15

Virtual Reality: The Search for Immersion

Sunk in their pneumatic stalls, Lenina and the Savage sniffed and listened. . . . "Take hold of the metal knobs on the arm of your chair," whistled Lenina, "otherwise you won't get any of the feely effects."

—ALDOUS HUXLEY, *BRAVE NEW WORLD*, 1932[1]

Can VR replace RL? Only if theater can replace actual life. Only the bumpkin rushes to the stage to rescue the maiden from the villain, but the late twentieth century is apparently filled with willing bumpkins! Like theater, VR developments contain devices that enhance the VR experience and distract from RL contexts."

—DON IHDE[2]

Theater has always been a virtual reality where actors imaginatively conspire with audiences to conjure a belief (otherwise known, after Coleridge, as a "suspension of disbelief") that a bare stage is in fact the courtyard of an ancient Theban palace, or the 1692 witch-trial courtroom in Salem. Pioneering Virtual Reality (VR) theater designer Mark Reaney describes theater as "the original virtual reality machine" where audiences can visit "imaginary worlds which are interactive and immersive,"[3] and VR artist and critic Diane Gromala argues that VR's historical precedents can be traced through "the fantastical worlds elicited through mimetic simulations of ritual, dioramas, art, literature and theater . . . the evocation and perception of a shareable but other worldly place in which humans extend and project their agency."[4]

Oliver Grau's *Virtual Art: From Illusion to Immersion* (2003) presents a detailed genealogy of the origins of VR, exploring the histories of immersive panoramas and illusionary spaces back to antiquity, effectively turning the whole of art history into a media history. For Grau, the computer is simply the latest tool permitting the artist to investigate the manipulation of the image and its relationship to reality:

> In many quarters, virtual reality is viewed as a totally new phenomenon. However, a central argument of this book is that the idea of installing an observer in a hermetically closed-off image space of illusion did not make its first appearance with the technical invention of computer-aided virtual realities. On the contrary, virtual reality forms part of the core of the relationship of humans to images. . . . The idea goes back at least as far as the classical world, and it now reappears in the immersion strategies of present-day virtual art.[5]

VR is an industrial computer graphics format simulating navigable three-dimensional environments and requiring considerable computing horsepower. Although the term has been used increasingly loosely in popular culture to refer to anything digital including even email, stricter definitions stress its highly specialized and particular nature which places it firmly out of reach of most computer applications and simulations. In 1995, Ken Pimentel and Kevin Teixeira called it "the first 21st century tool" whose primary defining characteristic is immersion: "inclusion, being surrounded by an environment. VR places the participant inside information."[6] Others highlight the responsive navigable elements using first-person cinematic point of view, which Daniel Sandin considers to be "the first redefinition of perspective since the Renaissance."[7] R. U. Sirius sees VR as creating an entirely new type of space, an extension of the imagination, articulating it in terms of a "re-virginizing . . . the creation of virgin space."[8] Howard Rheingold, one of its most enthusiastic early advocates and author of one of the first major books on the subject in 1991,[9] usefully summarizes VR's ontology in terms of three interdependent aspects: "One is immersion, being surrounded by a three dimensional world; another one is the ability to walk around in that world, choose your own point of view; and the third axis is manipulation, being able to reach in and manipulate it."[10] He goes on to describe VR as an ultimately theatrical medium, yet recognizes the challenge inherent in transforming a solo and subjective first-person experience into one that approaches Aristotelian understandings of theater. Nevertheless, central tenets of Aristotle's dramatic notions such as mimesis and empathy are intrinsic to VR, and, he suggests, "I think that properly done, a virtual reality experience will have a greater sense of mimesis and of participation in the events."[11]

Critics and academics have added some degree of confusion to the territory by applying the term VR to performances that do not in fact use classic VR technologies—where, for example, environments are fully navigable or use three-dimensional computer graphics. George Coates's digital theater settings, for example, were linked to VR by a number of critics during the early 1990s, although Coates himself was clear and categorical about the distinction between his work and immersive industrial VR applications, in 1995 calling his performances "virtual virtual reality . . . a way of evoking the sense of awe that immersing yourself in virtual reality produces. . . . Someday we'll be handing out VR goggles instead of 3D glasses."[12]

As we will see, the steps toward advanced VR theater and performance have been limited to date, although those relatively few practitioners involved in the field have been neither tentative nor unambitious in their approaches.

A History of VR

Major developments in VR took place in the 1980s, although its origins go back to Ivan Sutherland's 1965 paper "The Ultimate Display" and his development over the next three years of the first Head-Mounted Display (HMD) with student Bob Sproull for the Bell Helicopter Company, using ARPA military funding. Sutherland created the first computer-aided HMD in 1968, with internal sensors that tracked the user's head movements, an event Oliver Grau has subsequently called "the first step on the way to a media utopia."[13] The helmet design incorporated two miniature monitors placed directly in front of the eyes to create binocular 3D vision, and although certain features including the mini-video monitors have changed and been updated over the decades, the basic design remains the same today.[14]

Although most commonly associated with HMD devices that the user wears to eliminate peripheral vision of the real world, VR technologies and applications use a variety of interfaces including projection desks; flat, curved, or semispherical screens; and specialized computer monitors. Its industrial applications include military and flight simulations, medical training programs, engineering prototype designs, and navigable architectural and town planning environments. As Bolter and Gromala point out, "simulators are almost the only commercially successful applications of virtual reality."[15]

The most famous VR industrial pioneer (as well as one of its most noted aesthetic visionaries), Jaron Lanier, founded VPL Research in 1983, created the first commercial dataglove in 1984, and established "a networked virtual world system in 1989."[16] Given his hippie-like, New Age look (complete with dreadlocks) and radical artistic philosophy, Lanier appeared at that time an unlikely scientific boffin and was so distinctly "cool" that he became the first white man to be named "Black Artist of the Month" by *Ebony* magazine.[17] He was also responsible for coining the term "Virtual Reality" to distinguish between wholly immersive digital worlds and traditional computer simulations. VR necessitates absolute inclusion within a 360-degree digital environment, the user metaphorically stepping inside the computer:

> Virtual reality is all about illusion. It's about computer graphics in the theater of the mind. It's about the use of technology to convince yourself you're in another reality. . . . Virtual Reality is where the computer disappears and you become the ghost in the machine. . . . The computer retreats behind the scenes and becomes invisible.[18]

At the University of North Carolina, Frederick Brooks developed advanced VR systems which allowed a sense of touch. His Grope-III project, completed in 1986, used

motorized handgrips and magnets that controlled remote robotic arms. This Argonne Remote Manipulator (ARM) exerted tactile pressures or resistant magnetic forces against the operator's hands in response to the user's attempts to touch and manipulate the virtual materials viewed.[19] Around the same time, Lanier and Thomas Zimmerman developed wired gloves that enabled virtual objects to be grasped and moved around, thus enabling the user's body itself to become part of the virtual world. Though all normal vision is lost wearing a HMD, the dataglove allows the user to hold up her gloved hand in front of her face and see a digital representation through the HMD that moves in perfect synchronization with her own.[20] Pimentel and Teixeira have noted how "seeing the representation of your hand suddenly changes the perspective. You now have a perceptual anchor in the virtual world. You're actually inside the computer because you can see your hand in there"[21] (figure 15.1).

In 1991, Daniel Sandin and Thomas DiFanti developed the CAVE (Cave Automatic Virtual Environment), which takes its name from Plato's famous metaphor for humanity's sense of reality, whereby the other people and things we see are in fact *behind* us. We sit in a cave, wrote Plato, staring blankly at its dark interior wall rather than out at the light, watching a dance of shadows: the images of others cast by firelight onto the cave wall.

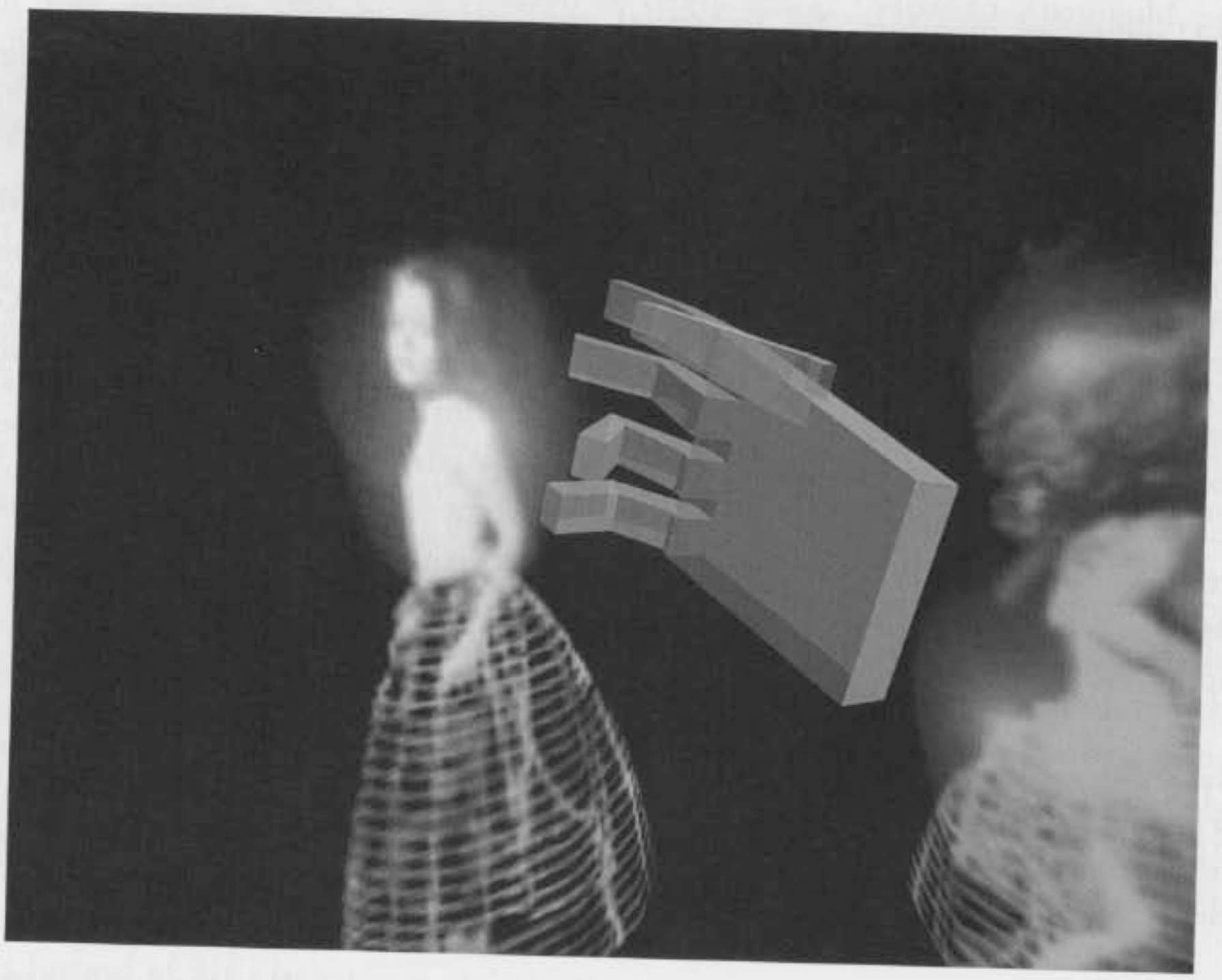

Figure 15.1 A dataglove helps locate the user "inside" the world of Toni Dove and Michael Mackenzie's dreamlike VR experience *Archeology of the Mother Tongue* (1993).

