Gesammeindruck in Wax: Alexander von Humboldt and Gustav Zeiller’s Anatomical Models

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Until recently, wax models have been a neglected area of investigation by historians of science and of art. Commonly associated with freak shows and fairs, both disciplines have often dismissed this kind of artefacts as mere “popular culture”. However, Nick Hopwood, Renato Mazzolini, Thomas Schnalke, and other renowned scholars have pointed out the importance of this kind of material culture in scientific practices.¹ From the eighteenth century to the beginning of the twentieth century, wax models played a significant role in anatomy, embryology, obstetrics, and dermatology. Waxes were not only involved in the preservation of observational practices but also in instructing students and professionals alike in how to use their eyes when dissecting cadavers. Anatomical models could evoke jokes and tricks of the senses when exhibited at fairs to the general public, but in the realm of their scientific use, they cultivated a skilled vision of the body.

This article will focus on the anatomical artefacts crafted by Gustav Zeiller (1826-1904), a very little researched German artisan. His models rendered the observation of the brain into a graspable object that served as a point of departure for the illustrations of Carl Bogislaus Reichert’s anatomical atlas *The Construction of the

**Human Brain** (1859-1861). When the work was nearly finished, the German physiologist sent the wax for inspection to his friend Alexander von Humboldt, who was delighted by its beauty. In this article I will first reconstruct the user’s experience of Zeiller’s artefact, and secondly analyse the combination of epistemic and aesthetic values. Therefore, I will discuss first the process of production and secondly the responses of an historical observer, namely the scientist Humboldt. I will argue that the combination of both categories – epistemology and aesthetics – endowed the model with the power of evoking responses that spurred an all-encompassing perception of natural phenomena.

The project of Carl Reichert’s Atlas

Carl Bogislaus Reichert (1811-1883) was a German anatomist and physiologist known for his contribution to embryology, cell theory and comparative anatomy. After having studied with von Baer and Johannes Müller (1801-1858), he taught at the Anatomy Institute of Dorpat between 1843 and 1853, and at the Physiology Institute in Breslau between 1853 and 1858. After Johannes Müller’s death in 1858, he held the chair of the Anatomy Institute at the Charité University in Berlin until 1883, the very year he passed away. His life’s work as a whole was especially relevant in embryology, the morphology of the brain and the inner ear. His atlas, *The Construction of the Human Brain*, was possibly his most significant treatise. The aim of this publication was to disseminate many years of anatomical observation to a broader community of medical experts.

As the historian Jean-Marc Besse has pointed out, in the 1570s European geography saw the rise of a kind of book called “atlas”. This specific type of edition consisted in a portfolio or collection of maps bound in a specific order, which was suitable for organizing geographic knowledge. However, atlas’ usages were not only confined to represent and circulate geographical phenomena. Since the eighteenth century, experts in the fields of botany, medicine and history have produced atlases within which a series of observations were carried out concerning realities that have been extremely diverse. Within medical practices, atlases could propose for instance, explications of the technologies employed for the classification of data, like Rudolf Grashey’s *Atlas typischer Röntgenbilder* (1923). Furthermore, as was the case of Reichert’s book, they could present a systematic investigation of the body’s morphology.

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A significant feature of atlases consisted in the priority of images over the accompanying texts. The pictures that composed these publications were abundant and costly, and their authors employed them to visually describe organs, plants or instruments, among other things. Atlases did not only present objects of scientific inquiry, but sharpened methods and proceedings for the skilful observation of natural phenomena. Reichert’s compendium included visual standards and fulfilled the main objective to “guide the professional through their own investigations and observations”. Since the atlas’s images were its most outstanding component, the anatomist looked for an appropriate team to produce the pictures. Reichert believed that anatomical models in wax were an exceptional technique to visualize observations, since the third dimension of the representation increased anatomical accuracy. Later, the brain was translated from the wax to the engravings, a cheaper technique than modelling and suitable for publishing. The transit between the second and the third dimension was a common practice. Reichert commissioned the engravings of the atlas to the illustrators Assman and Wagenschieber, who were specialized in the production of scientific images. Gustav Zeiller was placed in charge of the modelling work, which took eighteen months to finish.

