

Art as Science | Science as Art

What are images and what are they for?

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1. Introduction

In the 19th century the mathematician Richard Dedekind published an article entitled "What are numbers and what are they for?"¹ At the time, mathematicians such as Dedekind were endeavouring to overcome a "crisis in the foundations" of mathematics. They wanted to clarify the relationship of irrational and imaginary numbers to natural numbers and show that the latter were the basis of the former. At the same time, types of pictures that had never been seen before also began to appear: photography and Impressionist painting. Today, in the age of digital images, art scholars and psychologists, neurologists and media scholars, not to mention artists themselves, are looking at the question: "What are images and what are they for?" In the crisis in the foundations of mathematics, it was mathematicians who were responsible for number theory, but philosophers such as Frege and Russell also made important contributions in this field. The image, however, has never been a central theme in the history of philosophy. Whitehead's famous remark that the history of philosophy consists of a series of footnotes to Plato is particularly true of its attitude to the image. Plato's criticism of the work of the artist placed knowledge through pictures on the bottom rung of his scale of knowledge (*Eikasia*) (Pol. 509e). The distinction Plato makes between the limited knowledge, or indeed even lack of knowledge of people who create pictures and philosophers, who have no need of visual images, because they (alleged-

ly) have true knowledge, led to philosophy being profoundly suspicious of the knowledge value of images. According to this theory, images are doubly misleading: they detract from conceptual, ideal knowledge and their beguiling, powerfully emotive effect leads the mind astray. Today, however, imaging technologies exist in modern science and medicine that not only convey reliable knowledge but are, in fact, indispensable. The emotive effect of images is undeniable, but today both the artist and the public are all too familiar and conscious of that fact; we are so swamped with images that we scarcely look at them anymore.²

There have been theories of perception and art in philosophy, but little attention has been paid to the image per se. Thus in recent decades there has been extensive research in the philosophy of science, but scholars in this field have ignored the use of images in science because in their eyes these images had nothing to do with science but with art. At the same time, art historians ignored images in science because from their point of view they were not "art." There were of necessity a few exceptions: art historians had to acknowledge something like Leonardo's scientific drawings and there were also natural scientists with a philosophical bent, such as Helmholtz, who considered images worthy of study, but, as a rule, philosophers ignored images in science and left images in art to the aestheticians.³ Philosophy's major interest was language, the image remained terra incognita. That began

to change, when it became recognised that images, like language, are also symbolic forms.



Fig. 1: Transfer of cosmic systems to the body. In: Aby Warburg: *Der Bilderatlas. Mnemosyne*, hg. v. Martin Warnke unter Mitarbeit von Claudia Brink, Berlin 2000

An example of this change in perspective is the anthology "Picturing Knowledge. Historical and Philosophical Problems Concerning the Use of Art in Science" (1996), which contains general reflections on and individual studies of the role of images in certain disciplines such as chemistry, biology and archaeology. In this book, images are seen as crucial to the cognitive process, irreplaceable by any other form of representation. This change in the status of the image in the philosophy of science is connected with the sea change within the discipline that began in the 1960s. Scientific research is seen

today as centring on specific case studies, not the application of supposedly universal methods.⁴ After all digital imaging techniques ("scientific visualization" or "visual data analysis") are playing an increasingly important role in science today.⁵

A similar change has taken place in art history in recent years. The great pioneer in this field, who went unrecognised for so long, Aby Warburg, said of himself back in 1917 that he was not an "art historian" but an "image historian."⁶ He was not interested in the aesthetic qualities of images or the usual questions that interested art historians, such as what style or movement a picture belonged to, but in the image as the embodiment of particular contents. For him, images were the symbolic form of expressive contents. Warburg went so far as to attempt to systematically record forms of expression, which he called "pathos formula." Warburg thought that the study of humankind's use of the image should lead to an anthropological theory of culture. In recent years, art theory has been developing into visual theory internationally.⁷ So today the image has become the de facto link between art theory and philosophy of science. But even if we recognise that images are part of science's toolkit and at the same time a vehicle for art, the relationships between these types of image and the basis of images remains unresolved.