The VR CAVE uses immersive projections onto three walls and the floor of a (typically) small space, which dispenses with the need for HMDs (although stereoscopic glasses are worn). Users commonly operate a mouse "wand" to manipulate the environment, and a "head tracker" detects the user's changing spatial position and angle of point of view, prompting the software to display realistically changing perspectives.[22] Largely due to cost, relatively few art or performance projects have taken advantage of the rich potentials the environment affords, with notable exceptions including the colored aquatic architecture of Margaret Watson's *Liquid Meditation* (1997); Maurice Benayoun and Jean-Baptiste Barrire's war-torn VR wasteland *World Skin* (1997); and *ConFIGURING the CAVE* (1996, Jeffrey Shaw, Agnes Hegedüs, Bernd Linterman) where users transform imagery and sound within the CAVE by manipulating their life-size, puppet-like avatar.[23]

The theatrical and performative possibilities of VR took a quantum leap when Lanier's VPL Research company created a full body version of the dataglove—the DataSuit. This allows multiple users to don suits and headsets and see, talk, move, and interact with one another within a shared synthetic environment. Users can even change their physical form in the virtual world, choosing from a menu of options. One VPL demonstration had two people represented as lobsters, the networked computing systems visually reinterpreting the users' movements into those of the giant crustaceans, a friendly wave of the hand appearing as threatening swipes of an enormous front claw.[24] In *Virtual Reality* (1991), Howard Rheingold rightly predicted that adapted DataSuits would soon allow for fully sensory and tactile effects, with wearers able to transmit and receive "telecaresses," including simulated sex, which he termed "teledildonics."[25]

In the early 1990s, only a small number of artists experimented with VR. These included Kazuhiko Hachiya, whose *Inter Discommunication Machine* (1993) was a VR experience for two people where each user's HMD "projects one player's sight and sound perception of a virtual playground into the other one's display, thus confusing the borders between 'you' and 'me.'"[26] As Christiane Paul points out, it has close conceptual parallels with the "Sim-Stim" apparatus in William Gibson's *Neuromancer*, which enables users to experience other people's bodies and perceptions.[27] This notion became a recurring theme in VR performance experiments over the next ten years, particularly following the groundbreaking projects developed at the Banff Center in Canada between 1992 and 1994.

The Art and Virtual Environments Project, 1992–94

> We got this very fancy fellowship . . . and we have produced what is now considered the first virtual reality works that were ever done. They just came out in a book. . . . Every artist that contributed to the work has contributed both in writing and in visual imagery.[28]

So wrote the first man to have reputedly "danced in cyberspace," the Israeli/American choreographer Yacov Sharir. The book referred to, *Immersed in Technology* (1996), contains

eleven essays on the implications of cyberspace and ten theoretical/technical statements by practitioners then working with virtual environments, all arising from the Art and Virtual Environments Project at the Banff Centre from 1992 to 1994. It was a landmark project in exploring the artistic and performance potentials for VR, and Sharir's dance in cyberspace was considered by fellow digital performers at that time to be an artistic equivalent to the first moon landing—a small step for a man and a giant leap for (artistic) mankind. The space-age analogy seems appropriate for Sharir's collaboration with visual artist Diane Gromala, *Dancing with the Virtual Dervish: Virtual Bodies* (1994). The performer is described as a cybernaut, the (mental and technological) distance traveled appears great, and the environment is alien if not exactly hostile.

In all, nine experimental projects were supported by the scheme including Perry Hoberman's *Barcode Hotel*, Ron Kuivila's *Virtual Reality on 5 Dollars a Day*, Marcos Novak's *Virtual Worlds* (an architectural piece that grew out of the *Dervish* Project), and Toni Dove and Michael Mackenzie's *Archeology of the Mother Tongue*, a piece featuring some breathtakingly beautiful digital imagery (figure 15.2). The project director Douglas MacLeod notes, "We really had no idea what we were doing. This is a very liberating, if exhausting, method of production. It was like staging nine different operas in two years while at the same time trying to invent the idea of opera."[29] The project was indeed a unique development in the performing arts so early in the 1990s, and VR was such a novel technology at that stage that various options were still under active discussion (VRML and VRML2 standards, for example, were only agreed *after* the Banff projects). Gromala has paid tribute to "unprecedented funding" that enabled four computer scientists and six art technicians to work with the artists over two years to achieve a "landmark artwork . . . [that] was one of the very first in VR."[30]

Placeholder

Chronologically, Brenda Laurel and Rachel Strickland's much-celebrated *Placeholder* was the first work to be completed for the project, premiering in 1993. Driven by eleven computers (from a Silicon Graphics Reality Engine to an Apple Powerbook) and over 25,000 lines of code, it opened up the potential for virtual flight (through the character of a crow), although conceptually it was grounded very much in the earth and its gravitational pull. Rather than a futuristic journey into the far (metaphorical) reaches of outer space, *Placeholder* returned to nature, to the ancient and primeval, and to drama's distant roots in ritual and the sacred. In her PhD thesis, later published as *Computers as Theatre* (1991), Laurel conceived VR as a spiritual space, a place functioning like Dionysian festivals and primitive tribal rituals. She theorized VR as a distinctly new space, but ultimately one of return: a place to "reinvent the sacred spaces where we collaborate with reality in order to transform it and ourselves,"[31] and she attempted to put theory into practice with *Placeholder*.

Two participants each enter their own, green-matted "magic circle" (Janet Murray has noted its correspondence with the "fairy ring," a traditional space of enchantment),[32] ten

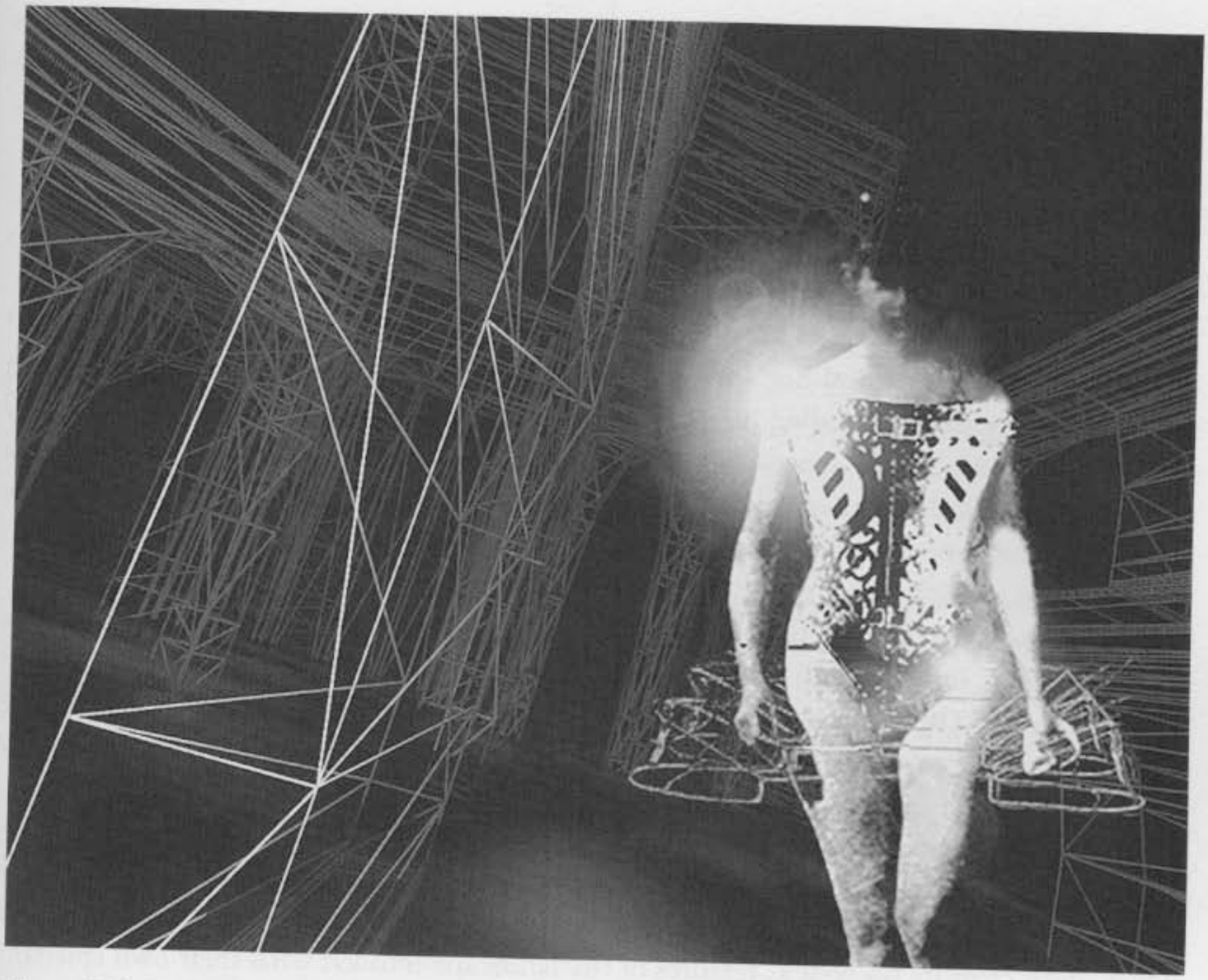

Figure 15.2 "The Coroner's Dream" sequence from Toni Dove and Michael Mackenzie's exquisitely designed *Archeology of the Mother Tongue* (1993).

feet in diameter and ringed by rocks. A technician fits them each with an HMD and attaches sensors to their bodies, which enables their full body movements to be tracked and interpreted within the VR environment, rather than through the simple head or hand movements of most VR experiences. The ritual pattern is begun with participants "being reborn in a different body, and acquiring enhanced powers of perception that deepen the bond of the subject to the natural world."[33] Participants adopt the character, ways of movement, point of view, and even voice (their own being synthetically manipulated)[34] of one of four animated spirit creatures: Crow, Snake, Spider, or Fish. As they encounter other creatures and move close to them to hear their stories, they can metamorphose to exchange "embodiments" and become them, in what Marie-Laure Ryan describes as "a forceful allegory of the immersive power of narrative."[35]

Participants are guided through the virtual landscapes by the disembodied voice of the Goddess, a live performer (normally played by Laurel) who watches the users' actions and

speaks to them via a microphone, offering navigational advice and secrets about the virtual world. "Only spirit creatures live in these places. You must join with them. Spirals move the spirit creatures through the world. The places here are marked with many voices," she says during one performance. The Goddess also coaches and encourages the participants' animal-like movements, which propel them through the virtual space: participants playing Crow, for example, can flap their arms in order to fly (at least from their visual point of view), and are rewarded with the Goddess's warm and reassuring praise: "Nice flight, Crow!" The landscapes they move through are modeled on three locations near Banff: a cave with a natural hot spring; a waterfall in Johnston Canyon; and an area of spirelike earth formations called hoodoos.

The background VR spaces are, in comparison to today's standards, relatively crude: the graphically rendered interior of a cave lacks detail, while an exterior wooded mountain landscape is constructed in VRML-style, from segmented and composited video images, which lend them a blurred and pixelated quality, and a 2D photographic perspective (despite their 3D navigability). But the signs, markings, and spirit characters that inhabit and float through the spaces are intriguing and arresting graphical icons. Their "petroglyph" designs derive from ancient iconography inscribed on the landscape around Banff since Paleolithic times, and from Aboriginal and primitive art.

