

# The measurement of angels. Images of pure mind as a matter of science in the 19th century

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During 19th century there was a migration of angels from their usual places in religion, art, and literature into the field of natural sciences. In works of Carus, Fechner and Exner, angels became objects of physiology, comparative anatomy, and astronomy. Although traditionally angels are considered as images or *materialisations* of pure *mind*, respectively of metaphysical/transcendental elements, such empirical methods of dealing with heavenly creatures have several precursors in history. This article discusses the traces of angels within the history of knowledge and arts as a specific dialectic of secularisation, focusing on the metamorphosis of heavenly creatures into representatives of the miraculous in 18th century aesthetics. Concerning the issue of representation, the article analyses the disappearance of *materiality* of painting through *techniques* of reproduction as prerequisites to transform the angels into objects of experimental research in 19th century sciences. As a result, the angels may be interpreted as symptoms of the problem of visualisation within a context where sciences have to address the boundaries of positivistic methods, for instance as a historical example for the epistemological problems of *brain* imaging.

Angels have often been considered as mediators between mind and matter, i.e. images and incorporations of the threshold and exchange between both realms. Etymologically derived from the Greek *aggeloi*, angels are carriers of a divine message and through them transcendental knowledge is communicated to earthly creatures and the material world. This means that they are mediators between the material, visual world and the beyond, whether called invisible, spiritual or virtual. They function as embodiments of the immaterial within the visible world: incarnations of mind in an imagined corporeal form, perceived as figures of epiphany, appearance or apparition. Since they occupy the threshold between

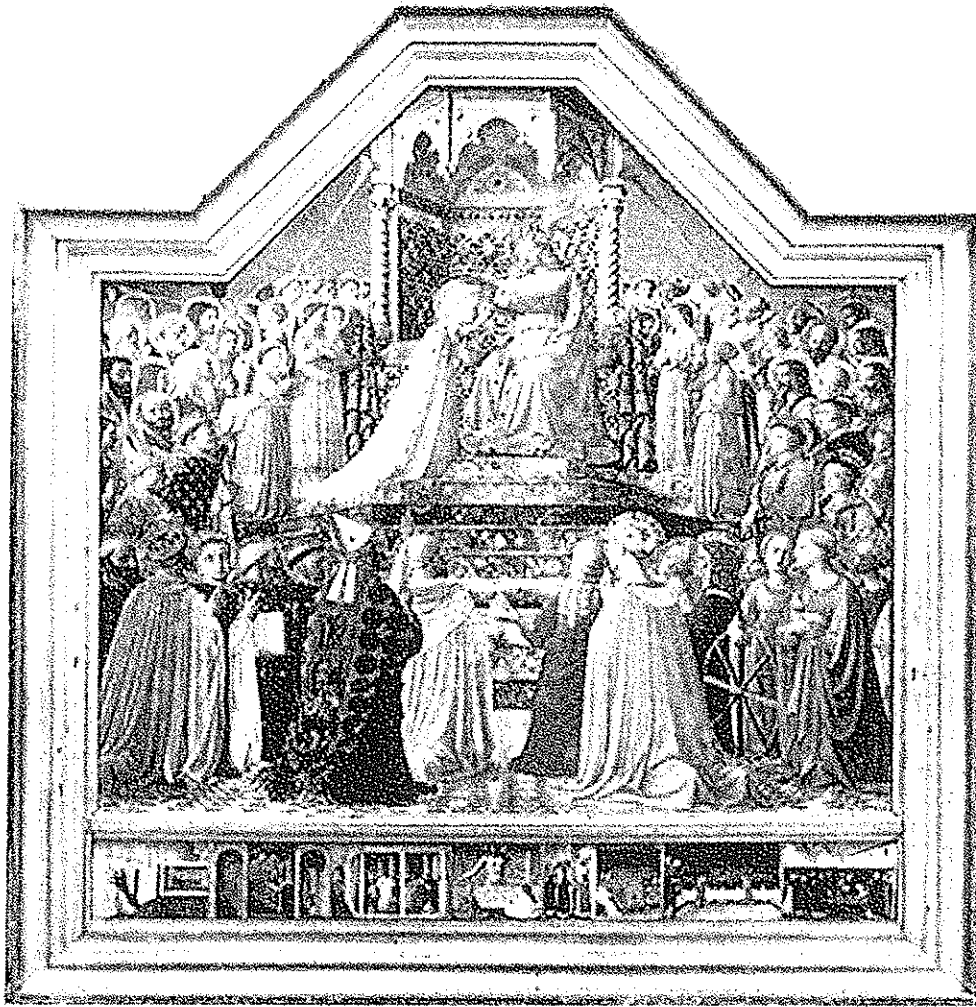
mind and matter, it is no wonder that angels – after they have lost their place in heaven during the process of secularisation – not only went into exile in the arts but also reappeared in the sciences. However, what is more remarkable is that in this context angels have also become objects of so-called exact methods in empirical based studies.

The history of angels as inhabitants and specialists of the exchange between mind and matter includes a yet undiscovered but rich source of knowledge. This concerns the epistemological problems of visualisation of the spiritual, intellectual, or immaterial world. In the context of new approaches to brain research, especially recent techniques (such as fMRI) for dealing with cognitive and emotional functions of the brain by making mind-indicators visible in the brain matter, angels are of special interest because they can be analysed as memory images for hidden problems of visualisation, more precisely as symbols for the role of art and images within the history of knowledge and sciences. In discussing this function this article is to be regarded as a contribution to an interdisciplinary analysis of images.

