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Mind Reading, Brain Mirror, Neuroimaging: Insight Into the Brain or the Mind?

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MIND READING AND THE UNCANNY

Mind reading is an ambivalent cultural phenomenon. At times, one can say admiringly to someone else, "You are a mind reader," when that person has guessed what one is thinking at the moment without the use of words, gestures, or other expressive signals. However, as soon as one goes beyond such coincidences, one no longer knows exactly what is going on. Extrasensory perception, charlatanry, or pathology are possible conventional explanations. Others might think of hidden mechanisms that cannot be explained rationally. This uncertainty about a phenomenon that appears to be such a riddle often leads to a feeling of the uncanny.

That uncertainty and a sense of the uncanny have something to do with one another is not new. S. Freud wrote in his essay, "The Uncanny"

(1955/1919), that "a particularly favourable condition for awakening uncanny feelings is created when there is an intellectual uncertainty whether an object is alive or not, and when an inanimate object becomes too much like an animate one" (p. 233). A feeling of the uncanny arises when two things come together that do not belong together according to previous experience, where something happens that is thought not to be possible, or where a certain order of things appears to be put in question. As examples Freud cited so-called "doubles" (*Doppelgängers*) and telepathy. When someone appears to have immediate contact with the thoughts or experiences of another person, when a doubling of the self appears to be happening, there is fertile ground for feelings of the uncanny. Mind reading is one variant of such contact, but thoughts are invisible. No one can say in what characters they are written. Reading is dependent on visibility. Whoever wants to read my thoughts may not necessarily want to attack me physically, but he or she definitely wants to cross a boundary. Whoever goes unbidden behind the door with the "No Admittance" sign on it acquires a sort of access that transforms my secure inner space into a zone of uncanniness.

Brain mirrors are anything but irrational or pathological, and yet they have something to do with mind reading. Brain mirrors, encephaloscopes, and cerebroscopes are apparatuses with which the world in our heads can be represented visually, without necessarily having to open the skull. Such apparatuses have been possible only for a little more than 100 years. There were twp presuppositions for them: (a) the idea that neurophysiological processes in the brain take place in direct relation to mental life, which today is largely undisputed and (b) that brain mirrors can represent these processes reliably and can therefore make direct statements about mental life, a claim that remains a topic of controversy until today. However that may be, the working mind is now under observation. The professionals interested in a rational, demystified form of mind reading—the military and secret service agencies, the courts and the police, anatomists and psychophysiologists—all of them have been trying for a long time to identify the writing of the nerve cells as legible thoughts. For this no magicians or psychics are needed but instead complex technologies of visualization and a code that makes the secret writing in the head legible. Even now it is foreseeable that lies will no longer be exposed with conventional lie detectors but instead—and with far greater effort—with the help of new, computer-aided brain imaging techniques.

One would think that this technological form of mind reading no longer allows any space for the uncanny, because, for better or for worse, it appears to be entirely open and above board. Nonetheless, traces of the uncanny are visible in various ways even in this scenario; the feeling of

insecurity inserts itself into the technological insights and expectations, precisely at the point diagnosed by Freud, because different things come together that do not seem to belong together, things that, when they show up in a common context, do not seem to be opportune. This constellation can be made clear with a brief history of the brain mirror, which can be divided into three periods. First, in the early 19th century, there are *fictions*, presented at an informed distance from *science*. Then, from the late 19th century, the story becomes a tale of *science fiction*, told by both scientists and literary writers. In the past few years, the brain mirror has become a topic of science itself, but one with strongly fictional elements.

Whether it will ever be possible to make the content of thoughts visible—and I would like to doubt that—does not really matter in this context, because both the stimulus and the uncanniness of the brain mirror lie in the possibility that it could perhaps make thoughts legible. The mirror thus remains located on the boundary between reality and fantasy, in spite of all the technical developments of the past 100 years. Even those scientists who think they can, or once thought that they could, develop a brain mirror are therefore acting within the field of science fiction, in which *science* is the nurturing soil of fantasy and *fiction* can be understood as commentary on, exaggeration of, and future perspectives for the science. Only so long as the brain mirror remains in the realm of possibility can it stimulate feelings of the uncanny. Should such an apparatus become reality one day, which appears to me, as stated above, to be improbable, the feeling of the uncanny would disappear immediately. The scientifically protected and explainable participation in mind reading could then still spread fear and loathing, but such feelings would no longer be located in the grey area that is the necessary location for feelings of the uncanny.