The two participants talk to and interact with the virtual spirit characters, and although physically remote in their two magic circles can also meet and communicate with each other; they can also touch and move virtual objects with the aid of gripper datagloves. Each creature (as well as features of the landscape imbued with their own spirits), can talk and tell their story, and thus "interactivity occurs on the macro level as freedom to explore, while narrativity is found on the micro level as embedded stories."[36] As Marie-Laure Ryan points out, *Placeholder*'s narrative structure owes more to epic theater than to the Aristotelian dramatic structures Laurel advocates in *Computers as Theatre*: "its architecture is more indebted to a poetics of space than to a poetics of plot."[37]

The user's character roles and the other nature spirits found within the VR environments were initially developed in workshop improvisations with actors from Precipice Theatre Society. A videotape of these improvisations shows the performers adopting different animal movements and characteristics while working outdoors in the specific locations the VR landscapes are derived from. One male actor scrambles about on all fours around another performer, who stands with her hands in the air. "I weave my alphabet in the Hoodoos, I tell the tales of the giants," he barks up at her. "The story is an ancient one, of the Hoodoos, who are frozen statues by day, and awake by night and by heat. All travellers who pass by in their way—hacked!"

In *Placeholder*, as the participants encounter the virtual spirits and speak to them to access their stories, they also leave their own "marks" within the space: their words are recorded and stored in rocklike graphical images, which later participants can access and

rearrange by touching. Thus, like the petroglyphs, graffiti, and trail signs in the actual landscapes that inspired the piece, "the virtual landscape accumulated definition through messages and story lines that participants left along the way."[38]

Laurel and Strickland have emphasized the importance of placement and spatialization of sound to the experience. The Goddess's voice, for example, is spatially positioned above the participant's head (yet still inside the landscape), and the artists stress that they "wanted people to feel they were being drawn through space and time by sounds coming from the world ahead." Marshall Soules notes how the spatialized auditory signals and perspectives are employed like nonvisual trails to orient participants, and he describes the considerable impact they have on the user's body. He highlights the role of sound in achieving a developed sense of user immersion and suggests that this works in accordance with Artaud's ideas for "a theatre of spectacle which subverts the conscious mind by impinging directly on the flesh."[39]

Placeholder has been discussed extensively by academics,[40] and Katherine Hayes provides a particularly interesting perspective. She observes that despite its celebrity, *Placeholder* was experienced by very few people during its short life at Banff, and Laurel and Strickland's video of the making of the project "is as much or more the work of art as the VR production itself."[41] She muses on the levels of simulation at play between the original VR simulation (of the real-life landscapes) and the video that in turn then simulates the VR. She argues that at both levels, Walter Benjamin's sense of the aura of originality is almost completely dissipated, and in the precession of simulacra, the lesson to be learned is:

> When matter and information begin to copulate, more is destabilized than contemporary constructions of the body. . . . Just as it is no longer sufficient to think of the body as flesh or code alone, so it is no longer sufficient to accept distinctions that rely on putting artists in one category and technicians in another, or originals in a gallery and copies in Walmart. It is not only the human body that is undergoing a sea-change. Also in the throes of mutation is the body of art.[42]

Marina Grzinic has also leaned on a perspective from Benjamin (though not in relation to either *Placeholder* or "The Work of Art in the Age of Mechanical Reproduction") to provide a fascinating argument in relation to VR's ultimate dissipation of aura. In "A Small History of Photography" (1931), Benjamin proposed that the longer the exposure time of the photograph, the more a sense of presence, time, expression, and aura is woven into the image. As photographic technologies developed (lenses, film sensitivities, and so on) and shorter exposure times were enabled, there was a negative qualitative shift in the sense of time, space, and aura evident within the photograph. Grizinic extends the argument to suggest that the near-instantaneous processing times of computers has similarly led to an eradication of a sense of time and aura within digital images, and that VR represents the most unauratic of all digital forms:

We are witnessing an ever more exact and complete aesthetic sterilization of the image. In virtual reality, the physicality of the connection of the image with reality-time is lost. Blurs and other imperfections in the image, which were evident in time's passage in the real world, are wholly absent from the idealized imagery of virtual reality. . . . The image undergoes a process of complete sterilization.[43]

Osmose

But visual aura, of the lack of it, was not the key issue for Char Davies when she created the most talked-about experience in the (short) history of VR art, *Osmose* (1994–95). Her concerns were spatial and corporeal, oriented towards a transformation of immersive virtual space into "a spatio-temporal arena in which mental constructs of the world can be given three-dimensional form and be kinaesthetically explored through full-body immersion and interaction."[44]

The revolutionary aspect of *Osmose* is its advanced sense of fully embodied immersion through the use of a (then) sophisticated datasuit, in contrast to most VR experiences, which utilize only HMDs and thus tend to emphasize the Cartesian mind-body split, since the user's experience and navigation corresponds only to their head movements. *Osmose*'s interface covers and "reads" more of the body (but contrary to many commentaries, not the full body, only from the waist up) and its monitoring of the user's breathing, the essential element of bodily life, is particularly important to the sense of a fully embodied, "living" immersive experience (figure 15.3). Its nature imagery and theme further enhance the sense of an organic, natural experience.

A single user, which Davies calls the *immersant*, is fitted with a HMD and a motion-capture vest equipped with breathing and balance sensors, and stands in a small private chamber facing a larger audience space. Her breathing and movement affect the projected stereoscopic imagery, as she undertakes a journey through forests, clearings, ponds, sky, and subterranean earth. In the other space, spectators watch two luminous screens; one relays the immersant's VR point of view, the other shows her shadow-silhouette (figure 15.4). Davies conceives the placement of the real-time shadow image of the immersant alongside her point-of-view projection as both poeticizing the relationship between her body and the artwork and drawing attention to the crucial role of the body as the "ground and medium" for the experience.[45] The experience begins with a projected three-dimensional grid, which helps to orient the immersant, providing clear spatial coordinates that can be seen to alter in direct relation to breath and body movement. Mark Jones describes the beginning of his experience:

I don my HMD and the assistant wires my chest and back with interface devices. *Osmose* is activated and I am transported to a 3-D wireframe grid. "Practice," they say, "get used to the space and the interface." I look all around me and the grid extends to infinity in all directions. I inhale and gradually begin to rise; if I lean forward I move forward. Lean back and I move

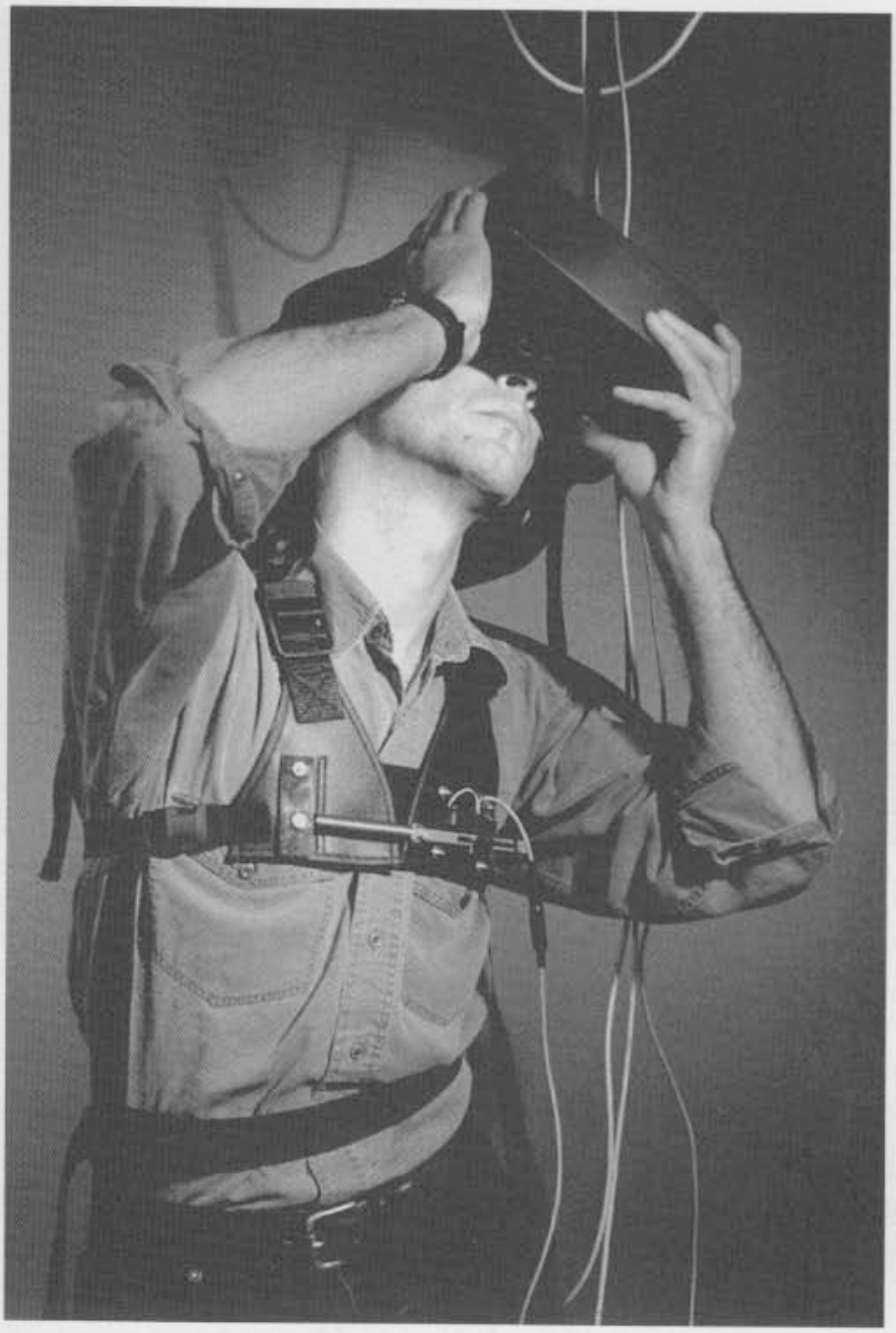

Figure 15.3 An "immersant" wearing stereoscopic head-mounted display and breathing/balance interface vest for a performance of Char Davies's Osmose (1995).

backwards. I'm flying, I am an enigma, I have no physical form, yet I am whole. I am an "immersant."[46]

The wire frame gives way to sumptuous and extraordinary navigable graphic landscapes, structured in a vertical model. Deep breath inhalation and upward body movement ascends the immersant through forest floor to tree trunk, to leaved boughs and up into clouds, while slow exhalations and low movements plunge one down into a pond, through subterranean earth, and to an abyss. At either end of the vertical spectrum (and

