Immersive Image Strategies of the Classical World

Wall paintings from the late Roman Republic painted in the Second Style of Pompeii have survived that include not only mimetic but illusionary elements. Through the device of seeming to extend the wall surface beyond a single plane, the room appears larger than its actual size and draws the visitor's gaze into the painting, blurring distinctions between real space and image space. The most effective examples of these frescoes use motifs that address the observer from all sides in a unity of time and place, enclosing him or her hermetically. This creates an illusion of being in the picture, inside an image space and its illusionary events.

A truly impressive example of this image strategy is found in one of the most famous surviving frescoes of antiquity: the Great Frieze in the Villa dei Misteri at Pompeii. Created ca. 60 B.C., the frieze covers the entire walls of Room no. 5 in the Villa Item, known as the Villa dei Misteri. Twenty-nine highly realistic, life-size figures against a background of glowing red and marble incrustations, rhythmized by lissières, are grouped in the oecus, which measures 5 x 7 meters (fig. 2.1). The spectacular painted scene almost entirely fills the observer's field of vision. This is not a hidden chamber; it can be accessed easily from the southwestern side of the building where it is connected, via a portico, to a terrace that, in former times, afforded a good view of the Gulf of Naples. With the exception of this opening in the wall, which is less than three meters wide, the visitor to the room is surrounded hermetically by a 360° vision with unity of time and place. The overall effect is to break down barriers between the observer and what is happening in the images on the walls. This is accomplished by a suggestive appeal to the observer from all sides that utilizes illusionism techniques.

It is a chamber dedicated to the cult of Dionysius, used by his followers for rites of initiation and ritual. In the presence of Ariadne and Dionysius as painted images, preparations are being made for a Bacchic rite: the initiation of a woman into the mysteries. This is, in my opinion, the most convincing interpretation advanced so far, therefore, I shall follow it here. The fresco brings gods and humans together on the same pictorial level: A woman in dignified apparel wearing a double cloak approaches a boy, who is reading, and a seated matron. Next to them, a serving girl carrying a tray with slices of ritual cake turns to face the observer. The next group of three people is attending to the sacrifice—a direct reference to the realm
of the mysteries: a priestess has a serving girl sprinkle water on a myrtle wreath while another attendant hands her a tray. A silenus, dressed in purple—the color of the Dionysian cult—and playing music, leads into the neighboring bucolic scene: Two young satyrs, one with a pan flute and the other suckling a goat, are sitting on the rocky ground. Simon is of the opinion that these may be contemporary portraits embellished with the pointed ears associated with satyrs. Drama is lent to the scene by a young maenad who, panicked and anxious, throws her clothes about her with a defensive movement of the hand in a gesture of pathos and ecstasy. She is depicted as being on the brink of leaving the level of the other painted figures, as about to step over the edge of the wall painting, out of the picture, and into the space of the observer. Her gestures and expression are reactions to what is happening on the adjacent right-hand wall; according to the logic of the work, they point across the intervening area, traversing the space of the observer.

This wall, the centerpiece of the painting, is devoted to the procession of Dionysius: nine figures, dominated by Dionysius-Bacchus and Ariadne, or Venus. The two gods lie intertwined, intoxicated and oblivious to their surroundings. The embracing bodies exude sensuality; although the initiation itself is not visualized, in Simon’s view, the epiphany character of the scene is given because of the volatile immediacy emanating from the divine pair. To the left is a papposilenus with two more satyrs. In the
mirror of a vessel, one of the satyrs appears to espy the mask of intoxication, another symbol of this cult. To the right, hidden under a purple cloth, the liknon is about to be uncovered, wherein the most sacred cult object of the Dionysian initiation is concealed—for Burkert, the real *fascinosum* of the rite: here, the phallus remains out of sight. Next, a winged female demon raises her arm to strike a mighty blow with a whip; again the dramaturgy of the painting transcends the limits of the second dimension, for the lash falls—or so one imagines—across the observer’s space on the back of a girl kneeling on the opposite wall (fig. 2.2). With hair still wet from the ecstatic dance, her head lies in the lap of a confidante whose face reflects the agonized expectation of the ritual flagellation, a means for the maenads to achieve trance, a spiritually ecstatic state. Holding a wand—the thyrsus, symbol of the initiated—in her hand, a bacchante bends over the neophyte. The naked dancer in this group of figures symbolizes the successful completion of the rite of initiation to bacchante: in an ecstatic trance, she appears to be in an exalted state of divine possession. Indeed, this was the core of the Bacchic rites: *Ek-stase* and *En-thusiasmós*, physical and psychological immersion of the individual in the god to attain fulfillment, submerged in an ecstatic state together with others and the god, a regression of consciousness, a journey of initiation into an infinite unity. This was the end to which techniques for achieving ecstatic states were used.

In the context of this study, primary interest centers on the picture’s function as an illusion. The events depicted are not shown in succession but as a spatial and temporal unity. The main illusionistic intention of the fresco, which seeks to meld the observer spatially with the mythical scene, demands a pictorial form that will envelop the observer hermetically. In addition to a highly realistic method of portrayal using great detail, for example, the finely veined marble and alabaster, the gauzy transparency of a serving-girl’s chiton, the silvery gleam of a vessel, or the fine rendering of the hirsute silenus playing his instrument, there is particular use of the individualized portrait. The positioning of the megalography, which is partly staggered, on a podium painted in perspective approximately one meter from its base on the floor, contributes to the optical effect of a relief, and thus of depth. However, the most important effect of all is its totality; it is an image space that addresses the observer from all sides: “The visitor to the chamber falls under the spell of the gaze
directed at him from all three areas, which rivets him for as long as he remains in the room. ¹⁵ And one can almost feel the dialogic communication between the figures, from wall to wall, as a lingering, almost physical reality.

Three groups of figures can be distinguished: the mortals making preparations for the initiation, the initiated mystes, and the group of guardians of the enigmatic Dionysian revelations, which includes the immortals. ¹⁶ A
decisive factor for the function and effect of the fresco is that all three groups, each with a different form of existence, are depicted on the same level and, additionally, fuse spatially with the observer. This combination of human cult followers and Dionysian divinities in the picture pursues the objective of intensifying the observer’s identification with the events. The picture is a gateway, which allows the gods to enter the space of the real, and, in the other direction, transports their mortal assistants into the picture. The glowing red color heightens the sensual and ecstatic atmosphere and its climax, the consummation of the sexual initiation rite, ultimately succeeds in involving the observer as well. With its suggestive exclusiveness and the resultant psychological effect, this pictorial form represents the maximum that the image medium of the fresco could achieve with the means available at the time.

Although the frieze still presents a wealth of unsolved riddles, for all that, it is clearly a palpable testimony to a virtual reality, which not only sought to involve the observer through its subject but also, through the use of panoramic images, specific colors, and dramatic gestures, aimed at emotionally arousing the observer to ecstatic participation: the psychological fusion of observer and image in the cult.

