The MIT Press

Nature, Technology and Art: The Emergence of a New Relationship?
Author(s): Ursula Huws
Source: *Leonardo*, Vol. 33, No. 1 (2000), pp. 33-40
Published by: The MIT Press
Stable URL: http://www.jstor.org/stable/1576759
Accessed: 19/01/2010 13:09

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at http://www.jstor.org/page/info/about/policies/terms.jsp. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at http://www.jstor.org/action/showPublisher?publisherCode=mitpress.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

The MIT Press is collaborating with JSTOR to digitize, preserve and extend access to *Leonardo.*

http://www.jstor.org

Nature, Technology and Art: The Emergence of a New Relationship?

Ursula Huws

ABSTRACT

The three-way relationship between nature, technology and the human subject has been a problematic and shifting one in the history of Western art and thought. In this article, the author begins by summarizing this history, pointing to the inadequacy of most theoretical accounts in the face of the growing interpenetration of the "natural" by the "technological" resulting from such developments as genetic engineering and artificial intelligence. The author goes on to argue that the convergence between scientific developments in the field of artificial life and the emergent art movement points to the development of a new understanding of this relationship and a new role for the artist.

The history of the human conception of nature in Western thought is a problematic and shifting one. We can trace the notion of the natural as a separate "other," counterposed to the human subject, back to Plato's *Phaedrus*, but this "otherness" has taken a number of different forms. In the early Judeo-Christian tradition, for instance, nature is a source of evil and original sin, while in the scientific conception it becomes a prey to be hunted and subdued—even raped, if necessary—a view perhaps articulated most clearly in the seventeenth century by Francis Bacon, who explained his experimental method in the following terms:

> You have but to hound nature in her wanderings and you will be able when you like to lead and drive her to the same place again. Neither ought a man to make scruple of entering and penetrating those holes and corners when the inquisition of truth is his whole object [1].

Fig. 1. Photograph taken in a London garden, 1997. "Biophilia" is the word used by biologist Edward O. Wilson to describe human aesthetic appreciation of the behavior of the animate earth, much of which derives from its unpredictability within known parameters. While the habit of any individual plant may be well known, for instance, the appearance of each leaf, and its relationship to the ambient environment is a continual source of surprise. (© Ursula Huws, 1997)

The self-conscious human pleasure in "nature" is often traced back by historians to the eighteenth century. Commentators may point to the careful reconstruction of asymmetrical wildness in the country gardens designed for English landed gentlemen by Capability Brown, or to the fashion among Marie Antoinette's courtiers for acting out the parts of shepherds and shepherdesses in contrived rural surroundings. Later, the romantic movement, as exemplified in the poetry of Wordsworth and Coleridge, or the paintings of Géricault and Delacroix, sought out and celebrated both the haphazard charms of the uncultivated countryside and the savage dramas of the elements in full fury. It became fashionable to admire not the tamed, gentle landscapes of tended garden and farmland but the windswept openness of mountain and ocean, the vicarious dangers of storms and torrents. In place of a Tudor knot garden we find a turbulent Turner seascape; instead of a Stuart lap dog, a snarling panther devouring its prey.

It is possible to interpret this romantic construction of nature as a product of and reaction to industrialization: the transformation of the natural world into a spectacle or "picnic" for a population living in a highly commodified urban society in which the satisfaction of daily needs no longer depends on wrestling food, shelter and warmth directly from a hostile environment; a society in which all contact with the natural is me-

Ursula Huws (writer, researcher, photographer). Analytica, Social and Economic Research, Ltd., 46 Ferntower Road, London N5 2JH, United Kingdom. E-mail: <analytica@dial.pipex.com>. Web: <http://dspace.dial.pipex.com/analytica>.

Editor's Note: For more works related to artificial life (A-Life), see Kenneth Rinaldo, ed., Special Section "Artificial Life Art," in Leonardo *31, No. 5 Sixth Annual New York Digital Salon special issue (1998) pp. 370–407.*

© 2000 ISAST

Fig. 2. The never-quite-repeated patterns made by the imprints of these sea-birds' footprints in sand on a Portuguese beach are evidence of a source of visual interest that parallels that to be gained from some works of emergent art. (© Ursula Huws)

diated through multiple layers of technology and an elaborate and specialized division of labor that permits few individuals to comprehend more than a fraction of any given process. In this conception, nature becomes an escape, an idealized space away from the world of machine-made artifacts that constitute the daily environment of work, home, consumption and urban leisure.

More recently, technology has even entered the body itself, in the form of processed food, manufactured drugs, plastic surgery, genetic engineering, chemical contraception and sexual responses conditioned by the lens of mass-market pornography. In a worldview in which the "technological" is counterposed to the "natural," this aligns the self ever more closely to the former and sets it in opposition to the latter. No longer the raw material of life, nature has become a site of non-activity or leisure, a negative, a signifier of the absence of human intervention, or simply an extra category in the vast and ever-expanding range into which commodities can be classified. Thus, we might buy "natural" remedies in a health food store, choose food to which only "natural" flavors and colors have been added, use "natural" methods of birth control, ask our hairdressers to give us a "natural look" or buy cosmetics made with only "natural" ingredients.

In the postmodernist vision (or at least Jean Baudrillard's version of it) all reality has become simulation, and the natural is reduced to a single—albeit heavily loaded—symbol in social discourse, to be manipulated and replicated like any other symbol. This view has a neatness and plausibility that is attractive to anyone trying to make sense of human consciousness under the conditions of advanced capitalism. Indeed, it appears to break down the crude mind/body dualism implicit both in the romantic artistic notion of nature "out there" as an escape and in the scientific notion of nature as raw material for experiment. Yet this view also poses problems: the human subject it assumes is one whose entire existence is produced and reproduced within the interplay of discourses, a person whose every dimension is socially determined. It thus tries to resolve the contradictory relationship between the cultural and the biological by writing the latter out of the picture altogether and denying any place for the material reality of the body as an entity made up of perishable, living tissue, formed of the same cellular material as other living beings, and hence itself a part of "nature."