### Measuring angels

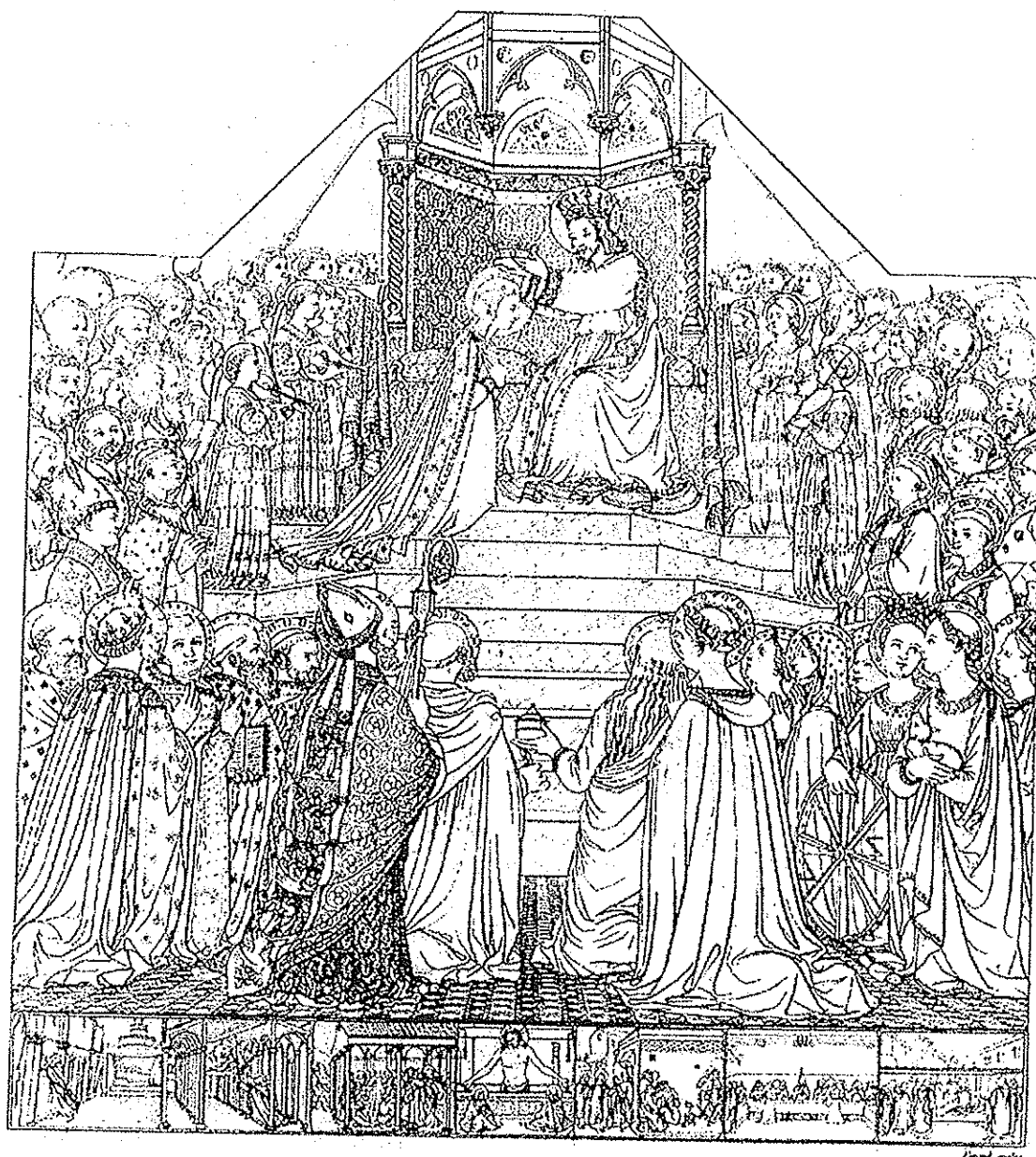
At first sight, the measurement of the images of angels by scientific methods seems like a chapter from the history of happier times when the boundaries between different faculties, like art and science, which were not distinct, i.e. when scientific and artistic capabilities were often united in a single person. One such person was Carl Gustav Carus, well known as a painter and medical physician and the author of treatises on landscape painting, physiology, psychology, zoology and other things. He argued both for a 'renewal of art through the spirit of science' and for the use of the aesthetically trained eye in scientific investigations of nature.<sup>1</sup> The conclusion of his essay on *The Significance of the Particular Shape of the Eye in Some Historical Paintings* (1825)<sup>2</sup> is that research simply brings to light knowledge previously unconscious or concealed, a knowledge, in other words, which was only revealed in art. If art is here regarded as science's pre-conscious, his argument is nevertheless irritating to present-day ears because he talks of the 'truth and beauty of the deeds of genius' and argues 'that the human being in actuality, in accordance with his inner divine nature, already possesses within himself, though unconsciously, the findings of all higher scientific research'.<sup>3</sup>

Carus refers to a book by August Wilhelm Schlegel that is dedicated to Ternite's graphic reproductions of Fra Angelico's *Coronation of the Virgin and the Miracles of Saint Dominic*. He discusses Schlegel's observation concerning the eyes in this work, which the latter has developed by interpreting Ternite's outline drawings of Fra Angelico (see Figures 1 and 2). According to Schlegel, the eyes in the paintings were 'always invested with soul' but 'not always correctly drawn';



**Figure 1.** The coronation of the Virgin Mary: Fra Angelico (1438–50), San Marco, Florence.

for the eyeball often seemed foreshortened and ‘in profile to have a broader curve than it ought rightly to have’.<sup>4</sup> This observation confirmed Carus’ own impression that the painter had ‘in the heads of his angels, his Maria, his Christ’ (see Figure 3) applied to the eye, the noblest organ of the spirit in the visage, a ‘type which appears in many respects alien to the eye as one is accustomed to seeing it in human faces’ (p. 19). Whereas Schlegel’s assessment did not differentiate between anatomically inaccurate and accurate representation and the licence for artists not to be constrained by nature, Carus wishes to solve the puzzle of what ‘at first glance’ might possibly be considered a misrepresentation. In his view, the faces were, through the smaller iris, given a ‘peculiar, other-worldly, spiritual expression’ (p. 20). In his three-volume *Basic Concepts of Comparative Anatomy and Physiology* (1828) he refers to this ‘scientific method’ to find out why a deviation from nature ‘can appear to us in this case as an ennoblement, as it were as a spiritualisation of nature itself?’ (p. 20). In doing this, he links the criterion ‘deviation from the given natural form’ to the distinction between more noble



**Figure 2.** Drawing of Figure 1: Wilhelm Ternite in A.W. Schlegel (1817) *Maria Krönung*.

versus lower, thus asking whether in this deviation 'a lower form is being set off against a higher form, or whether, on the contrary, the higher and more noble form is being represented here as more developed and thus superior?'

This mode of enquiry is derived from the developmental model in the 19th century biological sciences, i.e. the successor to 18th century paradigm of epigenesis, a sort of ontogenetic *visus formativus* (in Goethe-German, *Bildungstrieb*<sup>5</sup>) and to the *scala naturae* of living organisms in Lamarck's *Philosophie zoologique* (1809). At the end of 18th century, the field of comparative anatomy played an

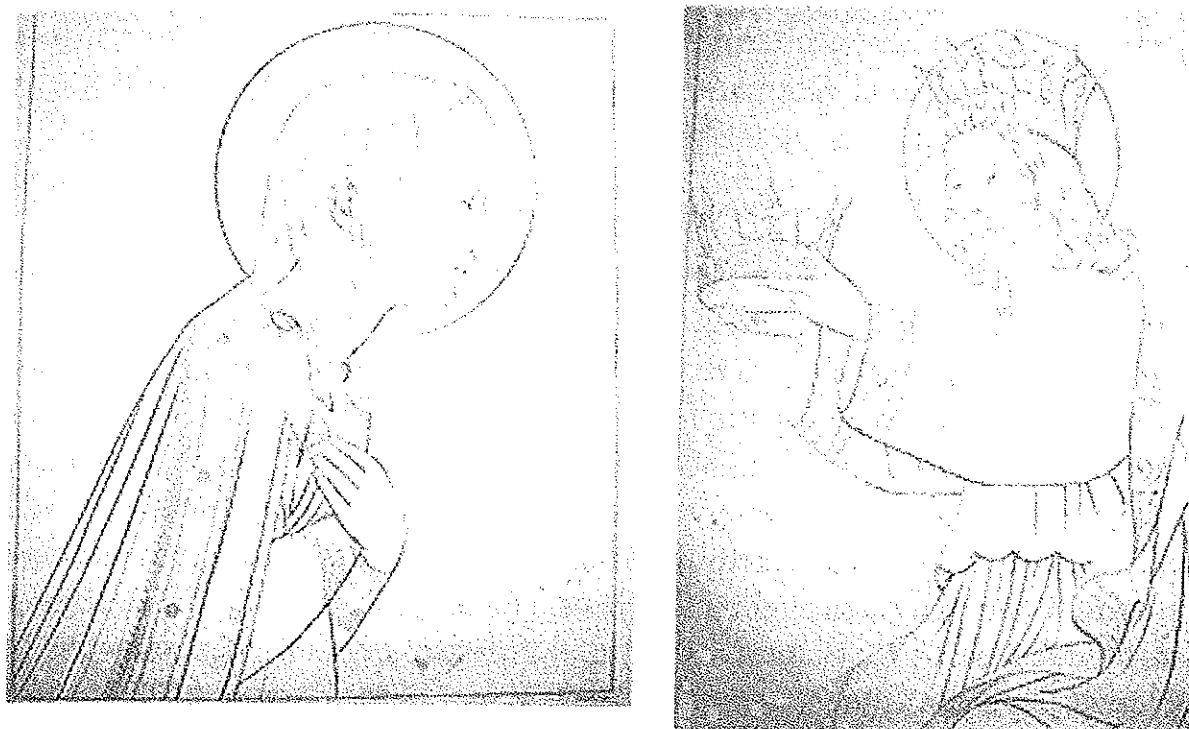


Figure 3. Detail from Figure 2.