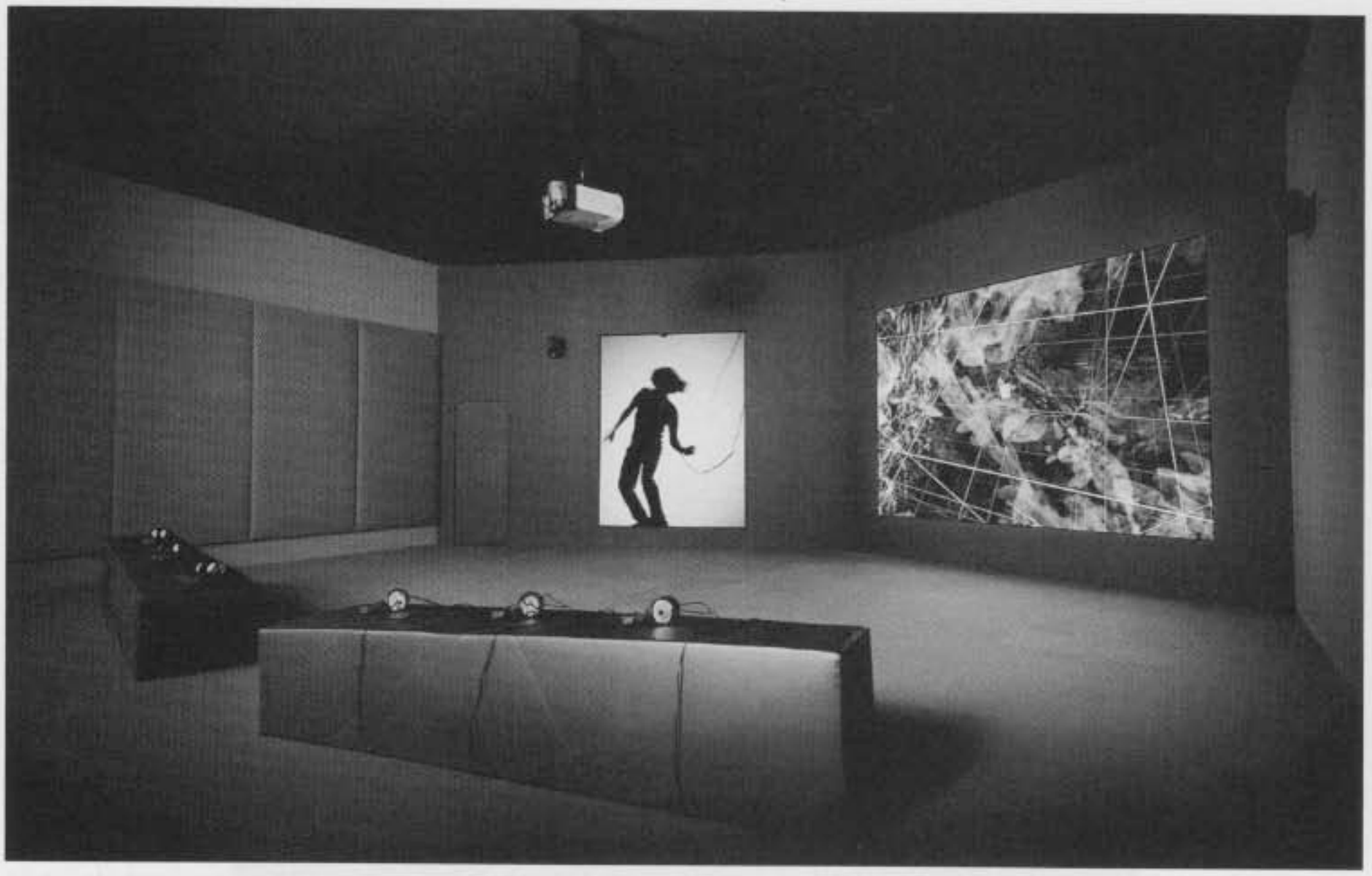

Figure 15.4 Installation view from 2003 of *Osmose* at the Australian Centre of the Moving Image, Melbourne, showing the audience's dual view of the shadow of the "immersant" and the changing virtual environment she journeys through.

the experience) stands the wire grid, and pieces of text by Davies reflecting on the relationship between nature and technology (above), and the computer code used to generate the *Osmose* worlds (below). Specific forms within the landscape spaces (clouds, trees, roots, rocks, water) are dramatically hyperreal and dreamlike. A magnificent giant tree appears like a translucent ghost, its multiple limbs and branches like white ice or sharpened glass, cutting into the surrounding blue-black sky sprinkled with showers of snowlike stars. The subaquatic and subterranean spaces are vast, rippling layers of quasi-organic visual forms and colors. The soundscapes are similarly multilayered, beautiful and haunting—like *Placeholder*, the audio is also spatialized, responding to the user's location, direction, and speed of movement.

Davies is categorical in pronouncing VR as a decidedly *new* and unprecedented artistic form:

> The medium of immersive virtual space is not merely a conceptual space but, paradoxically, a physical space in the sense of being extended, three-dimensional and enveloping. As such it is an entirely new kind of space that is without precedent. I think of immersive visual space as a spatio-temporal arena, wherein mental models or abstract constructs of the world can be given virtual

embodiment in three dimensions and then kinaesthetically, synaesthetically explored through full-body immersion and interaction. No other space allows this, no other medium of human expression.[47]

The piece's title, a derivation of "osmosis," suggests how *Osmose* aims to absorb the immersant into the artwork, and to pass them from one space into another, just as biological osmosis involves a passage from one side of a membrane to another. Davies's objective is to resensitize the user, to reconnect the links between body, mind, and world: "to heal the Cartesian split between mind/body, subject/object . . . in a dream-like way, shifting the immersant's mode of experience away from the everyday bias of eyesight to one that resonates deeper within the physical body."[48] Her success in doing so (or at least in creating a ground-breaking artwork) is evidenced by a veritable mass of critical eulogies; Oliver Grau goes as far as to suggest that *Osmose* "has received more attention in the international discussion of media art than perhaps any other contemporary work."[49]

What is most striking about the two most famous (by some considerable margin) early VR artworks, *Osmose* and *Placeholder*, is that they both use *Virtual* Reality to place the user in spaces which represent and accord with *natural* reality, with nature. Though neither installation attempts photorealism, both derive their environments directly from actual landscapes and natural objects (trees, rocks, and so on). Although the experiences are quite different from a "real" pastoral journey, in a significant sense the two works draw the user back to nature, effacing alternative or fantasy virtual realities in favour of conventional, known ones. Both use VR to present new perspectives on the natural world (for example, the spirit incarnations in *Placeholder* and the grid and code structures of *Osmose*), but their extremely *high-tech* systems are ultimately used to conjure worlds that are, at least at face value, distinctly *no-tech*. Indeed, the worlds are not even representations of contemporary natural environments, they are of primeval ones: the search for the VR future in performance art has begun with the search for the ancient and primordial. There are no human beings in these two, apparently pre-Neanderthal worlds—just creatures and spirits (*Placeholder*), primordial bogs, ponds, and abysses (*Osmose*).

It is tempting to make great play of the significant irony underlining this high-tech > no-tech paradigm, but that would miss the point. For the artists, the strategy is not ironic at all, since high technology is conceived as a potent new means of return: of (re)discovering the true nature of things, and of contacting or representing one's inner spirit. Nature (that is to say, unspoiled pastoral spaces outside urban confines) is a common theme and audiovisual backdrop in digital performance since it classically represents a place for spiritual enrichment, a locus to be at one and to rediscover timelessness without the nagging incursions of modern life. It is for this reason, we believe, that so many digital artworks and performances hark back, with no little passion, to nature, as we have already seen in relation to robot performance. Davies's later VR work *Éphémère* (1998) is similarly

grounded firmly within the archetypal nature metaphor, and is spatially structured into three, all-natural parts: "Landscape, subterranean Earth, and interior Body. The body, of flesh and bone, functions as the substratum beneath the fecund earth and the blooming and witherings of the land."[50]

Dancing with the Virtual Dervish: Virtual Bodies

The interior of the human body is Sharir and Gromala's natural setting for *Dancing with the Virtual Dervish: Virtual Bodies* (1994), which is programmed in continuous motion and undulates as if breathing, like a living body; like both *Placeholder* and *Osmose*, there is an anti-Cartesian concern to excite an embodied experience (figure 15.5). Sharir (in formal performance demonstrations where his VR view is projected on large screens around him) and user/participants (who can explore the VR world by donning the HMD themselves) navigate and dance through the VR body's three-dimensional interior, moving within and through a giant ribcage of what is:

> Literally and figuratively a body of enormous scale, the resultant virtual environment is an incomplete torso comprised of a skeletal spine, pelvis and ribs, along with the viscera of a heart, kidney and liver. . . . These organs can be "entered" to reveal otherworldly chambers. The virtual body thus becomes an immersive, nonlinear book, a text to be read, an architecture to be inhabited.

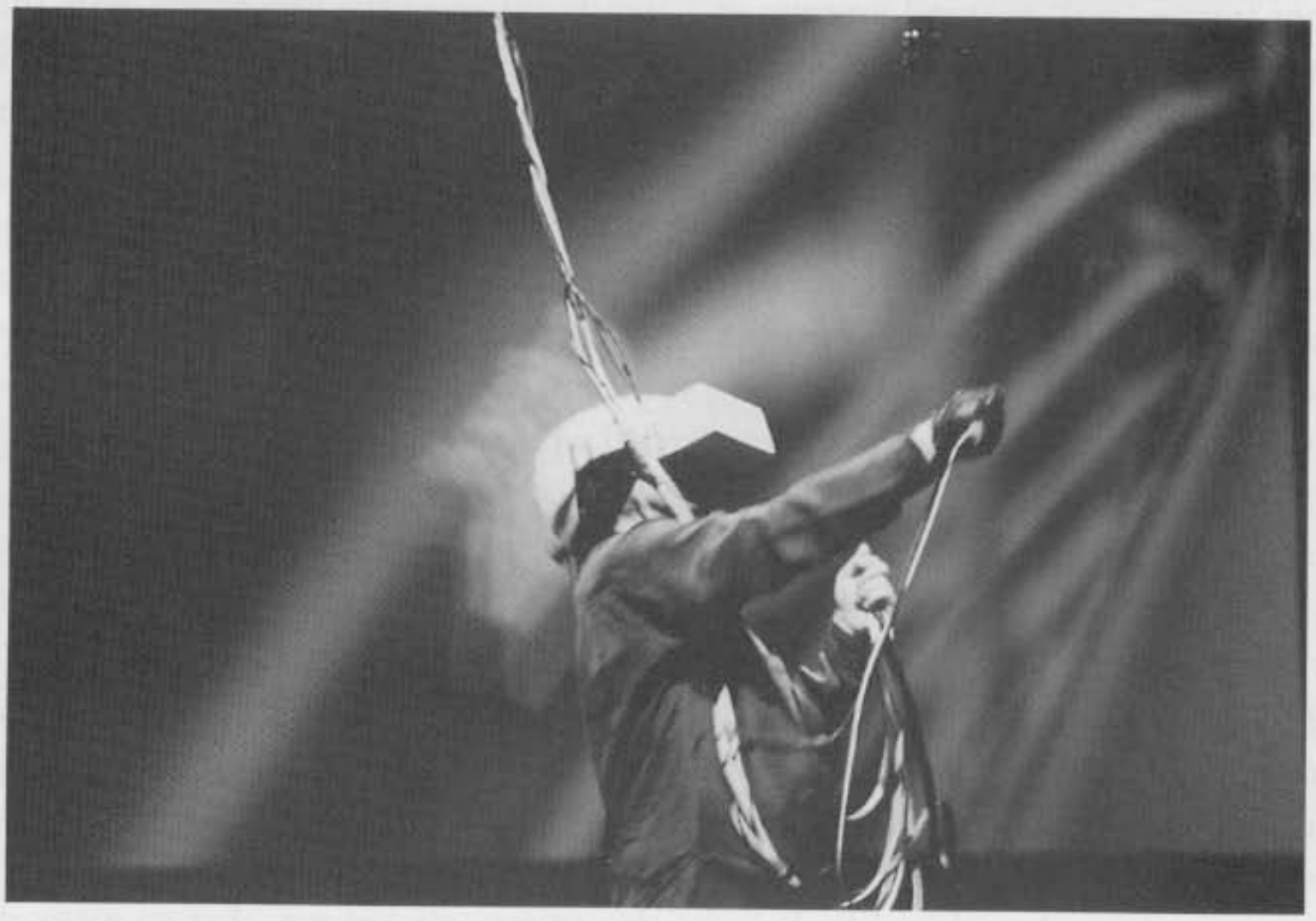

Figure 15.5 Yacov Sharir navigates through the interior of a VR human body in *Dancing with the Virtual Dervish* (1994, with Diane Gromala).