FICTIONS WITH SCIENCE: *DANTON'S DEATH*

For technologically protected mind reading there is a primal scene in Georg Büchner's drama *Danton's Death*, which is not really a primal scene, because a feeling of the uncanny cannot occur because of the brutality of the idea being proposed. Büchner, who was both a brain anatomist and a poet, makes a drastic suggestion for how to observe thoughts where they take place: "Know one another? We'd have to crack open our skulls and drag each other's thoughts out by the tails"[1] (Büchner, 1963, p. 3). Danton, in whose mouth Büchner places this

[1]The original reads as follows: "Wir müßten uns die Schädeldecken aufbrechen und die Gedanken einander aus den Hirnfasern zerren" (Büchner, 1992, p. 13).

sentence, makes this demand in reaction to the impossibility of truly knowing another person. On this account, the authentic and undisguised truth can be not found in words and looks, gestures and deeds, but only in the brain itself, as though one could search for thoughts there and could actually understand them if they actually were in that place, as though the brain fibers, which are beyond good and evil, lies or truth, could give us information about the content of thoughts.

Leaving aside the fact that the truth about brain fibers has not really been understood either in Büchner's time or today, his vivisectionist anatomy links an axiomatic certainty with desire, a topographical approach with a utopia. For Büchner and the science of his day, the certainty was that they connected thinking, experience, and sensation with the brain as a matter of course. The desire was the utopian wish to untie the puzzling knot of thought and brain. Büchner went beyond the diagnostic claims of the so-called "physiognomics" of his time, the aim of which was to read a person's character from his or her facial expressions; he also went beyond the skull diagnostics of phrenology, the aim of which was to discover people's interests, qualities, and talents by reading their skulls. Looking into the living brain is supposed here to discover the cerebral correlate of each individual thought: one fiber, one thought. Already in the late 18th century the doctrine of sensualism assumed that for each individual sense impression a single brain fiber existed. According to this view, the brain was a conglomerate of innumerable fibers, which were gradually filled with sense impressions (Bonnet, 1769, pp. 18–27). That was a beautifully simple theory, which was attractive for poets after 1800, but which presented considerable problems for increasingly empirically oriented brain research.

Although the poet Büchner could easily cite the brain fibers he had learned about in his medical studies, he and his contemporaries had little to say as anatomists. Instead, they worked incessantly on the question of whether the individual convolutions in the brain actually corresponded to specific mental functions, as phrenologists claimed. Many anatomists busied themselves for decades with the effort to bring some sort of consistent order into the confusing convolutions of the brain. And even when they had some success in individual cases, the variability among individuals was so great that the legibility of the cerebral cortex remained a notoriously difficult enterprise. This was true in incomparably greater measure for the innumerable smaller fibers, the paths of which could not be followed with the microscopes of that time.

Büchner's rough-hewn version of mind reading is a special case. He was not without historical predecessors—for example, the French scientist Maupertuis's demand that vivisection experiments be carried out on the brains of criminals who had been condemned to death

(Maupertuis, 1768, p. 410), or the galvanic experiments conducted on freshly guillotined heads during and after the French Revolution (Borgards, 2004; Hagner, 1997, p. 185–193; Jordanova, 1989). However, this imaginary vivisectionist's reach into the brain, which turns mind reading into a nearly cannibalistic act, is so unmistakably clear in its metaphorical force and in its absurdity that it cannot be located on the boundary between science and fiction but must rather be placed clearly in the realm of fiction. In such an unambiguous space, however, the phenomenon of the uncanny cannot prosper. Instead, it reappears at the moment when the hard, bloody form of grasping for thoughts is replaced by soft, media-based insight. Not cutting into the wet ware, but rather the regime of optics, would decide the future of mind reading.

SCIENCE FICTION: READING BRAINS AND MINDS FROM THE 19TH TO THE 20TH CENTURIES

The 19th century was the century of optical instruments, of visualization beyond previously known limits and supposedly insuperable obstacles. This meant primarily the visualization of the interior and internal workings of the human body. The spectacular beginning was Hermann Helmholtz's invention of the ophthalmoscope in 1853, which made visible the interior of the eye, including its blood vessels. At the end of the century, in 1895, came Conrad Wilhelm Röntgen, with his discovery of X rays, which made the skeleton and some internal organs, such as the heart and the lungs, visible, although not the muscles, the stomach, the liver, or the brain. However, even before Röntgen's entrance the ophthalmoscope, the laryngoscope, and the otoscope had so increased trust in the scopic power of instruments that even the brain mirror seemed possible after all. The fascination of medical scientists and the wider public for the new visual media can also be seen in the lectures of the Vienna experimental pathologist Salomon Stricker, held with the aid of an instrument called an *epidiascope*, in which students sitting in a darkened room attentively observed the projected image of a brain (see Fig. 13–1).