2. What are images?

Kant questioned the directness of perception by showing that certain forms of organisation in perception - the "successive quality" in time and the "contiguity" in space - do not actually exist a priori in sensibility itself, but presuppose it. Consequently, space and time as "forms of intuition" are subjective yet universal. In 1868, the natural scientist and philosopher Charles Sanders Peirce started a conceptual revolution in philosophy when he generalised this idea of Kant's and took it further. He

argued that no particular universally given forms of intuition exist, in the way that Kant thought, but went further and denied there was such a thing as direct "intuition" at all. Instead, Peirce claimed: "the idea of manifestation is the idea of a sign."⁸ In other words, each act of perception is always symbolic. Consciousness itself is a process of recognising signs. Thus the perceptual field - the imaginal worlds of our senses - seemed to Peirce to be a sign phenomenon. This was not mere "perspectivism," which believes that there is always a plurality of possible (static) views of the same perception, but a new concept of phenomena, which emphasises the fact that they are fundamentally process-based.

Phenomena always point beyond themselves; memories, expectations and perceptions are essentially made possible by different sign functions. For that reason, Peirce only ever spoke of perception as a process: semiosis, or the process of interpreting signs.

Peirce called the science of signs and symbols "semiotics" and thus quite deliberately expanded the meaning of a term used in the history of medicine. In the past doctors would make their diagnoses on the basis of external symptoms (as opposed to results of laboratory tests). Since Antiquity, the theory of symptoms was known as "semiotics." This type of reason-based perception - and not language - was for Peirce the prototype and pattern for the symbolic process.

Peirce distinguished three functions of the sign, which he called "icon, index, and symbol." "Icon" refers to the visual manifestation of a form in general, index to the relationship of this form to something else through a physical connection with it (a weather vane is an index, because it is physically connected with the wind; it is more than a copy or an imitation). A symbol has the function of carrying meaning in a sign system. The best example is the words in a language, which are

joined together by grammar to form statements. This triadic model is not a classification of things but describes functions. Things carrying the same or similar meaning can fulfil quite different functions. Visual presentations also follow particular rules.

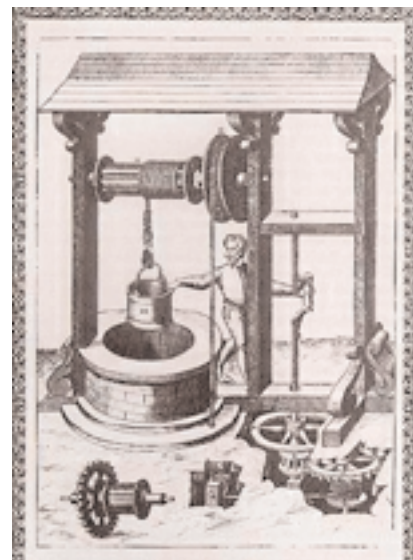


Fig. 2: Augustino Ramelli. Italy 1588, in: Bert S. Hall: *The Didactic and the Elegant. Some Thoughts on Scientific and Technological Illustrations in the Middle Ages and the Renaissance*, in: Brian S. Baigrie (ed.): *Picturing Knowledge. Historical and Philosophical Problems Concerning the Use of Science in Art*. Toronto 1996

The science historian Bert Hall showed that Chinese artists did not understand the forms used to represent space in the art of the Renaissance in the Western world (Fig. 3), so that their copies of Western representations were not only of no use to anyone trying to build a piece of equipment from them, they were not even comprehensible. Even simply copying a picture assumes mastery of the rules of the representation methods used. These rules in turn depend upon knowledge of other sign systems, which we call background knowledge (here, for example, knowledge of mechanics). Peirce pointed to the fundamental importance of repetition for the use of signs.⁹ But repetition always entails change.



Fig. 3: Ji Qi Tu Shuo. China 16. Ct., in: as fig. 2, p. 25.