important role for the emergence of evolutionary theory out of the system of species. And through the famous debate between Georges Cuvier and Geoffroy Saint-Hilaire on different models of comparative anatomy the field received a lot of attention, notably in Germany due to Goethe's commentary on the debate in 1832. Seven years later, Carus' article on *The Significance of the Particular Shape of the Eye in Some Historical Paintings*, written during a period when he worked on his own theory of comparative anatomy, may be considered as a sideline of his scientific system. According to his comparative anatomy, the development of separate organs and nerves, defined as a higher or lower grade in the organisation of the organism, provides the indicator for a hierarchy of living beings. In order to demonstrate the thesis that the lower the organisation, the larger the iris, Carus therefore provides a table (including observations on crocodile, golden eagle, chamois and humans at various stages of development) in which the diameter of the entire eye is correlated with the diameter or the breadth of the iris. He concluded that the lower the level of organisation of the species the larger was the iris. Carus thus uses the comparative anatomy of eyes to develop a hierarchy of species, moreover, he extends this to encompass those higher beings in Fra Angelico's paintings, which are distinguished by an even smaller iris, by including Christ, the angels and Maria in his evaluation. In the case of Christ and the angel, the relation of the iris to the diameter of the eye is half that of the normal person. In short, by exact measurement of the eyes in the *Coronation of the Virgin*, the observed effect of an ennoblement is seen as a deviation from the norm, which

at first had looked like a misrepresentation, now is empirically proven and may be regarded as anatomically reasonable.

### Intersections of art and science and the dialectics of secularisation

After this explanation the remaining puzzle is the question of how artists such as Fra Angelico, who did not have any knowledge of comparative anatomy, could have applied its means in order to represent otherworldly, highly spiritualised natures. The question was particularly acute since this, for Carus, was not an isolated case, as multiple examples from the history of art readily proved; for example, the 'attachment of wings to the human figure (the deep reasoning behind which could only be revealed so much later by a genuinely philosophical anatomy)', or the Ancient Greek figures of the gods, whose 'facial angles' acquired for Carus the same ranking in a hierarchy of skull formations as the otherworldly eyes in the *Coronation of the Virgin* in the developmental history of the eyeball. This puzzle, concerning an anticipatory knowledge of science in art, could not be solved with the methods of exact science. Instead, Carus refers to the idea of genius and his privilege 'with unerring eye to grasp in advance what to his contemporaries is yet veiled in a thick fog'. This argument transforms Schlegel's licence of the artist to deviate from the naturally given norm into a privileged knowledge. According to Carus, such knowledge was founded in the 'inner divine nature' of the human being, but could be distinguished from that of the 'human being of sound mind' in that 'the genius knew how to operate with the as yet unseen as with what is revealed'. Carus' little essay is interesting in the context of 'art and science' and of 'mind and matter' for a number of reasons. In his reinterpretation of a misrepresentation as an anatomically reasonable indicator of high species in images, iconology the traditional means of art studies gets replaced by a sign system that is derived from the semiotics of physiology. Here, morphological phenomena function as phylogenetic indicators, corresponding to Darwin's later statement about morphology as the ideal way of evolution. At the same time the other-worldly creatures of Christian iconology, the images of Christ, the Virgin Mother, and the angels, have been allotted a place in the *scala naturae*. Whereas in the 18th century, the tableaux and scales of the species had already removed the border between animals and human beings, now the border between the divine world and human beings is at stake. Assisted by comparative anatomy, heavenly creatures can now be integrated into a hierarchy of organisms – reaching from the lower via the higher to the noble. In this process, the *ladder of heaven* gets transformed into an extension of the *scale of nature*. However, this secularisation of heavenly images goes hand in hand with a process of sacralisation, which is indicated in Carus' rhetoric and his idea of a revealed knowledge. This constellation between religion, art, and science shows the typical

dialectic of secularisation. While the 'other-worldly' signature of the eyes of the angels, the Virgin Mother or Christ is subjected to scientific measurement, their divine attributes are transferred to the knowledge of the genius. In effect, the artist becomes the inheritor of the sphere from which the angels originate and have migrated. Carus' formulation that the genius 'knew how to operate with the as yet unseen as with what is revealed' points to the fact that the artist has taken over the place of the angels in the sense that he is identified as the recipient of revelation.

### From comparative anatomy to angelic cosmology

The extension of the *scala naturae* into heaven, by means of which the Christian personae are considered in relation to lower animals may explain why Fechner's *Comparative Anatomy of the Angels*, published in the same year as Carus' work, was by his contemporaries taken as satirical in intention. It is not clear whether Fechner knew Carus' essay, but the parallels are striking. Fechner explains the purpose of his project as follows: although in recent times the comparative examination of lower creatures has broadened the knowledge of human beings, the investigation of the higher creatures had not yet been undertaken. Because of the lack of a suitable name for these creatures supplied by the Linnean system, he was obliged to use the popular name of 'angel'.<sup>6</sup> The preface may read like an ironic commentary on Carus; however, Fechner's method is quite different. Since at that time he was engaged in translating textbooks on physics and chemistry, the language of physics made its way into his anatomical study of the angels. His point of departure is a polemic against the prejudices of vanity that make human beings fail to see that the human shape itself – with its 'many angles, protuberances, outgrowths, holes, cavities, etcetera' – could in no way be taken as the measure of beauty (p. 15). Only with all its roughnesses removed, in the form of a perfect sphere could the human being, as a microcosm in which philosophy and physiology are united, serve as the model for the angelic form. For it is in the shape of the sphere that beauty and harmony combine with the state of physical bodies: 'Objects which are not driven in any direction at all, or in all directions at once, remain similarly static.' Comparative anatomy here takes on the function of setting the 'direction for the development towards more perfect form', i.e. for Fechner a globular shape. Therefore, for him human beings only embody a transitional stage in an evolutionary process: 'Everything which in the human being we see only in the developmental stage, only in transition, will be perfected in the highest creature.' In this evolutionary model the angels occupy a place on the scale which marks a leap into another, non-corporeal, somehow esoteric mode of existence. As a result they find themselves back in their common place, namely in the cosmos. The decisive difference is that they are now regarded as animated or 'living planets'.

Fechner's entire text can be read as an exercise in conveying the concepts and laws of physics and astronomy in translating tales of angels into the nomenclature of natural sciences under the mask of traditional mythical figures, or vice versa. However, his project goes beyond this in its striving after synthesis, harmony and beauty.<sup>7</sup> In his later book *Zend-Avesta* ['the living word']. *On the Things of Heaven and the Beyond. Seen from the Standpoint of the Science of Nature* (1854), Fechner explained the application of the methods of induction and analogy even to the 'highest realities, God, heaven, the higher beings above us', since these issues could be examined only indirectly via the experiences of mind and body.<sup>8</sup> In this context, his interpretation of angels as animated planets reappears. It is only the stars or heavenly bodies that can be the angels of heaven, Fechner argues, since there are no other inhabitants of heaven. And here Fechner draws a direct link between biblical language and astronomy, equating the seven angels mentioned in the *Revelation of St John* with seven planets. In *Zend-Avesta*, Fechner extends the natural scale of the increasingly complex organisation (cited here from Carus) of organisms into space, considering the Earth from the perspective of the manifold nature of her parts and functions. However, in contrast to Carus, in Fechner's book art is given a negative role. In his view the anthropomorphic depiction of angels in painting is responsible for the fact that the angelic form of the stars was not understood for such a long time.

Now one has to ask, what on earth could have motivated a successful scientist, the director of the first Institute of Physics in Germany, to write a cosmology of angels in reconciling the world view of science with that of Christianity? In the history of science Fechner, one of the founders of psychophysics, is associated above all with research into the interaction between mind and body, using precise mathematical calculations under experimental conditions. The transfer of his research into the field of *last things*, which by definition are inaccessible to positive knowledge, ultimately led him to an entirely speculative model mixing up astronomy, physics, and Christian thought. The desire to overcome the limits of science brought the angels who traditionally occupy the threshold between the visible and the invisible back onto the stage of a scientific cosmos. Since the scientific transformation of *heavenly spheres* into a *physical space* includes the metamorphosis of the heavenly hosts into planets, it is the image of the animated planets, in which the presentiment of the limits of positive knowledge takes on concrete form and once again the angels embody this boundary.