There is a second objection to this model, more directly relevant to a discussion of art and technology. This arises from an examination of the evidence produced by anthropology and of the products of other cultures that suggests that it is dangerously simplistic to regard the "natural" as just another artifact or ingredient in our specific cultural vocabulary. I use the word "nature" here in the neo-phenomenological sense—ultimately derived from Heidegger [2]—in which it is employed by David Abrams to indicate "the animate earth" or the "life

Fig. 3. The fountain by Richard Huws (1902–1980) for the 1951 Festival of Britain formed the central feature of the "Sea and Ships" Pavilion. Partly inspired by the sight and sound of waves crashing on the shore in his native Anglesey, he designed its curving steel buckets so that they would empty at differing intervals, producing a pattern that, he calculated, would not repeat itself exactly for at least a million years. (© Richard Huws Estate, 1951. Courtesy of Ursula Huws.)

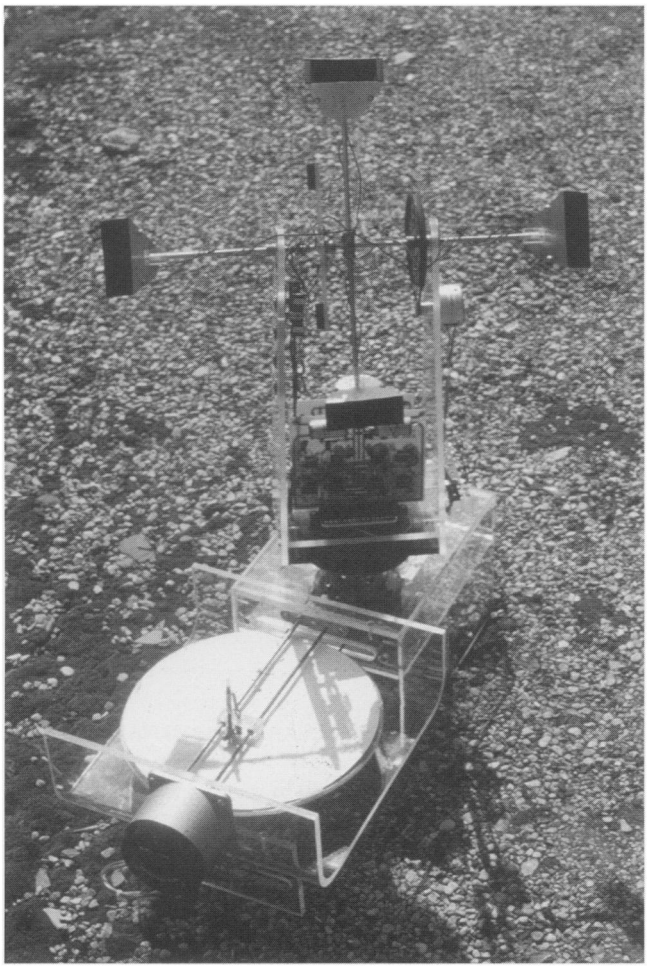


Fig. 4. Norman White, *Ménage*, 1974. *Ménage* produces surprisingly complex group behavior by relatively simple means. It consists of four robots with attached spotlights crawling back and forth along separate ceiling tracks, and a fifth stationary robot on the floor. Each of the five machines has a rotating antenna-like scanner, designed to point toward any strong light source. Ceiling robots therefore tend to lock into each others' gazes until their non-responsive track-motors pull them apart. The floor robot scans vertically as well as horizontally and graphs its own movements as it tracks the ceiling robots. (© Norman White, 1974. Photo: Michael Mitchell.)

of the land" [3], in other words, those aspects of the environment that are perceived by most people in Western cultures as "alive" or subject to non-human forces, to be studied by means of the biological and meteorological sciences.

Using this definition, we find that there is hardly a society known to literature that does not express some aesthetic appreciation of the natural. The evidence for this can be found in a variety of forms, including folksongs, stories, myths, rituals and the design and decoration of everyday and ceremonial objects. The evidence is there in the nostalgic laments of the exile for the beauties of the landscapes of home; in the comparisons made when enumerating the attractions of the loved one in songs or poems of loss and courtship; in paeans of praise to gods or invocations to spirits; or in representations of animals and plants on pottery, jewelry or fabrics. The interpretation of these representations is, of course, culturally specific and it would be naive to suggest that any pleasure derived from their contemplation in one context is directly comparable with that which would be experienced in another, or indeed that the original intention of their producers can ever be deduced by a viewer looking through the lens of another culture. Whether or not such representations are even to be regarded as "art" must remain a moot, and variable, point. Only a solipsist could deny, however, that there is overwhelming evidence that some joy in the contemplation of the natural is one of the most constant elements in human experience, as expressed across most of the range of cultural forms that have come to be regarded as "art." While the particular aspects of the natural singled out for special attention or admiration vary widely across cultures, some elements of aesthetic appreciation seem evident both when natural phenomena are represented descriptively or symbolically and when they are used as metaphors for human attributes.