Fig. 4: Les Mesurers. Fljåumisch. Exhibition catalogue: Jim Bennett (ed.): *The Measurers. A Flemish Image of Mathematics in the Sixteenth Century. Catalogue of the Exhibition. The Museum of the History of Science. Oxford 1995.*



Fig. 5: The measurers. Fljåumisch. Ausstellungskatalog: Jim Bennett (ed.): *The Measurers. A Flemish Image of Mathematics in the Sixteenth Century. Catalogue of the Exhibition. The Museum of the History of Science. Oxford 1995.*

We are not yet certain which of these two 16th-century pictures (fig. 4 and 5) is the original and which is the copy. But how do we understand these pictures? We cannot claim that we understand one version because we know the other. Perhaps we only know one of them. The pictures depict people measuring. To understand these pictures it is helpful to know Horace's saying "Est modus in rebus" (there is measure in [all] things). In one of the versions there is an allusion to this, because "Horatius" is standing at the bottom edge of the picture (not visible in this reproduction). However, to recognise that what is being depicted is the act of measuring, the observer needs to master all three kinds of sign interpretation: distinguishing or perceiving visible forms, practical familiarity with the physical relationship between these phenomena, for example a yardstick and a piece of fabric (otherwise we would have to ask what they are doing) and that means an idea of the rules for using these things.

In Peirce's theory of signs, symbols like these pictures are always viewed against a background of practical experience. We recognise three-dimensional objects on a two-dimensional panel, because we see these images on the basis of familiar indexical relationships and iconic perceptions that are symbolised by the panel paintings. We often overlook the role of action as a prerequisite for seeing, because we are distracted by language. Peirce describes the problem as follows: "Looking out of my window this lovely spring morning I see an azalea in full bloom. No, no! I do not see that; though that is the only way I can describe what I see. That is a proposition, a sentence, a fact; but what I perceive is not proposition, sentence, fact, but only an image, which I make intelligible in part by means of a statement of fact."¹⁰ Every image needs a medium: in the case of the panel painting that medium is the paints and possibly the wooden panel. In the case of our perceptual

images, the medium is the human body. Hans Belting therefore calls his idea for an image theory "visual anthropology." For him the human body is the "place of images." From this standpoint, human existence cannot be described as the relationship between body and soul but the relationship between body and image. The body appears to humans as an image in the sense of an icon as defined by Peirce.

The theory of signs and symbols makes it possible to undertake a comparative study of images in art and science.¹¹ But what is the connection between the images in a museum and those in the laboratory? First of all, the fact that they are not comprehensible to the uninitiated. Only a few people are able to interpret what is shown on a scientific image or - without practice - in modern art. In both cases, these images are the products of a long cultural development. But, in both cases, the human capacity to recognise images has been expanded not created.

What is this capacity? Is it a cultural phenomenon or a natural quality? I would like here to put forward a view that follows on from the work of the biologist Terrence Deacon. A few years ago Deacon, who was head of laboratory research at Boston University and Harvard Medical School, published a highly acclaimed book entitled: *The Symbolic Species. The sub-title: The Co-Evolution of Language and the Brain.*¹² The book looks at the relatively new science of "biosemiotics", the "study of signs, of communication, and of information in living organisms".¹³ Deacon defines human beings as "Homo symbolicus". In this, he is not continuing the philosophical definition of human beings, as represented for example by Ernst Cassirer's similar formulation of the "animal symbolicum". He is formulating his definition not on the basis of philosophical argumentation, but on empirical research on the human

brain. He wants his definition to be understood as a *biological classification*. In his book, he proves that the human capacity to create and understand symbols, "is the principal source of natural selection in the development of our bodies and brains."¹⁴ By that he does not simply mean that learnt behaviour can bring about physical changes to the body such as the acquired ability to organically tolerate lactose, but that language and other symbols, which human beings have learnt to use, have changed the brain and increased its size. The reasons for that are connected, according to Deacon, with the social nature of symbol systems, with the fact that these symbol systems are ultimately not something "in the brain". They exist in the objective social reality of human beings. Thus the distinction between what is natural (biological) and what is cultural (symbol systems) is, if not entirely invalid, at least no longer useful on this level of study. For his conceptual framework, Deacon makes reference to Peirce's semiotics.

Deacon underlines the fundamental meaning of the iconic, that is the pictorial sign. Peirce has often explained "pictorial representations" by attributing them to the phenomenon of resemblance.¹⁵ I agree with Deacon when he refutes this view and writes: "Resemblance does not produce iconicity" (74), but "the interpretative process, which generates iconic representation is ... what we call recognition."¹⁶ He illustrates this with an example that shows two important characteristics of the iconic function. Deacon takes an example from the animal world that could also apply to human beings. A moth has landed on a tree and a bird does not distinguish its outspread wings from the tree trunk. The bird sees them as bark. That means the wings are seen and they are seen as something. We might think that they have been mistaken for something else, but this closure of the field of vision to a continuous level is an iconic sign, even though we are looking

here at a phenomenon of vagueness and lack of contour. Deacon describes iconic interpretation as a function of omission: "Icons are created by our failure to produce critical indices in order to distinguish things."¹⁷ This example illustrates the fact that the basic achievement of iconic cognition consists in perceiving continuities and that this perception can also



Fig. 6: Face, in: Kurt Koffka: *Principles of Gestalt Psychology*. London 1962.

be misleading.