### Measuring the hell, baroque heavens and the aesthetics of the miraculous/fanciful

Fechner's angel cosmology was not the first example in the history of science for an otherworldly topography to meet with a scientific approach. Three centuries



earlier the 22 year young Galileo in his *First Lecture at the Florentine Academy on the Shape, Position and Size of Dante's Hell* (1587) undertook to prove and to make real the poetic scenario of Dante's *Divina Commedia* by means of mathematical calculations. Galilei not only identified the geographical place where Dante and Virgil in 1300 entered hell (between Naples and Kyme) and defined the conic shape of hell and its cartographical position on the map. By reference to comparative knowledge, as for example to Archimedes, to antique geometry, and to Albrecht Dürer's theory on the proportion of the human body, Galilei interpreted various details from Dante's poetic verses. His project invented an interesting constellation of art and science which should become paradigmatic for the scientific age or modern era. On the one hand, Galilei estimates the poetic description as *più maravigliosa* (more miraculous or marvellous) than the scientific observations of nature by men, which he calls *mirabile* (admirable), yet on the other hand by producing the evidence of the poetic depiction through calculation he positions the authority of science above the arts. Thus, the opposition between qualitative value and quantitative methods of evidence was established. During the following centuries the concept of the miraculous compared to the wonderful became a heated argument in the struggles about the image and character of the heavenly personnel, at least after the Copernican revolution had cast doubt on the construction of the Christian heaven and the home of angels. However, as the philosopher Hans Blumenberg has argued, the Copernican revolution not so much established knowledge in opposition to a theological worldview but has actually provided an explanation for its appearance, because Copernicus' *Revolutionibus orbium caelestium* (1543) analyses the constellation of earth to the stars, i.e. the position of human beings to heaven:

The great Copernican achievement is not the destruction of an illusion and the substitution of appearance (*Schein*) by truth, instead it is the explanation of this appearance, the proof how the mechanism of its origin works – and thereby it is the access to the way in which we may recognize and rescind our projections into the world. Since Copernicus the world has begun to learn how to cope with its self produced images and inexorably to penetrate into the field of their certainties.<sup>9</sup>

The baroque painters used this insight into the construction of the image of heaven, in order to produce their coloured fresco heavens by means of a perspectively distorted spatial painting (Figures 4 and 5). By means of a scientific informed technique the whole space of the ceiling, filled with their painted heavenly bodies, became transformed into a product of a projection, i.e. an effect of a human gaze directed toward heaven from a given earthly viewpoint. As a result of this invention the mythological images of the Christian worldview assumed a double



**Figure 4.** The Assumption of the Virgin: Peter Paul Rubens (1614), Vienna, Museum for Art History.

meaning: they may be admired as art and at the same time be reflected as images produced by means of a perspectively constructed viewpoint.

However, the relationship between art and science gets more complicated when language comes into play. Whereas images provide a condition of possibilities for an ambiguity and tension between various connotations of appearance – from revelation and apparition over illusion up to emergence or visualisation, in



**Figure 5.** Institution of the Rosary: Tiepolo (1748/50), Santa Maria del Rosario, Venice.

language one has to name and define the phenomena. This problem was at stake in the ongoing debates on the concept of the miraculous, wonderful or fanciful (*das Wunderbare*) in philosophy and aesthetics during the 17th and 18th centuries. Spinoza, for example, when discussing the concept of 'wonder' in his *Tractatus Theologico-Politicus* (1670) developed different methods to cope with the discrepancy between the narratives of the holy book and scientific knowledge about the laws of nature. He used hermeneutic solutions as well as metaphorical interpretations or distinctions between 'pure notions and imaginations' and facts. The 18th-century aesthetics, instead, responded to the same problem by introducing a new category to consider unnatural phenomena as poetic products but at the same time as probable, i.e. the concept of *das Wunderbare*.

One of the most interesting contributions in this context is Bodmer's *Critical Treatise on the Fanciful in Poetry and Its Connection with the Probable* (1740)<sup>10</sup> in which he defended John Milton's *Paradise Lost* against critics (like Voltaire) who were especially irritated by Milton's description of the war in heaven and his fantastic depiction of the angel's bodies. In Bodmer's aesthetical theory the angels become embodiments of a specific sort of a poetic genesis, and this is the capacity to bestow spiritual creatures with a body in order to expose them to the sensual perception by readers and to transfer these creatures from the state of possibility into mimetic representation, in other words from virtuality into the concrete corporeal world. However, as products of imagination, poetic images are by no means considered as opposite to reality, instead the poetic language constitutes a sphere that is different from the binary paradigm of opposing 'facts and fiction'. Since metaphors here function as means in order to make the invisible, spiritual world, the ideas and products of the mind visible within language, the metaphorical language here is not considered as a so-called indirect language (*uneigentliche Sprache*), instead it gets related to visual images. The German word *Einbildungskraft* for imagination (it literally means a capacity to inscribe an image into a body) reminds us that the products emerging from imagination have to be considered like inscribed images. They mediate between the outer material world and the physiological basis of the mind, perceiving images from outside which shape the mind as well as forming the expression of ideas and notions. It is no wonder that this poetic capacity has been developed through the discussion of angels. The 18th century aesthetic debate on the angel's bodies thus became the origin of a concept of an image, be it visual or linguistic, which functions as a corporeal appearance of non-corporeal, invisible, unnatural or super-natural phenomena or notions. In short, the theory of image inherits the tradition of angels – or more precisely the tradition of depicted and described angels.

### Angels as intermediate beings – the image between philosophy and painting

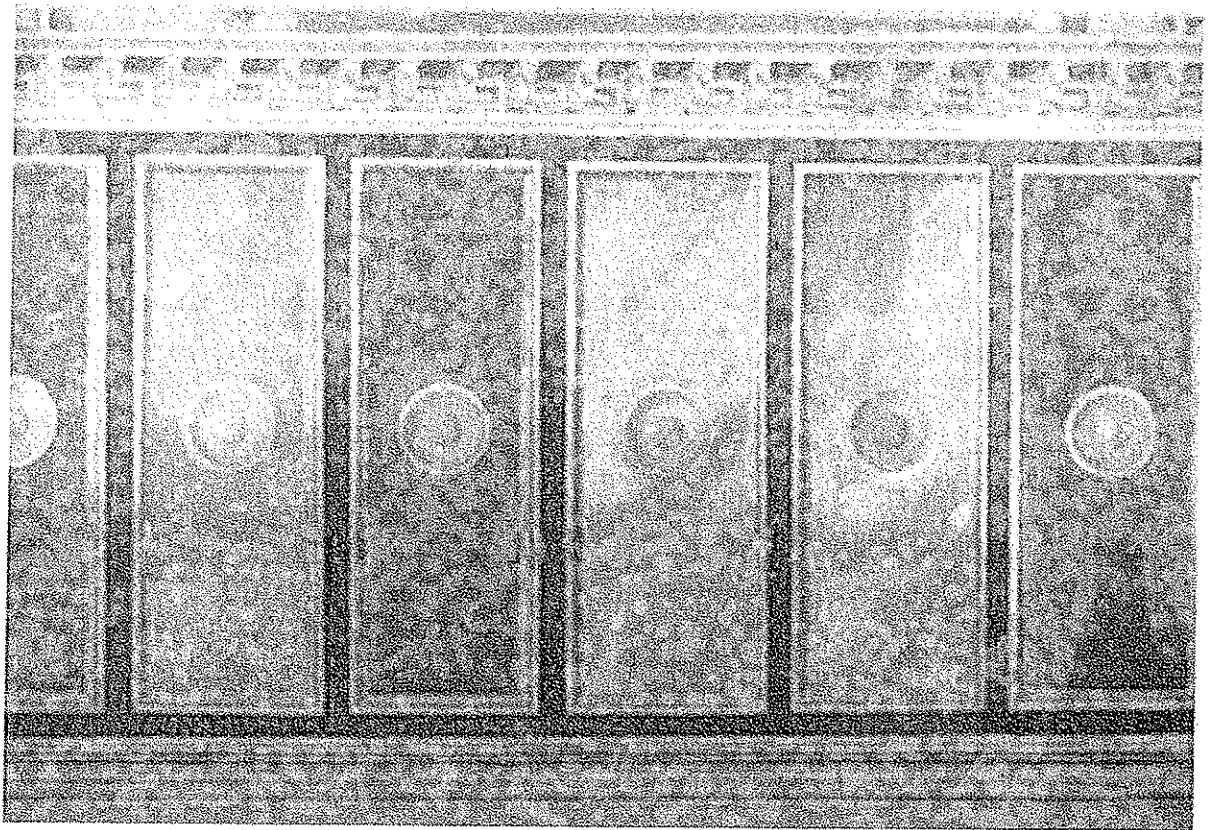
In the theological-philosophical tradition, angels occupy the sphere of spirituality, the soul, or, in Cartesian terms, *res cogitans*, and are opposed to corporeality or *res extensa*. The canonical discussion of angels in Christian tradition is to be found in the *Summa Theologica* of Thomas Aquinas, who was also called *doctor angelicus*. In his *Questiones*, angels are characterised as intermediate immaterial beings of the intellect without corporeality, which represent pure form. Their specific mode of cognition, *intellectus et mens*, is that of similitude, not of abstraction; it does not proceed discursively, but as contemplative immediacy. They are the creatures closest to God and most like Him; they recognise God ‘as a reflection within his own angelic nature’. Particularly interesting is the way in which he defines the relationship of angels to space, they are in a place, but not located.<sup>11</sup>