Within the body stands another primary component, another body, video grabs of a dancer transcribed onto a plane. The dancer exists both as representations within the virtual environment and as a performer in the physical performance space, connected to the virtual environment through the umbilicus of the head-mounted display.[51]

Following its premiere at the Fourth International Conference on Cyberspace at the Banff Center for the Arts in May 1994, several further performances and exhibitions followed, including the first Virtual Reality Software and Technology Conference held at the University of Singapore in August 1994, where it was the only arts project represented. In the days following the first experiments Sharir wrote expressively of the novel experience that had seemed like an "otherworldly" or "out of body" incident:

Even though you are grounded in a physical space, you are immersed in cyberspace, and you live now two lives; one in the physical space and one that you are immersed in, which is cyberspace via your goggles. Disconnected from the physical world: entering the cyber world that is designed on the computer. Surfing in cyber world where the surf speed is 60 to 70 miles an hour. . . . But surfing that fast, you get nauseous, sick in your stomach, and you haven't moved physically. . . . So you have this duality of not knowing how to behave in cyberspace and you have now a new life where you have to retrain yourself how to behave in cyberspace, as opposed to in the physical space. . . . It's a new set of behavior that has to be learned and studied and practiced.[52]

This challenge to learn and study physical behavior within VR space would later be taken up and explored in an intriguing way by Gromala in her *Meditation Chamber* (with Larry Hodges, Chris Shaw, Fleming Seay, 2000) which employs a voiceover to take the user through progressive relaxation exercises. Biofeedback devices register the user's physical tensions and releases, and displays equivalent computer-generated 3D graphic representations of the body parts through the user's HMD. The installation underlines meditation's long tradition of enabling "subjects to reimagine their relationship to their bodies in order to achieve a state of relaxation that is simultaneously and indissolubly psychological and physical."[53]

Sharir's experience at the time of *Dancing with the Virtual Dervish* seems to have been something of a conversion: as a practicing choreographer it was as if he had discovered and entered an entirely new dimension, a new environment for performance. Like Char Davies, Sharir conceptualized VR as an entirely new type of space. This was to raise the computer above being seen as a mere tool, a helpful or recalcitrant *device,* to being, conceptually, a means whereby practitioners and audiences could traverse to new locations and horizons:

We still look at computers and video cameras as tools to do things with. I think I like to look at it as *a world, a space.* That once you participate in it, you find for yourself new ways to behave in it. Instead of thinking this is a computer, I like to think this as a theater space, as a performance

space. A performance space is a representation of a whole world of imagery. So it's not like this computer, like this tool, like you have a hammer and a nail, and I need to use this hammer to put the nail in the wall. . . . The concept of *using this as a world, as a space where images can take place and come to life*, that's, to me, a larger conceptual framework.[54]

But not everybody was immediately convinced that this was going to be a new space where performance could easily exist or benefit. Johannes Birringer, for example, wrote of the event,

While her [Gromala's] conceptual relocation of her body as a virtual stage is truly astounding, what is more difficult to understand is Sharir's relationship to it and his assumptions about choreographing his movements and video images in response to his distressed, dis-orientated body experience. Is his internal experience translated into conscious movement choices or do we see him react to a state of disconnection from himself?[55]

Sharir was well aware of such questions and problems, and his own description of the event ends with seven questions to be pondered, the first being "is the nature of dance altered by this potential?"[56] His subsequent work suggests that he is still engaged in that mission, undertaking exploration of a larger conceptual framework by various means but not always following the most obvious route: for example, he has undertaken enhancements of the initial developments by working collaboratively with computer scientist programmers, by utilizing motion capture and computer animation leading to live performance with virtual entities, by developing cybersuit-activated performances, and, most recently, by translating the real-time movement of crowds in a public space into virtual dance.

VR Theater Reconstructions

In the same way that we have discerned a significant return to the myths and eras of the past in the performative usage of advanced technologies in areas such as robotics and the VR worlds of *Placeholder* and *Osmose*, futuristic VR found an early affinity with the ancient theater of Greek and Roman civilizations. By 1997, following years of historical and archaeological research, a team from Warwick University's 3D Visualisation Unit led by Richard Beacham had created accurate and exquisitely detailed 3D reconstructions of ancient theater buildings, including the Theatre of Dionysus in Greece and the Theatre of Pompey, Rome's first permanent theater (figure 15.6). These VR reincarnations seemed every bit as extraordinary as the dramas once performed in their spaces, and involved dedicated and meticulous work, drawing upon existing information and new data and measurements obtained by the team's visits to what little remains at the physical sites. It resulted in VR screen-based reconstructions that could be explored and "flown through" with an ease and facility that exceeded anything that even the original architects or audiences could have witnessed. The VR software enabled structures to be explored from the micro to the macro,

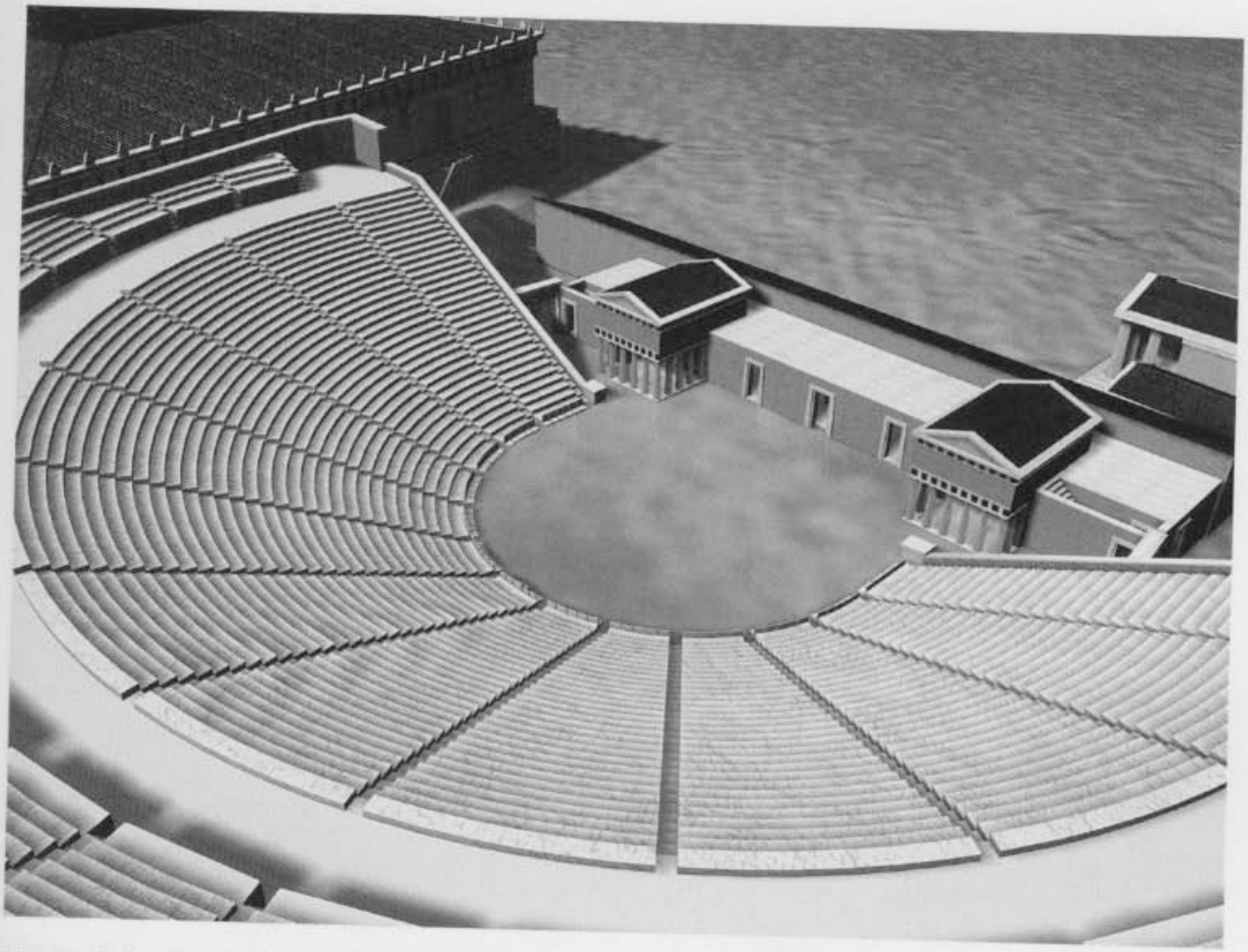

Figure 15.6 Richard Beacham's detailed VR reconstruction of the Theatre of Dionysus. Courtesy of Kings Visualisation Lab, Centre for Computing in the Humanities, Kings College London.

along with all the theatrical and practical aspects of sightlines, facilities, access, egress, and even the acoustics within the space. Moreover, as Beacham has emphasized, the clean lines of computer-reconstructed ancient theaters create a picture of magnificent auditoria *as then* and *as new*, and every bit as impressive as our most recent arenas and auditoria, rather than as spaces of dusty ruins and broken columns, as many are still naively prone to think of them as existing in their own day (figures 15.7 and 15.8).

VR technology hereby made a clear and unequivocal contribution to theater history research and classical scholarship, and its impact was recorded widely outside academia, including a *The Times* (London) color supplement in 1998 headlined "Unmasking the Greek Mysteries: virtual reality revives the oldest theatre."[57] Significant aspects of this unmasking and revival of the mysteries of ancient theater were its newfound archaeological accuracy, visually arresting computer modeling, accessibility and maneuverability, and also its particular contributions toward archaeology and the humanities (particularly history and theater studies), as well as information technology itself. The project's status

Figure 15.7 Richard Beacham's VR model of Rome's Theatre of Pompey emphasizes its grandeur and newness at the time it was originally built. Courtesy of Kings Visualisation Lab, Centre for Computing in the Humanities, Kings College London.

as an excellent example of the new world order (computing) valuing and investigating the ancient one to reveal new perspectives and insights led to substantial financial support from the United Kingdom, Europe, and America. This has resulted in a range of equally extraordinary reconstruction projects including the theaters of Pompey and Messene, and subsequently more recent theatrical antiquities such as Christopher Wren's Theatre Royal in Drury Lane, and Vanbrugh's Queen's Theatre in London, the Paris Opera, the Teatro Olympico at Vicenza in Italy, the Hellerau Festspielhaus in Dresden, and Wagner's Bayreuth Festspielhaus. But while these reconstructions involve rigorous archeological and academic research, Beacham is quick to point out that "every picture is a hypothesis or a guess based on a number of evidence sources. . . . There is a serious danger with virtual reality images. They have a bogus persuasiveness and are increasingly interpreted as reality."[58] Beacham now continues his research at Kings Visualisation Lab, Centre for Computing in the Humanities, at Kings College London.