Because of the limitations of the media available, most of the visual representations of nature available to us are static. We might think of the delicate silhouettes of trees, birds and prancing deer in Persian miniatures; the solemn, hieratic profiles of clan animals on Native American totem poles; the misted mountains in the backgrounds of early Renaissance Italian paintings; a whirling carp or spray of cherry blossom on a Japanese scroll; or even the leaping horses in the Lascaux cave paintings—all share a quality of a moment frozen in time, however grandly and expertly this may have been synthesized to produce the effect that we can only describe, inadequately, as "timeless" or "classical." Even when it adorns an object that is handled every day, the "natural" thus appears in a separate, framed-off space, set a little apart from the dynamic flows of life around it. Indeed, in some concep-

Fig. 5. Norman White, *Splish Splash Two*, 1975. Commissioned by the Canadian Broadcasting Corporation for the foyer of its Vancouver headquarters, *Splish Splash Two* uses hard-wired electronic circuitry to trigger randomly initiated "ripples" of light, designed to simulate the effect of falling raindrops on a pool. (© Norman White, 1975)

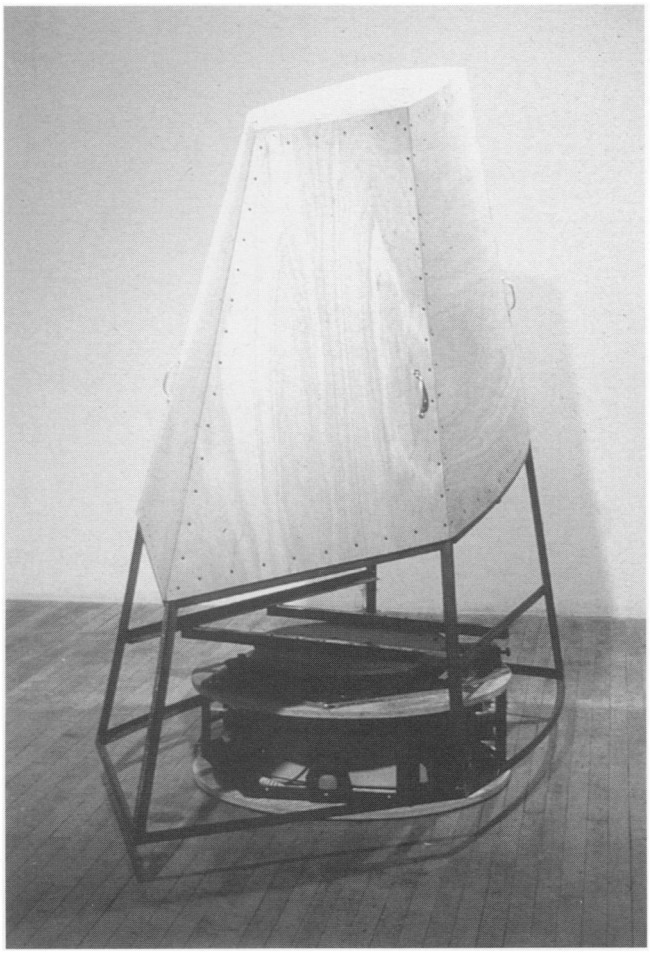


Fig. 6. Norman White, *Helpless Robot*, begun in 1987, still being refined and developed. This work comes closer than any of White's other work to date to the concerns of the artificial life community. This is a speaking robot that can only be moved by human assistance. In a parody of emotionally manipulative human behavior, it senses the presence of a person and begins by pleading politely for help. Having enlisted aid, it senses how roughly it is being handled and responds to considerateness by becoming progressively ruder and more demanding. (© Norman White, 1990)

tions of art this quality of timelessness and unchangeability is precisely what gives it its character as art. In John Keats's classic formulation of the romantic aesthetic, for instance, the conclusion that "Beauty is truth, truth beauty" in the *Ode on a Grecian Urn* derives precisely from the freeze-frame nature of the forever unconsummated terra-cotta image that will remain perfect even "when old age shall this generation waste." Change over time (except that resulting from the aging of the materials from which it is made) is explicitly precluded from this characterization of art, and it is from this quality of being outside time that a work derives its poignancy.

However, if we move beyond the media narrowly defined as "art" in Western culture, we can find evidence of the natural being enjoyed aesthetically, not just as a frozen, visual image but in another way: for how it behaves. There are, for instance, the simple pleasures of watching the movement of clouds across a sky, the play of ripples in water or the movement of wind in leaves. There are examples from many societies of people going to some lengths to contrive situations in which such pleasures can be visited at will or even to cultivate a sort of connoisseurship of their delights. How else can we explain keeping birds in cages or fish in tanks, or the many elaborations of gardening, both indoors and out, that most cultures have developed? Part of the joy of such spectacles is surely the tension afforded to the viewer between the expected and the unexpected. One can know the characteristic form of development of a particular plant, for instance, or the characteristic pattern of movement of a particular species of fish, or butterfly, but one can never anticipate quite how any given leaf or flower will arrange itself against its neighbor (Fig. 1), or precisely what direction any given movement will take. One may well know the cuteness of a kitten, and it is perhaps its very familiarity that endears one to the sight of it. Yet the chief charm of watching a litter of kittens at play is the unpredictability of their interactions with each other and their environment. In other words, one derives a great part of the pleasure not from capturing a passing moment in some near-eternal form but, on the contrary, from the continuing surprise of watching how each moment evolves into the next. The very evanescence of the event forms part of the attraction. This phenomenon, christened "biophilia" by biologist Edward O. Wilson, has been discussed in relation to the selective breeding of ornamental plants by George Gessert, who concludes that "one of the great unacknowledged forces of domestication today may be hunger for diverse uselessness [4]."

Whether we can describe a tank of tropical fish or a pot of geraniums or even a window looking out over a spectacular "view" as "art" is a debatable point. What is undeniable is that these are a source of aesthetic pleasure and interest to a great many people, perhaps many more than ever gain enjoyment from the contemplation of the officially canonized works on display in art galleries.