Reichert had already conceived the idea of publishing the atlas about the brain’s morphology during his stay at the Anatomical Institute in Dorpat. Postponed due to his move to Breslau, he took up his project again once he was installed in the Polish city. It was at this time that Gustav Zeiller contacted him in order to offer his collaboration. Gustav Zeiller was a son of a renowned wax modeller family from Munich. His elder brother Paul, who worked for the local university under the anatomist Erdl’s academic supervision, helped him to hone his

5 Ibid.
7 Ibid., p. v.
9 Unfortunately little is known about both artisans. The only short reference about their collaboration is penned by Carl Reichert in the introduction to his atlas. See REICHERT Carl B., Der Bau des menschlichen Gehirns durch Abbildungen mit erläuterten Texten, op. cit., p. vi.
10 Ibid., pp. iv-v.
11 YOUNG-OK Kim, Karl Bogislaus Reichert: (1811-1883); sein Leben und seine Forschungen zur Anatomie und Entwicklungsgeschichte, Thesis (Ph. D), Johannes Gutenberg-Universität, Mainz, [s.n.], 2000.
specialized know-how. Gustav collaborated for several years with his brother and, after that, he made a living on his own. His anatomical models enjoyed great prestige. His waxes were exhibited at the Industrial Exposition in Munich in 1854 and at the Global Exhibition in Vienna in 1873, and received a very favourable review. Above all, Gustav Zeilller turned out to be well-known among relevant German scientists of his time, such as Johannes Müller, Friedrich Theodor von Frerichs, or Emil Du Bois-Reymond, who recommended his work on several occasions. When he met Reichert, Zeiller claimed to possess the expertise for the production of anatomical objects, and recommendations of the eminent scientist Alexander von Humboldt quickly convinced the physiologist to accept the offer.

The object of Reichert’s inquiry lay in the human brain. Studying that body part has produced, and still produces, an enduring fascination among the researchers of the life sciences. Till the end of the eighteenth century, experts dedicated to the life sciences referred to the brain as the organ of the soul. The conception of the brain as the soul’s house constituted an historical phenomenon that was linked to the differentiation and material inscription of the mental functions of the brain. Towards the end of the century, the conception of the organ’s relation to the soul disappeared from cerebral investigation.

It is worth mentioning Samuel Soemmering and Franz Gall, whose inquiries produced outstanding works about the organ. Soemmering denominated the brain as a sensorio communes or the locus of the soul. His anatomical intention consisted of locating the organ of the soul in the intersection between anatomy, physiology and neurology. Two years after Soemmering’s publication, Franz Gall published his version of a brain study for the scientific community. Gall was the father of phrenology. In order to obtain evidence about the intelligence or mental qualities, the anatomist established close correspondences between a person’s mental faculties and cranial form. When Reichert decided to publish his atlas, important investigations had already been done in that area of inquiry.

17 ZEILLER Gustav, letter to Dresden’s authorities, December 18, 1872, Gewerbeakte Stadtarchiv Dresden.
19 Ibid., p. 10.
Nonetheless, in contrast to previous investigations of the brain, Reichert based his observations on the ontogeny principle.\textsuperscript{20} Ontogeny (in German \textit{Entwicklungsgeschichte}) was still, at that time, an emerging discipline that situated Reichert’s methodology close to the investigations developed by Caspar Friedrich Wolff (1734-1794), Johannes Friedrich von Meckel The Younger (1781-1833), Heinrich Christian Pander, and Karl Ernst von Baer. In 1759, Wolff published his \textit{Teoria Generationis}, a work that proposed to study the gestation of the body from its beginnings to its culmination. His conception of generation was strongly influenced by mechanical medicine.\textsuperscript{21} While Albrecht von Haller, representative of the \textit{pre-existentialist school}, and his sympathizers believed that the embryo pre-exists in some form in an egg or sperm, Wolff was convinced by the theory of epigenesis. That is, he understood the development of corporeal form through forces, denominated \textit{vis essentialis}, which drive the processes of transformation of the body. His research started to have repercussions years later, on account of the translation of his texts by Johannes Friedrich von Meckel The Younger, who showed a great interest in his findings.