This means that the angels not only embody the moment of visualisation, but they bring into appearance what has never been seen. Representations of angels in painting, that is, images of angels, therefore actually are images of images. They fit in what the French art historian Georges Didi-Huberman has explained as a ‘figure of the figure’. This ‘finds itself between two things, two worlds, two times, two ways of meaning. It lies between appearance and truth as this applies to the “fullness of time”. It lies between the sensual form (*schema*) and its opposite, the ideal form or the idea (*eidos*); in short, between the form and the formless’.<sup>12</sup> In his book *Fra Angelico. Dissemblance and Figuration* (1990), Didi-Huberman sees this ‘in-between-ness’ literally in the images of the Annunciation and of the Virgin Mary from 14th and 15th century Italian painting: for example, in those *marmi finti*, the painted, fake marble bases that fill the bottom sections of frescoes (Figure 6). These *marmi finti* are surfaces of colour which on closer inspection reveal the materiality or the paintedness itself, they are surfaces in which matter becomes recognisable as the principle of non-similar figuration. It points to something that is beyond the world of bodies, these surfaces are meaningful, but without specific meaning.

However, Didi-Huberman’s readings uncover such zones of colour not only below the iconic image, but also within the site of the Annunciation itself, i.e. on the floor between the figures’ feet, on the ground of the bodies, that is, in that place where the angel appears, yet without being located – a kind of *heterotopia* which is represented by some painters in an image of suspension (Figure 7).

When in art history these zones of colour were replaced in perspectival scenes by the complex arrangement of architectural structures and geometrically patterned floors, the signifiers towards the non-visible – or the moment of appearance or incarnation, which the scene captures – migrated into the