A more interesting question, perhaps, is whether art (that is, formal art, as practiced by people whom society labels as "artists") can ever satisfy this hunger for diverse uselessness, generating the sorts of satisfaction produced by the observation of nature not as static image but as process (Fig. 2); whether, in other words, it is possible to represent, comment upon or simulate nature in an artistic form not as likeness but as behavior.

Twentieth-century art has produced occasional and sporadic experiments that might be interpreted as attempts to do this. The mobiles of Alexander Calder recreate the visual interest and pleasure derived from observing the interplay of natural shapes in motion, such as seaweed swirling in a rock pool, a butterfly investigating a flowering shrub or gulls wheeling in a current of air. The self-destructing "meta-machines" of Jean Tinguely could be interpreted as artistic analogies of dramatic natural events such as storms or tidal waves. The water sculptures of my late father, Richard Huws, in which curved buckets of different sizes and forms emptied their contents with a crash, were designed to emulate the never-quite-repeating patterns of waves breaking on the shore (Fig. 3). It could be argued that the medium of film, and later video, also added a dynamic dimension to visual art. However, films and videos (reproducible commodities as they are) offer closed, repeatable experiences. While they have a beginning, a middle and an end, and movement and progression take place within them, they are nevertheless "outside time" in the sense that each showing is identical to the last. The director's vision remains frozen, printed permanently on celluloid or magnetic tape for

as long as the medium survives. In a slightly different way, the "landscape architecture" or "nature sculptures" of artists like Christo, Richard Long, Andy Goldsworthy and Carl-Erik Stromm entail a sense of interaction between art and nature, and of process as a characteristic of both. The work of art placed in a "natural" outdoor setting, outside the rarefied space of the gallery, takes its place alongside and within natural processes and may be constructed of ephemeral materials that weather and decay as do leaves or twigs (if indeed the works are not actually made of these materials). Ironically, though, the means by which audiences usually become aware of such works are precisely those the artists appear to be trying to subvert: still photographs in exhibitions or books, or documentary films.

If we except the forms of art that involve live human performance (among which I would include music and much conceptual art), it is only recently, with the introduction of information technologies, that it has become possible to envisage forms of art that make it possible to explore or model the way "nature" behaves (as opposed to how it looks) in any depth. Perhaps the most promising vehicle for such exploration has been the coming together of the nexus of technologies currently known as "artificial life" (or AL) with the movement that is beginning to be called "emergent art" [5].

The relationship between computers and art has in the past been sadly dominated by graphics. Seduced by the ability of ever more powerful and memory-rich machines to store ever more densely packed concentrations of pixels, computer designers and artists have become obsessed with reproducing on the screen the sorts of images, both still and moving, that could previously be constructed only on canvas, paper, celluloid or magnetic tape by hours of painstaking work or laborious special effects. However, none of these admittedly dramatic effects exploits the unique attributes of the computer. Just as early photographers strove for recognition as artists by aping the look of the conventional salon paintings of the period, and early films mimicked the theater, so these computer artists can be seen as copying the externals of older forms of visual art. To the extent that "nature" makes an appearance at all in such work, it does so in its traditional role, depicted descriptively and passively, as a point of reference or as metaphor.

