Into the Belly of the Image

Historical Aspects of Virtual Reality

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Abstract

Virtual reality (VR) is a constant phenomenon in art history that can be traced back to antiquity. It can involve an area of ritual action, a private, artificial paradise, or a public sphere with politically suggestive power—in short, it encompasses a visual history that is characterized by totality. The concept of transposing viewers into an enclosed, illusionary visual space has been revived and expanded in the VR art of the current age. The more intimately an interface nestles into viewers' senses, the more intense their immersion will be. Such an interface weakens the viewers' sense of psychological distance and puts the relationship between art and consciousness into question.

Virtual reality is seen by many today as an entirely new phenomenon. However, the idea of transposing the audience into an enclosed, illusionary visual space was not born with the invention of the computer; indeed it is grounded in a solid tradition within art history. Its core idea, which reaches back to antiquity, has been revived and expanded in the VR art of the current age. This kind of virtual reality excludes the sensation of being alienated by the image and surrounds the observer in an illusory setting where time and space are one. At the very least, it fulfills the concept of total perspective. To understand the VR phenomenon and to make a contribution to the debate concerning the so-called iconic turn [1], it is necessary to develop J. Steuer's argument that VR should not be solely viewed at the technological level [2] but should be historically contextualized in order to comprehend its explosive impact as well as its close connection to political power.

Illusionary Spaces of 360 Degrees

Virtual reality can entail an area of ritual action, a private, artificial paradise, or a public sphere of politically suggestive power. Important aspects of the idea can be explained by focusing on historical examples.

In the second Pompeiian style of late republican Rome, there were wall paintings that extended the room through representations of views into other spaces [3]. A particularly forceful example is shown in one of the most famous frescos of antiquity: the Villa Item, the so-called Casa dei Misteri at Pompeii, which dates from 60 BC [4]. The audience finds itself amidst a series of life-sized, highly realistic figures (Fig. 1). Some appeal directly to the recipient; others communicate with each other from wall to wall across the real space. The borders between visual and actual space seem to dissolve as the figures apparently move in real space. Visitors are trapped in the gaze of the figures, which hit from all sides and do not let go. The illusionary space surrounds the spectators entirely,

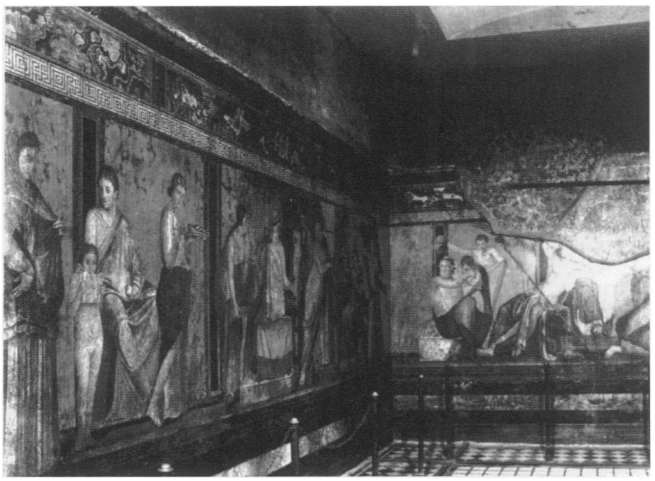

Fig. 1. Casa dei Misteri, Pompeii, 60 BC. Photo courtesy of Photothek Kunstgeschichtliches Seminar, Hamburg.

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 received 15 February 1998

fixing them into the same place and time.

This is the initiation or cult room of a Dionysian community. In the visual presence of Dionysus and Ariadne, a mystical consecration is being prepared: women filled with the divine presence make sacrifices while servants unveil a phallus, the *liknon*. A female initiator—expectant and frightened by the epiphany—and a dancing Bacchant covered only with a veil are also represented. At the center of the Bacchanalian rites are *ekstasis* (ecstasy) and *enthusiasmos* (ardor). Physical and psychological frontiers are torn down and filled with the divine in order that participants may dive into a precivilized world [5].