Whereas ritual drives the concept of immersion in the Villa dei Misteri frieze—images aimed at creating a particular state of mind—the totality of the fresco images in the Villa Livia at Primaporta create the illusion of an artificial garden. Dating from 20 B.C., these wall paintings of a peaceful refuge flooded with light surround the observer completely (fig. 2.3). The scene depicted on the walls of the room, which measures 12 × 6 meters, follows nature closely. There are cypress trees, oleanders, pines, and carefully detailed acanthus, roses, and irises. Realistic birds populate the natural-looking space, including jays, quails, and orioles; Gabriel has counted around thirty species. Although the picture’s flora and fauna are painted exactly true to their natural size, it is nevertheless an ensemble that does not occur in this form in nature. Selection and combination present an ideal that improves on nature (fig. 2.4).

The landscape addresses the observer frontally and, so it seems, in close proximity. The effect is to incorporate the visitor physically into the space of illusion, yet without creating an impression of great depth, owing to the nebulous turquoise background. Illusionistic painting techniques create an artificial space into which the observer is “integrated.” Completely filling
Figure 2.3  Landscape room in the Villa Livia. South wall, fresco, near Primaporta, 20 B.C.
Soprintendenza Archeologica di Roma.

Figure 2.4  Landscape room in the Villa Livia, detail. By kind permission of Michael Greenhalgh, The
Sir William Dobell Professor of Art History, Australian National University.
the field of vision, there is no possibility for the observer to compare extraneous objects with the scene, which might relativize the impression made by the picture. As in the Great Frieze of the Villa dei Misteri, the principle of unity of time and place is also used here. Further, the observer confronts a simultaneous image that envelops panoramically and transports him or her into another space. To increase the effect of the illusion and maintain continuity, light falls into the chamber from an opening in the wall immediately below the ceiling, which is painted to represent the overhanging rocks of a grotto. This construction is similar to the lighting method used later in panoramas.

Archaeological research has not succeeded in discovering what this room was actually used for. Yet it is apparent that, with the aid of the most advanced contemporary techniques of painting and representation, the intention was to create a virtual refuge in the form of a peaceful garden.

These "heroic" landscapes from Homer's epic poem stand apart from the illusion spaces discussed above because of the smaller vertical dimensions of their panoramic vistas. In the remains of a building on the Esquiline Hill in Rome, which dates from the late republican era and is of unknown function, a frieze was discovered with pictures of mythological scenes from Cantos 10 and 11 of The Odyssey. Each picture is approximately 1.50 meters high and 1.55 meters wide, and together they form a sequence (fig. 2.5). Experts agree that originally, the frieze formed a band on the upper part of a side wall in a room that measured approximately 20 × 14 meters. The only surviving portion began at a height of some
3.50 meters and is from a single wall. Opinions differ as to whether these scenes, which represent only a small excerpt from the poem, continued on the other walls of the room that have not survived. I wish to focus on a different aspect: although the scenes are arranged in chronological order, they are set against a background of a continuous and uniformly rocky landscape and although the frieze is broken up into sections, framed by illusionistic, painted pilasters, the cursory representation of the natural landscape is a unity. Thus, the observer’s gaze is dominated horizontally, but not vertically, by the panoramic landscape. The effect is not all-pervasive and does not dominate the observer’s field of vision; yet it is a prospect of a distant panorama. The use of aerial perspective together with the discreet integration of the small-scale figures of the protagonists in an image space with differentiated color-shading is very similar to techniques employed much later in the panorama. The resulting effect of illusion is that of “a form of second reality,” which opens into the space of illusion but does not evoke a feeling of presence or immersion in it.

A further similarity with later panoramas is that the eye point of the vista is located above the landscape, which has the effect of pushing back the horizon even further into the distance. The framing pilasters, rendered in parallel perspective, are oriented toward the observer standing a few meters below, but the elevated position of the frieze (about 4.50 meters from the floor) prevents the observer from aligning his or her eye with the painted horizon and thus also from relating directly to the landscape, which would create a feeling of presence. Instead, the observer gazes up at the far-off mythological landscape of The Odyssey, a mechanism that serves to relativize one’s own existence. The employment of this same mechanism was perfected in the painted ceilings of the Baroque.

The triad of mystery, magic, and pictorial illusion that was used to such effect, for example, in the Villa dei Misteri functioned in the ancient world and was understood by and communicable to many people. This tremendous power of the image was recognized by the early Christian church and banned. The influence enjoyed by monasteries in the early Byzantine period was due in no small part to the worship of images, or idolatry, that they organized for the people. In the seventh and eighth centuries, the iconoclasts sought to break this influence. It was not until 787 that the Council of Nicaea conceded it was permissible to worship God through the veneration of images. This victory for the monastic orders opened up
the way for the production and worship of icons, the quintessential sacred representations of early Christianity. Although for centuries these religious images conformed to rigid rules of depiction, they nevertheless facilitated mental and emotional reception of the subjects they presented.

**The Chambre du Cerf in the Papal Palace at Avignon**

In Western painting, the earliest postantiquity example of an entire space of illusion is the Chambre du Cerf (Chamber of the Stag) with its hunting scenes, which date from 1343. At the beginning of his pontificate, Pope Clement VI extended the new fortified palace at Avignon by adding a forty-meter-high tower on the south side, the Tour de la Garde-Robe. From the top, there is a spectacular view of the Provence countryside. The Chambre du Cerf, which measures $8 \times 9$ meters, is located on the fourth floor and served Clement VI as a study and living room. The frescoes cover all four walls, and experts agree that they were created in the autumn of 1343. They are attributed to Matteo Giovanetti, the *pictor papae* of Clement VI. With the exception of the windows, where the paintings end abruptly, and the beamed ceiling, which is painted with heraldic devices, the entire wall space is covered with a lush dark forest landscape with only a thin strip of azure blue sky above the treetops (fig. 2.6). Parts of the frescoes were destroyed by the temporary addition of two fireplaces, including the main section, a life-sized stag that gave the room its name.

The paintings present some uses and pleasures of nature from the standpoint of the rulers of feudal society, in particular, fish farming and the hunt. There are scenes of hunting the stag and wild boar, hare coursing, trapping, and hunting with the longbow, cross-bow, ferrets, decoys, and the falcon, a form of hunting reserved almost exclusively for the nobility. On the south wall, young men are pictured bathing in a prominently placed piscarium, a fish pond surrounded by a low yellow wall, where young attendants are trying to catch pike, carp, and bream with hand-nets and bait.

The frescoes are remarkable because they surround the observer entirely and almost completely occupy the field of vision. Although the murals begin at around 1.20 meters from the floor, the room can be classified as a space of illusion because of the effect created by its $360^\circ$ design and, most important, the fact that there are no framing elements, neither painted nor architectonic.
The desire to be in the picture, in both the metaphorical and nonmetaphorical sense, did not disappear with the panorama but lived on in the twentieth century. In this chapter, I shall follow the ways in which 360° images continued and entered developing new media and art trends. Further, I shall look at how visions or utopias, that is, the desire to produce art, interweave with actual attempts to realize new media for illusions.

