the 1926 edition is a consequence of the aversion to conflict that originates from the First World War, an aversion that Heilmann expressed in various interviews. However, what I expect is the true cause is Gerhard Heilmann's own, personal desire for anatomical accuracy, which we also see reflected in his drawings of fossils. One thing we should also not disregard when looking upon Heilmann's work is that aside from social and scientific considerations there was a very strong desire to be recognised as a leading worker in the field of vertebrate zoology. In this, Heilmann undoubtedly succeeded. He continuously reworked his images to keep up with the latest scientific insights, and they are meant to be precise reconstructions rather than 'impressions', of past life. This is the reason that Gerhard Heilmann's images are still popular as illustrations even in modern work, and explain why his book remained the standard text for over forty years.

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