Vienna was a good place for visual and other projections. The fictional birth of the brain mirror lies chronologically between Helmholtz and Röntgen; it took place in Vienna, and a surgeon functioned as the midwife, who developed his vision without either scalpel or a slice in the flesh. In 1884, Vienna surgeon Eduard Albert presented the brain mirror in a public lecture in the following words:

> Let us allow our imaginations to run free. Let us imagine how these things will look after a thousand or ten thousand years. In that time a pro-

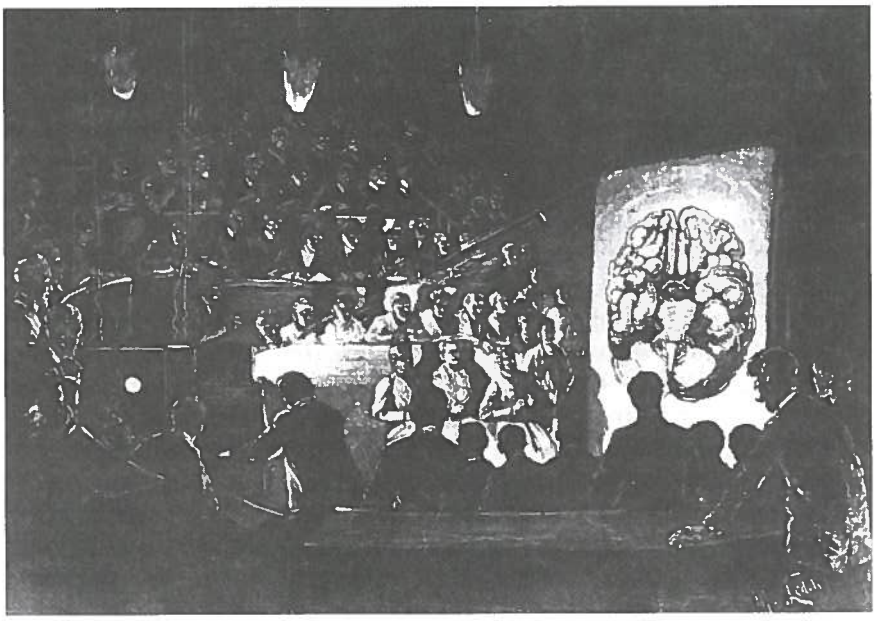

Figure 13–1. The pathologist Salomon Stricker projects the image of a brain onto a screen with the aid of an epidiascope, ca. 1885. Source: Institute for the History of Medicine, University of Vienna. Published in E. Freud, Freud, and Grubrich-Simitis (1976, p. 83).

> cedure will be discovered to make transparent the living skull, including the brain. A light will be produced that will be so strong, that it can penetrate the entire skull. With a single instrument called the encephaloscope the interior of the brain will be projected into the air in enlarged format, so that during a popular lecture everyone present will see everything. (Albert, 1885, p. 96)

Albert may have erred somewhat in the chronology of his prognosis for the realization of such an apparatus, but it is clear that he understood the illumination of the skull to be the royal road to the reading of the mind. In this he found himself fully within the scientific and cultural horizon of the late 19th century. This was true for his ideas about what was to be seen in such an image in real time and for the question regarding with whom one was allowed to perform such investigations. Albert's setting fit in quite comfortably with the mores of his educated upper middle class Vienna public. This began with his choice of experimental subjects. As he said, adults "do not like to have their interiors shown" (Albert, 1885, p. 96). This sentence is best understood in light of the fact that hypnosis was flourishing at the time, a procedure that made public the will-less and un-

controlled interior of the hypnotized. One year later, in 1886, the young Sigmund Freud became involved in a passionate controversy over the reliability and permissibility of hypnosis with his former teacher, the psychiatrist and brain anatomist Theodor Meynert (Mayer, 2002, pp. 138–140, 146–153). Albert seems to have wanted to avoid any controversy, so in his little science fiction he lets a child instead of an adult come onto the stage, and he asks the child to perform the most typical of all activities for members of the educated middle classes: The child recites a poem, while it's brain is illuminated by the brain mirror.