In the traditional view of gestalt perception the basic principle of perception was the so-called "good gestalt", known as the principle of "Prägnanz". This stated that: "psychological organisation will always be as 'good' as circumstances allow."¹⁸ By "Prägnanz", and "good gestalt", the Gestaltists were referring to the way a form stands out against its background or the way qualities come together to create a form: rounded-off, closed, symmetrical, etc. (fig. 6). According to Deacon, Prägnanz phenomena are forms of iconic significance, but they are not the most fundamental kind. As the example of the moth on the tree illustrates, even the perception of *something vague and without contours*, or a continuum, is an iconic perception. Thus the perception of spatial and temporal continuity (Kant's forms of intuition) is iconic. Images are visible icons, but there are also icons that are perceived

through the auditory or tactile senses, such as the continuous feeling when a finger slides across a cold sheet of glass. This feeling can be of varying degrees of strength; however, a Prägnanz form can only emerge from a phenomenal continuum. This can itself be quite vague in character.

Decades ago, the art historian and critic Sir Herbert Read emphasised the importance of non-Prägnanz forms in perceiving images. Read was England's most important advocate of modern art in the first half of the 20th century. His late work "Icon & Idea" was not art theory, but visual theory. In it he drew attention to the role of non-Prägnanz forms in modern art (fig. 7).¹⁹ The phenomenon of emergence of form was a theme in abstract Expressionist art of the 1950s, in action painting and also in photography (fig. 8). In Read's works and those of the psychologist Anton Ehrenzweig,²⁰ who was intellectually close to him, vagueness advanced to the central focus of image theory. That development was sparked off by the central position occupied by vagueness in the art of the time, but Read and Ehrenzweig saw it as something of fundamental importance not merely a stylistic development. Vague forms gave insight into the very process of how images are perceived. Vague forms were (in art) always the expression of a mood. The indistinct, unspecific



Fig. 7: Marc Tobey: *Edge of August*, 1953, in: Marc Tobey. *A Centennial Exhibition*. Galerie Beyeler 1990



Fig. 8: Aaron Siskind: *Chicago 224*, 1953. David Anfam: *Abstract Expressionism*, London 1994.

and ambiguous are seen as being "full of atmosphere" and sometimes threatening.

In *Icon & Idea*, Read endorsed the principal thoughts of the philosopher Ernst Cassirer, who never made modern art an actual subject of his work.²¹ However, as early as the 1920s, Cassirer had reinterpreted the Gestaltist principle of *Prägnanz* in terms of symbol theory. For him gestalt phenomena were symbolic achievements of the good gestalt. They do not refer to anything else, but they symbolise more than what is apparent on the sensory level. For Cassirer "symbolic *Prägnanz*" was far more comprehensive than what the Gestaltists understood by *Prägnanz* phenomena. Cassirer defined symbolic *Prägnanz* as "the way in which a perceptual experience, as a 'sensory' experience, also contains a certain intuitive 'meaning', which it expresses directly and specifically."²² This meaning need not necessarily exist in a self-contained form, but is also inherent in expressive qualities, such as qualities of friendliness, menace, gloominess, cheerfulness, etc. Cassirer thus took the study of symbolic functions to a more fundamental level than did Gestalt psychology: to the level of expression. For Read, Cassirer's theory was the key to understanding modern art.

We also recognise many forms that are not "good" gestalts. They include handwriting, the so-called physiognomic qualities of a voice or the

footsteps of someone we know (and can identify in the dark).²³ These perceptions of characteristics are vague uniform phenomena, similar to the bark of the tree in Deacon's example. Iconic signs can also be found in the animal world, and Deacon claims that it is not what we call "consciousness" that differentiates human beings from animals (animals also have consciousness), but the signs that human beings recognise: for human beings iconic signs take on a symbolic [non-intuitive] meaning.