In 1818, the anatomist Pander investigated the evolution of a chicken and discovered that the embryonic sheet possesses two distinct parts, one inferior and one superior, which go beyond a transformation that leads to adult form. The theory of the embryonic sheet was picked up again by the German physiologist von Baer, who related the two parts of the sheet, on the one hand, to sensations and movement, and on the other, to feeding, circulation, secretion, and transformation.\textsuperscript{22} Von Baer conferred a programmatic use to the study of ontogeny and proposed that organic form developed without any implication of God or mechanical forces. His viewpoint influenced Reichert’s investigations years after. For both scientists, organic nature went through a process of development that was purposeful and according to a law. “The scientist”, Reichert pointed out, “must observe the gradual constitution of the organism starting from its foundation in the embryo till his plain adult development”.\textsuperscript{23} Unlike the investigations conducted by the former embryologist, in Reichert’s view the process of ontogeny was inherent to organic material and started within the cell.\textsuperscript{24} Equipped with magnifying glasses and dissecting tools, Reichert

\textsuperscript{20} REICHERT Carl B., \textit{Der Bau des menschlichen Gehirns durch Abbildungen mit erläuterten Texten}, op. cit., p. v.
\textsuperscript{23} REICHERT Carl B., \textit{Beiträge zur Kenntnis des Zustandes der heutigen Entwicklungsgeschichte}, Berlin, Hirschwalde, 1843, p. iv.
\textsuperscript{24} For further information, see HARRIS Henry, \textit{The Birth of the Cell}, New Haven and London, Yale University Press, 1999.
proceeded to scrutinize the brain in order to identify those phenomena that played an active function in the development of its organic form.\textsuperscript{25}

Reichert’s analytical method guided Zeiller’s production process. Thus, the artefact envisioned multiple states of the body’s development. There was a model expressing the brain of an embryo, and another describing the cerebral form of an adult [FIG 1 and 2]. Each piece belonged to the same cadaver.\textsuperscript{26} The wax could be split up into ten parts and be reassembled again, according to the section technique employed by Reichert. The introduction of his Atlas provides an insight into how his observational practice was translated into symbolic transactions that ultimately led to the making of the waxes. The physiologist described how he had performed the dissection and which organic forms captured his attention the most. The model that corresponded to the engraving of plate VIII represented the brain’s trunk [FIG 3]. The author explained that he had decided to omit part of the brain’s vein for an adequate observation. Its visibility in the image, he went on to argue, was of “no scientific interest and can be easily completed with the mind”.\textsuperscript{27} Reichert emphasized certain regions of the brain and excluded others. His observational process was related to an action of highlighting and emphasizing. This action was transported later to the artefact. The model was thus no substitute for the cadaver. Moreover, it was an extraordinarily selective object that expressed what to see and what not to see.

Furthermore, in the introduction of his Atlas, Reichert described his observation as a process of intervention. Nature was not there in front of him waiting for scientific explanation. The anatomist elaborated, highlighted, and particularized his area of scrutiny. In order to provide these observational practices with a solid form, Zeiller employed graphic tools, such as volume, texture and colour, to delineate the artefact’s surface. His symbolic transactions consisted in transforming those anatomical aspects that the eye of the anatomist had previously discerned through autopsy into pictorial details. The result was a coloured sculpture in wax that brought together the sculptural and pictorial techniques in one single object. Hands and eyes, observation and modelling, were both part of inscribing professional practices onto the artefact’s surface. The observational process was closely attached to corporeal engagement.

\textsuperscript{25} REICHERT Carl B., \textit{Beiträge zur Kenntnis des Zustandes der heutigen Entwicklungsgeschichte}, op. cit., p. iv.
\textsuperscript{26} \textit{Ibid.}, p. vi.

Expression and poetics of description

Once the long work was nearly concluded, Reichert sent the wax model and the engravings for preliminary inspection to his friend, the scientist and traveller Alexander von Humboldt. The author of *Views of Nature* (1808) and *Cosmos* (1845-1862), a work that aimed to review the totality of the physical and geographic knowledge of its time, showed great interest in the images and waxes. Since Reichert’s doctoral thesis, which had triggered Humboldt’s attention, both scientists maintained a friendship. But Reichert and Humboldt shared something more than mutual recognition. The geographer was a naturalist of extraordinary polyvalence, and was also captivated by medicine. He had taken anatomy lessons with Justus Christian Loder in 1797 and experimented of his own accord on the irritability of the nerves. He also conducted research with insects and amphibians on the incitement of palpitations through the stimulation of the brain.