Albert asks his public to concentrate its attention on the third left frontal convolution, that is, the region that the Parisian physical anthropologist and physician Paul Broca had localized the motoric language center of the brain in 1861. And the public sees, according to Albert, the following:

> As the child begins to speak, an indescribable movement begins in that place; the molecules vibrate at a great rate, some move about in circles, others in ellipses, etc. Suddenly he child hesitates, because it has forgotten a word or line; it turns red from embarrassment and becomes excited, the molecules shoot irregularly toward one another, and suddenly they follow regular pathways again, the blood circulates more regularly in the blood vessels; the child continues speaking. (Albert, 1885, p. 96)

One could describe a functional magnetic resonance tomography in this way today, if it were to produce not only images but a film in real time. The play of the represented elements would be similar, if meditating monks, punishing altruists, or love-smitten youths would be studied in the tomograph while gazing at a picture of a loved one or of a child reciting a poem according to the script just described. The molecules would be the oxygen atoms, the enrichment of which in certain activated zones is being measured; whether their staggering motions correspond to insecurity in speech flow, to the inner mood of the monks in prayer, to the self-punishment of the altruists, or to being in love, is another question. Albert at least plainly assumes a correspondence between the order of the molecules and that of thoughts. He even believes that the equivalent of thought contents can be seen in the play of the molecules and thinks it possible that "one would recognize and be able to conclude what the observed person thinks, the way one can conclude from spoken words often, but not always what the speaker thinks" (Albert, 1885, p. 96).

With this consideration the surgeon brushes against the boundary to the uncanny, but then he immediately steps back from the edge when he adds that "one will never be able to observe the actual inner state, the processes of consciousness with the senses." (Albert, 1885, p. 97). Why

the thought processes just described do not belong to the processes of consciousness proper remains the speaker's secret. At least the idea of seeing the soul appears to cause him to shudder, while a thought process can be deduced from the encephaloscope just the way it can from an ordinary speech. But Albert does not touch on this point again; by choosing a child as an experimental subject he avoided the possible embarrassment that an adult might notice a contradiction between the spoken word and the brain image. A possible feeling of uncanniness that could have come from the idea that public participation in the brain processes of a child has nothing secret or intimate about it is suppressed from the start. The apparently visible onrush of emotions indicated by the turbulence of the molecules betrays nothing more than reddening and stuttering due to forgetting a line of poetry. The uncanny would come into play only when something could be seen in the brain image that was supposed to be hidden from view. That cannot happen, according to Albert, but nonetheless he makes no attempt actually to explore the full potential of his brain mirror.

Albert's optical fantasies were not accidental. The idea of illuminating the brain and its supposed thought contents was repeated in different versions after Röntgen's discovery. The precarious status of revealing the mind's intimate affairs, so carefully suppressed by Albert, soon came to be central to the question of illuminating the brain. This can be seen also in the field of so-called "thought photography" which was in fashion briefly after the discovery of X rays. After 1895, many scientists actually believed in the possibility of representing thoughts in photographic images (for further discussion, see Chéroux, 1997; Fischer, 2004). William Crookes, an important English chemist and physicist, predicted in 1897 that photography of the interior of the skull would soon take place and that in this manner the mechanisms of thinking would become understandable. He made this prediction in a lecture before the London Society of Psychical Science, the center of mesmerism, telepathy, and parapsychology in Britain. For a brief moment, it appeared that the fantasies of the spiritists had been fulfilled by the optical technologies of the turn of the 20th century. After the French psychiatrist Hippolyte Baraduc, who worked after all at the famous Salpetrière clinic, heard of Röntgen's new discovery, he began to work in a field that he called *thought photography*. His method was in principle the same as that of Röntgen. He fixed a sensitive photographic plate onto the forehead of a subject and waited for a time. Baraduc was convinced that rays streamed from the body carrying substances too fine to be visible with the naked eye but that might be captured on the photographic plate. He attributed the images that he produced with this method to cerebral discharges. In 1896, he wrote: "When a thought is fixed in an image, this photograph,

the glowing covering of our thought, will produce a photochemical effect that is strong enough to make an impression on gelatine film—albeit in a way that is not visible to the human eye. The images thus obtained I have called psychicons, glowing and living images of thought" (cited in Chéroux, 1997, p. 15).

Unfortunately, the images were somewhat disappointing compared with this hopeful statement. They showed contingent patterns of light and shadow, and not even Baraduc was able to interpret his results in detail. Another experimenter, Louis Darget, appeared to be luckier, because he could show pictures with apparently more realistic forms. Röntgen had merely illuminated his wife's hand and published the image, but Darget presented a thought photo of his wife, while she was in a hypnotic sleep. *Dream* and *eagle* were the words that Darget noted on his picture (see Fig. 13–2), which he produced only 4 years before the publication of Freud's *Interpretation of Dreams*. However, Darget did not go into further detail about the meaning that the idea of an eagle could have for his hypnotized wife.

Of course, the parallels between Röntgen and the French experimenters should not be emphasized too heavily, because the latter believed in rays that flowed from the body instead of rays that could be projected into the body. This claim led to considerable controversy in Paris. Critics showed that perspiration, heat, electricity, and the handling of the photographic plate sufficed completely to explain these pictures. Despite this result, which was so embarrassing for the spiritists, the idea of being able to produce visual images of thoughts was not given up. Instead, it traveled from experimental photography into literature.