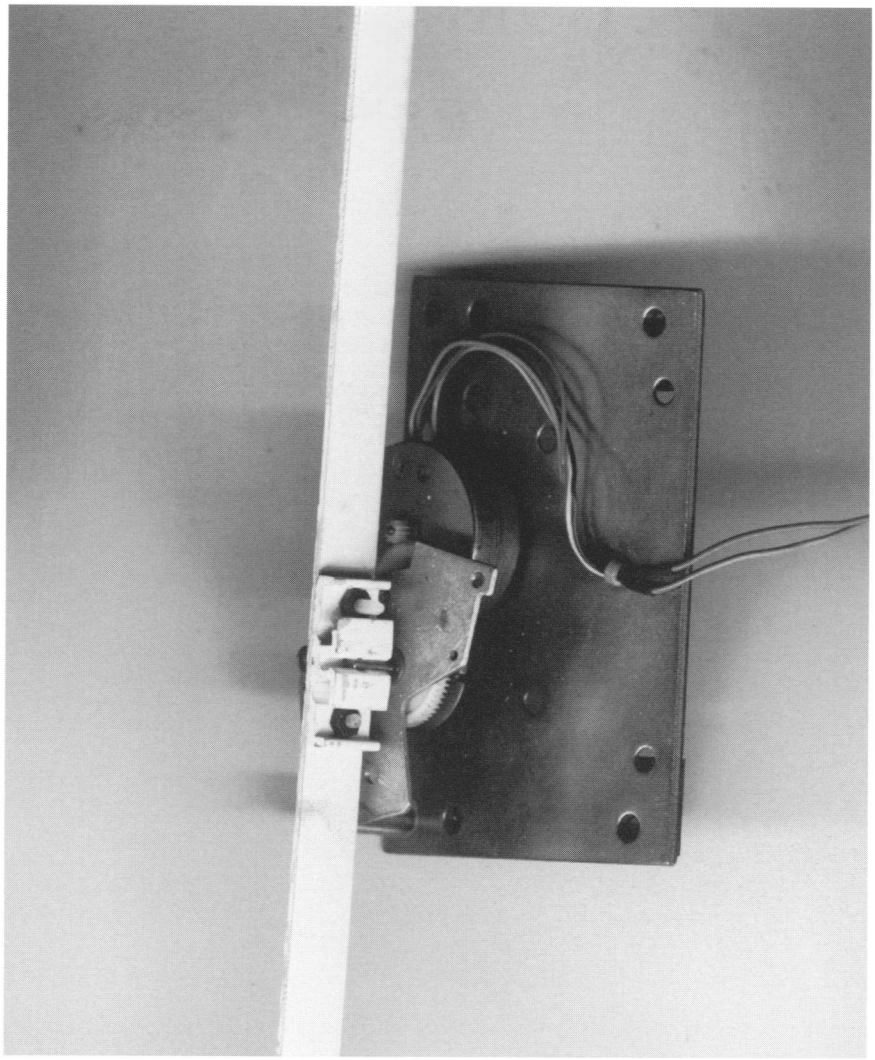


Fig. 7. Doug Back, detail of *Sticks*, 1979. *Sticks* produces patterns that appear to mimic animate behavior with an extraordinary economy of means. The work consists of a series of identical stepper motors, each with a horizontal stick attached to the shaft, arranged so that the sticks can bump into each other as they spin. Each collision produces an automatic reversal of the direction of spin, producing the illusion that each stick is "learning" to avoid its neighbors. Back discovered this characteristic of two-phase stepper motors by accident when, in a spirit of experimentation, he attached a motor that he thought was broken to a source of alternating (instead of direct) current. (© Doug Back, 1979)

A small and largely neglected group of artists have chosen to use computers not just to imitate brush or camera, but to model or set in motion patterns of behavior that, by analogy or mimicry, can parallel those found in the natural world and give rise to the responses of surprise, insight, amusement or delight that are triggered by observing other (non-human) forms of life.

The starting point for such work has not been so much the computer's ability to produce dramatic visual effects on a screen as its ability to process non-graphical information. We can detect an evolutionary chain running from mechanical engineering (as in Tinguely's Heath Robinson-esque machines, set in motion by gears and pulleys) via hard-wired electronics to more complex software-driven works. These pieces are closer to robots than to paintings or videos, making use of sensors and motors to move around in and respond to their environments, including interacting with human spectators and, very often, with each other. Eduardo Kac has traced the origins of this approach to a small group of artists who began experimenting with robotics in the 1960s, including Nam June Paik and Shuya Abe, Tom Shannon and Edward Ihnatowicz [6].

While there are isolated individuals (for example, Simon Penny at the Carnegie-Mellon Institute in Pittsburgh) working at the interface between art and robotics in several parts of the world, a major center of this new movement is

Canada. The Toronto-based Artist Robot Group has about 40 members, most of whom have links with the Ontario College of Art and Design, many of them as students of Norman White, who has been exploring the artistic potential of electronics and computing technologies since the 1960s. White is described by Kac as "the first artist to have consistently championed robotics as an art form throughout the years" [7].

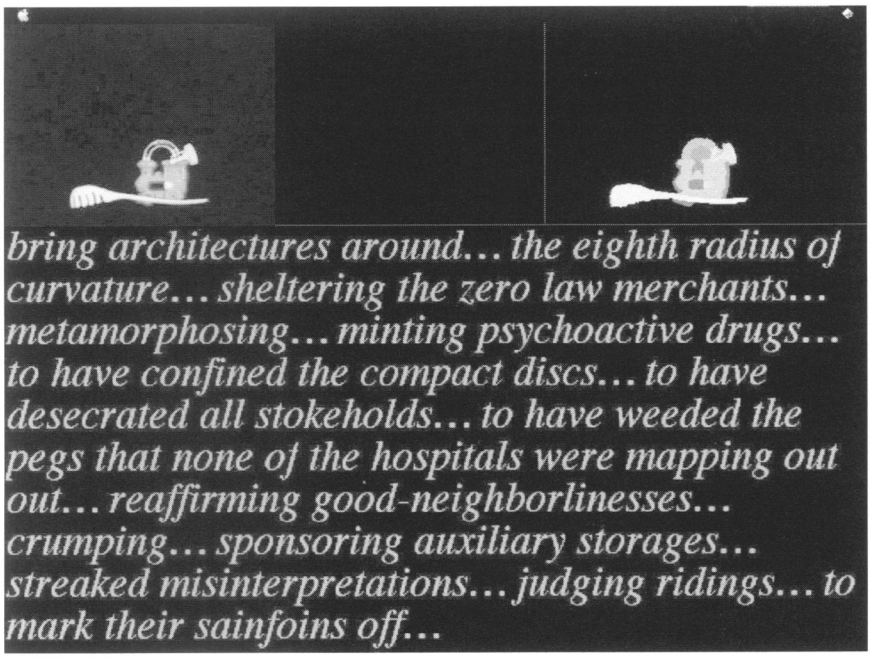
Although produced without computers, some of White's early electronic works already demonstrated his interest in producing unpredictable behavior analogous to natural processes. His 1974 *Ménage* (Fig. 4) (built in homage to the brain researcher W. Grey Walter, who pioneered the artificial modeling of organic behavior) consists of five robots, which both emit and respond to light and respond to each other with complex and unpredictable movement. The 1975 *Splish Splash Two* (Fig. 5) uses randomly initiated ripples of flashing lights to simulate the effect of raindrops falling on the surface of a quiet pond. In 1977, White introduced a microcomputer to control the interactive robot in *Facing Out Laying Low* (Color Plate B No. 2), which surveys its surroundings from a fixed point and responds to activity that it finds "interesting" with a variety of audio responses. White's more recent *Helpless Robot* (Fig. 6) also has a "voice" that it uses to entice passersby to move it. When they oblige, the robot becomes progressively more demanding and imperious until they are forced either to become its slaves or to disengage themselves. Offering an ironic metaphor for certain kinds of interpersonal relationships (or indeed for the general relationship between people and technology), this machine is sensitive enough to detect and respond to very slight variations in the behavior of its human operators, thus producing a vast range of differentiated responses from a limited vocabulary.