In connection with its commission on the panorama, in 1800 the Institut de France suggested developing a smaller-scale apparatus, which would also create a panorama-type illusion and shut out distractions of the environment. The stereoscope, invented in 1838 by Charles Wheatstone and improved in 1843 by David Brewster, was an apparatus that fulfilled these criteria. It utilizes our physiological ability to perceive depth of field: Two eyeglasses arranged as far apart as the eyes, the binocular parallax, allow the combination of two images taken from viewpoints a small distance apart. The stereoscopic view results from a system of mirrors and gives the observer an impression of space and depth. In 1862, Oliver W. Holmes and Joseph Bates began to market an inexpensive model of the stereoscope, and by 1870, it had become a standard piece of furniture in middle class homes. Modernized versions were available well into the twentieth century (fig. 4.1).

**Monet’s Water Lilies Panorama in Giverny**

It is perhaps surprising that modern painters intent on abstraction should have utilized image spaces encircling the observer to reduce the distance between image and observer. Claude Monet, for example, spent decades searching for ways to fuse the observer and the image. The triptychs, Iris, Saule pleureur, Agapanthus, and Nuages, painted between 1915 and 1917 and each measuring 12.75 m by 2 m, created “the illusion of a single continuous canvas”: a complete panoramic view of Monet’s water lily lake (fig. 4.2). To begin with, Monet planned Nymphéas as a proper panorama for a garden rotunda lit only by daylight from the glass roof. However, its first public exhibition in 1927 was as eight series of images displayed in two rooms of an orangery at Giverny, the Musée Claude Monet. Although this mode of display also aroused associations in contemporary visitors of being “submerged” in a lake, Monet’s original concept intended to avail itself of the far more effective illusion medium of the panorama. Monet’s water lilies, floating on the wind-ruffled water that reflects the changing
colors of the sky, have lost almost all distinct contours. The artist’s intention was to locate observers within the watery scene, not “submerging” them in water, but immersing them in an image space with an indeterminate perspective: floating above the water’s surface, without distance, confronted on all sides by the 360° images.

By 1904, Monet had already removed the banks of the lake, the imaginary viewpoint of external observers on terra firma, thus bringing the pond’s surface closer. The fragmentary depiction fills the paintings entirely. Monet, who used to sit only 15 to 20cm away from the canvas when painting, succeeds in transferring his own view to the observers. He forces them out of a secure inner distance, blurs the perspective, forms, and colors of the homogeneous images, obscures the familiar view of near and far, and encourages them to glide into the exclusiveness of a water landscape. The synthesis of natural environment and mental impression puts the
observer in a bird's-eye view position that overcomes the laws of gravity in the image space; in a certain sense, it is disembodiment. The linking of a nondistanced impressionist interpretation of a natural scene with the mechanisms of suggestion found in the image apparatus of the panorama suited the artist's intentions perfectly. Thus, one year after Monet's death and fifty years after his Impression, soleil levant, a late example of modern art reached the changed artistic landscape of the late 1920s, transported in a derivative of the mass medium for images of the nineteenth century.

Prampolini's Futurist Polydimensional Scenospace
In an entirely different social and aesthetic context, Enrico Prampolini (1894–1956), probably the most prominent member of the second generation of Futurists,\(^7\) was also fascinated by the idea of using all available technical means to remove the boundary between observer and image space. In his manifesto on Futurist scenography (1915), the twenty-year-old Prampolini called for the immediate and radical removal of all static, painted scenery and its replacement by dynamic electromechanical scenic architecture of luminous plastic elements in motion. Prampolini was not interested in replicating natural elements of the world; he wished to dynamize the dramatic action on the stage, convinced that this would lead
to corresponding effects on the minds of the audience. The actors, whose performance he assumed would be much more intense on such a dynamized stage, he later rejected entirely. It is interesting that Prampolini applies the fantasies of fusing different elements into one, typical of the Futurists, to the theater stage. Contemporaneously, Filippo Tommaso Marinetti was extending his theory to include cinema. In his Futurist Cinema Manifesto of 1916, Marinetti declares cinema to be the most dynamic of all human media of expression because of its ability to compound traditional forms of art and media. Futurist cinema will demolish the limitations and structures of literature through its images, through a realm of images augmented by appeals to the other senses deriving from other art forms.

Prampolini continued to work on his new concept for the theater, and in 1924, he proclaimed the polydimensional Futurist stage. The traditional, box-shaped horizontal stage, seen from one direction only and with a clearly delineated area for the audience’s attention, was to give way to “spherical expansion.” The stage would contain “new vertical, oblique, and polydimensional elements” that are set in motion electromechanically. These would enlarge the perspectival view of the horizontal, which, in concert with the light elements, would move “in simultaneous penetration toward a centrifugal irradiation of infinite visual and emotional angles of scenic action.” The distanced overview does not feature in this concept: Prampolini’s goal is a paradoxical amalgam of a synthetic and dynamic image space, which creates a sharp contrast between strict contraction and absolute expansion in order to communicate spiritual moments of eternity.

Prampolini was not the only one thinking in this direction. Although following different artistic and political goals, a short time later Bauhaus artists were also directing considerable efforts toward the union of stage and audience. The sociopolitical perspective is a different one, but notions of a totality are also found in the theories of László Moholy-Nagy, in Theater der Totalität, and in Walter Gropius’s Totaltheater (1927), written for Erwin Piscator. In his essay, “Theater, Zirkus, Varieté,” Moholy-Nagy wrote: “It is high time to develop activities, which will not allow the masses to remain mute spectators, which will not only move them inwardly but seize them, make them participate, and in the highest transports of ecstasy, allow them to enter the action on the stage.” He called
for a new type of expanded stage including other media, which would level out the way theatrical space is organized, and the introduction of a system of separate, moveable surfaces fastened to a wire frame. Moholy-Nagy reinterpreted certain ideas of Richard Wagner's: He reduced the importance of the spoken word and envisioned a synthesis of space, movement, sound, light, composition, and abstract artistic expression, enhanced by technical apparatus.

In 1919, Kurt Schwitters, who inspired the Dadaists, also conjured up visions to eradicate barriers with a multimedia work of art: "I demand Merz theater. I demand the complete mobilization of all artistic forces to create the Gesamtkunstwerk. I demand the principle of equal rights for all materials, equal rights for able-bodied people, idiots, whistling wire netting, and thought-pumps. I demand inclusion of all materials, from double-track welders to three-quarter size violins. I demand conscientious modernization of technology until complete implementation of molten melting-togetherness. . . . I demand revision of all the world's theaters according to the Merz idea."12

The Futurist conception of a spazio scenico polidimensionale futurista centered on blending observer and mechanodynamic image space. Prampolini was convinced that this would open up "new worlds for theatrical magic and technique."13 The more powerful the suggestive potential of the seemingly living theatrical images became, the more logical it seemed to the Futurists that the actor was a useless element in the action. For since the Renaissance, the actor on the traditional stage of a theater represents a relative viewpoint, the spectator's opposite number, and this endangers the immediacy of the new images and their efficacy. Prampolini's position on the actor is much more radical than, for example, Gordon Craig's of a few years earlier; he even regards actors as "dangerous for the future of theater"14 because of their unpredictability and ability to interpret: "I consider the intervention of the actor in the theater, the element of interpretation, to be one of the most absurd compromises for art in the theater."15 Without going into detail here, it does seem remarkable that the core motivation of Prampolini's ideas for the theater is religious and spiritual; every spectacle was, for him, a mechanical rite of the eternal transcendence of matter, a magical revelation of a spiritual and scientific mystery.16 Prampolini saw the theater as "a panoramic synthesis of action, a perfectly mystical rite of spiritual dynamism. A period of time for
the spiritual abstraction of the new, future religion," and he translated Futurism's well-known visions of merging humans with machines into a state of permanent dynamism on stage. He wanted to amalgamate this image, now mechanized and "totalized," with the spectator. Without actors, it would be possible to revolutionize the spectators' perception and direct their thoughts toward a spiritual state, which would prepare the ground for a new religion. To this end, Futurist scenospace theater creates a virtual and dynamic sphere from which the spectator cannot escape.