At the turn of the 20th century, the philosopher and storyteller Kurt Laßwitz wrote a fairy tale with the title "The Brain Mirror" (Laßwitz, 1928). In this text, too, an intense light—but not X rays—penetrates the skull, when the subject first ingests a chemical substance called *Craniophane*, which makes bone transparent. The first-person narrator of the short story meets a friend, who reports to him the following event. He is invited to see his Uncle Pausius, an ingenious tinkerer, in order to examine a spectacular invention—indeed, a brain mirror—about which, however, the nephew knows nothing when he enters the darkened room into which Pausius invites him. The surprise is complete: "Finally I recognize a weakly illuminated screen and on it—I am not a little shocked—my own form" (Laßwitz, 1928, p. 99). The inventor, who at this point is invisible, asks his nephew, where his wife, who was supposed to accompany him, might be. Immediately the image of the wife appears alongside that of the man on the screen. The nephew demands an explanation. Pausius has demonstrated in an experiment on himself

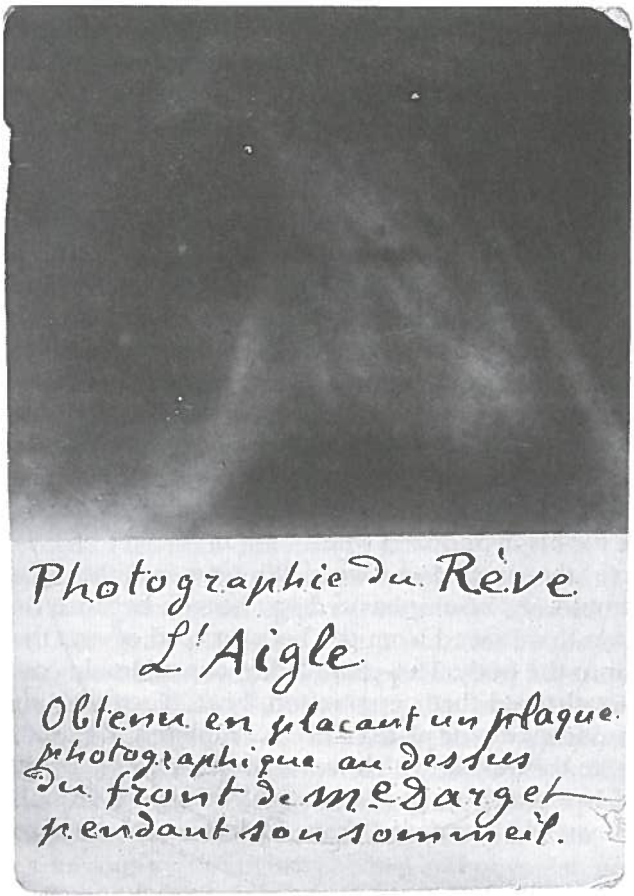

Figure 13–2. Louis Darget, photography of thinking, 1896. Source: Institut für Grenzgebiete der Psychologie und Psychohygiene, Freiburg im Breisgau, Germany. Published in Fischer (2004, p. 149).

that he can localize and make visible his own optical images in the brain. Even before the nephew has actually entered the darkened room, he is already there in the mind of his uncle. Because this inner brain image can be projected onto the screen, the nephew sees himself when he enters the room: "What you are thinking now, so to speak—yes, I can even photograph that" (Laßwitz, 1928, p. 101).

In this case the visual image is one of something that someone expects to see, but in principle any possible inner images can be transferred to the screen, and from this Laßwitz gains storytelling capital, with which he also brings the feeling of the uncanny into the game. Fi-

nally the nephew's wife appears, as expected, but she is worried because she has lost her key. In this situation the brain mirror is just the right thing. Pausius recommends that the woman place herself in front of the apparatus and take *Craniophane*, in order to make the key visible as a memory image and in this way to identify its location. What happens now shows Laßwitz's feeling for the dialectic between the practical or even therapeutic usefulness of the apparatus and the undesired effects it can also have. On the screen appears not the key, but the head of a man—the first person narrator, at which point the husband loses his composure, because he suspects that his wife is cheating on him with his best friend. Just then it occurs to his wife that she has misplaced the key at home by hanging it on the wall behind the photograph of the friend. The husband rushes home and actually finds the key. His suspicion has evaporated, but there remains an uncomfortable feeling: "Suddenly an uncanny feeling of anxiety overcame me [...] the thought that I should suddenly see what my wife can imagine in her inmost thoughts [...] no one can know, what secrets she has in her head" (Laßwitz, 1928, p. 104).