Normally we seldom experience vague perceptions or at least we do not experience them for very long, because they soon acquire symbolic meaning. We experience vagueness only if we make an effort, through the attempt to not perceive something along with its symbolic associations. We do not see a vague brownish surface; we immediately see the bark of a tree, or of an azalea even. For human beings iconic perception is always connected with indexical and symbolic processes. The abstract Impressionists recorded this condition of the vague icons in their work. This art movement is therefore often termed "subjectivist", but it also has the opposite tendency. The abstract Impressionists recorded the iconic and to a great extent excluded the symbols and the subjectivity of the "civilised" world.

Vague icons are not necessarily unreliable, they are only unreliable as a result of their symbolic interpreta-

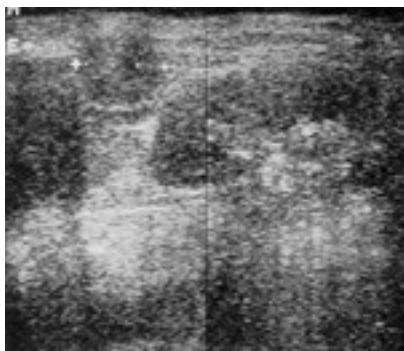


Fig. 9: *Sonographie I*. In: Dr. med. Gerd Brehm: *Tumor-Ultraschalldiagnostik. Ein Atlas zur Diagnose, Differentialdiagnose und Verlaufskontrolle in Klinik und Praxis*. Stuttgart

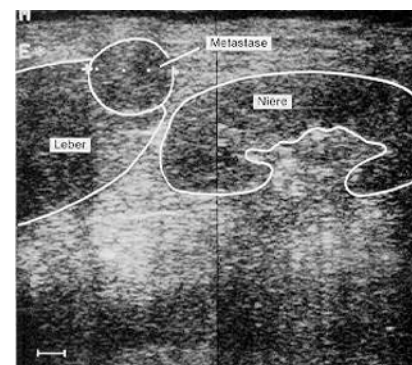


Fig. 10: *Sonographie II*. In: Dr. med. Gerd Brehm: *Tumor-Ultraschalldiagnostik. Ein Atlas zur Diagnose, Differentialdiagnose und Verlaufskontrolle in Klinik und Praxis*. Stuttgart

tion. An ultra-sound image (fig. 9) is reliable because it is also an index: that is, it is physically connected with an organ (fig. 10). According to experts, modern diagnostic imaging has "now become the most important method for making precise diagnoses", even though these images might seem contourless to the untrained eye.²⁴ Developments in computers have brought about a revolution, which can be seen, for example, in the fact that the term "radiography" has now been replaced by the word "imaging" in medical diagnostics.²⁵ These new imaging techniques (ultra-sound, ionising radiation, optics [endoscopy])²⁶ are iconic, but they acquire a quality of extreme reliability due to their indexical (physical) connections and their symbolic meaning within a system of images. As iconic signs, images are capable of being further interpreted as indices and symbols. As icons they are the essential beginning of the cognition process.

3. What are images for?

We know how difficult it sometimes is to put something into words. Wittgenstein's saying "Whereof one cannot speak, thereon one must remain silent", can be understood in positive terms as reference to the necessity of sometimes switching symbolisms. After all, much of what cannot be put into words can be

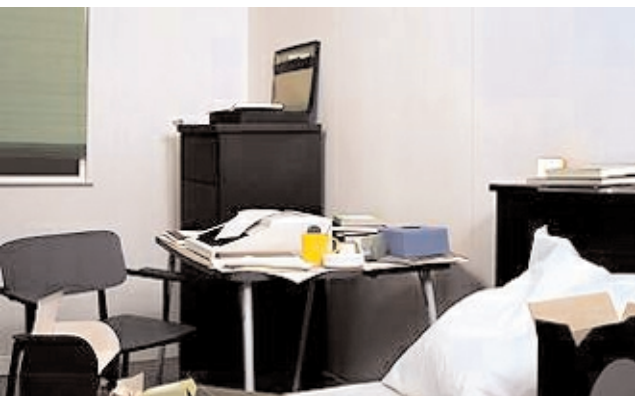


Fig. 12: Thomas Demand. Room. Chromogenic color print. 67 3/4 x 91 3/8". Source: <http://www.moma.org/exhibitions/newphoto12/thomas.demand.html>

shown.