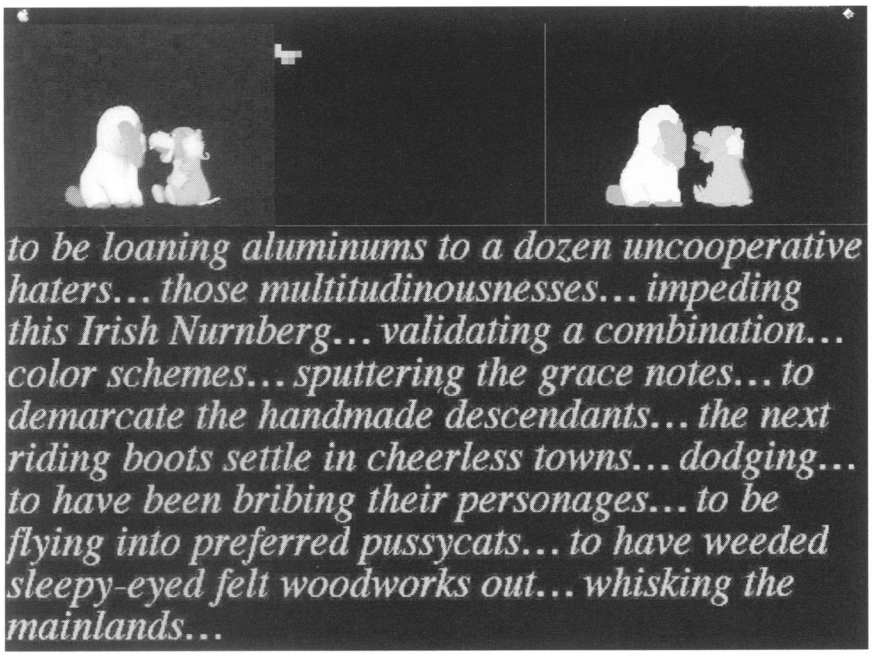
Doug Back was another early experimenter with self-organizing kinetic sculpture. His 1979 *Sticks* (Fig. 7) produces what appear to be extraordinarily lifelike behavioral patterns by means of a simple series of identical two-phase stepper-motors, each with a horizontal stick attached in such a way that the sticks collide with each other as the motors turn, reversing their direction of spin in the process.

Another important artist in the Artist Robot Group is David Rokeby, whose *Very Nervous System,* begun in 1982, involves a large wired-up space within which any movement is tracked, responded to and transformed into music. The piece thus permits a dancer to generate his or her own soundtrack. His *Giver of Names* (Fig. 8) is a computer installation that "grabs" an image of any proffered object, processes it onscreen and "radiates" the results of this analysis through a metaphorically linked associative database from which phrases or sentences are constructed and then spoken aloud.

In Europe, a central locus of this movement is at Newport College of Art in Wales, under the directorship of Roy

Fig. 8. David Rokeby, *Giver of Names,* first exhibited in 1997 but still under development. *Giver of Names* consists of a computer that "grabs" as an image any object proffered to it and visibly performs many levels of image-processing (including outline analysis, division into separate objects or parts, color and texture analysis) while uttering an audible commentary through a voice synthesizer. The results of these analytical processes are then "radiated" through a metaphorically linked associative database in order to select an appropriate phrase or sentence, which is finally "spoken" by the computer. The original (1997) database consisted of all Rokeby's own writings over a 12-year period and, in his words, "used this landscape of word usage as a terrain to wander. The work generated sentences that I might have written, often absurd, often very funny, sometimes startlingly wise. It was a sort of self-portrait." (© David Rokeby, 1999)





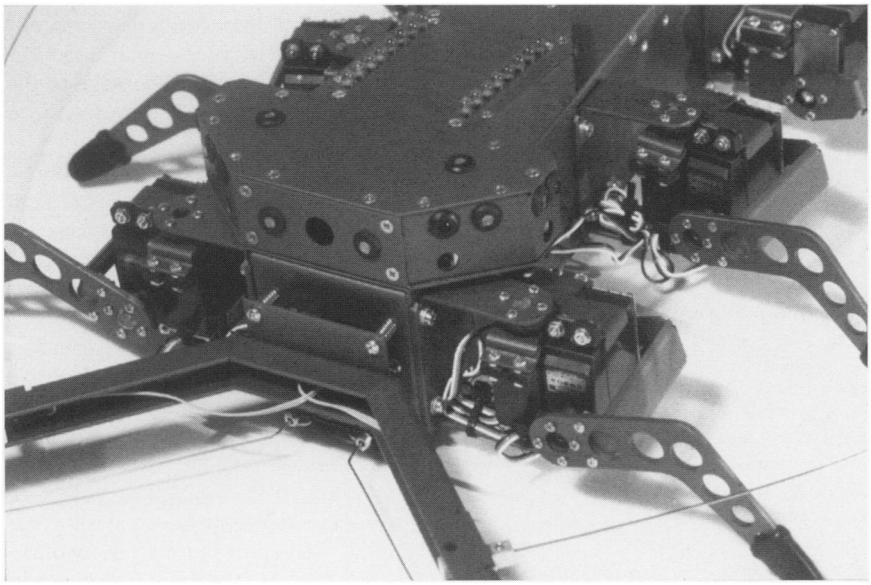


Fig. 9. Nick Jakobi, *Evolved Octopod*, 1997. *Evolved Octopod* was designed by Jakobi at the School of Cognitive and Computing Systems at the University of Sussex and built by Applied AI Systems, Inc. Ant-like creatures simulate evolutionary processes by testing a wide range of possible strategies at random and selecting those that work best. The "winners" are reproduced with some mutations and the cycle repeated, producing, in Jakobi's words, "control systems that work, but we don't know how." (© COGS, 1997)