Laßwitz took the story of the brain mirror seriously at the point at which Albert had turned away from it. The visualization of the intimate and the scandalous, of the feared adultery, has brought the husband a kind of participation in his wife's thoughts that he does not want to have at all, but which for a moment had put the entire order of his life in doubt. By means of this insight into the inner thought world of the wife, which neither of them wants to acquire, the uncanny is raised to an ordering principle. Here too the uncanny enters at the moment when it is uncertain whether the image shown by the brain mirror is real or unreal. Laßwitz's sophisticated construction is to use a media technique to introduce the mistake. The difference between a real person and his or her photograph is eliminated in the cerebral representation. Although it is true that the subject can say before the brain mirror whether he or she is thinking of a person in a real situation or of that person's photographic portrait, in the brain image this distinction disappears. What the brain mirror makes visible on the screen is the image of the person of whom the subject is thinking at the time, no more.

We could put it this way: For the neurons in the brain it matters not at all whether a real, a filmed, or a photographed person is being represented. For them it is all the same. The important implications of this fact for the idea of brain imaging was first recognized, so far as I can see, neither by a brain researcher nor by a philosopher, but by a popular medical writer, Fritz Kahn (1929). In 1929, in his widely distributed book, *Human Life*, he imagined the brain mirror as an X ray microscope that follows the nervous excitations in the brain. Accordingly, it would

be possible to determine with this apparatus "whether a person is speaking or playing the piano, whether he is writing or playing cards" (Kahn, 1929, p. 184). Everything seems to point to a direct correspondence among experience, action, and brain process, but according to Kahn this is mistaken. The active nerve cells in the brain never come into contact with the external world; they only receive information from other nerve cells. How can they know whether, for example, the experience "elephant," decoded by the brain mirror, represents the image of a real elephant or is only being imagined? Not at all, says Kahn, because a nerve cell makes no distinction between reality, imagination and dreams:

> Life is a dream and a dream is life, a true experience, excitation of the cortex, excitation of nerve cells [...] The X-ray microscopist, who follows the brain excitation, can perhaps some day in a far off utopia recognize the following: in the optical memory cells the picture of an elephant appears, the motor cells of the nerves in the hand "grasp," the nerve cells of the leg "climb," but he will never be able to succeed in deciding whether the brain dreams or has real experiences. (Kahn 1929, p. 184)

The brain organizes itself. That is how current neuroscientists would also put it. Nerve cells communicate with one another, not with the outside world. Nonetheless, a brain would soon give up the ghost, so to speak, if it were isolated from the environment. Brains are arranged for a high level of plasticity, which means that they want to be fed not with significance, deeper meaning, jokes or irony but with impulses that neurons can do something with, that keep a sort of permanent dynamics in play. Presumably it is the case that continuous change is needed in order to keep cerebral status intact. However, none of the meaningful connections or contexts of our life world can be completely represented in these neuronal processes, as the examples from Laßwitz and Kahn have already suggested.

The uncanny is to be sought neither in our daily experience—to which we have immediate access—nor in the activity of the brain itself—which we can measure—but rather in the space between them, the logic of which is hidden from us and from the measuring devices. We surely tend to base our ordering of the world on the distinction between dream and real experience, meaning experience of reality in the waking state. When we cannot make this distinction for the organism, which like no other is the basis for our ability to think and have sensations or feelings, then an obvious gap exists, which could be bridged easily with a strictly dualistic position on the relation of body and mind. If we do not accept such a dualism, because it has not made a single coherent argument for the idea of a soul independent of the brain, then a

feeling remains that can be located with Freud in the zone of the uncanny, but in a sense opposite to the one Freud had in mind. Here things are not being brought together that do not actually belong together. Instead, some things obvious belong together, that seem to fit together less and less well, the more details we learn over their exceedingly complex connection with one another.

In 1929, when Kahn published his volume about the nervous system, the Jena psychiatrist Hans Berger also published his first article on electroencephalography (EEG; Borck, 2005b). Even though Kahn presumably did not know of this text when he wrote his chapter, his considerations on the observation and observability of neuronal activity went in a direction similar to that which led to the EEG. Naturally, there are differences: The EEG records the activity not of individual nerve cells but of the mass action of many neurons. Nonetheless, some important brain researchers were convinced that the recorded brain waves offered insight into mental life. Among them was the mathematician and cyberneticist Norbert Wiener (for the following, see Borck, 2005a, pp. 296–300). He not only assumed that the brain worked like a computer but also asserted that EEG curves revealed, in a certain sense, the language of the brain. He was particularly interested in the so-called "alpha wave," which he associated at first with form perception, because "it partakes of the nature of a sweep rhythm, like the rhythm shown in the scanning process of a television apparatus" (Wiener, 1961, p. 141). However, the analogy between television and brain became doubtful when Wiener's coworkers found that there are significant individual differences in the alpha rhythms of experimental subjects. Wiener was not easily intimidated, however, and proposed the hypothesis that an individual's alpha rhythm was an expression of that person's intelligence. He then planned a new research project, in which the EEG curves of three geniuses were recorded: Wiener himself, John von Neumann, and Albert Einstein. Naturally, Einstein's EEG got the largest amount of public attention. During the recording session, he was asked to think either about relativity theory or about nothing at all. The curves differed from one another, and those of Einstein, Wiener, and von Neumanns actually differed somewhat from those of so-called "normal" subjects. But not even the *New York Times* wanted to conclude from this data that the curves represented relativity theory or the genius of its creator.