**Film: Visions of Extending the Cinema Screen and Beyond**

It is now more than seventy years ago that Rudolf Arnheim set out to classify film as art, armed with an entire catalog of aesthetic concepts. After the intense debate on cinema and writings by Walter Benjamin, Erwin Panofsky, and others published shortly afterward, this appeared to mark a pause for reflection and thoughtful review after the turbulent early days of this young medium, which had been largely spectacular. From the limiting frame of the screen, the absence of the space-time continuum, movement of the camera, to slow motion and and many other parameters besides, Arnheim (who studied art history in Berlin) fans out his aesthetic vocabulary of film. Although the artistically creative subject is threatened with near-liquidation by the complexity of organizing the machinery of film production, Arnheim interprets the medium as being free for artistic utilization. In his view, the time was past when film was under the influence of its precursor media—diorama, panorama, pleorana, mareorana, and so on—which meant first and foremost illusion and immersion. Arnheim emphasizes the difference between filmic reality and human perception primarily in order to better analyze the directors' possibilities for artistic intervention, yet the career of cinema as an image medium began because it appeared capable of fulfilling the unkept promises of its suggestive precursors, whose effects and affects no longer had the power to captivate the urban mass audiences. The consciously reflected universe of images was penetrated by the visuality and particular nature of the film and first scientific studies presented their findings. Just as today the dynamic images produced with the aid of high-performance computers are regarded as a turning point in the evolution of images and a challenge to theorists, at that time film was perceived as a dramatic and decisive event. To approach a fuller understanding, however, is possible only through
the relativization of a historical appraisal. Arnheim was fully aware of this, when, nearly a centenarian, he stated: “In pondering the future we are tempted to limit our attention to the curiosity about the inventions and discoveries awaiting us. This, however, would be narrow-minded. What is needed is a wider view encompassing the coming rewards in the context of the treasures left us by past experiences, possessions, and insights.”

Many and diverse were the ways in which the film became the successor to the mass medium for images that was the panorama. Much less well known are the developments that culminated in this new medium. In 1894, the stereopticon was presented to the public, an apparatus that used sixteen slide projectors working in rapid succession to project circular pictures (fig. 4.3). For a short time, the panorama united with the new technology of cinematography in Cinéorama (fig. 4.4). First presented at the 1900 World Exhibition in Paris, it was a hybrid medium: Ten 70mm films were projected simultaneously to form a connected 360° image. In fact, the walls of older panorama rotundas were often whitewashed and used as presentation spaces for the new cinematic version.
The history of the World Exhibitions has not yet been written, but these mammoth trade fairs are closely linked with the development of new media of illusion. Even a cursory glance reveals their concerted attempts to provide the millions of visitors with images that conjured up visions of the future. In this respect, Paris 1900, with the giant panorama, *Le Tour du Monde*, dioramas of colonies, panoramas of Madagascar and the Congo, Cinéorama, and mareoramas, was no different than the New York World Exhibition in 1939. Under the motto “Building the world of tomorrow,” new designs for urban development were on show as large walk-in models; inside the exhibition symbol, a sphere measuring 60 m in diameter, visitors could enter a cityscape entitled “Democracy.” However, the real expression of the American vision was created by Norman Bel Geddes and sponsored by Chrysler: the Futurama. It depicted a journey through an automobile-friendly city of 1960, thus offering a simple direction for consumer optimism after the recent Great Depression (figs. 4.5 and 4.6). Thousands of model cars flowed along a freeway—later, the stereotyped image of urbanity par excellence—past high-rise buildings stretching as far as the eye could see and occupying the horizon. The visitors sat in

darkened cabins, arranged in a circle and hanging several meters above this model world. At the World Exhibition in Osaka of 1970, which attracted a record number of visitors, the Pepsi Cola pavilion presented a playful artificial sphere that addressed the senses with dry ice, interactive laser effects, stroboscopes, and music. The result was a confusion of the senses that approached synaesthesia. Colors and sounds mix, shapes have taste, you can describe the color, shape, and flavor of someone's voice or music, the sound of which looks like "shards of glass." A technopoetic composition designed by the legendary group Experiments in Art and Technology (EAT), it revamped the appearance of something now familiar to urban societies around the world: the polysensory environment of the discotheque. The vision of a media society informed the World Exhibition EXPO 2000 in Hanover. Both the pavilions of corporations, such as Bertelsmann's 100 million mark Planet m, and national pavilions, such as Germany's (fig. 4.7), took the visitors to bright worlds full of multimedia images, often accessed by dark tunnels filled with low-pitched sound. In the "longest cinema in the world," Jean Nouvel used dramatic light effects, spatial sound, and powerful emotional and nostalgic images to create an apotheosis of Mobility. The long, dark passageways between the incalculably moving images also produced a feeling of immersion, not so much in an explicit image space but rather a lasting feeling of
Figure 4.6 Futurama, World Fair New York 1939. Interior, worker with model of a building from the Vision of a City, 1960. By kind permission of Herbert Rolles.

Figure 4.7 Expo Hannover 2000. Themepark: Mobilität; architect: Jean Nouvel.
suggestion image spaces. The scenography adhered closely to the concepts of EXPO 2000's management. In a theoretical article on scenography published before the Hanover exhibition opened, Martin Roth, director of the theme park, stated that in Hanover, the content of the visualizations is characterized by a relationship of competition to their modeling by new projection techniques. Referring to Buckminster Fuller, Disney, and El Lissitzky, among others, he wrote: "It is within this tension that the true dynamic and dramaturgical momentum of the exhibition is realized."30

The architectonic designs of the pavilions' interiors, where materiality, complexity, and expression are barely recognizable, retreat behind the surfaces used for projecting worlds of images. The visitors find themselves in dark caves, which—like IMAX cinemas or virtual art installations—transport meaning only through moving pictures. The architectonic structure is merely a vehicle for the images, and this allowed variability in what could be shown. Each World Exhibition has introduced new image experiences to the public using the most advanced media technology of the day. Their aim is to create a credible and irresistible vision of the future, and this can be achieved most readily by employing large format images that enclose the visitor.