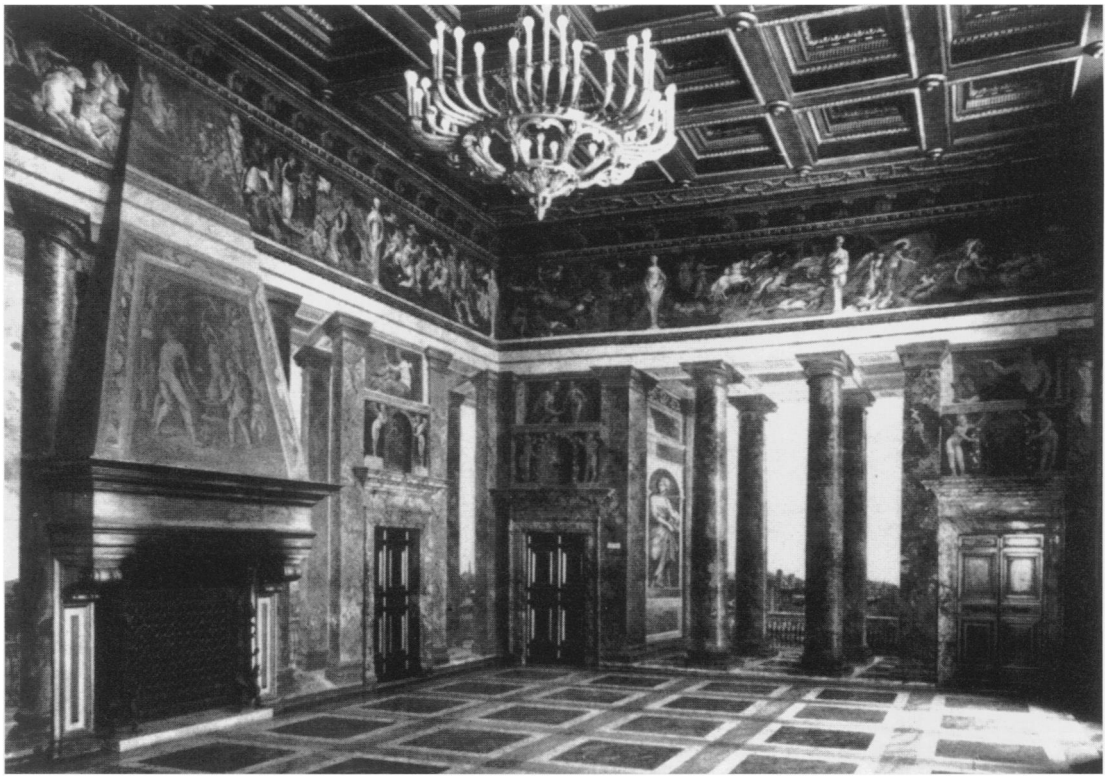

Fig. 2. Sala delle Prospettive by Baldassare Peruzzi, 1516. Photo courtesy of Photothek Kunstgeschichtliches Seminar, Hamburg.

The image is a portal through which in one direction the gods pass into the real world and in the other real people enter into the image. The frieze bears witness to a virtual reality meant to encourage an emotional, ecstatic participation through the use of such suggestive visual means as totality of representation, choice of color, and dramatic gesture, thereby creating a fusion of audience and image in cult. The shining red vehemently projects a sensuous atmosphere, climaxing in a sexual initiation ritual which draws the viewer inexorably into the image. This type of painting achieves the maximum potential available to the medium of the fresco in antiquity.

Sala delle Prospettive

In the Renaissance, illusionistic spaces were in great demand: the Villa Barbaro in Maser or the virtual pilgrimage at the Sacro Monte near Varallo are just two outstanding examples. The most remarkable of these 360-degree spaces is the Sala delle Prospettive (Fig. 2), created between 1516 and 1518 by Baldassare Peruzzi on behalf of Agostino Chigi in the Villa Farnesina in Rome. Chigi was a *nouveau riche* desperate to secure his reputation and name largely by means of obsessive patronage. Peruzzi encircled the audience with the fresco of a virtual columned hall, painted in perspective, that offered illusionistic views of Rome and its surrounding countryside. The resultant panoramic effect was impressive enough to garner the admiration of Serlio [6]. According to Vasari, Titian was unwilling to believe that it was a painting [7].

The view of the landscape contrasts with the monumentality of the illusionistic temple hall. The splendid isolation of this architecture creates a feeling of the sublime, matched only by the view from a mountaintop, here resembling an imaginary Mount Olympus from the top of which the visitor is surveying the skyline of contemporary Rome [8]. Chigi's poet Marcantonio Casanova compared the Farnesina—which he said was destined by Chigi to be the residence of the gods—with the Olympian palace [9]. Chigi uses the feeling of a pictorial presence to deify his own reputation with antique grandeur.

The decorative ceilings of Baroque church architecture (for instance at San Ignazio in Rome) also create illusionistic spaces. But their task was not to give the audience a sense of being transported to another place (which in this case would have been heaven). Instead their aim was to entrance the faithful and to overcome their sense of reason with a highly persuasive religious vision. These pictures simultaneously depict a heavenly promise to the audience on the floor and act as a means of sacred control.

During the seventeenth and eighteenth century in the palaces and country houses of the aristocracy, hundreds of illusionary spaces were created [10].

Panoramas

In England at the time of the Industrial Revolution, the new image-machine, the panorama, achieved hitherto unknown dimensions of illusionary effect (Fig. 3) [11]. With the financial help of Lord Elcho, Robert Barker realized his 1787 patented invention in the Guard's Room of Holyrood Palace at Edinburgh. As a military strategist and enthusiastic member of Parliament, Elcho was interested in any reconnaissance and planning technology that might aid in the control of occupied Scotland. Barker was a draftsman; at the Edinburgh headquarters of the English

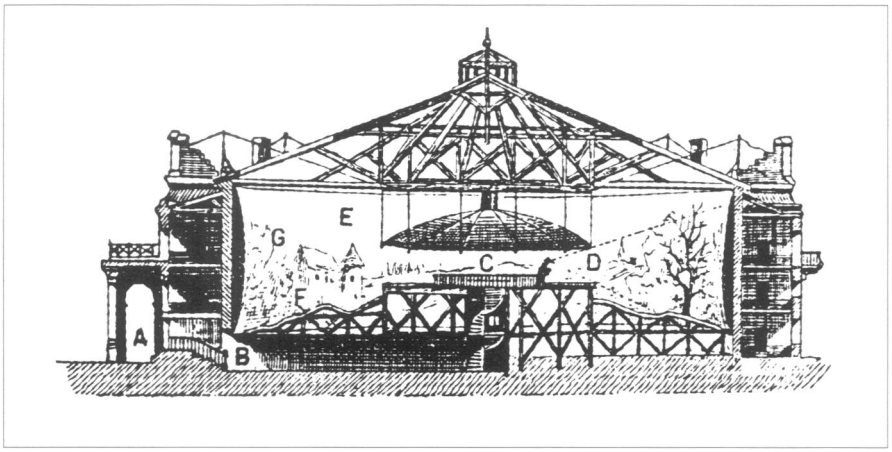

Fig.3. Diagram of a panorama from S. Oettermann, *Das Panorama: Die Geschichte eines Massenmediums* (Frankfurt: Syndikat, 1980), p. 41.