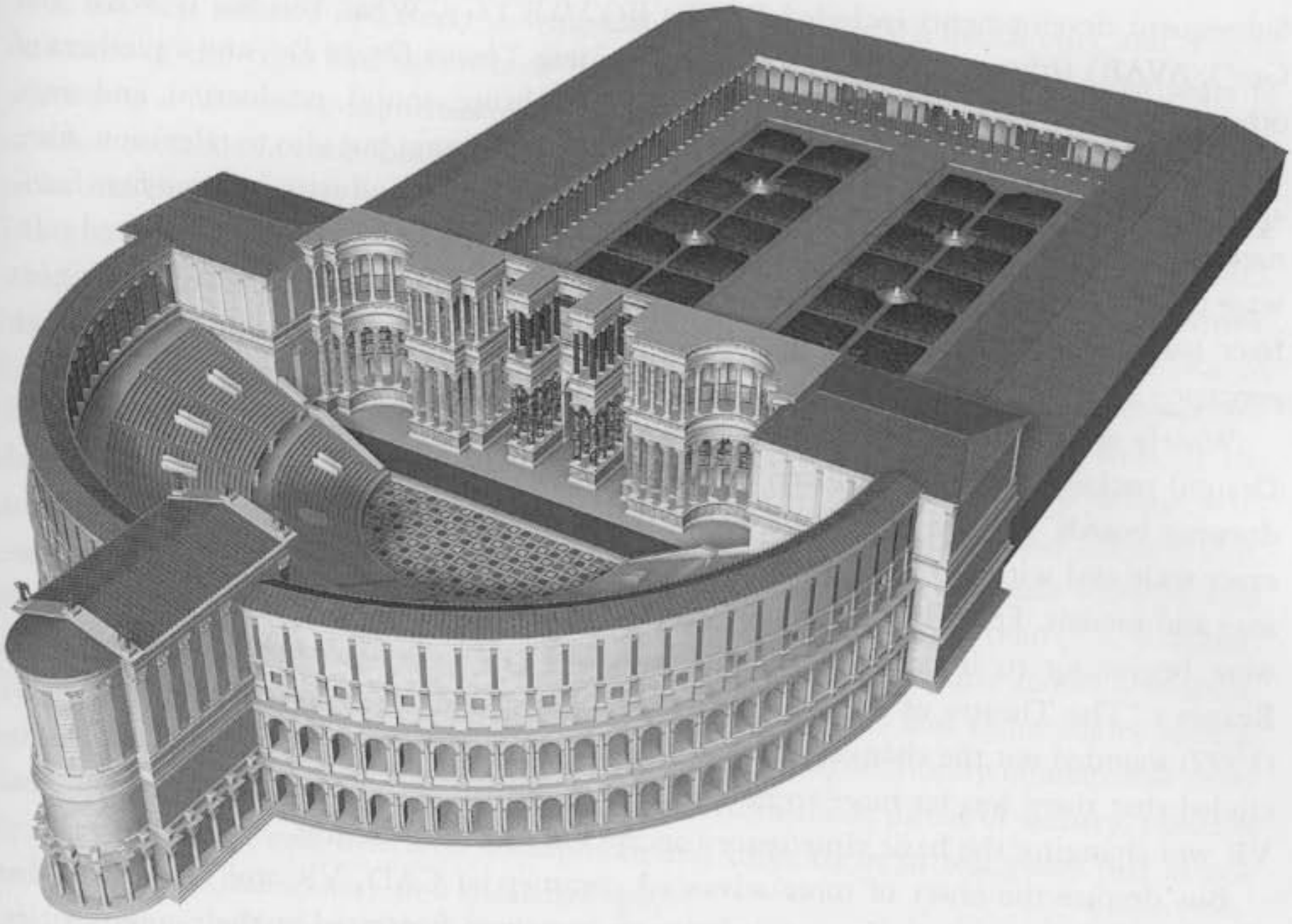

Figure 15.8 An aerial view of Richard Beacham's VR model of the Theatre of Pompey.

Other computer reconstructions and virtual tours have been created by others, including Shakespeare's Globe in London, developed by the Open University in collaboration with the BBC. Other developments were perhaps less eminent but equally signaled that VR had real value for theater research, such as *Scenic Spectacle*, a study of spectacle on Renaissance and Baroque stages produced by the Department of Theatre and Dance at Appalachian State University. Nonetheless, it should be noted that such developments were in no way common in the sector at this time, nor have they been since. They were carried out by particular individuals who were skilled, experienced, and committed to the task of producing inventive visual research applications, and were supported by large institutions (mostly universities) and significant funding.

3D Theater Design

VR and related 3D applications such as VRML have exerted a significant influence on theater set and lighting design, and a range of commercial applications were released in the early '90s, including Crescit Software's *Design Suite,* programmed by Canadian Bill Kirby with smaller companies and nonprofit/educational theaters specifically in mind.

Subsequent developments included CAST's *WYSISWYG* ("What You See Is What You Get"), AVAB's *Offstage,* Luxart's *Microlux,* Schneider's *Theater Design Pro,* and a plethora of others covering various specialist applications of lighting, sound, production, and stage management, many being applicable not only to theater stages but also to television, film, and advertising sets and studios. Much of the entertainment industry became first fascinated by and later largely dependent upon the labor-saving shortcuts that dedicated software offered to the basic processes of designing, which at least in theory left the designer freer (software problems apart) to concentrate on the overriding vision of the design concept.

Widely available, but at that time expensive professional CAD (Computer Aided Design) packages were also utilized by a number of theater designers, and these "digital drawing boards" opened opportunities to construct and tinker with complex designs to exact scale and with 3D perspectives in significantly shorter time than traditional drawings and models. From 1992, specialist publications such as *Theatre Design and Technology* were beginning to indicate the opportunities that lay ahead. Articles such as Mark Reaney's "The Theatre of Virtual Reality: Designing Scenery in an Imaginary World" (1992) sounded out the changes and highlighted the questions being raised. Reaney concluded that there was far more to new technologies than designer convenience, and that VR was changing the basic time/space concepts available to theater.

But despite the onset of more advanced commercial CAD, VR and other specialist design packages, many performance designers remained frustrated at their complexities, particularities and limitations. British academic Colin Beardon was one whose frustration led to the development of alternate approaches and resultant freeware that has been used widely, particularly for the training of British university theater-design students. Beardon has a background in computer science as well as an involvement in theatre production, and his approach to software development "stemmed from previous familiarity with software design and implementation, and awareness that commercial software was disinclined to embrace the plasticity, ambiguity and 'creative practices' of performance designers and practitioners."[59] Between 1991 and 1996 he worked with Suzette Worden to produce *The Virtual Curator*, a program for design history students to virtually curate a design exhibition, and this was modified and expanded into the theater design and visualization program *Visual Assistant* (1997) as part of a European Union funded project with collaborators in Finland and France. *Visual Assistant* acts as a simple interface to permit scanned images and default "objects" such as stage flats and pillars to be assembled and manipulated on a perspective stage. The user can navigate freely in three dimensions around the stage and theater set to view different angles, and can add to the design using freehand drawing. Beardon describes the program as more of a designer's sketchbook than a technical drawing board, which is part of its appeal to students who can learn and create with the software very quickly and easily, something that could certainly not be said of CAD software.

It was first released as a freely downloadable program for Macintosh only, and it is an indicator of the time and investment required that *Visual Assistant* took nine years to develop to a reasonably sophisticated dual platform level to include the PC. For its time it was a remarkable contribution to the growing awareness of what was potentially possible, and Beardon went on to establish the Networked Virtual Reality Centres for Art & Design, located at three universities in England (Coventry, Plymouth, and Teesside), which experimented with accessing and transferring digital 3D designs over networks. He continues related work through the biannual CADE (Computers in Art and Design Education) conference and the journal *Digital Creativity*, both of which he is a cofounder.

Chris Dyer, an established British theater designer with awards for his work at the Royal Shakespeare Company and the Royal Opera House was another early pioneer, who developed a more sophisticated and professionally oriented program, *Open Stages* (1998, also known as *Virtual Stages*). Like Beardon, Dyer was concerned to create software that was specifically evolved and adapted to the particular creative (rather than purely technical) needs of the theater designer.[60] The program offers a 3D computer model of a specified theater or performance space into which associated objects and technologies such as lights, sound, fly bars, revolves, and trucks can be arranged. A library of adaptable templates allows the user to then pull in generic or custom-made pieces of scenery, position them on the stage, and thereafter manipulate and light them in real time, just as one would with physical scenery in a theatrical space.[61]

Such custom-built theater-design packages, as well as those from the commercial sector, have brought about change and new approaches, but a debate nonetheless continues about the computer's advantages over traditional methods in conceiving and developing stage designs. Roma Patel undertook a comparative study in 1999 using Ionesco's play *Amédée* as a case study and sounding board, and produced *A pLACE TO pLAY* (2000), a CD-ROM that records the process and outcome. It demonstrates and evaluates—by means of an interactive presentation combining drawings, stills, storyboards, walkthroughs, and 3D models—a design for *Amédée* developed through Internet collaborations with other designers, and applying computer techniques to traditional problems of set, props, and costumes. In 2001 she repeated the exercise with another CD-ROM, *The Design Diary: Working Across Borders*, which she describes as "a practical example of using Computer Aided Design & the Internet for Remote Co-operative Working amongst Theatre Practitioners in the USA & UK."[62] Patel's conclusions stress a balance between the creative potentials of design technologies and the requirement for theater designers to also have a thorough grounding in more traditional, analog techniques:

> Computer technology is fast reaching the point where it can be used to produce work as far as our imagination can take it. It is time that the Theatre Design profession realised its potential as a tool to bridge gaps in the work of a scenographer. At the same time . . . many conventional skills are transferable and the new mediums need not alienate the scenographer. I am convinced . . . the work

achieved here would not have been possible without my foundation in traditional model making and drawing.[63]

The professional theater designer has always had the task of considerable number crunching to ensure the accuracy of the dimensions of technical drawings and scale models, and the computer is now seen as *the* essential tool of the trade for many. Refinements of CAD programs to aid simplicity of use has been particularly important, including CADD (Computer Assisted Drafting and Design) and subsequently AutoCAD software, where the alteration of one aspect by the operator automatically tumbles the effect throughout the whole design in a form of "double entry." Of even greater consequence has been the migration of software from expensive high-end computers to the ordinary desktop and then laptop; and the ability of programs to automatically render 2D drawings into 3D "visual reality" designs.

But a key issue remains that first prompted designers such as Beardon and Dyer to create their own programs: that commercial software has built-in limitations and can constrain originality and innovation through its particular look and approach to drawing, layering, rendering, and texturing. This is an aspect that both software programmers and theater designers are still seeking to address, on one hand by theater designers continuing to combine traditional drawing board conception and creativity with screen-based techniques, and on the other hand by improving software to stretch and overcome its own preferences and limitations, so that default styles and repeated traits become less discernible.

VR Scenography in Real Time: ieVR

In the early 1990s, American theater designer and academic Mark Reaney was using early VR software as his drawing board tool before building his sets in metal and wood. One day in 1993, he thought it would be useful to project the VR images onto the stage cyclorama to get a larger-scale impression of the design he was working on. He set up a projector, and on seeing the result, he decided not to go back to the analog technologies of wood and steel, but to rely almost entirely on VR.[64] With modest budgets and resources, Reaney and his colleagues at the Institute for the Exploration of Virtual Realities (ieVR) at the University of Kansas have since pioneered a series of theater productions combining live actors with VR environments.

ieVR use VR technology as their prime scenographic medium in order to achieve a sense of immersion, which Reaney believes is a central concept shared both by theater and VR. Echoing Brenda Laurel's ideas, he also sees reciprocity between theater and computer technologies, suggesting that industrial VR developers could adopt theatrical ideas and metaphors: "theatrical practices may prove to be worthy of emulation in designing virtual environments."[65] In "Virtual Reality and the Theatre: Immersion in Virtual Worlds" (1999), he discusses the nature of immersion and how it applies to VR and theater. He

argues that in commercial applications where technology is used to mimic actual objects and environments such as machinery or buildings, a perceptual and biochemical sense of immersion may take place, but after a short time the virtual environments become less immersive since they lose the interest and engagement of the user. Reaney's work in VR set design attempts to negate this problem, by not simply immersing, but also engaging the visual and imaginative attention of the theater spectator.