Today, contemporary accounts of first film shows by those pioneers of cinematography, August and Louis Lumière, read like a blend of legends, anecdotes, and sensational journalism. *Arrivée d'un train en gare le ciotat* (1897) was, as R. M. Hayes has pointed out,31 actually the first 3-D film to be screened in public, although it is unlikely that the optical aids really did enable the images to be seen in three dimensions. Like the panorama before it, film began by replicating what could actually be experienced to establish its potential as a medium. The audience reacted to the approaching train in this film, its "brutal reality,"32 with screams of panic, by running away, and, according to many contemporary sources, by fainting.33 These reactions resulted from the fact that for the first time, the camera lens angle and the observer's eyepoint corresponded. James Gibson has described this effect and its influence on film in his outline of an ecological theory of perception.34

The immersion experienced by early cinemagoers is described by Siegfried Zielinski: a "darkened room, where the spectators, like Plato's cave-dwellers, are virtually held captive between the screen and the projection room, chained to their cinema seats, positioned between the large-size
rectangle on which the fleeting illusions of motion appear and the devices that produce the images of darkness and light. Cinema as an environment for the enjoyment of art, for immersion in traumatic experiences, for hallucination, for irritation of real experience; and, what is more, with films constructed in deliberate opposition to the experiences of those who pay to enter the dark womb and be at the mercy of the play of light and sounds.”

Early cinemagoers' reactions to silent black and white films tax our imagination and seem explicable only in terms of the novelty of the medium of illusion and its then unknown potential for transitory suggestive effects. Film greatly affected an audience whose perception was unprepared and not habituated to processing moving, simulated images. However, this effect must be regarded as relative in view of the similar drastic reactions of the public to the first panoramas and the long historic chain of innovations in illusionist image production. At first, the audience is overwhelmed by the new and unaccustomed visual experiences, and for a short period, their inner psychological ability to distance themselves is suspended. This contention needs to be tested by comparative research on immersion, which as yet is only just beginning. The connection between innovations in technologically produced illusions and putting the inner ability to distance oneself under pressure, may, for a period of time (the length of which is dependent on the illusion potential of the given new medium) render conscious illusion unconscious and confer the effect of something real on that which is merely appearance. When a new medium of illusion is introduced, it opens a gap between the power of the image's effect and conscious/reflected distancing in the observer. This gap narrows again with increasing exposure and there is a reversion to conscious appraisal. Habituation chips away at the illusion, and soon it no longer has the power to captivate. It becomes stale, and the audience are hardened to its attempts at illusion. At this stage, the observers are receptive to content and artistic media competence, until finally a new medium with even greater appeal to the senses and greater suggestive power comes along and casts a spell of illusion over the audience again. This process, where media of illusion and the ability to distance oneself from them compete, has been played out time and again in the history of European art since the end of the Middle Ages.
Film, or cinema, is such a heterogeneous media complex that it resists being subsumed under a general definition. Here, I shall follow the Russian director Andrey Tarkovsky’s characterization of film as “emotional reality,” which allows the viewers to experience a “second reality.” Cinema is intended for direct sense and emotional perception, and this inevitably gives the director “power” over the feelings of the audience, even leading some filmmakers into the aberrant self-deception of being a demiurge. For Tarkovsky, these highly sensitive and suggestive components of film that, for a period of time, allow the audience to believe in an artificial reality created by technology, impose a heavy responsibility on the director. This perspective, Tarkovsky’s iconic understanding of film, allows us to interpret and comprehend the recurrent forays attesting to film’s polysensory aims. Their basic trend is toward extending the system of illusion beyond the visual to include the other senses. Essentially a reproductive and psychological art form, the medium of film has seen many attempts in the last century to advance beyond two-dimensional screen projection in order to intensify its suggestive effect on the audience.

Teleview (1921) introduced the 3-D film to the United States. Colorful light projections, viewed with two-color glasses, created impressions of space and depth. Like the panorama, the subjects of these films were distant and, for the average urban American, exotic places: a Hopi camp in Arizona, scenes from the Canadian Rockies, or a main feature entitled M.A.R.S. Abel Gance also planned to include 3-D sequences in his epochal film Napoléon (1926–1927). However, at private previews, the 3-D scenes were felt to be too overwhelming, even more powerful than the panoramic effect of three simultaneous screen projections. Gance decided to remove the 3-D sequences in order not to risk compromising the effect of the rest of the film, which was in 2-D. Zeiss-Ikon put their 3-D color Raumfilm system on the U.S. market at the end of the 1930s, but, apart from a few short films, it was hardly used during World War II. For the cinema newsreel Wochenschau in Germany and the lavish color productions of the German UFA film company, the standard format in the latter war years remained 2-D.

Sergei M. Eisenstein was one of the visionaries of new media of the art of illusion (fig. 4.8). In the late 1940s, he described a symbiosis of art and utopian technology. An influential Soviet film director and theorist, he interpreted the history of art as an evolutionary process inseparable from
the development of technology. From the perspective of the 1940s, Eisenstein considered film the most advanced developmental stage of art. In his essay "O Sterokino" (1947), he stressed the long continuity in the dialectical relationship of art, science, and technology.\textsuperscript{43} The ultimate synthesis of all art genres would culminate the imminent realization of Sterokino, stereoscopic cinema,\textsuperscript{44} which Eisenstein believed humankind had been moving toward for centuries and represented a further expression of a deeply human urge to create images.\textsuperscript{45} Then, the image, experienced as "real threedimensionality" (Eisenstein offered no technical details about stereoscopic cinema) would "pour" from the screen into the auditorium.\textsuperscript{46} Further, stereo sound would be "absolutely essential."\textsuperscript{47} This would enable the director to "capture" the audience and the audience to "immerse themselves completely in the powerful sound."\textsuperscript{48} Sterokino would have the power "for the first time ever, to 'involve' the audience intensely in what was once the screen and to 'engulf' the spectator in a manner no less real and devastating with what was formerly spread across the screen."\textsuperscript{49} Eisenstein is not sketching a blueprint of virtual reality here, in the sense
of panoramic images; his reflections revolve around rendering images so powerful, with plasticity and movement, that they can tear the audience psychologically out of their actual surroundings and deliver them into the environment of the stereoscopic film. His use of language, such as "immerse," "engulf," "capture," and so on, is a clear indication of what lies at the heart of this idea: the expectation of soon having a medium at his disposal that, at an advanced technological level, would have the capability to amalgamate image and spectator psychologically. These film images would have a suggestive power with hitherto unknown potential and effects: "That which we were accustomed to see as an image on a screen will suddenly 'swallow' us in the distance that opens up behind the screen, which has never been seen before, or 'get into' us through a 'tracking shot,' which has never been realized before with such expressive power."50

Obviously, Eisenstein is not looking to facilitate inner distance in the spectator or to construct an arena of manageable, controlled reception and subjectivity. He saw Sterokino as a tool for "getting into" the audience and "sucking them into" the images.51 The essay "About Stereoscopic Cinema" documents Eisenstein's will to take possession of this future high-tech medium of illusion as an instrument for exercising a great deal of control over the emotions of the audience. He seeks to infuse the inevitable development and phenomenology of this medium of illusion from art history and anthropology:52 Sterokino is rooted in the ritual union of actors and audience, an archaic urge to reconcile "show and mass audience" to form "an organic whole."53 Eisenstein saw this new image machinery as the goal of a teleological development and justified his intention to utilize it with arguments invoking art history and anthropology. It goes without saying that he desired to further the aims of Socialism in this way.54 Yet his formulation of the intent to control audience emotions and his supporting arguments did not proceed from any Communist party directives. These visions and arguments are the product of an analytical thinker and went far beyond what the Party expected of filmmakers. Irrespective of how one judges the politics, they are a true reflection of Eisenstein's personal endeavors as a politically thinking artist and aesthetician.