troops in occupied Scotland he taught perspective drawing as a technique for military reconnaissance. To prepare for campaigns, the military was immensely interested in taking down detailed panoramic views of the topography and geography of the terrain. Panoramic images made it much easier to make tactical plans for deployment zones, fields of fire, or retreat than was possible with cartographic data alone. The birth of the panorama can thus also be seen as a connection between virtual media and military history.

In the panorama the audience is immediately surrounded on all sides by a three-dimensional interior, the Faux Terrain, which is imperceptibly connected to the two-dimensional visual action and often makes the visual frontier untraceable. Because of the "magical" luminosity of the images, which comes from a hidden source of light, the visual space itself appears to be the source of reality. This representation of nature gives the vision totality and creates a sense of journeying through space and time —a complete universe of illusion.

In a manner reminiscent of modern fears of simulator sickness, the panorama was criticized mainly for psychological reasons. It was argued that the illusion could result in an inability to perceive reality [12]. Nevertheless the mass-media panorama spread successfully, with at least 100 million people visiting the 300–400 panoramic rotundas in Europe and America between 1870 and 1900 alone, making this medium a focal point of pictorial art in the Industrial Era [13].

The Panorama of the Battle of Sedan

In the early nineteenth century, the military leaders of France and England, Napoleon and Lord Nelson, both soon realized the panorama's potential as a medium for propaganda. (Bonaparte's plan for eight rotundas in the park of Versailles to publicize his victories remained unrealized.) Almost 35% of all the panoramas show battles, in England and France often from the colonial wars.

In Germany it was not until much later, after the 1870–71 war with France, that the medium was first used for political propaganda. A paradigmatic representative was the Panorama of the Battle of Sedan, which opened in 1883 in Berlin.

The monumental picture (the screen measured more than 7000 square feet) transported the "military birth of the Empire" into the very center of urban Berlin. For the opening ceremony, the Emperor Wilhelm I and the most powerful figures of the German Empire were present. The picture gave an almost photo-realistic portrayal of the action: on the 3D battlefield one could see bushes, stones, and entrenchments as well as real weapons and cardboard soldiers.

Today our eyes are used to following increasingly accelerated movement; thus we can hardly appreciate the effect that a still panorama picture had at that time. Many witnesses attest to the strength of the deception in the first few moments. They experienced the luminous scenery as a real battle, and the press headlines spread this news all over the country. The *Neue Preußische Zeitung* wrote on its front page:

> At first the visitor is startled, he is surprised, and naturally keeps a distance. He is afraid to collide with the horses and feels inclined to move backwards. The air seems to be filled with swirled-up dust and mist. Trumpets sound and drums beat [14].

With the calculated precision of illusionism, both the 360-degree picture and the 3D interior concentrated and fixed the attention of the onlooker. The image was not experienced as a self-contained object; indeed it negated the experience of a closed work of art, appearing instead as an artificial reality—everything was picture. The Berliner Tageblatt reported: "It is as if one were standing amidst the awful battle" [15]. One was devoured by the image. This prodigious, pseudoreligious experience was meant to implant an unforgettable collective memory.

The artist Anton von Werner, who created the panorama [16], always proclaimed its historical veracity, insisting that it was based on a careful scientific reconstruction. The German state, however, was mainly interested in sanctioning a mythic truth, and Wilhelm's patronage imbued the panorama with the authenticity of a vera icon, although neither he nor Werner had witnessed the actual events. Despite Werner's insistence on verisimilitude, the panorama was aimed at glorifying the Prussian soldiers. The Prussian aggressor is shown as a "politically correct" defender of the nation.

Interestingly enough, since the 1980s, authoritarian regimes in North Korea, China, Iraq, the former USSR, and Egypt have increasingly revived the battle panorama as a means of enhancing national unity [17]. Furthermore the panorama has reappeared on the World Wide Web in the form of programs like QuicktimeVR and Virtual Reality Markup Language (VRML) [18].

Virtual Reality

Since the discovery of this heretofore unresearched image tradition [19], it has been realized that the total images of VR are no novelty. The history of VR can be traced through nearly all epochs and media

of art history, from the Wagnerian concept of the *Gesamtkunstwerk* [20] to Claude Monet's immersive Impressionist panorama of waterlilies [21], Enrico Prampolini's futuristic theater concepts [22], Sergei Eisenstein's theories about the multisensual 3D movie [23], and Gene Youngblood's expanded cinema of the 1960s.

Technologically, the development of VR continued with the Stereoscope, Cinérama, Stereopticon, Photorama, Stereoscopic Television [24], Sensorama [25], and IMAX-Cinema. All had the same aim: to immerse the onlooker deeper and deeper into the image. These artistic visions represented a constant search for illusion, using the most advanced methods available in order to address the senses. As a result of artists' persistent role in the development of new illusional media, those media are now regarded as belonging not only to the history of technology, but also to cultural history.