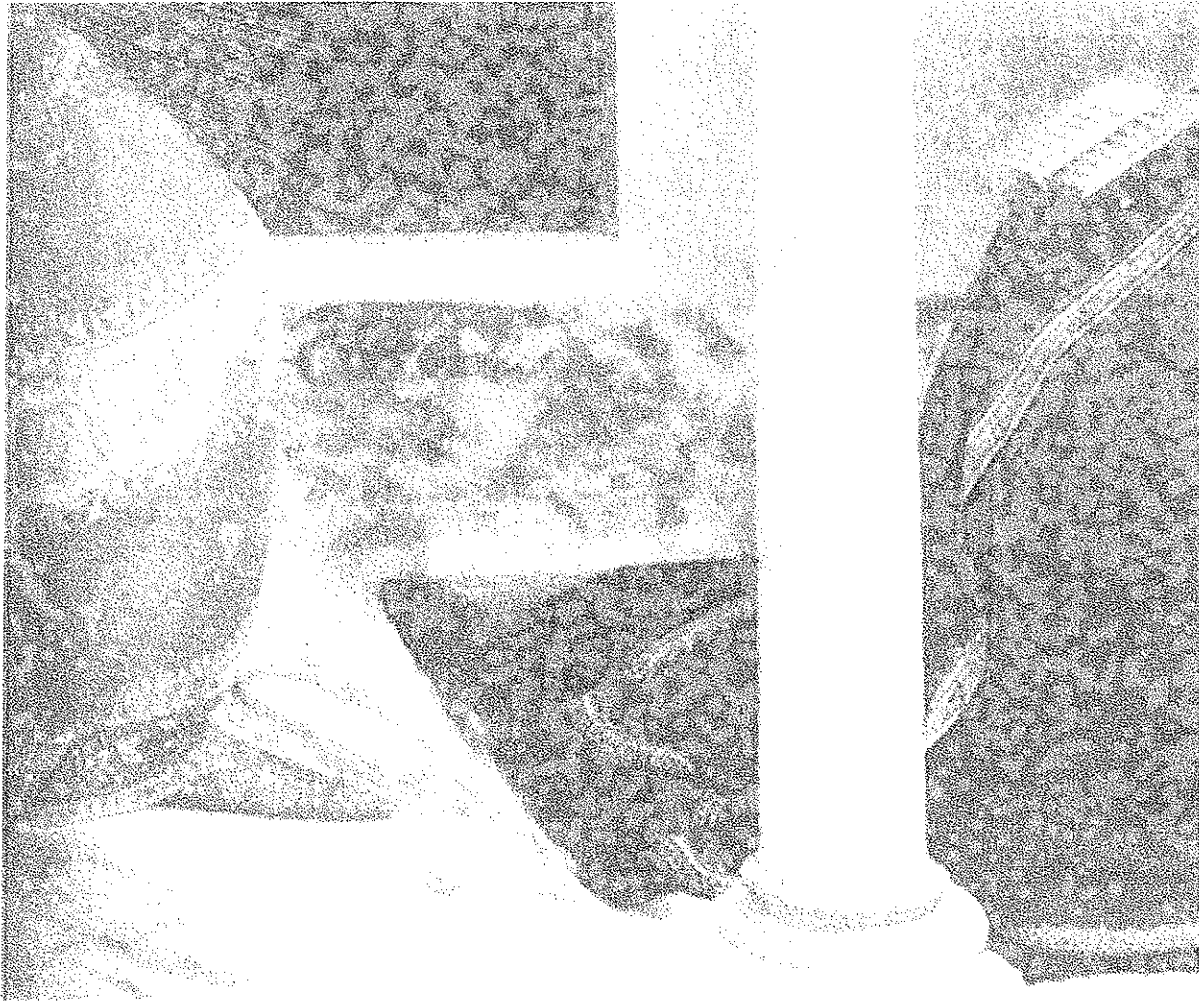




**Figure 6.** *Marmor finto* below Annunciation: Agnolo Gaddi (1438–50), Cathedral of Prato.

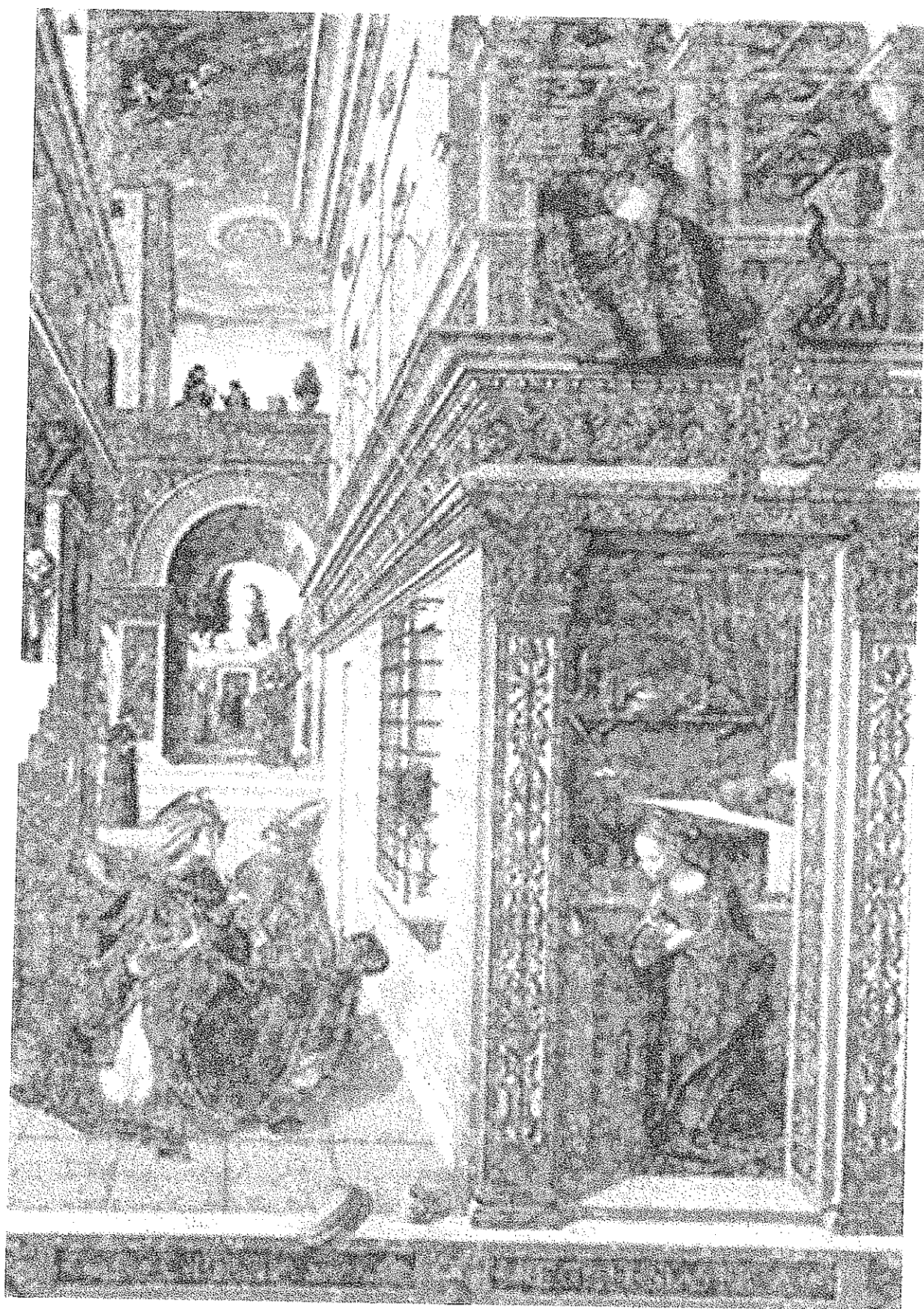
iconography itself, by means of niches, windows, doors, gardens and pillars, the space is now represented as simultaneously open and closed. Locks and other details indicate that the scene of the Annunciation is an image-space, into which something from beyond the world of physical bodies has entered (Figure 8).<sup>13</sup> God really is in the detail here, and in a way that is far more direct than Aby Warburg ever dreamed of.<sup>14</sup>

Moreover, if painting is the place in which the intermediate beings appear as unlocated and often quite literally hovering bodies, these figures are at the same time means for reflection on painting itself. In this sense, the eradication of the genuinely painterly aspects of materiality and colour turns out to be the precondition for the project of measuring angels. We recall that Carus undertook his comparative anatomy of the eyes not in relation to Fra Angelico's painting, but in relation to Ternite's graphic reproduction of it. His scientific project was historically preceded by re-evaluating outline drawings and copper engravings vis-à-vis original paintings. These reproductions were already dominant in literature and science around 1800, in Goethe, for example in his famous reference to an engraving of the Vera Icon, and Schlegel, as well as in Runge's etchings of the *Seasons* (1805) where the angels were transformed into mere schemata, integrated into arabesques as ciphers (Figure 9). Since the individual figures in



**Figure 7.** Anunciation: Fra Angelico (1433/4), Cortona.

these etchings, as in engravings and outline reproductions more generally, appear anyway unlocated in time and space, it is not just the colour and the materiality of painting that is lost here, but also the distinction between place and location. That means that the angels were turned into ornaments – or they became literally marginalized, i.e. shifted to the margins of paintings and images. As a result, these figures were themselves transformed into signs that direct the eye towards other things, either directing the Romantic gaze towards the most popular motifs of the Romantic religion of art, e.g. in Raphael's *Sistine Madonna* or directing the anatomically trained gaze towards the deviant eyes of other-worldly creatures, as in Carus' essay. The removal of the angels from their heavenly context and from painting was thus the condition of possibility for turning angels into the objects of scientific investigation and integrating them into the *scala natura*. At the same time, the eradication of materiality and colour as the sign of the invisible is also the symptom of the secularisation of the images, which goes hand in hand with the systematic and scientific approach to looking at art and not just in the sciences.