Of the many projects to expand the Silver Screen in the United States during this period, Fred Waller's Cinerama, with its 180° screen (fig. 4.9), occupies a salient position. Compared with the idea of 360° images and the short-lived attempts at projecting circular images at the turn of the
Figure 4.9 The Cinerama. Courtesy of the private collection of John Mills.
century, Cinerama represented a step backward; however, it was commercially successful. In company with several other large-scale image projection apparatus, Cinerama originated from an attraction exhibited at the 1939 World Exhibition: the Vitarama, a product of Waller’s experiments in the late 1930s for the U.S. air force to improve their flight simulators. At the height of its popularity in the early 1960s, Cinerama films were screened in their own specially equipped cinemas of which there were about one hundred around the world. The films were shot with three cameras and presented with stereophonic sound. Cinerama occupies a paradigmatic place within successful 3-D entertainment cinema of the 1950s and 1960s.55

In the same period, Morton L. Heilig developed a far more radical vision of the immersion idea: the Cinema of the Future, offering illusionary experiences to all of the senses, including those of taste, smell, and touch.56 The screen would not only fill 18 percent of the spectator’s visual field, like CinemaScope in 1954, or 25 percent, like Cinerama; Heilig’s declared aim was 100 percent: “The screen will curve past the spectator’s ears on both sides and beyond his sphere of vision above and below.”57 The Cinema of the Future would, Heilig felt, even outdo the “Feelies” envisioned by Aldous Huxley in Brave New World and represent an image medium with a unknown suggestive potential: “it will be a great new power, surpassing conventional art forms like a Rocket Ship outspeeds the horse and whose ability to destroy or build men’s souls will depend purely on the people behind it.”58 In Heilig’s opinion, an artist’s powers of expression would benefit considerably through knowledge of the human sensory apparatus and perception—a simple idea, yet remarkable for the period. Along with so many other projects, the Cinema of the Future was destined to remain a futuristic vision. However, its motivation and orientation continued to drive aspirations in the realm of technical development, though tempered by the fact that these are always subject to economic viability and prevailing political interests.

Heilig’s pioneering research focused exclusively on immersive image apparatus for the rapidly expanding medium of his day: television. In 1960, he patented the “Stereoscopic televison apparatus for individual use” (fig. 4.10). This consisted of stereo glasses with two miniature TV screens that produced 3-D images and combined the principles of the stereoscope with the technology of television.59 Only two years later, he developed
the Sensorama Simulator (fig. 4.11), which soon made its way into the entertainment sector. In addition to 3-D CinemaScope images and stereophonic sound, the audience in the Sensorama were subjected to vibrations and smells simulated by chemicals. The Sensorama was not interactive, but it did succeed in addressing four of our five senses: sitting on an imaginary motorcycle, the spectator saw the streets of, for example, Manhattan whiz past, heard the noise of traffic and the streets, smelled petrol fumes and pizza from snackbars, and felt the vibrations from the road. In this case, the objective of polysensory experience of images is clear. In the 1960s, the Sensorama was found mainly in amusement parks in California but hardly anywhere else.

Besides 3-D cinema, a constant phenomenon but one that never exerted a determining influence on mainstream film production, many other attempts were launched to enhance cinema with tactile elements or smells. Films such as Earthquake (Robson 1974) and The Tingler (Castle 1959) included haptic sensations: The audience sat in special seats that shook. Polyester (Waters 1981) included smells: With the entrance ticket came a card strip which the cinemagoer rubbed during the appropriate film sequences releasing corresponding smells.
Parallel to these developments in filmic art, popular and spectacular versions of virtual spaces existed as amusement park and fairground attractions in the 1970s and 1980s, particularly in the form of small immersive circular cinemas. At regular intervals, new concepts were advanced, and some even realized, of how to enhance immersive experiences in the cinema, for example, Omnimax cinema's spherical projection (fig. 4.12). James Gibson has defined these endeavors in terms of the urge to extend the view by banishing all forms of frame from the field of vision:

Intermedia Stages of Virtual Reality in the Twentieth Century
"With a Cinema screen, the virtual window may sample as much as 160° of the ambient array, instead of the mere 20° or 30° of the usual movie theatre, and the illusion of locomotion may then be compelling, uncomfortably so."\(^{65}\) From the point of view of illusion, IMAX (Image Maximalization), introduced in the 1990s, represents the state of the art. This U.S. company has installed over 150 of their spectacular cinemas in more than 20 countries. With curved screens of up to 1000m\(^2\), spectators are literally in the images. For 3-D IMAX films, the audience wears special glasses with lenses that are opened and closed in rapid succession by high frequency infrared light. Each eye sees the images of the two film projectors separately and the brain combines the slightly different images into one, producing an impressive effect of spatial depth. Commercially, the IMAX cinemas are highly successful;\(^{66}\) thematically, the films' subjects follow a pattern prefigured by the panorama: IMAX takes the spectators to inaccessible, far-off foreign places. Today, this means the depths of the oceans, the wreck of the Titanic, the summit of Mount Everest, or outer
space. The distant places that beckon us now have shifted to the most extreme zones the planet has to offer. Frequently, IMAX films show spectacular locations, such as the Grand Canyon in the United States, which are of such vast dimensions that the human eye cannot take them in at a glance. With edited sequences of takes from inaccessible angles, IMAX expands natural spectacles, and it is to this effect that it owes its millions of visitors.