With the military invention of the Head Mounted Display (HMD) [26] and the Dataglove, the viewer could now enter an interactive and dynamic image for the first time in its history. Constant calculations in real time give computer images the illusion of transformability. Pictorial action, determined by the action of the user, is limited only by the interactive restrictions of the program. VR represents the search for an interface which, ideally, appeals to all senses and occupies physiological space as immediately and imperceptibly as possible, as if it were a real experience [27]. Art itself reflects the paradigm of the illusion through its very methodology. The current renaissance of the classical alliance of art and technology in postindustrial societies has developed the profile of a few artists who work in privileged positions in the development of technology [28].

Osmose

The most remarkable first glimpses of this illusionistic genre are the immersive VR installation *Osmose* by Char Davies and the interactive installation *A-Volve* by Christa Sommerer and Laurent Mignonneau.

Osmose (Fig. 4) represents a visually powerful real-time simulation of a dozen nature and text spaces [29]. Immersed participants control their navigation through the dataspace with a chest-hugging rubber vest that contains sensory devices sensitive to the body's breathing—*a natural interface.* Just as in diving, as one's lungs fill, one rises. Concentrated, even breathing results in a feeling of balanced motion.

As weightless and solitary as a diver, the observer glides through opaque fog banks, abysmal oceanic depths, glinting dew, translucent swarms of insects, and the thickets of dark woods. The HMD provides a soft and fluent transition between the worlds as if they are seen through a soft-focus lens, with phosphorescent lightpoints glimmering in the dark. In the symbolic center, isolated on a clearing, stands a leafless tree, transparent and permeable, shining like a crystal. The tree, which can be traced as a symbol of life through art history is now also virtual. *Osmose* is a mineral-hard yet fluidly intangible sphere, a non-Cartesian space. Although it is a technically illusionary picture, *Osmose* suggests an optically poetic atmosphere. Nevertheless the artist does not aim at replacing nature: if her vegetable representations do not appear abstract, neither do they attempt digital realism.

The result of this finely tuned and physically intimate interface is a strong feeling of bodily presence, causing a corresponding emotional mood. Many participants speak of experiencing a contemplative sense of tranquility and security. Such descriptions testify to a central effect of virtual reality: that suggestive presence in a total picture causes a mental—and, in *Osmose*, a specifically meditative—immersion.

The Enlivening Effect: Evolution

The suggestive effect of presence in *Osmose* can be intensified by what C. Heeter calls social presence: when agents in the virtual space act like individuals [30]. The higher the degree of correspondence between perceived actions and probable phenomena, the more likely it is that what is seen (as in the panorama) will be taken for real. VR research pursues this aim in every detail.

A big step in this process can be seen in the non-VR installation *A-Volve* (1994) by Sommerer and Mignonneau (Fig. 5). For the first time *A-Volve* presented an opportunity both to create virtual beings and to interact with them in real time [31]. The outline and cross-section of the creatures are sketched on a touchscreen, then projected into a water-filled tank. In the water (a metaphor for life) they develop a physiognomy. Gathered around the pool, the viewers observe the survival of their amorphous 3D creations, which from this point on are subject to the laws of evolution. The guiding principle is the survival of the fittest. Certain forms swim faster and are

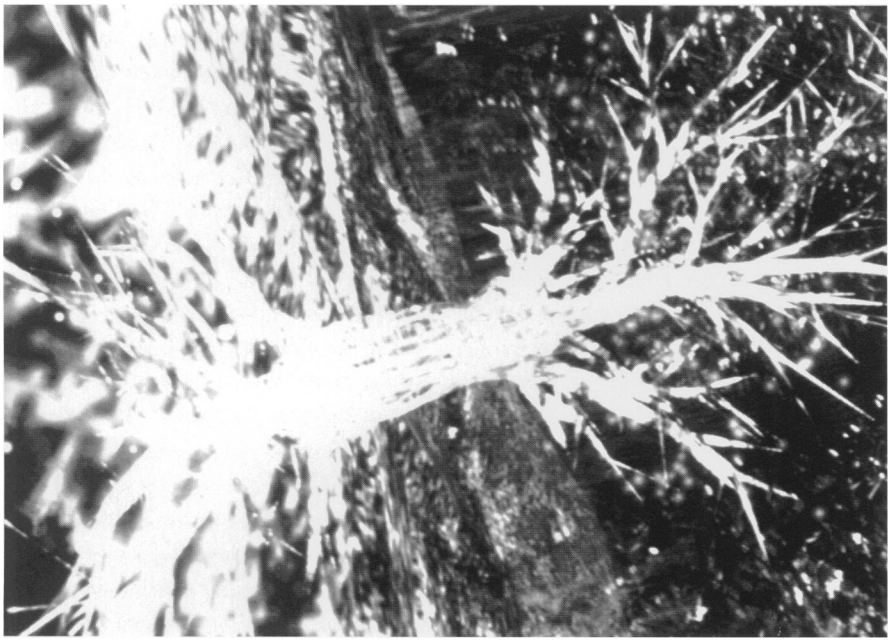

Fig. 4. An image from *Osmose*, virtual reality installation by Char Davies/Softimage, 1995.