Furthermore, Humboldt believed in the historicity of natural phenomena. For Hans Blumenberg, the most important observation of *Cosmos* concerns the historical and scientific significance of the moment in which the work was published, importantly marked by the conviction of evolution shared by his contemporaries. Humboldt conducted his own observations as a synchronization of multiple physical, chemical and biological processes that occurred in a longer period of time and due to their historical development. Therefore, he might have taken special notice of Reichert’s anatomical atlas, since the book summarized several years of investigation of the historical development of the brain.

Throughout his life, Humboldt maintained a large system of correspondence with scientists working in different places all over the world and dedicated to all kinds of topics. The written connections were a method of work, which allowed him to stay in contact with colleagues, update new discoveries and exchange ideas about observations. Between the manuscripts, documents of his social network and a method of work, the Humboldt biographer Hanno Beck found a letter that the geographer had sent to Carl Reichert written in the middle of the night in Berlin, on

10 October 1856. In the communication Humboldt discussed extensively Zeiller’s brain model and the engravings of Reichert’s Atlas.\footnote{HUMBOLDT Alexander von, qtd. in BECK Hanno, “Zur Lebensgeschichte Alexander von Humboldts: Ein Brief Humboldts an Karl Bogislaus Reichert”, \textit{op. cit.}, p. 67, my translation.}

First of all, the geographer started describing the communicative functions of Zeiller’s brain models: “In this way we make permanent, what without the safe representation only would have provided a fleeting effect”.\footnote{Ibid.} On the one hand, representing observations fulfilled the aim of preserving visual arguments of justification for a longer time. Thereby, the wax provided the possibility to \textit{see again}, what the anatomist had previously discerned during autopsy. Converting nature into an object of inquiry for science implied for the erudite materializing the experience between observer and body. On the other hand, the German geographer highlighted the importance of its value of dissemination. He went on to explain that the model “talks and stimulates posterity”.\footnote{Ibid.} Moreover, he points at the social potential of the material world to transmit ideas and communicate observational practices to the community of experts. The solid appearance of the wax was the condition for its socialization and enabled the acting upon of the atlas reader in order to evoke a response.\footnote{Ibid.}

Secondly, Humboldt described the response he expected Zeiller’s models to evoke in the recipient. The ingenuity of his friend and colleague resided in Reichert’s great judgment for having chosen such an appropriate medium for the fixing of observations. The solidness of a plastic artwork offered a way to highlight the ontogeny of the brain and to disseminate a particular kind of visual perception: “You have wittily reminded, as everything you propose, that a plastic artwork that guides the organic development […] show[s] that everything is solely part of a huge harmonic totality”.\footnote{Ibid.} In Humboldt’s perception, each fragment of the sectioned brain was part of an all-encompassing perception that had been translated faithfully to the model with the help of Reichert’s wise supervision.\footnote{Ibid.} Even though dissection implied fragmenting and separating, the aesthetic outcome expressed an image of nature that pointed towards the unity of manifold phenomena. As the geographer stated in the introduction of \textit{Cosmos}, the appropriate response beyond the harmonic totality of nature consisted in an immediate visual perception – in German \textit{Totalanschauung}.

\begin{footnotesize}
\footnotetext{33} Ibid.
\footnotetext{34} Ibid.
\footnotetext{35} For the relation between materiality and sociality see MOL Annemarie, “Notes on Materiality and Sociality”, \textit{The Sociological Review} 43/2 (May 1995), pp. 274-94.
\footnotetext{36} Ibid.
\footnotetext{37} Ibid.
\end{footnotesize}
The meaning of the term *Anschauung* denominates not only “visual perception” but also “intuition”.38 The historian Henning Schmidgen has summarized the various meanings of the concept in the realm of philosophical idealism and romantic biology in the late eighteenth and early nineteenth century Germany as followed:

In his *Critique of Pure Reason* (1781-87), Immanuel Kant introduced distinctions between “internal” and “external” as well as “sensory” and “pure *Anschauung*. […] Another form of *Anschauung*, labelled “intellectual”, concerned a purely spiritual view of the essence of things without mediation of any sensory experience. In Fichte and Schelling “intellectual *Anschauung*” was considered to be the basis of immediate self-consciousness. […] Finally, in Humboldt’s cosmology, sensory *Anschauung* was an aesthetic principle guaranteeing the unity of the dispersed, manifold, and heterogeneous facts with which natural research was confronted”.39