**Highways and Byways to Virtual Reality: The “Ultimate” Union with the Computer in the Image**

Ever since the early days of the computer during World War II, there have been attempts to connect, synchronize, or analogize this universal machine with human beings. One of the first to see computers in relation to humans was Vannevar Bush, adviser to Franklin D. Roosevelt and, in his capacity as director of the Office of Scientific Research, decisively involved in the development of the atom bomb. In a classic, highly influential article written in 1945, “As We May Think” for *Atlantic Monthly*, he referred to the computer as a “mind machine.” Further, he discussed ideas for the collection, storage, and accessibility of information in a world based increasingly on efficient data processing. Norbert Wiener followed suit in 1948, and Alan Turing in 1950. They both saw analogies between the work processes of humans and computers and thus laid the foundations for later theories of robotics, cybernetics, and research on artificial intelligence. Wiener defined cybernetics as the science of conveying messages between humans and machines. This remarkable conceptualization derived from an idea that later formed the basis of all concepts of interaction and interface design: communication between humans as the model for communication with or between machines. In 1960, when the successful launch of Sputnik into space had also sent shock-wave visions of similar technology in conjunction with nuclear devices through the military establishment, J. C. R. Licklider, who worked on computer networks in defence, sketched a vision of symbiosis between humans and computers. Licklider was interested in simplifying exchange of information between human beings and computers, which would make it possible to give orders and pass them on quickly in wartime, for as he said laconically, “Who can direct a battle when he’s got to write the program in the middle of the battle?” As director of the U.S. Defense Department’s
large to their sensationalist credo. Serious business journals were not left untouched by these technological flights of fantasy. An unprecedented investment fever swept the Stock Exchange, and billions of dollars gave a new direction to the worldwide economy. When Jaron Lanier coined the term “virtual reality” in 1989, this was also an attempt to package heterogeneous areas of research on the human–computer interface with different labels together with utopian dreams in one, albeit paradoxical, buzz word with a strong appeal to the public imagination. Terminological fuzziness widens the scope of the imagination and feeds dynamics of development. Rhetoric of this kind often heralds utopian imaginings that are located in a spatiotemporal distance with an appointed redeemer. The hopes placed in a future, as yet nonexistent, technology indicate the presence of religious motifs. Strikingly, expectations are not placed in anything human or divine but in an artificially created apparatus, an artifact. In the mid-1990s, certain Republican intellectuals in the United States discovered cyberspace as a place for projecting the old “westward ho” ideology, which led not only to the conquest of the Wild West but also the genocide of native Americans. They proclaimed that America’s future would lie in the networks.

Virtual Reality in Its Military and Industrial Context

The new alliance of art and technology embodied by virtual reality and its image culture cannot be considered as an isolated phenomenon; it is an integral part of revolutionary developments in the economy and military technology. According to the German ministry of economic affairs (Bundesministerium für Wirtschaft), contemporary developments in new information and communications technology are radically changing both the economic and technological spheres to a degree “that is comparable with the transition from the agrarian- to the industrial-based society, with all accompanying changes.” The computer is transforming entire sectors of the economy, production, planning, administration, military operations, and leisure time: Virtually all areas of life are changing rapidly. The degree to which society is dependent on functioning telematic networks and information infrastructures is also increasing rapidly, for which the near-panic concerning the year 2000, or “Y2K,” serves as an impressive demonstration. The diversity and speed of communication now possible is influencing the education system, speeding up and expanding the production
of information, and transforming the structures of knowledge. The welfare state and legislature strive to keep up with developments. In brief, in the space of relatively few years, the computer has engineered massive transformations, and the pace is accelerating, rather than slowing down.

For decades now, the price of graphics hardware has reduced annually by a factor of 4, while performance increases 20 to 100-fold. For example, a supercomputer today can process one thousand million instructions per second (1000 MIPS). If a human were to read just one instruction per second, he or she would take 32 years, without sleeping or resting, for the same amount of data. The popular formula expressing this development is Moore’s Law; in 1965, Gordon Moore predicted that the number of transistors per integrated circuit would double every 18 months (fig. 4.13). If this exponential rule still holds, then it will only be a matter of years before the computing power is available to realize high-definition spaces of illusion.

At the beginning of the new millennium, it appears that the computer will amalgamate with telecommunication in a new synthesis, a hyper-medium. As soon as the Internet is able to handle greater quantities of data, image spaces will be available in a quality that is currently achieved only in expensive installations, stand-alone systems, at festivals or media
museums, which are, on their own admission, future models for the Internet. The majority of exhibitions of interactive art use systems of this kind. However, a precondition for telepresent access to virtual reality applications via the networks is new cables, for example, glass fiber, worldwide. Further, new tools for data compression and standards for bandwidth are needed, as both are important for speed of data transmission and image quality. Currently, telecommunications companies are investing large sums of money to achieve these goals. To put networks in place that will enable high-speed exchange of data on wide bandwidths, companies in the United States, Japan, and Europe have already committed themselves to investments of several hundred billion U.S. dollars.

This close-knit fabric of economic and technological interests, sensation-seeking, and escapism has all but banished the military origins of this
technology from public consciousness. To cite but two examples: In the 1980s, the McDonnell Douglas Corporation developed an HMD, which enabled pilots to double their quota of “kills.” 121 The U.S. airforce has used flight simulators for years in pilot training, and even back in 1991, these were capable of such realism that the pilots’ adrenalin levels were higher in the simulators than when flying real missions during the Gulf War (fig. 4.14).122 In addition to this staple application in military aviation, simulation models were also developed for the navy and the army by Bold Beranek and Newman Inc., largely supported by funds from the defense budget: The SIMNET network allows U.S. forces to simulate battles in which over 1000 tanks are deployed. Before combat in the Gulf War and the intervention in Somalia, the armed forces practiced simulated maneuvers. A similar network was installed for the U.S. air force, the Aircrew Combat Mission Enhancement Network (ACME). The German Bundeswehr uses the AGPT system, which provides simulations after the manner of SIMNET but with better quality graphics. Installed in mobile containers, it can be transported to anywhere in the world.123 The U.S. army works with virtual reality environments for tens of thousands of participants with simulations that are highly realistic.124 In addition to
investments by the military complex and the space industry, in the early 1990s, particularly the electronics and information sectors of civil industry invested heavily. Of particular interest were applications for developing prototypes faster, simulating industrial production processes, constructing walk-in simulations of the built environment from the past, present, and future (fig. 4.15), visualizing scientific research results, and simulation-aided research. Many commercial companies have their own virtual reality research departments that are tailored to their specific requirements. This does not only include telecommunications and software firms or the giants of the entertainment industry, such as Disney, Nintendo, and AOL Time Warner, but also traditional industries, such as automobile manufacturers and civil aviation. Medicine uses the new technological applications in a wide variety of fields. Further, hitherto inaccessible sections of the market are being opened up, not only in remote regions, by the introduction of e-commerce. Producers and consumers are brought together on a global scale, with all the positive and negative effects for disparate economies that ensue from these encounters. The entertainment sector was the first to develop marketable virtual reality applications. Almost without exception, the leading finance and economics journals have published reports on virtual reality technology; the general drift being that there is hardly an area where this polysensory medium cannot be utilized. R&D of virtual computer worlds has become a globe-spanning project, and a list of the institutes, companies, and organizations involved would fill an entire chapter of this book. Therefore, I shall present a few examples of leading institutes where artists are involved in research, have developed new forms of interaction and interface designs for virtual spaces and telepresence models, and are working on the future of the Internet: a network that will allow access to immersive spaces of illusion.

Art and Media Evolution I

In the mid-1980s, artists of interactive works, such as Jeffrey Shaw, Lynn Hershman, Grahame Weinbren, and Myron Krueger, worked for the most part alone. By comparison, virtual art developed at first in a few research institutions that were equipped with the necessary, very expensive technology. Thirty years after C. P. Snow introduced the idea of two cultures, the distinct contours of the boundaries between technology and
art began to break down. Today, a global network of artists work in privileged research institutes on the development of virtual realities.