NEUROIMAGING: SCIENCE, THE MEDIA, AND A REALM OF (UNCANNY) POSSIBILITIES

After this rather peculiar episode, the idea that the EEG could depict thoughts was finally given up. Put more generally, the cognitive neuro-

sciences kept rather quiet about the visualization of thoughts for several decades. This situation has changed fundamentally in the past 15 years. Now, at the beginning of the 21st century, talk about mind reading is more popular than ever. The explanation lies, of course, in the new computer-aided methods of neuroimaging, such as functional magnetic resonance tomography. In this new kind of brain mirror the distribution of oxygen atoms is measured by activating a strong magnetic field. The data are then transformed into images by means of complicated mathematical operations. The procedure is called imaging (*Bildgebung* [picture giving] in German); this term is supposed to make clear that a direct image of the object is not involved, but rather something produced or achieved indirectly from signals. The correspondence between measured data and mental process is supposed to be secured by mathematical operations, and no longer by optical procedures as before. However, despite all of the scientific and technical sophistication being brought to bear there is here, too, a place where science is transformed into fiction, and again the ambivalent concept of mind reading plays an essential role.

"Supercomputer makes thoughts visible"—so, for example, runs the headline of a recent article in a German weekly newsmagazine about a new model magnetic resonance tomography that can produce magnetic fields with an intensity of 9.4 Tesla, three to six times stronger than the equipment currently in use (Spiegel online, 2004). The same metabolic processes are measured as before, clearly with higher resolution, but metabolic processes are not thoughts. It appears that no technical innovation in this field, no matter how positive, can be presented to the public today without indulging in such fundamental category mistakes or producing science fiction. This is legitimation by illusion, and such procedures are among the most notorious in today's knowledge society.

The results of neuroimaging studies are presented to the public in much the same way. Here is a drastic example from the "brave neuro world": A Canadian neurologist pushes test participants into a scanner, shows them pornographic films, and measures the increase of activity in the so-called emotional areas of their brains, when the participants become sexually excited by a scene. The reporter, obvious stimulated himself by such studies, then turns to his or her readers and asks: "And what about you? Do you excite men, women—or maybe even both sexes? Does cuddling sex turn you on, or do you prefer S and M?" (Kraft, 2004, p. 29). These appear to be important questions that can be answered by magnetic resonance tomography. The reporter forgets to add that simply reaching beneath someone's underwear under the same experimental conditions would produce the same result. The genitals do not

lie and can hide nothing, and a study using direct genital stimulation would no doubt be much cheaper than one using such an apparatus.

The problematic character of studies such as the one just cited cannot be located in sensationalist journalistic reporting on them alone but begins with the studies themselves, because they have been designed by the scientists involved in such a way that they will get media attention. This collaborative game played by science and the public (and assisted by the media) would have to be analyzed in more detail than can be provided here, in order to understand better the current fascination of cognitive neuroscience. Nonetheless, it is already clear without such an analysis that the price of this public fascination is a noticeable reduction in the precision, skepticism, and clarity of scientific research itself in this field. Yet again we find that the boundary between science and fiction lies at the point at which a space of possibility has been created. No one, and certainly no machine, can read thoughts, and yet the possibility of doing so is being presented to us yet again. Does this also mean that the brave new world of the brain's interior that is now being made visible with the new model brain mirror lead us back to a zone of the uncanny? Let us return to Freud's discussion.