For his works *Cosmos* and *Views of Nature*, Humboldt approached the representation of that aesthetic composition principle in the following way. During his fieldwork, he would prepare sketches that portrayed the different aspects of his object of study in situ. Later, these details had to be pressed together into a totality, able to transmit to the viewer the harmonic unity of nature. The viewer ought to perceive nature in one overall impression – in German *Gesamteindruck*.40 He commissioned the difficult task of this composition to the artists Josef Anton Koch, Gottlieb Schick, Friedrich Wilhelm Gmelin, Ferdinand Bellermann and Moritz Rugendas, who integrated the sketches into representations according to the conventions of contemporary standards of landscape painting.41 The symbolic operation of translating nature into an artefact should attend to what he denominated “poetry of description”.42

The composition of Zeiller’s brain model reflected a similar assembly principle. His model pictured a general image of the organ. In the introduction of the Atlas, Reichert explained that the wax provided a “systematic organization plan of

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42 Ibid., p. 48.
the organ and its development”. Its communicative functions consisted in what he called a “general overview”. The material property of the model was to be split up and reassembled in ten parts. In this way, the model established a close connection between fragment and totality. The user could easily relate the particular details of the sectioned brain without missing its place and relation with the rest of the organ. Reichert had described the observation of the brain as a process structured around diverse events that finally lead the scientist to a synthetic judgement. His understanding of corporal form was determined by the ontogeny principle that considered each state of the development of the body. As he conceived form not as stable but as variable over time, he approached his object of study in different moments. Thus, the observation consisted in successive actions during a longer period. The model was assigned to describe that sequence. Therefore, the purpose of the artefact was not to register mere isolated impressions. The wax model synthesized a completed experience, composed by an itinerary of diverse steps and moments between observer and natural phenomena.

In the letter, Humboldt called Zeiller’s wax model artwork, and therefore situated the anatomical artefact in relation to aesthetic values. The model also produced a perception of beauty in Humboldt. Aesthetics and anatomical purpose worked together to provide the viewer with an all-encompassing perception. On the one hand, the composition of both categories, aesthetic and epistemic, in one single representation ought to produce a delightful experience in the viewer. In Humboldt’s opinion, this pleasurable response ought to motivate the scientist to study nature. The art of describing fulfilled the didactic aim of triggering his interests. On the other hand, the poetry of description fulfilled the aim of investing the artefact with the power of evidence in order to remind the viewer of its status as scientific object.

In the book Cosmos, Humboldt explained that an appropriate representation ought to portray observation without revealing the author’s intervention. That is, Humboldt’s poetry of description produced a mirroring effect, establishing a distance between the marks of subjective intervention and the object of representation. As a consequence, the author and the medium of expression tended to vanish. In a letter to Karl August Varnhagen von Ense, Humboldt stated: “A book about nature ought to provide the impression of being nature itself”. The art

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44 Ibid.
of describing what Humboldt had in mind was an illusionist representation that blurred the distinction between nature and represented nature. The specific aesthetic attitude that structured Humboldt’s perception was informed by the belief that nature imprints and stamps itself onto the artefact’s surfaces. In this way, the wax model could justify its “truthfulness”. A visual rhetoric that valued the language of phenomena itself informed the style of representation in question, and that, in Humboldt’s viewpoint, had been successfully accomplished in Zeiller’s brain model.

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Zeiller’s model expressed an immediate visual perception of the brain. The artefact synthesized the different steps executed by the anatomist, who conducted his observation as a process of multiple actions that occurred in a longer period of time according to the ontogeny of the brain. These observational actions were integrated later into an artefact. The symbolic transaction that led to the making of the wax expressed an intricate network of epistemic and aesthetic values. The poetry of describing rendered the wax model an account of connected events, so that the atlas recipient could read the observation of the body as a sequence of states of development. The aesthetic strategy fulfilled the function of providing the epistemic object with a narrative. Moreover, the aesthetic composition principle invested the artefact with the power of evoking responses in the viewer. The art of describing, expressed by Zeiller’s model, aimed at more than simply making the invisible visible: it aspired for an integration of step-by-step procedures into a response that oscillated between perception and a flash of intuition.