In the early 1990s, when lower-cost high-performance computers came on the market, it became possible to depict naturalistic three-dimensional bodies with up to 500,000 polygons. Silicon Graphics Workstations introduced the possibility of real-time operations, which also allowed interactive simulations. Installations were created that not only put the observer more intensely in the image but, through elaborate interactions, involved the observers in the actual creation of the work itself. Artists working at well-equipped research institutes, such as Monika Fleischmann and Wolfgang Strauss, Christa Sommerer and Laurent Mignonneau, Charlotte Davies, Ulrike Gabriel, Agnes Hegedues, Knowbotic Research, Peter Weibel, Paul Garrin, Christian Möller, Edmond Couchot, Jean-Louis Boissier, and Toshio Iwai, achieved international recognition.

As early as 1991, the Banff Center for the Arts in Canada decided to let artists develop and open up virtual reality technology actively. The result was a program, scheduled for two years, for realizing sections of artistic projects. From 1991 to 1994, virtual installations, such as The Placeholder by Brenda Laurel und Rachel Strickland, Inherent Rights by Paul Yuxweluptun, and Archaeology of the Mother Tongue by Toni Dove and Michael MacKenzie, were among the artworks created within this framework.

One of the most important research institutions for virtual reality is Carnegie Mellon University's SIMLAB. Under the directorship of the late Carl Eugene Loeffler, virtual environments were developed that could be experienced simultaneously by several users, for example, via telepresence, "inhabited" by artificial agents, and controlled by A-Life programs. Loeffler enriched technology with artistic concepts as, for example, in the installation Virtual Ancient Egypt. In collaboration with the Egyptologist Lynn Holden and the Center for Creative Inquiry team of Carnegie Mellon University, Loeffler created the simulation of an ancient temple, the installation Virtual Ancient Egypt: Temple of Horus. According to Holden, this was the first module of a large-scale project, Virtual World of Antiquity. Using the latest photographs of the excavations, they reconstructed the 60-foot-high walls and pillars of the Temple of Horus, including the many chambers. By clicking on certain points on the walls, the user could activate animations and in the innermost shrine a statue revealed the chamber's secrets to background music of Egyptian chants.
In 1967, Gyorgy Kepes, a friend of Laszlo Moholy-Nagy, founded the Center for Advanced Visual Studies (CAVS) at MIT, which aimed at high-level cooperation between art and technology. Having worked at the New Bauhaus, Kepes was firmly committed to interdisciplinarity. This is also reflected in his six-volume work *Vision and Value*, where he outlines an attempt to overcome the specialization of the modern age through integration and synthesis of art and technology. Kepes's intention was to develop a language of vision. To this end, he included findings from biology, experimental psychology, anthropology, communication theory, linguistics, engineering, and relational mathematics. However, the technology-centered Architecture Machine Group at MIT soon eclipsed the CAVS model, both in standing and securing research grants.¹³⁶

Internationally, the University of Geneva's MIRALab, directed by Nadia Magnenat-Thalmann, holds a top position in the field of 3-D animation. This applies particularly to applications such as the simulation of naturalistic body movements in realtime, facial expressions, and the highly complicated animation of materials and objects.¹³⁷ Present research focuses on constructing virtual environments populated by avatars, which can be accessed from distant locations via high-performance networks.

In 1986, the Japanese telecommunications corporation NTT and the Japanese government in Kyoto founded together the Advanced Technology Research Institute (ATR) for the purpose of developing virtual reality technology for telecommunication.¹³⁸ In the institute’s artist in residence program, Christa Sommerer and Laurent Mignonneau work on the design of new interfaces and innovative forms of interaction. Programmatically, the president of the ATR laboratory, Ryohei Nakatsu, stresses that the cooperation of art and technology is focused on developing highly complex methods of communication, including sensitive, nonverbal interaction. In his address at the opening of the ATR-Science-ATR Congress in May 1996 in Kyoto, Nakatsu stated that “It is indispensable to study the mechanism of interaction and to develop technologies that can realize highly human-like communication by integrating communication and interaction technologies as well as interactive arts.”¹³⁹

When they applied virtual reality technology to architecture and urban planning, the Berlin association ART+COM, founded in 1988, broke new ground.¹⁴⁰ In addition to interactive installations, such as *Zerceber* (1991) by Joachim Sauter and Dirk Lüsebrink,¹⁴¹ the same year saw Monika
Fleischmann and Wolfgang Strauss' first virtual reality work, *The Home of the Brain*. In Germany, virtual reality research is concentrated mainly in the Fraunhofer Institutes in Stuttgart (PhG-IGD, IAO), the Zentrum für Graphische Datenverarbeitung (ZGDV) in Darmstadt, German Aerospace in Oberpfaffenhofen (primarily telerobotics research), and the Fraunhofer Institut in Sankt Augustin near Bonn. Fleischmann, who works closely with Strauss, became artistic director of the GMD's Institut für Medienkommunikation in 1992, where the main research focus is to develop interactive virtual scenarios and innovative interface design for human-machine communication.

Roy Ascott, one of the foremost pioneers of interactive art, founded the Centre for Advanced Research in the Interactive Arts (CAiiA) at the University of Wales in Newport, where he established an international joint research program, CAiiA-STAR, which allows media artists to gain a Ph.D. A significant number of internationally important media artists participate in this program, artists who normally work in high-tech institutes on the development of new interfaces, interactive models, and visual strategies and who are playing a decisive role in the design of the high-performance future of the Internet. His position as director of this program, which attracts so many leaders of cutting-edge research in media art, confers on Ascott the role of *spiritus rector*, who gives the younger generation of visualization developers of the new millennium a wealth of new impulses, consolidated further in the series of meetings entitled Consciousness Reframed initiated in 1997 by Ascott.

In addition to the artist in residence programs of the research laboratories, there are the important festivals that have nurtured and promoted interactive art—events such as Ars Electronica, Interactive Media Festival, Siggraph, Imagina, and the Biennales of Kwangju, Lyon, Nagoya, and St. Denis. In Germany, media art has received support since the 1980s. With the foundation of the new Kunsthochschule für Medien (KHM) in Cologne, the Hochschule für Graphik und Buchkunst in Leipzig, the Institut für Neue Medien in Frankfurt, and particularly the Zentrum für Kunst und Medientechnologie (ZKM) in Karlsruhe, Germany, along with Japan, is among the foremost pioneers of media art. Japan's institutions include the InterCommunication Center (ICC) in Tokio and the International Academy of Media Arts and Sciences (IAMAS) in Gifu.
Notes
1. See Wheatstone (1838).


4. Monet worked on this theme for many years, and in 1921, he had over 50 waterlily paintings in his atelier that could be combined in a variety of ways.


7. For the artistic policies of the Futurists, see Falkenhausen (1979).

8. See Prampolini (1924), p. 7: "Questa nuova costruzione teatrale per la sua ubiacazione permette di fare sconfinare e l’angolo visuale prospettico oltre la linea d’orizzonte, spostando questo al vertice e viceversa in simultanea compenetrazione, verso una irradiazione centrifuga di infiniti angoli visuali ed’emotivi dell’azione scenica."

9. Ibid.


11. Ibid., p. 55.


14. Ibid.