S. Freud (1919/1955) emphasized

> that an uncanny effect is often and easily produced when the distinction between imagination and reality is effaced, as when something that we have hitherto regarded as imaginary appears before us in reality, or when a symbol takes over the full functions of the thing it symbolizes, and so on. It is this factor which contributes not a little to the uncanny effect attaching to magical practices. (p. 244)

Neuroimaging is not a magical practice, but the effect with respect to thought reading is much the same. The brain image is a symbol that is supposed to represent the achievement and significant of the object allegedly being symbolized, meaning a thought or thought process. In the reality of our experience only the thought appears to us, while the underlying brain activity remains invisible, as long as we are not connected with a measuring device. And even then, to get from one situation to the next, we refer to thoughts, not to patterns of cerebral activity. However, if we believe some brain researchers, then this relationship must be reversed with the visualization of brain processes that occur during thought. For them, the neuronal chatter is real, and the thoughts are in the realm of fantasy. According to this logic, we are all illusionists living in a realm of metaphysical uncanniness. But this visually evoked reversal also lies on the boundary of science and fiction. To maintain such a position, a machine like the brain mirror is required, along with the wish to be able to read minds. In other words, we must link two things

with one another that do not belong together in ordinary experience, and we find ourselves yet again in the realm of the uncanny.

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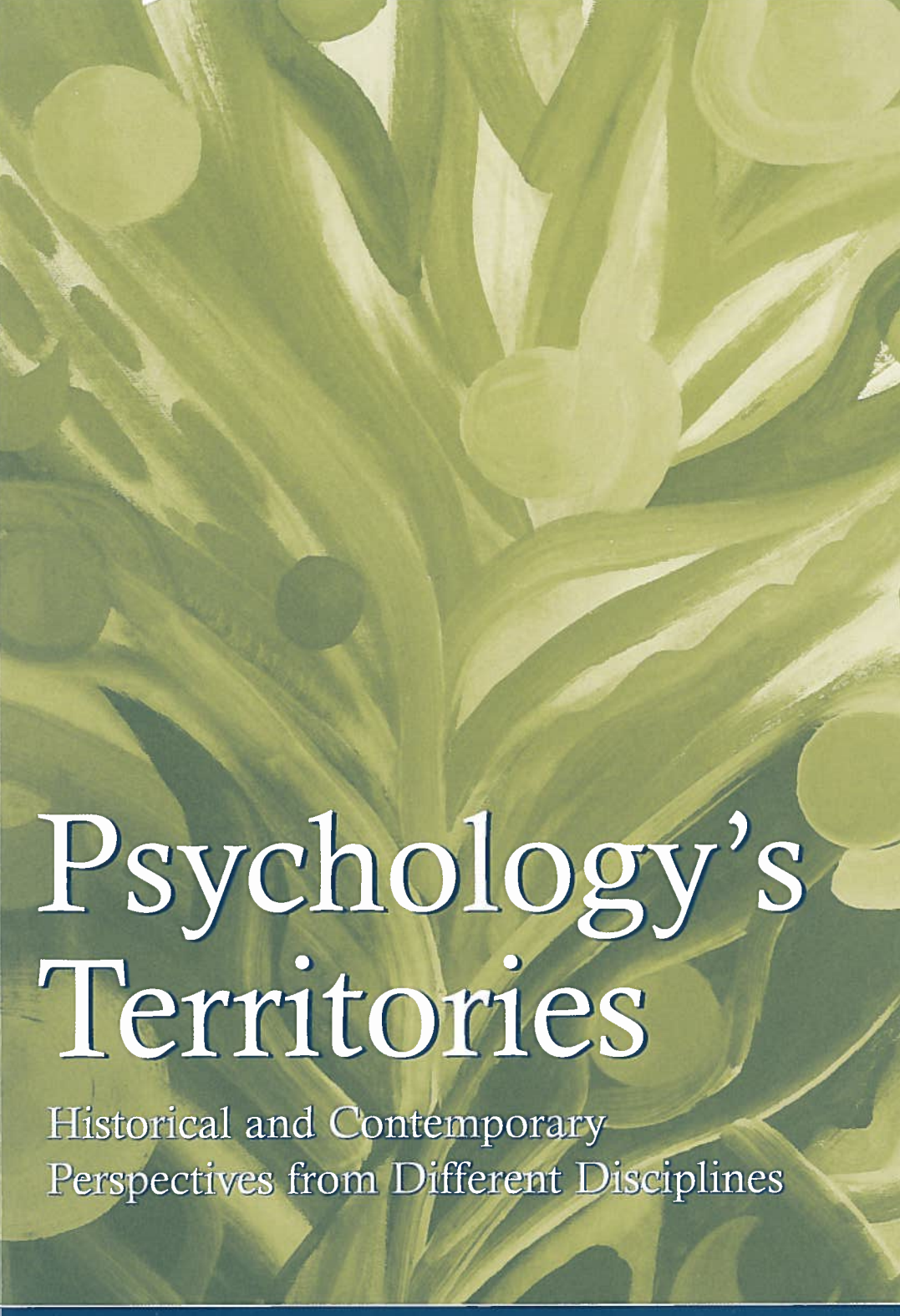

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