Ascott (who can also be credited, indirectly, with introducing electronic art to the Ontario College of Art during his brief spell as principal there during the early 1970s). In the summer of 1997, Newport hosted a "research conference" on Art and Consciousness in the Post-Biological Era, where artists as diverse as Rebecca Allen, Ebon Fisher, Zoe Beloff and Nik Williams, as well as double-acts Alan Dunning and Paul Woodrow, Nita Sturiale and Anita de Waard, and Knut Mork and Stahl Senslie put on what amounted to a 3-day interactive experimental workshop in emergent art [8].

As artists like these have been moving closer to the world of computing in their search for newer and subtler ways to model, parody or comment on the behavior of the natural world (including human behavior), so computer scientists have been meeting them halfway in attempts to simulate natural processes that have come to be described as artificial life. A development from the more tightly conceived field of artificial intelligence (AI), AL uses computing not simply to try to mimic human intelligence but also to gain insight into a wide range of natural processes, from the evolution of particular biological forms to patterns of communication. Indeed, it is sometimes claimed that the development of an AL model is closer to art than to science. Lars Risan, for instance, argues that the process is essentially a branch of engineering, involving skilled craftsmanship and a much greater degree of intimacy with the subject than the "distance" of the scientist, and that therefore "as artistic expressions, Alife simulations have aesthetic value" [9]. The AL movement has already produced some curious interdisciplinary hybrids. For instance, the Moscow-based company AnimaTek, which has produced "software toys" in which virtual fish breed new progeny with constantly mutating forms, methods of swimming and responses to their virtual environments, resulted from a collaboration between psychologist Vladimir I. Pokhilko, theoretical and experimental physicists and Alexey Pajitnov (the hacker who invented the game Tetris, known only too well to all Gameboy owners and their parents), backed by investment from the U.S.–based Bullet-Proof Software company [10].

Since its inception, one of the ways in which the AL movement has distinguished itself from AI has been by a fascination with art and a willingness to collaborate with visual artists. Since the late 1980s, "artistic" presentations have been used as a way of demonstrating work-in-progress at AL conferences, and in 1992 a 2-week workshop was held in Aix-en-Provence in which some 50 scientists came together with about the same number of artists to explore themes related to artificial life [11].

This blurring of the boundaries between art and science results in part from a convergence in methodology, brought about by the nature of the technology employed in the creation both of AL simulations and of emergent art. To the extent that artists are concerned with developing unpredictable patterns of behavior (as opposed to producing robots that mimic the externalities of "natural" behavior), they are using information technology in ways that are closely allied to those of the AL research laboratory.

In some cases, this process also involves a conscious rejection of traditional, positivist, scientific models. AL scientist Inman Harvey says,

> I would claim that the false gods of scientific objectivity prevent scientists and engineers from reaching goals that we can achieve, as in my own research on artificial evolution and evolutionary robotics. So when I think it will annoy somebody I call ALife a "postmodern science" and our style of evolutionary robotics "postmodern robotics." Gratifyingly, some scientists are outraged by this [12].

This scientific version of "épatant la bourgeoisie" goes further than a simple desire to shock, making a serious point about self-referentiality [13]. Harvey continues,

> We reject the premise that animals, humans (and ideally robots) are basically rational creatures reasoning about a pre-existing objective world, in favor of seeing them as organisms that maintain their identity through contingent adaptive behaviour in a world which arises for them and is given meaning through such behaviour. One way of pointing this up is to bring into a scientific conference artists who are recognisably dealing with the same issues that concern us. And anyway it is fun [14].

Along with Joe Faith and other colleagues from the University of Sussex, Inman Harvey organized in July 1997 an exhibition called Like Life at the Brighton Media Centre, bringing together the works of AL scientists and emergent artists. Here, White's *Helpless Robot* and works by fellow Canadian artists Mark Tilden and Nell Tenhaaf could be seen alongside products of AL research. The latter included an octopod with an evolved control system (Fig. 9), designed by Nick Jakobi of Sussex University's School of Cognitive and Computing Systems "to create a virtual reality within which possible control systems could be tested at speed." The exhibition also included an appearance by a charming meccano ant and a computer game, designed by Stephen Grand and CyberLife Technology, in which graphically represented "creatures" evolve in their own virtual world, with simulated

brains, biochemistry and genomes. Like sophisticated versions of the Japanese "cyberpet" toys known as *tamagotchi* (which "die" if their tenders do not keep them fed, clothed and amused), these creatures can be "talked to" and taught to eat, drink and meet other creatures with whom, after a period of about a week, they can mate, producing a new, distinctive and, in theory, more evolved generation of creatures. Such exhibitions may come to be regarded in the future as a turning point, a first encounter between emerging branches of technology and art with the potential to generate a new synthesis that could enrich both science and art by producing fresh insights into natural processes.

One of the most striking aspects of this exhibition, and of the Fourth European Conference on Artificial Life to which it formed an adjunct, was the strength of the interest it provoked in the British media. The subject of AL appears to strike a strong chord with the general public, summoning up images of the AL engineer as a tamperer with nature, a Frankenstein-like creator of monstrous pseudo-people. Linked in the popular imagination with fears provoked by such developments as experiments in genetic engineering, cloning or computer programs that can beat grand masters at chess, AL is seen as the technology that finally makes people redundant. The artist-scientist who uses it becomes a sort of alchemist who, instead of producing gold out of dross, produces life itself out of silicon, plastic and bits of wire. In its insistence on the "unnaturalness" of any experimentation, this reaction reinforces the dualistic model in which the "artificial" is counterposed to the "natural."