**Figure 8.** Anunciation: Carlo Crivelli (1486), National Gallery London.



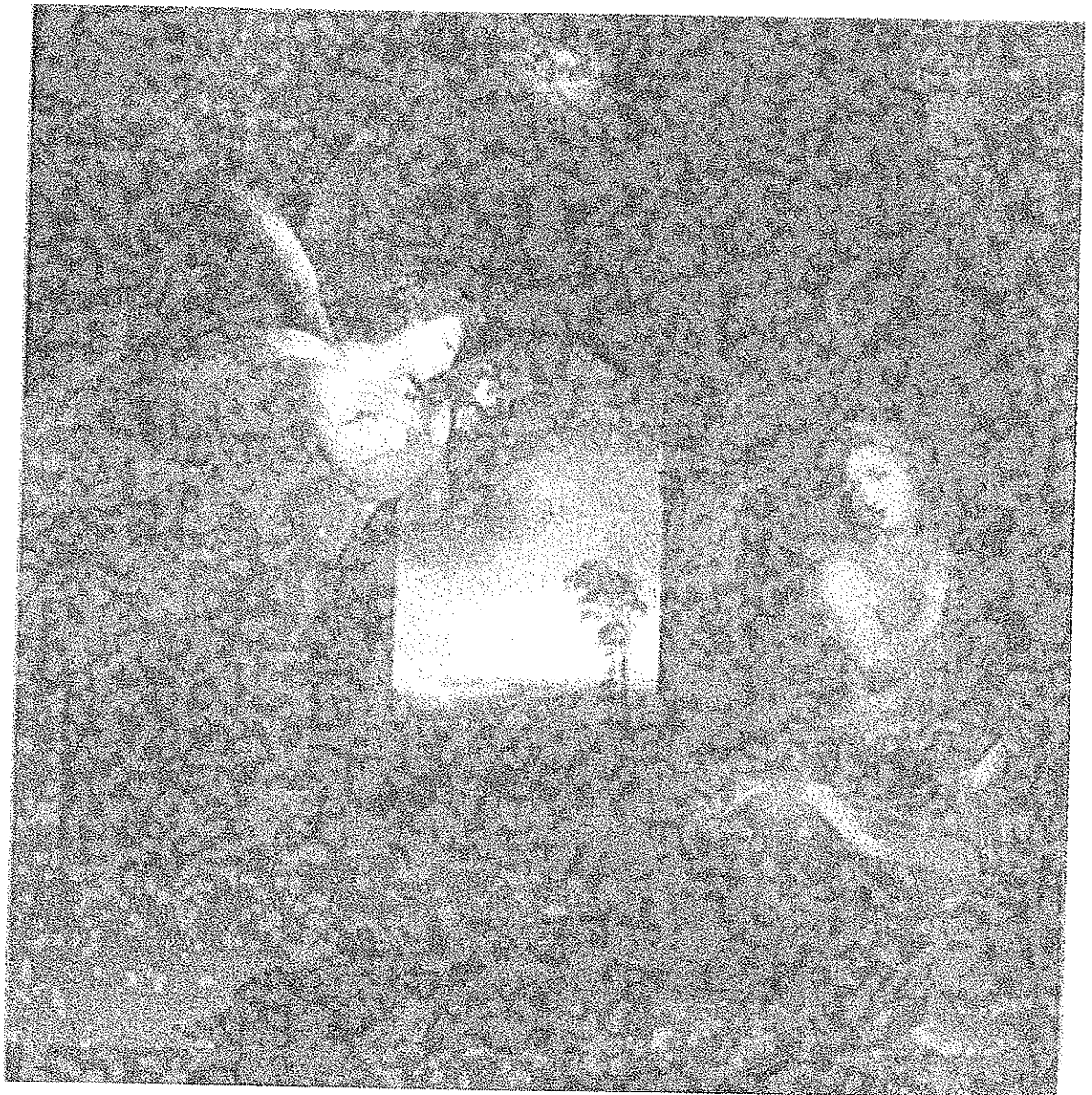


**Figure 9.** Evening, Times of Day: Philipp Otto Runge (1807), Kunsthalle Hamburg.

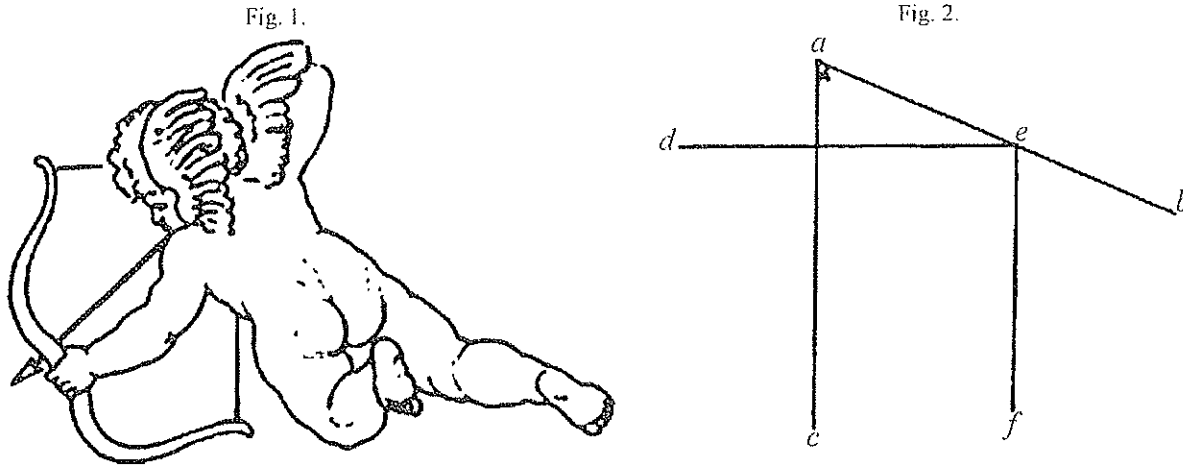
### The angel as a memory-image and the origin of *Kulturwissenschaften*

Outline drawings were also used by Exner in his lecture on the *Physiology of Flying and Hovering in the Pictorial Arts*, in which he subjected the probability of flying and hovering figures as represented in art (Figure 10) to scientific scrutiny. Like Carus, he proceeded from the observation that, despite the deviation from the imitation of nature, there is something familiar to us in these works of art which represent what the artist could not possibly have seen in reality.

In the first step, Exner examines the question of what, from the anatomical point of view, a human being would have to look like who could fly, by calculating the relation between the weight of the muscles necessary to enable flight and that of



**Figure 10.** Annunciation: Domenico Beccafumi (1546), San Martino, Sarteano.



**Figure 11.** Drawing and diagram: Exner (1882) after Triumph of Galatha by Raphael, in *Die Physiologie des Fliegens und Schwebens in den Bildenden Künsten*.

the rest of the body. The result, he concludes, 'would be a monster'.<sup>15</sup> Exner then considers a slightly different type of figure, i.e. hovering figures that appear as if they are without any weight. Here, though, he finds that their weightlessness, as the physical precondition of their suspension in space, is contradicted by the pictorial images: 'Recall the angels and saints who are visibly making an effort to carry through the air an object which we must think of as heavy, for example the cross'. In addition, he argues, their weightlessness would not fit to the movements of the muscles, the folds of the garments, and the form of the hair, which are common for their depicted bodies. The solution to the problem as he presents it is a distinction between artificiality and artistry. The 'flight of human figures in the mechanical sense' has, he claims, 'never been artificially represented'. 'What have been represented artistically are always only figures who are freed from their normal human weight, although they are not necessarily completely weightless either.' Finally, he tries to examine these images by a number of calculations, figuring out the impossible weight of the wings a human being would need in order to fly or, for example, to find out at what speed 'the position given to it by Raphael might be physically possible' (Figure 11)

His lecture was part of a whole series of investigations into the mechanics of flight, for which he also undertook laboratory experiments with models to simulate flight movements, this time supplemented by outline drawings as objects for mathematical calculations.<sup>16</sup> However, in his essay on *Physiology of Flying and Hovering in the Pictorial Arts* he uses outline drawings, supplemented by mathematical calculations of weight and speed. Based on the finding that the artistic representations show thoroughly improbable states of flight or suspension in space, not flight 'in a mechanical sense', he proposes a typology in which the



**Figure 12.** Drawing after Michelangelo (1508/10) Sistine Chapel: Exner.

artists are distinguished from one another according to the degree by which their figures appear to be weightless.

In the course of his lecture a quite different methodological approach creeps into his physical-mechanical argumentation when he appeals to the psychological basis of artistic representations in order to discuss the plausibility of the hovering figures in the perception of the viewer, and in doing so brings memory into play. This means that at the very limit of empirical methods Exner changes to a different approach based on memory traces of moods or affects in depicted bodies, instead measuring their physiological parts. Seeing memory as a medium in which the production and the reception or contemplation of art communicates, Exner interprets the outlined drawings of the figures' movements now as recollected images or moods discussing their psychological plausibility for the observer. Thus, he reconceptualised the images of angels and other flying figures as 'recollected images' and 'memory-images' considering art as a kind of 'treasure store of memory' (*Gedächtnisschatz* [sic.]) an archive of meaning focused on the posture and the gestures of animation, the folds of the clothing, and the hair of the figures, i.e. traces and signs of their inner and outer movement. As a result of the changed approach of his investigation, it is not just the hovering figures – the putto, for example, or a Christ figure emerging from the grave, or the creator God and father of the universe from Michelangelo's Sistine Chapel (Figure 12)

that attract Exner's interest, but also other figures, notably nymphs: 'Figures of this kind are the painted realisation of our ideal of dance, the beauty of which increases in accordance with the degree to which the dancer makes us forget the necessity of the ground which bears us.' The figure of the dancing nymph, the study of the phenomena of movement, the transformation of artistic figures into moving images, and not least the significance that Exner ascribes to the posture and the gestures of animation, the folds of the clothing, and the hair of the figures, his definition as recollected images which affect us unconsciously – all these signs are exactly the same aspects of images which only a decade later were to be emphasised by Aby Warburg, the founder of a cultural-scientific reading of images as a memory archive for the European history of civilisation, the Jewish thinker and founder of the *Kulturwissenschaftliche Bibliothek*. His main concern was to substitute the conventional method of art history, i.e. iconology, by a new sort of iconography, i.e. a psychoanalytically informed method of deciphering specific phenomena in paintings and photographs as memory traces of affects. Thus Warburg created the concept of *pathos formula*, a category derived from focusing the interpretation of paintings on former marginalized aspects like 'excited gestures' and 'moved accessories' (*bewegtes Beiwerk*).<sup>17</sup> Since Sigmund Exner not only introduced the concept of pathos formula but also developed the idea that such recollected images affect us unconsciously, his lecture has to be seen as a precursor to Aby Warburg's cultural-scientific method. Exner, who was also a teacher of Sigmund Freud, in fact was an important inspiration and source of terminology for the young Aby Warburg.<sup>18</sup> His lecture marks a primal scene for the development of *Kulturwissenschaften*<sup>19</sup> around 1900 as an approach beyond the opposition between natural sciences and humanities.