ieVR's interpretation of Elmer Rice's classic expressionist play *The Adding Machine* (1995) became the first full-length theater performance to use VR. Rice's play was first produced in 1923, and traces the journey of Mr. Zero in his search for happiness in a mechanized and dehumanized society. The company notes the irony that the dark specter of computers foretold in Rice's play are here used "not as a dehumanizing force, but as an artistic medium . . . to simultaneously illuminate Rice's story even while it embraced another, more sympathetic, view of technology."[66] The actors performed in front of a rear projection screen displaying stereo-optically polarized VR imagery created using *Virtus WalkThrough Pro* software, which the audience viewed through 3D polarized glasses. As in all ieVR productions, movement and navigation through the VR backgrounds was rendered in real time, operated live by an offstage technician known as a VED (Virtual Environment Driver). The VED uses a mouse or joystick to move through the simulated spaces or to change the backgrounds in relation to the movements of the onstage actors or developing dramatic action. Two further projection screens displaying 3D still images were placed at a 45-degree angle at either side of the main screen to enhance the sense of immersion. The virtual scenery was sometimes used as an impressionistic or expressionistic representation of the location the characters were in, and at others it reflected psychological elements, particularly the inner thoughts and fears of the protagonist, Mr. Zero: "Fanciful and frightening environments were created in order to illustrate the mindset of the main character. As he becomes disorientated, walls shift and furniture floats off the floor. . . . In prison, the bars of his cell appear immense, the window miniscule. But in his daydreams, he and the audience are whisked away to a blissful beach."[67]

ieVR stress that VR is used "not merely as spectacle for its own sake, but as a new and exciting scenographic medium in the service of a script; virtual reality becomes another component of the collaborative theatre art."[68] David-Michael Allen concurs with the analysis, suggesting that through the use of VR computer graphics and real-time television techniques "the production explored the mental state of Mr Zero more successfully than traditional production techniques,"[69] citing one scene as a particularly effective example. Zero stands onstage and is fired after twenty-five years of work (to be replaced by the adding machine of the title) by his Boss, who plays the scene offstage in a green-screen space, with his live video image projected on the main screen behind Zero. Using chromakey video-mixing techniques, the green background is filtered out and replaced by computer-generated office scenery to form a composite image of the Boss in his office. As Zero reacts to the news, the camera zooms in on the Boss, his laughing face growing larger

and larger above Zero, emphasizing the protagonist's impotence and diminishing status. Allen also notes the power of a romantic sequence where Zero and Daisy fall in love and dance in front of a VR projection of a vast expanse of flowers: "As the dance continued, the field of flowers receded and fell away as the dancers appeared to take flight, travelling through blue skies and star-filled heavens."[70]

In 1997, audiences donned half-silvered Head-Mounted Displays[71] for ieVR's production of Arthur Kopit's *Wings* (written in 1977), enabling them to see a superimposition of both the VR computer-generated graphics projected into the headsets, and the live actors performing onstage. Reaney describes the quality of immersion as "very pronounced" and the VR design as being conceived to enable the audience to share the sense of distress and mental anguish suffered by the central character, Emily, following a stroke:

> Shattered images of the people and places that surround her pass by before her and our eyes. Sights and sounds born from her memories float just out of our reach. This proved to be a powerful source of engagement. In a traditional staging, the audience can empathise with Emily by seeing her distress and helplessness. In a VR staging we experience the stroke with her.[72]

It is interesting to note that one of the most powerful and beautiful VR images in *Wings* was also one of the simplest to create graphically: a snowstorm that surrounds Emily. While a similar effect could have been produced using a theatre snow machine, the ghostly, ethereal superimposition of virtual snow on the corporeal body of the actor conjures an image that is more poetic, poignant, and ambiguous (is the snow a scenic representation of Emily's "real" environment, or her state of mind?)

HMDs were also worn by spectators for ieVR's adaptation of Samuel Beckett's *Play* (1996 [written in 1963]), which projected into the headsets prerecorded 3D video of the play's three characters cocooned in their urns. Reversing traditional stagings whereby the actors are live and the spotlight that interrogates them is a technological device, director Lance Gharavi took the "role" of the spotlight, and controller of the technology. The technician VED thus became the central character, appearing as the only live performer on stage and acting as a master of ceremonies who activates and manipulates the virtual characters. This interesting experiment explores, in Gharavi's words, ideas around "presence," "absence," and "apparent presence" that he identifies as fundamental themes in Beckett's later plays. He also suggests that "because it relies heavily on electronically mediated images, this presence/absence continuum also plays a pivotal role in the performance text of almost all forms of cybertheatre."[73]

ieVR's *Machinal*

Machinal (1999) readopted the staging configuration of ieVR's first production *The Adding Machine*, with a central VR rear projection screen and two angled side screens, and the

audience wearing polarized 3D glasses. However, the side screens no longer played still images, but prerecorded moving 3D imagery of landscapes, objects and hyperrealistic machinery. The production of Sophie Treadwell's 1928 expressionist play was the most ambitious VR theater production of its time, as Reaney's Press Release suggests:

> The "virtual scenery" for *Machinal* will far outstrip i.e.VR's previous projects in terms of the quality and detail of the scenic image, creating three-dimensional "real-time" environments that are at once fantastical and startlingly life-like. Powerful new computer workstations and WorldUp R4 software from Sense8 will create virtual scenic environments with astonishing complexity and rendering speeds. . . . With its capacity to give visual emphasis to both the outer life the Young Woman faces as well as her inner torment, VR forcefully extends the dramatic reach of this already powerful work.[74]

Its opening sequence is a visual tour de force. From the spectator's perspective, a small 3D cinematic-style title appears and looms toward us, giving way to what appears to be a subterranean tunnel that we travel along and down. This emerges into a surrealistic office with huge animated metal arches that circulate and cascade like silver waterfalls. Massive revolving shafts and cogs rise ominously from the floor. The side screens display sharp graphical clockwork mechanisms, continually rotating and spinning, while on stage, actors (playing secretaries) scurry back and forth in a hive of noisy activity. Our movement around the virtual office is constant for several minutes, as we roam through 360 degrees past filing cabinets, desks, and typewriters, and into the office's hidden, angular alcoves. The swirling VR point of view and the antlike activity of the onstage secretaries finally and dramatically come to a halt on the entrance of the boss, Mr. Jones. On his exit, the flurry of action and movement continues once more (figure 15.9).

Movement through the VR environments is used to memorable effect in a number of sequences. The protagonist Helen lies onstage recovering after giving birth following her reluctant marriage to Mr. Jones. The VR set is a hospital room with a graphical 3D bed, drip-feed, and light, all seemingly suspended in space. There are no walls. The background is a matrix of metal, a menacing construction site, where cranes lift huge diagonal girders into the sky. During the scene, as Helen struggles with increasing depression and desperation, our point of view moves higher and higher away from the room to look down on the bare hospital bed as it slowly diminishes in size, finally becoming invisible. During the trial scene following her murder of Mr. Jones, Helen sits in front of a huge image of scales of justice that tip back and forth, while close-up live camera images of the two warring lawyers are projected high on either side of her (figure 15.10). In the final scene, following Helen's conviction for murdering her husband, we follow her journey from a bright square cage representing her cell to the electric chair. The door of the cage swings open and, as two guards lead Helen offstage, the VR image travels through a narrow, high-walled corridor to an ominously bare and silhouetted electric chair. The live actors

Figure 15.9 Mark Reaney's VR scenography for ieVR's *Machinal* (2000) is operated in real time to move in relation to the actors' movements and actions.

playing Helen and her guards then appear in silhouette behind the screen, and a clever illusion is created, as Helen appears to "sit" on the virtual chair and the guards strap down her arms and legs (figure 15.11).

The synthesis of live theater and computer technology as realized by ieVR is visually rich and theatrically inventive, and features skilful direction of actors by Ron Willis and Lance Gharavi, as well as Reaney's bold and frequently stunning 3D VR designs. ieVR's co-production with the University of Kent (UK) is also impressive, setting *A Midsummer Night's Dream* (2000) against VR backgrounds of fantasy sci-fi, machinic chessboards, cyberspace, and computer games, and using a floating 3D avatar of a donkey's head to signal Bottom's transformation. The lovers' arguments in the forest are counterpointed by the VR image of their avatars fighting in a boxing ring, characters get lost in three-dimensional mazes and sewers filled with broken Pac-Man and Pong games, and the whole performance ends with a cataclysmic computer crash and the words "Fatal Error."

Figure 15.10 The trial scene from ieVR's *Machinal*.

However, the aim to create a truly immersive theatrical environment in ieVR productions ultimately remains unrealized. The sense of movement through the virtual sets and spaces is gripping, yet the audience remains a considerable distance from the action, in traditional rows of raked seating, distinctly separated from the stage and the VR screens. Budgetary considerations also mean that the projection screens themselves are relatively small (four meters tall and six meters wide for *Machinal*) and constitute only a limited percentage of spectators' overall angles of view, thus limiting the feeling of complete visual immersion associated with industrial VR applications. Traditional notions of user-controlled exploration and interactivity within the virtual environments are also absent. Nonetheless, ieVR's exploratory work offers significant and exciting glimpses into the future of VR scenography in theater, and has led Thomas W. Loughin to suggest that the importance of their experiments to theatrical development may be "equivalent to the introduction of stage lighting."[75]

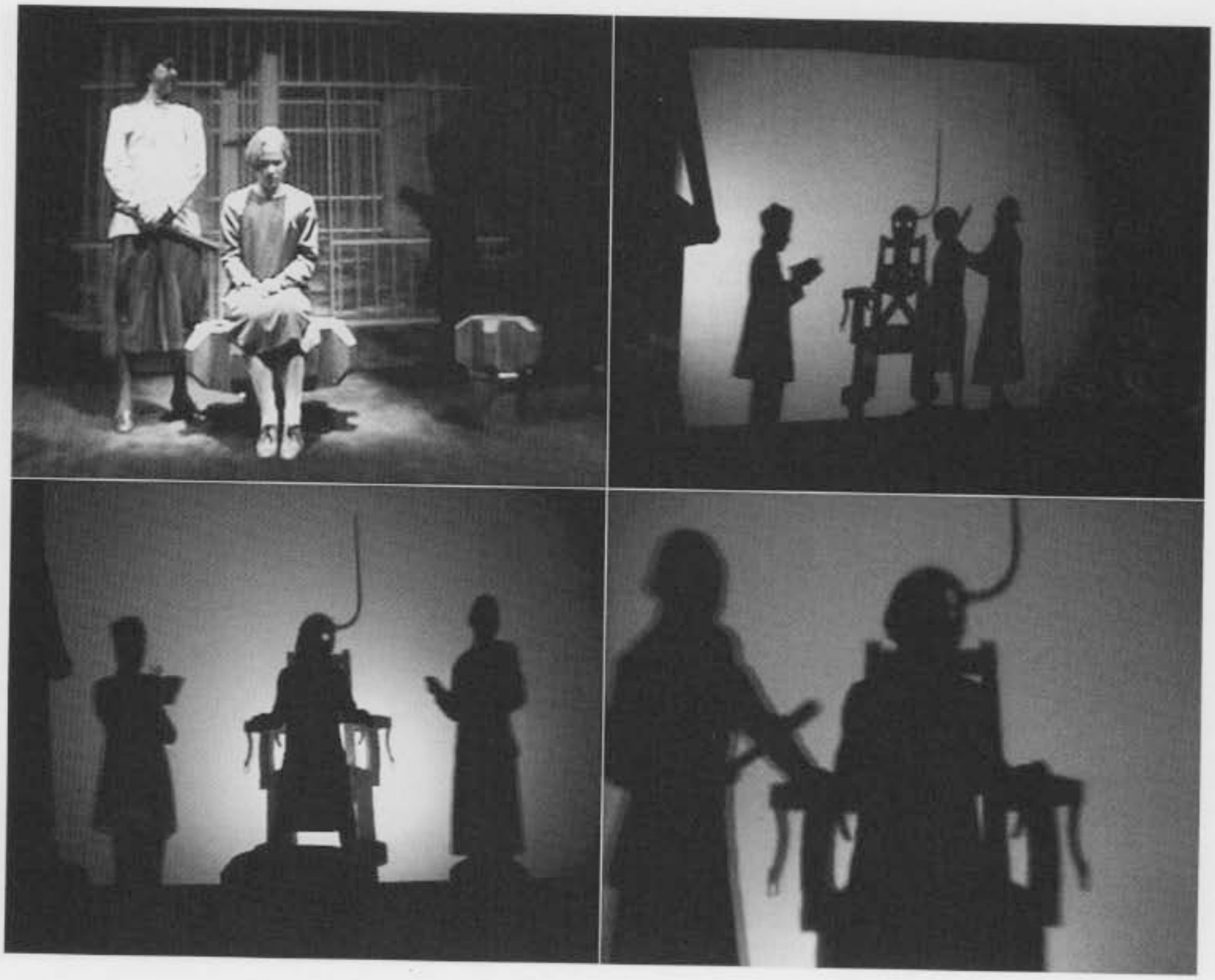

Figure 15.11 Live shadow play and a VR model electric chair combine for the climax of *Machinal*.