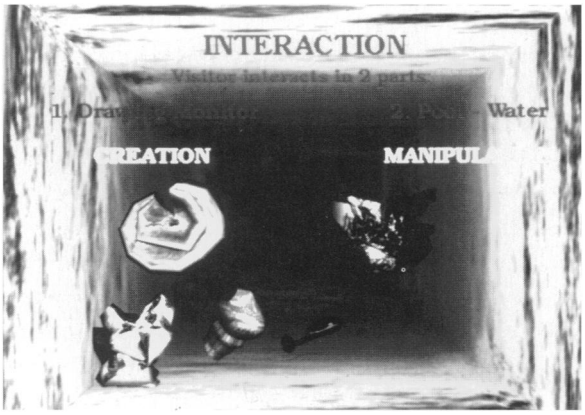

Fig. 5. An image from *A-Volve*, interactive real-time installation by Christa Sommerer and Laurent Mignonneau, ATR Laboratories, Kyoto, 1994-95.

better able to assert themselves against others; as a result they are able to pass on their genetic makeup, including any mutations, to their descendants.

Onlookers can "play God," creating new beings or bringing the simulated biotypes under their influence. By slightly stroking the water—a natural interface—the creatures can be attracted, trapped, manipulated, or even killed. By encouraging an identification with the creatures, *A-Volve* reduces the apparent distance between life and artificial life (A-life).

A-Volve's evolution is founded on genetic algorithms. Sommerer and Mignonneau innovatively apply procedural principles of evolution, such as selection, crossover, and mutation to enable the creatures to adapt homogeneously and uniformly. Evolution creates pictures of a nature that is unpredictable, transitory, and unique, and its impact on art emerges: the variety in forms that might evolve during these processes is theoretically unlimited, comprising all beings in the past and future, maybe even beings from beyond our imagination [32]. The more complex these structures are, the more intensely the pictures seem to live. In the end they are not terminated, but are changeable, adaptable, even able to learn under cumulative methods of selection [33].

In other papers, I have described the consequences of interaction for the work of art [34]. With evolution, the suggestive potential of the image has to be defined on a hitherto unknown level. At present it seems as if dynamic real-time images are revitalizing a premodern concept of the image that had previously been transmuted into a more rational—and distant —relation of picture and observer. In the longest period of its history, even before the "invention" of art, the image was believed to be endowed with occult powers. We can see this in the etymological root of the German word for image, *Bild*, and its Germanic root, *bil*. These roots carry with them an often-overlooked connotation of something permeated by an irrational, magical, and spectral power that cannot be fully understood or controlled by the observer [35].

With evolutionary image processes, a dialectical relationship with the image machine seems possible. Here interaction is not only about freedom of choice for the player, as Vilem Flusser noted [36], but about unexpected change, forcing the user to react. Evolution removes conceptual control from the artists, making them passive witnesses to random changes which the user can select like a breeder.

Finally, the use of evolutionary formats in VR-installations supports the illusion of life. It has been argued that the audience becomes emotionally involved when a balance is created between the freedom of interaction with interesting characters and a prearranged dramatic plot [37]. Psychobiological tests show that the more the participants are involved, the less they are able to differentiate between the artificial world and personal experience. Thus the system can manipulate participants even without their becoming aware of it [38]. In fact the body's output of endorphins causes a sense of a "high" [39].

Whatever one might think about scenarios of this nature, it seems clear that virtual culture will not experience its greatest illusionistic potential at the hands of ardent, hard-working engineers calculating each and every detail, but by combinatory processes generating unforeseeable forms.

Interface

The "living" virtual picture, which is the aim of current research, is better experienced the more real and the more natural the connecting interface is, like the surface of water in *A-Volve*. Virtual reality, which has at its core the complete disconnection of human senses from nature and matter, presents the strongest challenge of illusionism so far. Increased processor capacity raises the potential for increased verisimilitude—and for psychological manipulation. Seen against the historical background of illusionism, the intended abolition of the interface becomes a highly political question.

Distance

In animated virtual environments, a very fragile center of art is put into question: the gesture of distance by the recipient, which allows critical reflection in the first place. The further the illusionary symbiosis between work and onlooker progresses, the more it will weaken the psychological distance between the two. Yet without distance, the work cannot be perceived as an autonomous esthetic object. It was Ernst Cassirer and, later, Aby Warburg in his *Mnemosyne Atlas*, who stressed the intellectually productive, awareness-raising power of distance [40]: H. Jonas [41], T.W. Adorno [42], A. Gehlen [43] and M. Foucault [44] developed this idea further. As much as the viewer might crave to overcome these barriers, the very experience of the subject *as* subject depends on distance [45]. Traditionally, as Serres writes [46], the onlooker mentally activates the elements of fixed artworks. Virtual Reality and evolutionary image processes via genetic algorithms, however, seem to turn this concept on its head: the objects move first, apparently activating the onlooker. In our panel discussion at the International Symposium on Electronic Arts (ISEA '97), Char Davies spoke of this annihilation of distance as "the bittersweetness of VR" [47].

More and more people have experienced machine-made illusionary spaces, whose function has a historic continuity stretching from Pompeii to the present: as forums of ritual fusion, subtle escapes from the world, and means of manipulation by political power. Historically, each extension and intensification of sensory activity has coincided with both an increasing dependency on sensory machines and the expansion of technical means of control

and power. VR reveals itself as the heir to illusionism as manifested in its paradigmatic representative, the panorama. Although today the audience can exert its creative powers over the image, this control is counterweighed by the highly suggestive powers of the image itself. Maybe we are regaining a relation to the image that reaches far back into precivilized history, giving it a power that transcends a psychic as well as physical boundaries and enables us to regress, leading to an ecstatic symbiosis of onlooker and image.