The 19th century project of measuring angels evidently had to come up against the epistemological boundaries of comparative anatomy and physiology in order for the images of painting to be rediscovered, at this boundary, as memory-images, to be reformulated as a repertoire of pathos formulae of movement for pictorial memory and also to be considered as memory images for crucial epistemological problems of visualisation in general. This means that the development of cultural science could only happen via a traversal of the methods of the natural sciences. Only at the point where the empirical and experimental methods of sciences met the limits of measurability a change of perspective could take place through which the object, instead of being measured, was interrogated for its significance for human memory.

To conclude, for 19th-century physiology, the angels represented bodies, in relation to which the attempt was undertaken to penetrate into the sphere of the unknown and unseen by empirical scientific means. The measurement of angels in this respect may be considered as a symptom of secularisation through which

the sciences advanced into those empirically inaccessible areas whose interpretation was formerly the privileged field of religion. As a figure which represents the logic of apparition itself, however, the emergence of angels in comparative anatomy points towards a problem of pictorial representation that continues to dog the natural sciences to this day. For to the extent that sciences represent their objects of study by means of outlines and contours, today by digital diagrams and graphic representations, the problematic of the image – i.e. the awareness of the epistemological problems of apparition – tends not to be appropriate for these tools. One of the crucial questions in which the angels remain with us today is: what is it actually that gets visualised by image-producing techniques and how are they transformed into meaning-producing procedures?<sup>20</sup> Which are the angels of current brain research and where are they located within the exchange of mind and matter?

### References and Notes

1. See J. Müller-Tamm (1995) *Kunst als Gipfel der Wissenschaften. Ästhetische und wissenschaftliche Weltaneignung bei Carl Gustav Carus* (Berlin: Walter de Gruyter).
2. See also C. Blümle (2006) Abstrakte Anschauung. Physiologie und Kunstbetrachtung bei Carl Gustav Carus. In S. Peters and M. J. Schäfer (Eds), *Figurationen von Evidenz zwischen Kunst und Wissenschaft* (Bielefeld: transcript), pp. 152–164.
3. First published in the journal *Kunstblatt des Morgenblattes*, and in slightly revised form in *Mnemosyne. Blätter aus Gedenk- und Tagebüchern*, n.p. [Pforzheim 1848], pp. 18–26 (here p. 25). My quotations are from this edition.
4. August Wilhelm Schlegel, *Mariä Krönung und die Wunder des heil. Domenicus nach Joh. v. Fiesole in 15 Blättern gezeichnet von W. Ternite nebst einer Nachricht vom Leben des Meisters und Erklärung des Gemäldes*, n.p. [Paris 1817].
5. J. F. Blumenbach (1789) *Über den Bildungstrieb*.
6. G. T. Fechner (1825) *Vergleichende Anatomie der Engel* (Leipzig), Edited by M. Bertleff (Vienna: Karolinger Verlagsgesellschaft 1980), p. 9.
7. See also R.M. Erdbeer (forthcoming) *Deskriptionspoetik. Humboldts Kosmos und das Wissenschaftsarchiv der literarischen Moderne*.
8. G. T. Fechner (1854) *Zend-Avesta oder Über die Dinge des Himmels und des Jenseits. Vom Standpunkt der Naturbeobachtung*, 2 vols (Leipzig: Leopold Voß), p. XXI.
9. H. Blumenberg (1964) Kopernikus im Selbstverständnis der Neuzeit. In Akademie der Wissenschaften und der Literatur, *Abhandlungen der geistes- und sozialwissenschaftlichen Klasse*, Jg. Nr. 5, pp. 339–368, here p. 354.



10. J. J. Bodmer (1740) *Critische Abhandlung über das Wunderbare in der Poesie und dessen Verbindung mit dem Wahrscheinlichen. In einer Vertheidigung des Gedichtes Joh. Miltons von dem verlohrnen Pardiese* (Zürich: Conrad Orell und Comp), Ed. by Wolfgang Bender (Stuttgart: Metzlersche Verlagsbuchhandlung, 1966).
11. T. von Aquin (1985) *Summe der Theologie* (Stuttgart: Kroener), vol. 1, pp. 224–229.
12. G. Didi-Huberman (1990) *Fra Angelico. Dissemblance et Figuration* (Paris: Flammarion).
13. See D. Arasse (1992) *Le Détail. Pour une histoire rapprochée de la peinture* (Paris).
14. W. Schäffner, S. Weigel and T. Macho (Eds) (2003) *Der liebe Gott steckt im Detail'. Mikrostrukturen des Wissens* (München: Fink).
15. S. Exner (1882) *Die Physiologie des Fliegens und Schwebens in den Bildenden Künsten* (Vienna: Wilhelm Braumüller), p. 9.
16. See P. Geimer (2004) Das Gewicht der Engel. Eine Physiologie des Unmöglichen. In: *Kultur im Experiment*, edited by H. Schmidgen, P. Geimer and S. Dierig (Berlin: Kadmos), pp. 170–190.
17. A. Warburg (1999) *The Renewal of Pagan Antiquity: Contributions to the Cultural History of European Renaissance*, edited by K. W. Forster (Los Angeles: The Getty Research Institute).
18. Actually, the angels belong in Warburg's nymphs series, although at a yet hidden place. Interestingly, Warburg's library contained a copy of Exner's lecture with handwritten annotations and the note 'Strrsgb. Nov. 89'. The library also contains a copy of Exner's *Entwurf zu einer physiologischen Erklärung der psychischen Erscheinungen. Theil 1* (1894). My thanks to my college Martin Tremel who carried out research for me in the *Warburg Institute London* and found these titles in the Warburg library.
19. The epistemological approach of *Kulturwissenschaften*, developed by thinkers like Aby Warburg, Sigmund Freud, Ernst Cassirer, Georg Simmel, Walter Benjamin and others, has to be distinguished from 'Cultural Studies'. The former focuses much more on historical perspectives; it has emerged from taking the relevance of the survival or 'afterlife' (*Nachleben*) of religious meanings, cults and rituals within modern culture into consideration. – Concerning the differences between 'Cultural Studies' and 'Kulturwissenschaften' see for example S. Weigel (2002) Zum 'topographical turn'. Kartographie, Topographie und Raumkonzepte in den Kulturwissenschaften. In *KulturPoetik. Zeitschrift für kulturgeschichtliche Literaturwissenschaft*, Bd. 2,2, pp. 151–165.
20. See for example the analyses of face myography methods in: S. Weigel (2004) Phantombilder zwischen Messen und Deuten. Bilder von Hirn und Gesicht in den Instrumentarien empirischer Forschung von Psychologie und Neurowissenschaft. In: B. von Jagow and F. Steger (Ed.) *Repräsentationen. Medizin und Ethik in Literatur und Kunst der Modern* (Heidelberg: Universitätsverlag) Winter, pp. 159–198.

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