Brainscore

An abstracted VR war game filled with smart weapons and featuring men in quasi-military uniforms is played out by two performers for the benefit of a theater audience in David Grassi and Darij Kreuh's thirty-minute performance *Brainscore* (2000). Two male performers in red boiler suits recline in full-body-length, high-tech chairs at either side of the stage, their heads motionless in large neck rests. Electrodes attached to their heads monitor their brainwave activities, and eye-tracking cameras are focused on one of each of their eyes. A video image of each moving eye is relayed onto two floor monitors in the center of the stage, which place the performers' pupils within a gunsight-style graphical target. Facing the operators, and the audience, whose members wear polarized glasses, is a large screen projecting a rotating, custom-designed 3D VR environment, its virtual walls, ceiling, and floor composed of the word "Brainscore."

A synthesized female computer voice announces that she is "Loading Properties," and the screen environment transforms into a concave space composed of small, stretched green

oblongs somewhat reminiscent of the streaming computer code in the opening credits sequence of the movie *The Matrix* (1999). In the foreground, two amorphous spheres, red and blue, float, rotate, and dance around each other, suspended in space. These are the two performers' avatars, and at this stage they are like soft, plasticine planets: "empty . . . they neither possess any specific aesthetic characteristics, nor behavioural."[76]

The system then loads five sets of twenty objects containing different types of information that the operators use to feed, fill, and mold their avatars by using their brainwaves and eye movements to fulfill a series of operations and commands. These objects appear as other, smaller, spherical shapes on screen, which move in accordance with the operators' brain and eye activities. Three head electrodes transmit their brainwaves to an electroencephalograph, which analyzes and transfers the EEG signals to a computer which interprets and processes them, while the eye-tracking system also enables the performers to effect real-time manipulations of the objects within the VR screen space. LCD monitor consoles set in front of the performers (and also projected onto large side screens) show a brain, divided into five active areas and cortexes (motor cortex, auditory cortex, and so on), and each brain area relates to one of the sets of spherical objects loaded and its manipulation.

Each brain area has been designated a theme regarding the global migration of goods and information: transport, the media, meteorology, the stock exchange, and epidemic diseases, and each theme is represented by twenty global webpages that refer to it. The performers direct their eyes and brainwaves on the appropriate brain area displayed on the LCD screen to activate direct contact with the Internet and the server that hosts the page they are looking for. This "pinging" procedure activates the real time transfer of the objects' data to the performers' avatars, and the computer Voice helpfully informs us: "Properties chosen by users' brain activities." On the main center screen, the cellular spheres send concentric circles of graphical "beams" that the protagonists' avatars absorb, transforming their color, shape, texture (and sound) to become like irregular, bulging boulders, which spin and rotate.

The synthesized voiceover then announces "Passwords to define aesthetic value," and a stream of graphical passwords (collected from the webpage of an anonymous hacker) appear to swarm and spin around the screen. These are programmed as links to the other objects, and when the performers use their eyes and brainwaves to manipulate them (using a specific pattern of beta and theta frequencies), they "score" (hence the piece's title) and "feed" their avatars with data, whereupon the password flies away off screen. The avatars grow larger and more physically and kinetically defined, and the climax is reached when the performers' avatars have absorbed sufficient data, and the computer voice announces "Avatars Ready . . . Avatars Perform!"

The other graphical objects and passwords disappear, and the two avatars begin to communicate with one another kinetically and sonically using the data that composes them. The musical effects increase to a crescendo of "conversational" computer whirs and bleeps,

ambient musical sounds and computer-game style "stings," as they undertake a frantic and frenetic improvisational dance. The 3D avatars change color and shape rapidly, and loom forward and backward dramatically in the shadowy VR space. Their amorphous, meteorite-like appearance gives way to head and skull-like shapes that "dance" and "sing" together as they luminously metamorphose in gravitation-less space. At the end of their pas de deux, the computer voice declares, "All properties matched," and the stage lights and screen fade to black.

Brainscore is a highly sophisticated neuro-VR performance based on the model of an advanced, avant-garde 3D computer-game, but it arguably works more effectively as a technological demonstration than as a satisfying performance. That is to say, it demonstrates complex and fascinating software research undertaken to present new technological paradigms for performance, rather than creating an intellectually or dramatically fulfilling piece of theater. By contrast, the war game at the heart of Blast Theory's VR performance installation *Desert Rain* (1999) provides a theatrically unified and unforgettable VR experience for its six audience members/players, who pursue their human targets through a VR desert landscape projected onto a rain-curtain of flowing water, which we analyze in detail in chapter 24.

Eduardo Kac, an artist seemingly with a finger in every conceivable digital arts pie, has utilized VR to quite different effect, providing headsets to offer gallery visitors unique views of his telerobotic creatures, such as a macaw in *Rara Avis* (1996), and a bat in *Darker Than Night* (1999, with Ed Bennett). Visitors to the Blijdorp Zoo in Amsterdam were given access to the point of view of Kac's *Darker Than Night* "batbot" as it flew among three hundred real Egyptian fruit bats in a small cave. The telerobotic bat "contains a small sonar unit in its head, a frequency converter to transform bat echolocation calls into audible sounds, and a motorized neck which enables its head to spin."[77] As the batbot flies around the cave using its sonar to avoid the other creatures, the user's vicarious view through the VR headset shows the hundreds of real flying bats as kinetic white dots. Kac points out how the presence of the artificial bat significantly affects the behavior of the real ones, and how both continually monitor and track each other. "*Darker than Night* emphasizes the barriers that prohibit each individual to move beyond one's insular, self-reflective experience," he writes. "The bat, a rarely understood, enigmatic, flying mammal, represents the mystery and nuances held within each individual's consciousness."[78]

The Future of VR Performance

Now we're at the threshold of the next revolution in user-computer interaction: a technology that will take the user through the screen into the world "inside" the computer—a world in which the user can interact with three-dimensional objects whose fidelity will grow as computing power increases and display technology increases. This virtual world can be whatever the designer makes it.

—JOHN WALKER[79]

Despite the enthusiasm of John Walker, and the heady predictions of other VR prophets of the early 1990s such as Lanier, Rheingold, and Pimentel and Teixeira, artistic VR applications have so far failed to fully realize the visionary expectations. Writing in 2003, Christiane Paul notes how "full immersion into a simulated world that allows users to interact with every aspect of it is still more of a dream than a reality." She points out that the art world is currently far behind the VR experiences which use force-feedback devices in theme parks, which is currently where the most advanced experiments are taking place.[80] Scott deLahunta reflects that while dance has been at the forefront of experimentation with interactive technologies, performances have mostly been presented in conventional proscenium spaces, and the potentials of VR for dance have been largely unexplored. He notes that even the most radical choreographers have become somewhat entrapped by a fixed sense of performance space and time, and a separation between dancer and spectator, whether in live or "dance for camera" contexts, and he suggests that dance's engagement with VR is now long overdue.[81]

Bolter and Gromala suggest that "although VR has proven useful for specialized applications, we are not any closer today [2003] than we were in 1990 to a general, 3D, immersive interface." They see "ubiquitous computing," defined by Mark Weiser as "when almost every object either contains a computer or can have a tab attached to it,"[82] as the future direction of digital technologies. Rather than VR's search to eliminate the interface and become a converged, transparent window into pure experience, it is the opaque scattering of multiple computational devices throughout the environment that presents the most compelling model for future human-computer interaction: "Digital designs intersect with our physical world; they cannot escape into pure cyberspace."[83]

Two major issues impede the development of VR-based performance experiences: cost and time. The time part of the equation relates not only to the programming and design of thousands of polygons defining the 3D spaces and objects, but also to the time it takes for each individual user to be fitted with the VR equipment and to operate in the virtual environment. Most HMD-based VR experiences are for one or two individuals (although others may watch them and the projections they see from the sidelines, as in *Osmose*), and throughput problems have therefore been a major issue inhibiting widespread development of HMD immersive experiences, including in the commercial sector and in theme parks. Classic VR experiences are highly individual and improvisational, and require sufficient time for users to orient themselves and explore. As Brenda Laurel, Rachel Strickland and Rob Tow put it: "A hard-driving plot with distinct beginning, middle and end is a great way to control how long an experience takes, but 'classic' VR is inimical to this type of authoritarian control—it works best when people can move about and do things in virtual environments in a relatively unconstrained way."[84]

These writers contrast the passivity of mass entertainment forms with the activity and interactivity of VR, where both perceptual and emotional experience depends on the user's action and the environment's responses: "In VR, one is not *done unto*, but *doing*."[85] Like

Michael Benedickt, who once hailed VR as a space where "we will become again 'as children' but this time with the power of summoning worlds at will,"[86] they conceive VR as more a form of play than entertainment, and observe that through their *Placeholder* project they learned that in VR adults play and use their imaginations like children. Equally, they write, "the environment proceeds to record our presence and actions and the marks that we place there—this is a reciprocal affair."[87] They see the future of VR not in installations and public venues, but in VR sites and even virtual theme parks on the Net, enabling much wider audience access.

There have already been some impressive achievements in VR performance, although these are few in number, and interest in using the technology is not widespread. Perhaps, like 3D movies—with which VR shares some distinct similarities—the VR art form will simply not catch on, and will remain an oddity, a novelty. But the potentials of VR application to performance are so enticing that we predict they will be fully embraced and significantly developed in the future for both commercial and avant-garde performance forms. Indeed, it is possible that in the twenty-first century, VR may become as important and revolutionary an artform as cinema was to the twentieth century. With that in mind, we will leave the last, defiantly upbeat words on Virtual Reality to the man who coined the phrase, and has been one of VR's principle industrial originators and popular advocates. Jaron Lanier's breathless vision of VR's future is quintessentially theatrical, and psychologically and sociologically radical:

> It'll become a sort of community utility in which dreams are shared and ideas cocreated. . . . You go into your house and you look around, and everything's normal except that there's some new furniture added, but only when you put on these special glasses. . . . One of the items of furniture is a big set of shelves with fish bowls, and if you look in these bowls there aren't fish, instead there are little people running around . . . and a few of them have really weird things going on inside, like bizarre parties where people are changing into giant snakes, and what you do is put your hand into one of the bowls, put your head into it, and all of a sudden it starts getting really big, until you're inside it and become one of those people. . . . I think something very special is going to happen, which I call postsymbolic communication. This is an idea of a new type or stratum of communication where people are skilled at, and used to, cocreating shared worlds spontaneously, improvising the content of the objective world. Without limit, on an ongoing improvised basis . . . like a conscious shared dreaming.[88]