Acknowledgments

The present essay has been adapted from the texts of two papers presented at the international research conference *Consciousness Reframed: Art and Consciousness in the Post-Biological Era* at the Center for Advanced Inquiry in the Interactive Arts (CAiiA) in Newport, Wales, in July 1997, and at the Eighth International Symposium on Electronic Art (ISEA) at the Art Institute of Chicago in September 1997.

I am grateful to Horst Bredekamp, Hans Belting, Iris Mahnke, Richard Barbrook, Joseph Nechvatal, Friedrich Kittler, Stefan Germer, Wolfgang Coy, Martin Kemp, Ken Goldberg, Joachim Sauter and Wolfgang Welsch for their helpful comments on the ideas presented. The following people and institutions kindly provided access to VR and related technology: Monika Fleischmann and Wolfgang Strauss (Gesellschaft für Mathematik und Datenverarbeitung GMD/Sankt Augustin), the Fraunhofer Institut/Stuttgart, Christa Sommerer and Laurent Mignonneau (Advanced Telecommunication Research-Lab. Kyoto), Itsuo Sakane-san (International Academy of Media Arts and Sciences/Gifu), Yukiko Shikata (ARTLAB/Tokyo), Char Davies (Immersence/Montreal), Knowbotic Research.

References and Notes

1. The iconic turn has made the image the central object of research for various academic disciplines. M. Jay, *Downcast Eyes* (Berkeley, CA: Univ. of California Press, 1993); W.J.T. Mitchell, *Picture Theory: Essays in Verbal and Visual Representation* (Chicago, IL: Univ. of Chicago Press, 1994); H. Bredekamp, "Metaphors of the End of the Images," in Heinrich Klotz, ed., *Contemporary Art: The Collection of the ZKM Center for Art and Media Karlsruhe* (New York: Prestel, 1997) pp. 32–37; O. Grau, "In das lebendige Bild: Die Virtuelle Realität setzt der Kunst neue Spielregeln," in *Neue Bildende Kunst: Zeitschrift für Kunst und Kritik*, 7, No. 6, 28–35 (1997); Klaus Sachs-Hombach, ed., *Bildgrammatik* (Magdeburg, Germany: Scriptum Verlag, 1999).

2. J. Steuer, "Defining Virtual Reality: Dimensions Determining Telepresence," *Journal of Communication*, 42, No. 4, 73–93, esp. 91 (1992).

3. V.M. Strocka, "Der Zweite Pompejanische Stil" in G. Cerulli Irelli, ed., *Pompejanische Wandmalerei* (Stuttgart, Germany: Belser, 1990) p. 213; and B. Wesenberg, "Römische Wandmalerei am Ausgang der Republik: Der zweite Pompejanische Stil," *Gymnasium*, **92** (1985) p. 473.

4. E. Simon, "Zum Fries der Mysterienvilla bei Pompeji," *Jahrbuch des Deutschen Archäologischen Instituts*, 76, pp. 111–172 (1961); B. Hundsalz, "Neues zum großen Fries der Mysterienvilla," *Kölner Jahrbuch für Vor- und Frühgeschichte*, 24 (1991) pp. 73–78.

5. W. Burkert, *Ancient Mystery Cults* (Cambridge, MA: Harvard University Press, 1987) pp. 58, 95; R. Merkelbach, *Roman und Mysterium in der Antike* (Munich, Germany: Beck, 1962).

6. S. Serlio, *I sette libri dell'architettura*, Vol. 1 (Venice, Italy: Arnaldo Forni, 1978 [1584]) p. 192.

7. G. Vasari, *Le Vite* (Florence: Studio per le edizioni scelte, 1976 [1568]) Vol. 4, p. 318.

8. U. Ewering, *Der mythologische Fries der Sala delle Prospettive in der Villa Farnesina zu Rom* (Münster, Germany: Hochschulschriften, 1993) pp. 57ff.

9. I.D. Rowland, "Some Panegyrics to Agostino Chigi," *The Journal of the Warburg and Courtauld Institutes*, 47, No. 18, 198ff. (1984).

10. E. Börsch-Supan, *Garten-, Landschafts- und Paradiesmotive im Innenraum* (Berlin, Germany: Hessling, 1967).

11. A number of contemporary sources compare the illusionary space with the panorama and consider the advantages and disadvantages of the latter. On the other hand, the experiences gained from the panorama were used in the development of illusionary spaces. See J. Britton and N. Whittock, *The Union of Architecture, Sculpture, and Painting: with Descriptive Accounts of the House and Galleries of John Soane* (1827), pp. 3ff., quoted in W. Croft-Murray, *Decorative Painting in England*, 1537–1837 (London: Country Life, 1970) p. 64. A further connection between the panorama and the private illusionary space is suggested by panorama wallpaper, which could be fabricated at a low cost and was fashionable in the nineteenth century among the urban bourgeoisie. *Papiers panoramiques*, French hand-printed wallpaper, were miniaturized versions of the illusionistic decoration of the panorama. Musée des Arts décoratifs, eds., *Décors de l'imaginaire: Papiers peints panoramiques, 1790–1865* (Paris: Flammarion, 1990).