Artists are past masters at "showing". Today, art is often reflective, seeing has itself become a theme in art (Fig. 11). In many contemporary art movements, the impression might arise that artists have taken on academia's theoretical opinions and have devoted themselves totally to conceptualisation. In this talk the impression might also have been given that the sign and symbol theory of the image must of necessity lead to a kind of scientism, in which art has ultimately become a vehicle of scientific knowledge.

Time constraints require that I limit myself. I shall therefore close by making reference to the observations of a philosopher of science (Gaston Bachelard). Chemistry text books in the past treated combustion processes as visible phenomena. Today, combustion is considered to be a sub-category of oxidation. The phenomenon of the flame has thus been replaced in science by an invisible process. The image of the flame has thus to a certain extent been banished from chemistry. But the flame, like the other ancient elements of air, earth and water, has lost none of its symbolic power of expression. Bachelard points to the atmosphere created by an open fire, to how it invites one to dream. But the quiet all-consuming flame symbolises far more than that. To recognise the symbolic power of an image like that (fig. 12), it is necessary to

understand what is being seen as the symbolic depiction of an expressive meaning. That is precisely not a call to use intuition, because even if we are talking about understanding an expressiveness, this is a kind of symbolic knowledge. Terrence Deacon states that the theory of the mind should not begin with consciousness, but with sentience,²⁷ because it is through feeling that the first iconic images are conveyed. For animals, it is highly indexical signals to which they react. For human beings they can take on symbolic meaning. The flame is for human beings not only hot but also a symbol of transitoriness, or of eternal life, and of much more besides. The concept of the image, or of visual symbolism, is now a topic of interdisciplinary research. Anyone looking at these scientific developments must come to the conclusion that a new science of the image is now emerging which links the natural sciences and the cultural studies. This development also promises to bring about a change in philosophy, where for so long language has been considered the only notable kind of symbolism.



Abb. 13: George de la Tour: Magdalena mit zwei Kerzenflammen, ca. 1640. Metropolitan Museum of Art, New York. Aus: Philip Conisbee: *George de la Tour and his world*. Washington 1996.

Notes:

¹ Dedekind, Richard: Was sind und was sollen die Zahlen? 1888, 2nd unpublished edition. Braunschweig 1893. In this article, Dedekind was trying to establish a structure for a theory of natural numbers based on set theory.

² Plato was not only a philosopher, but also an artist himself, the "Dramatist of the Life of Reason" as he has been called (George Santayana, John Herman Randall. In philosophy the view has become established that there is no royal road to knowledge, on which human beings are protected from erring, and particularly not in philosophy where supervisory bodies are difficult to identify.

³ This also applied when a philosopher made extensive use of images. Cf. Brian S. Baigrie: Descartes' Scientific Illustrations and 'la grande mécanique de la nature', in: Baigrie (ed.): *Picturing Knowledge. Historical and Philosophical Problems Concerning the Use of Art in Science*, Toronto: University of Toronto Press, 1996, p. 86-134.

⁴ The most important ideas came from Thomas Kuhn: *The Structure of Scientific Revolutions*, 1962, 2. enlarged edition, Chicago: Univ. of Chicago Press, 1970.

⁵ Cf., for example <http://www.scivis.gatech.edu/>

⁶ Diary entry of 12 Feb. 1917. Cf. Michael Diers: *Warburg aus Briefen. Kommentare zu den Kopierbüchern der Jahre 1905-1918*, Weinheim 1991, p. 230, note. 142.

⁷ These research trends are now so widespread in the theory of art and science that it is difficult to keep up with the latest developments. Representative publications are: Gottfried Boehm (ed.): *Was ist ein Bild?* Munich: Fink 1995; W. J. T. Mitchell: *Picture Theory. Essays on Verbal and*

Visual Representation, Chicago: Univ. of Chicago Press 1994; George Didi-Hubermann: Vor einem Bild, Munich: Hanser 2000.

⁸ Peirce: from the Lowell Lectures [1903]. In: *ibid.*: Collected Papers, Cambridge: Harvard Univ. Press, vol. 1, § 346: "the idea of manifestation is the idea of a sign".

⁹ Peirce's basic definition of generality is "habit".