The specific focus of this reaction appears to be the fact that the AL product has "a life of its own" (to quote the title of an emergent art exhibition held in Mexico City in November 1997). The prospect of out-of-control robotic creatures (or, even more frighteningly, genetically engineered life forms) rampaging around doing their own thing regardless of the human or environmental consequences is the stuff of science fiction. Whether the originating puppetmasters of these machines are believed to be mad scientists/inventors or profit-hungry transnational corporations, the fear evoked is essentially the same: the powerlessness of the ordinary human being in a world in which individual agency has largely been removed and vested in technology. This fear can, perhaps, be regarded as legitimate in a society in which technologies that are understood by the few have to be used by the many in ways that are not life-enhancing. Many have experienced the computer as something that makes redundant or de-skills what was previously a secure job; that standardizes and depersonalizes processes that used to be friendly and intimate; that makes parents seem dumber than their children, and grandparents dumber still; that makes it possible for strangers to collect personal information to be used for commercial purposes. Few people believe in the altruism of governments, employers or the manufacturers and providers of goods and services, and there appears to be a strong intuitive understanding that most of the technologies used extensively in our society are technologies of control adopted precisely because they offer their controllers new ways of consolidating their power [15]. Why else would they want them? Such fears feed an "us-and-them" model in which "we" are natural and vulnerable while "they" stand for artificiality, technology and insensitivity; "we" represent life, while "they" represent death.

It is precisely because of such fears and stereotypes (and the underlying experiences of which they are expressions) that the project of reinventing the relationship between technology and nature is so important, and that this project should not be left in the hands of specialists but should be reappropriated for humankind at large.

Perhaps the development of genetic engineering draws attention most strikingly to the blurring of boundaries between the animate and the inanimate—between biology and technology. Joe Davis, an MIT-based artist, has already dramatized this by embedding a visual image—a feminist symbol—onto the DNA structure of an *E. coli* bacillus, now reproduced many millions of times (he claims to be the world's most "published" artist!). It is possible, of course, to imagine interventions that are less benign in their effects, wittingly or unwittingly.

This is where the role of the artist becomes crucial. It is the artist who can act as a sort of freelance commentator, providing insights into the workings of the universe that go beyond the literal, drawing our attention to the irony, pathos, beauty or sheer extraordinariness of the world we inhabit, and to the awesome powers to destroy or mutate it that lie in the hands of scientists. To the extent that scientists are free agents, independent of large companies, governments or other interest groups, they too form part of this enterprise that involves an interactive dialogue across disciplines, spanning emotional, ethical and sensory experiences as well as addressing more narrowly scientific questions about the nature of the universe. Few scientists, however are granted the freedom to step out of their disciplinary straitjackets and present an integrative vision that is accessible to a lay audience. For the time being, in the urgent project of making sense of the relationship between human understanding and the natural world, it seems likely that art is the best means we have.

References and Notes

1. Quoted in S. Harding, *Whose Science? Whose Knowledge?* (Buckingham, U.K.: Open Univ. Press, 1991) p. 43.

2. M. Heidegger, "The Question Concerning Technology," in D.F. Krell, ed., *Martin Heidegger: Basic Writings* (London and Henley: Routledge and Kegan Paul, 1978) pp. 287–317.

3. D. Abrams, *The Spell of the Sensuous: Perception and Language in a More-than-Human World* (New York: Vintage Books, 1997) p. 202.

4. G. Gessert, "The Rainforests of Domestication: Ornamental Gardens as Sites of Maximum Genetic Diversity among Domesticated Plants," *Leonardo* **30**, No. 2, 129–132 (1997).

5. The exact origin of the term "emergent art" is obscure. According to Norman White, who describes himself as an emergent artist, "'Emergent' is a term borrowed from the Artificial Life community, which may well have got it from theoretical mathematics or physics. I have no idea of its precise origin within this context. I only know it fits." (From E-mail communication with the author, 1999.)

6. E. Kac, "Foundation and Development of Robotic Art," *Art Journal* **56**, No. 3 (1997).

7. Kac [6].

8. Anonymous, "Consciousness Reframed," *Entropy* **1**, No. 3 (Fall 1997).

9. L. Risan, "Why Are There So Few Biologists Here? Artificial Life as a Theoretical Biology of Artistry," in P. Husbands and I. Harvey, eds., *Fourth European Conference on Artificial Life* (Cambridge, MA, and London: MIT Press, 1997) p. 29.

10. E. Corcoran, "One Fish, Two Fish," in *Scientific American* **267**, No. 1 (July 1992) p. 109.

11. Artificial Life, Art and Cognition, International Summer School, Aix-en-Provence, 6–17 July 1992.

12. Inman Harvey, E-mail communication with the author (September 1997).

13. This is French for "shocking the middle class," a term used to describe the social role of the avant-garde artist since at least the Dadaists.

14. Harvey [12].

15. This view was expressed in a particularly overt way when information technology began to be introduced on a mass scale by Italian industrialist Franco di Benedetti, managing director of Olivetti, who, speaking at a *Financial Times* conference in 1979, pronounced that "information technology is basically a technology of co-ordination and control of the labor force: the white-collar workers Taylorian organisation does not cover." (Quoted in U. Huws, *Your Job in the Eighties* [London: Pluto Press, 1981] p. 26).

Manuscript received 6 June 1998.