12. "I am swaying between reality and unreality . . . between truth and pretense. My thoughts, my whole being are given a movement which has the same effect as spinning or the rocking of a boat. Thus I explain the dizziness and sickness which overcomes the concentrated onlooker in the Panorama." J.A. Eberhard, *Handbuch der Ästhetik* (Halle, Germany: Hemmerde and Schwetschke, 1805), part 1, letter 28, p. 175. Translation by O. Grau.

13. S. Oettermann, *Das Panorama: Die Geschichte eines Massenmediums* (Frankfurt/Main, Germany: Syndikat, 1980) p. 192. For the specific history of the panorama, see S. Bordini, *Storia del Panorama* (Rome: Officina Edizioni, 1984). In order to make maximum profits, the panorama became international and toured the world. When the profits no longer covered the operating costs, the pictures were neglected and often discarded.

14. *Neue Preußische Zeitung-Kreuzzeitung*, **205** (4 September 1883) p. 1.

15. *Berliner Tageblatt*, **409** (2 September, 1883) p. 1.

16. Von Werner was a protégé of the Kaiser and came to hold a dominant position in the cultural politics of the Empire. For many years he controlled its agenda. He suggested that the developing modern art movement should be countered by a state policy for the arts which determined beauty "as an international commission keeps watch over security, certainty, and accuracy of the standard meter." A. von Werner, *Ansprachen und Reden* (Berlin, Germany: Schuster 1896) p. 42.

17. *Battle of Stalingrad*, Volgograd, USSR, 1962; *Battle Near Al Qadissiyah, Al-Mada'in*, Iraq, 1968; *Panorama of the Liberation of Pleven*, Pleven, Bulgaria, 1977; *Battle at Teschou*, Pyongyang, North Korea, before 1987; *Panorama of the Arab-Israeli War*, Cairo, Egypt, 1988; *Battle at the Lo Gou Bridge on 7 July 1937*, Beijing, China, 1988; R. Hyde, *Panoramania!: The Art and Entertainment of the "All-Embracing" View* (London: Trefoil Publications, 1988) pp. 200ff.

18. M. Mirapaul, "World-Wide Views on the World Wide Web," *The Wall Street Journal* (3 September 1998) p. A-20.

19. O. Grau, "Die Sehnsucht, im Bild zu sein, Mag. Art." Thesis, University of Hamburg, 1994, p. 20.

20. Richard Wagner was known to plead for multisensory, true-to-life, mass-effect multimedia art that unifies all art forms: R. Wagner, "Das Kunstwerk der Zukunft," in *Gesammelte Schriften*, Vol. 3 (Leipzig, Germany: E.W. Fritsch, 1887) pp. 42–177.

21. The Nymphéas reveal a complete panorama of Monet's water lily pond. Monet induces onlookers to imagine themselves immersed in the absoluteness of the water landscape. K. Sagner-Düchting, *Claude Monet: Nymphéas: Eine Annäherung* (Hildesheim, Germany: Georg Olms, 1985) pp. 55–67.

22. E. Prampolini, "L'atmosfera scenica futurista," *in NOI: Rivista d'arte futurista, Rome, numero speciale*, 6–7 (1924).

23. With *Raumfilm*, Eisenstein envisioned a symbiosis between art and utopian technique. The Raumfilm would have the power "to draw the spectator for the first time with such a strong intensity into the screen and simultaneously to overwhelm him with that which was previously enclosed in the mirror of the screen," S. Eisenstein, "O sterokino" (1947), in Oksana Bulgakova, ed., *Das dynamische Quadrat: Schriften zum Film*, (Leipzig, Germany: Reclam, 1988) p. 207. Translation by the author.

24. W.R. Halbach, "Reality Engines," in Norbert Bolz, ed., *Computer als Medium* (Munich, Germany: Fink, 1994) pp. 231ff.

25. L. Lipton, "Now Step into a Movie: Sensorama," *Popular Photography*, July 1964, 114, 116.

26. I.E. Sutherland, "A Head-Mounted Three-Dimensional Display," in *Proceedings of the Fall Joint Conference*, AFIPS, 33, 757–764 (1968).

The HMD was financed by the Advanced Research Projects Agency (ARPA); see B. Wooley, *Virtual Worlds: A Journey in Hype and Hyperreality* (Oxford, UK: Blackwell, 1992) p. 53.

27. W. Barfield, "Comparison of Human Capabilities with Technical Specifications of Virtual Environment Equipment", in *Presence: Teleoperators and Virtual Environments*, 4, No. 4, 329–356 (1995); M. Slater et al., "Depth of Presence in Virtual Environments," Presence **3**, No. 2, 130–144 (1994); and K. Stanney, "Human Factors: Issues in Virtual Environments," *Presence* **7**, No. 4, 327–351.

28. C. Sommerer and L. Mignonneau, eds., *Art@Science* (New York: Springer, 1998) and M.A. Moser, ed., *Immersed in Technology: Art and Virtual Environments* (Cambridge, MA: MIT Press, 1996).