¹⁰ Thomas A. Sebeok, Jean Umiker-Sebeok: "Du kennst meine Methode". Charles S. Peirce und Sherlock Holmes Frankfurt/Main: Suhrkamp 1982, p. 332.

¹¹ What is important here is to create a bridge between the two, not to unify them. Scientists and artists do not have to take notice of one another and the results of scientific research and artistic activity do not need to be measured against each other, nor should they be. Nevertheless, they both use visual symbolism.

¹² Terrence W. Deacon: *The Symbolic Species. The Co-Evolution of Language and the Brain*, New York: W.W. Norton 1997.

¹³ Biosemiotics is defined as "the study of signs, of communication, and of information in living organisms" (*Oxford Dictionary of Biochemistry and Molecular Biology* Oxford: Oxford University Press 1997, p. 72). Cf.. "Biosemiotics" in: *Encyclopedia of Semiotics*, edited by Paul Bouissac, New York: Oxford University Press, p. 82-85.

¹⁴ Deacon: *The Symbolic Species*, p. 345: "the principle source of selection on our bodies and brains. It is the diagnostic trait of *Homo symbolicus*."

¹⁵ Cf. my critique in: *Kultur als Symbolprozess*, in: *Deutsche Zeitschrift für Philosophie*, 2001.

¹⁶ Deacon: *The Symbolic Species*, p.

74: "resemblance doesn't produce the iconicity" ... "The interpretive process that generates iconic reference is ... what we call recognition".

¹⁷ Deacon, *The Symbolic Species*, p. 77: "icons arise from a failure to produce critical indices to distinguish things".

¹⁸ Kurt Koffka, *The Principles of Gestalt Psychology*, London: Routledge & Kegan Paul 1935, p. 110: "Psychological organization will always be as 'good' as the prevailing conditions allow". The theory of Prägnanz still remains central to Gestalt theory; cf. James R. Pomerantz and Michael Kubovy, *Perceptual Organization: An Overview*, in: *Perceptual Organization*, edited by Michael Kubovy and James R. Pomerantz, Hillsdale: Lawrence Erlbaum, 1981, p. 436-449.

¹⁹ Herbert Read: *Icon & Idea. The Function of Art in the Development of Human Consciousness. The Charles Eliot Norton Lectures at Harvard University* [1953], New York: Schocken Books 1972, p. 121f.

²⁰ Cf. Anton Ehrenzweig: *The Psycho-Analysis of Artistic Vision and Hearing. An Introduction to a Theory of Unconscious Perception*, 1953, 2nd edition. New York: George Braziller 1965), especially chapter II: *Gestalt-free Art Form*, p. 22-44. Ehrenzweig refers (p. 22) to Read, who pointed out that abstract pictures "make the eye wander".

²¹ Read refers to Cassirer in *Icon & Idea*, p. 1; cf. also pp. 18 and 128.

²² Cassirer: *Philosophie der symbolischen Formen*, Bd. 3, [1929], Darmstadt: Wissenschaftliche Buchgesellschaft 1964, p. 235.

²³ Cf. on this Read, *Icon & Idea*, p. 121.

²⁴ A. Margulis: *Einfluß des technologischen Fortschritts auf die radiologi-*

sche Praxis, in: J[osef] Lissner (ed.): *Moderne Bildgebung. Stand der Technik*, International Symposium, Berlin 1988, Vienna/Berlin: Uebber-euter Wissenschaft 1988, p. 236-241, p. 236.

²⁵ M. S. Joshi: *Die Radiologie in Ländern wie Indien*, in: Lissner (ed.): *Moderne Bildgebung*, p. 93-98, here: p. 93: "In the field of radiography, the medical world has, in the last 20 to 30 years, witnessed a boom in new methods that make it possible to see human organs – each one aiming to be better than all others. This young discipline with its vast number of imaging techniques has long since expanded way beyond the horizons of conventional radiography. The very name 'radiography' has been replaced by the word 'imaging.'"

²⁶ On this cf. Klaus Ewen (ed.): *Moderne Bildgebung. Physik, Gerätetechnik, Bildbearbeitung und -kommunikation, Strahlenschutz, Qualitätskontrolle*, Stuttgart/New York: Thieme 1997.

²⁷ Deacon, *The Symbolic Species*, p. 4