29. C. Davies and J. Harrison, "Osmose: Towards Broadening the Aesthetics of Virtual Reality," *ACM Computer Graphics* **30**, No. 4, 25–28 (1996); F. Dyson, "Charged Havens," in *World Art* 3 (1996) pp. 42–47; M. Morse, *Virtualities: Television, Media Art and Cyberculture* (Indianapolis, IN: Indiana University Press, 1998), pp. 208–209; O. Grau, "*Vom Zen des Tauchens*," *Die Zeit* (19 June 1997) p. 62.

30. C. Heeter, "Being There: The Subjective Experience of Presence," *Presence: Teleoperators and Virtual Environments* **1** No. 2, 264ff. (1992); P. Maes et al., "The ALIVE System: Full Body Interaction with Autonomous Agents," *Proceedings of the Computer Animation '95 Conference* (Genoa, Italy: IEEE-Press, 1995).

31. C. Sommerer and L. Mignonneau, "Art as Living System," *Systems, Control & Information* **40**, No. 8, 16–23 (1996); and Sommerer and Mignonneau, "Interacting with Artificial Life: A-Volve," *Complexity 2*, No. 6, 13–21 (1997).

32. K. Kelly, *Out of Control: The New Biology of the Machines* (London: Fourth Estate, 1995); M.A. Boden, ed., *The Philosophy of Artificial Life* (London: Oxford Univ. Press, 1996).

33. T.S. Ray, "An Evolutionary Approach to Synthetic Biology: Zen and the Art of Creating Life," in C.G. Langton, ed., *Artificial Life* (Cambridge, MA: MIT Press, 1997) pp. 179–209.

34. O. Grau, "Hingabe an das Nichts: Der Cyberspace zwischen Utopie, Ökonomie, und Kunst," *Medien.Kunst.Passagen*. 4, pp. 17–30 (1994).

35. A. Wolf, *Die germanische Sippe bil: Eine Entsprechnug zu Mana*, in *Universitets Årsskrift* (Uppsala, Sweden: 1930) pp. 18–56.

36. V. Flusser, *Ins Universum der technischen Bilder* (Göttingen, Germany: European Photography, 1985) p. 123; F. Rötzer: "Interaktion: Das Ende herkömmlicher Massenmedien," in S. Bollmann, ed., *Kursbuch neue Medien* (Mannheim, Germany: BI Verlag, 1995) pp. 57–78; S. Krämer, "Vom Mythos 'Künstliche Intelligenz' zum Mythos 'Künstliche Kommunikation' oder, Ist eine nicht–anthropomorphe von Internet-Interaktionen möglich?", in S. Münker, ed., *Mythos Internet* (Frankfurt, Germany: Suhrkamp 1997) pp. 83–107.

37. M. Kelso and P. Weyhrauch et al., "Dramatic Presence," *Presence: Teleoperators and Virtual Environments*, 1, No. 1, 10 (1993).

38. Kelso and Weyhrauch [37] p. 14.

39. D. Sheff, *Game Over: How Nintendo Conquered the World* (New York: Vintage, 1993).

40. E. Cassirer, *Individuum und Kosmos* (Darmstadt, Germany: Wissenschaftliche Buchgesellschaft, 1963 [1927]) p. 179; A. Warburg: "Einleitung zum Mnemosyne-Atlas," in C. Geissmar, ed., *Die Beredsamkeit des Leibes: Zur Körpersprache der Kunst* (Salzburg and Vienna, Austria: Residenz-Verlag, 1991) pp. 171–173. Historically the distance paradigm goes further back: since the eighteenth century it has been regarded as the fundamental prerequisite for experiencing art and nature. The inner distance was to be matched carefully in order to allow the total view as well as a detailed perception. Distance rejects neither the compulsive and the passionate nor religion and myth; it focuses, however, on their integration into the experience of human entirety.

41. H. Jonas, "Der Adel des Sehens: Eine Untersuchung zur Phänomenologie der Sinne," in *Organismus und Freiheit: Ansätze zu einer philosophischen Biologie* (Göttingen, Germany: Vandenhoeck & Ruprecht, 1973) pp. 198-219.

42. "Distance is what nearness to a work's substance requires first. In the Kantian term of indifference, which demands an esthetic behavior that does not seize the object, does not devour it, this is noted. . . . Distance concerning the phenomenon transcends the mere existence of a work of art; its total nearness would be its total integration." T.W. Adorno, *Ästhetische Theorie* (Frankfurt, Germany: Suhrkamp, 1973) p. 460. Translation by O. Grau.

43. "The immediate emotionalism of experience is from the outset regarded as foreign to art—and with justice." A. Gehlen, *Zeitbilder* (Frankfurt, Germany: Klostermann, 1986) p. 60. Translation by O. Grau.

44. The Foucaultian subject is primarily based on self-detachment: M. Foucault, *Histoire de la sexualité I: La volonté de savoir* (Paris: Gallimard, 1976).

45. "All bliss is immersion into the flesh and withdraws the history of the subject. All self-consciousness is release from the flesh which determines our submission to nature." H. Böhme, *Natur und Subjekt* (Frankfurt, Germany: Suhrkamp, 1988) p. 221. Translation by the author.

46. Only in the fixed artwork whose elements the onlooker "sets into motion" does the spatial configuration become a vivid, sensuous event. M. Serres, *Carpaccio: Ästhetische Zugänge* (Reinbek, Germany: Rowohlt, 1981) p. 152.

47. C. Davies at the "Virtual Illusion" panel at the Inter Symposium on Electronic Arts (ISEA), Arts Institute of Chicago, 4 September 1997.

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