Designing the Artificial: An Interdisciplinary Study

Massimo Negrotti

Introduction: Beyond Common Sense

Even in a scientific lexicon, some terms suffer from a sort of meaning inertness which seems to disappear only in actual use Take, for instance, the adjective *artificial*· for almost everybody, it seems to designate something designed and produced by man, or anything that is not natural. In this way, "artificial" is a simple substitute for "technological," since all not-natural things, obviously, are made by means of some more or less refined human technology.

Scholars including Herbert Simon[1], Jacques Monod[2], and others have taken this position, neglecting the teleological difference between a cathode tube and an artificial heart. Actually, the *perspectiva artificialis* which Leonbattista Alberti and Piero della Francesca had in mind in the Renaissance was something quite different from this inertial meaning. In fact, everybody today also, understands the expression "artificial kidney," while nobody would attach any meaning to the expression "artificial telephone."

The reflexion on technology has not yet come to a scientific theorization and, on the basis of illuministic or romantic attitudes, it confines itself to an analysis which deals with technological objects as something which man constructs, after Archimedes, as "secondary and pleasant applications" of the so-called pure sciences, such as mathematics or geometry.

But, as a matter of fact, since the dawn of civilization, man shows a great, twofold constructive ambition: one, the Prometheus syndrome, aims at *inventing* objects and machines able to dominate the nature grasping its laws and adapting itself to them; the other, in turn, the Icarus syndrome, aims at reproducing natural objects or processes through alternate strategies,[3] as compared to those nature follows While the former may be called *conventional technology*, the latter should be called the *technology of the artificial*. From the wings of Icarus, attached by naive glue, to current techniques for replacing human organs, or to reproduce the capacities of the mind or the properties of life through ancient or recent automata, there emerges clearly a *continuum* worthy to be seriously considered as a man's specific turn, which today's and future technologies will greatly enhance.

1 H A Simon, *The Sciences of the Artificial* (Cambridge, MA MIT Press, 1969), tr it *Le scienze dell'artificiale* (Milano ISEDI, 1970) 18–9

2 J Monod, *Il caso e la necessità* (Milano Est Mondadori, 1972), 18

3 R Rosen, "Bionics Revisited" in H Haken, A Karlqvist and U Svedin, eds , *The Machine as Metaphor and Tool* (Berlin and Heidelberg Springer Verlag, 1993), 94–5

Design Issues Volume 17, Number 2 Spring 2001

A formula for defining the artificial may involve three logical points:

1. *A necessary condition:* the object or the process must be built by man;
2. *A sufficient condition:* the object or the process must be inspired by a natural one; and
3. *A methodological constraint:* the object or the process must be realized by means of materials and procedures different from those nature adopts.

Thanks to his extremely well-developed brain, man is an animal that not only adapts itself to the natural world, but tries to *know* it, to *control* it, and even to *reproduce* it. Furthermore, from a cultural point of view, many of us think that the ability to reproduce natural objects or processes exceeds our capability of knowing.[4] The rationale behind this is: if one is able to make an effective artificial organ, he cannot lack some deep knowledge of the natural organ. Nevertheless, what really happens very often is a different affair. As the history of artificial devices openly indicates, the reproduction of natural objects, or processes, frequently is an attempt to cope with nature "cost what it may." In other terms, under the pressure of some kind of urgency—curiosity or whatever—man has designed a wide range of devices, most often neglecting any accurate knowledge of the correspondent natural object. It is enough to think of artificial hair, teeth, arms, flavors, flowers (often and meaningfully defined as "feigned"), or even processes very far from each other, such as rain or intelligence, and taste or gravity

On the other hand, what is it meant by an "accurate knowledge" of some natural object or process? This is a key point if one wants to understand the artificial and, on a different plane, science itself

Logic of the Artificial

In whatever field one chooses, in order to consider artificial objects or processes (bioengineering, substitutes for natural elements or substances, artificial intelligence, robotics, artificial life, remakings, etc.), we may say that man cannot but reproduce something—which we shall name the *exemplar* —he has experienced at some *observation level.*

He then attributes to the *exemplar* some peculiar structural or dynamical property, that is to say its *essential performance.* Both the selection of an *exemplar* and the attribution of an *essential performance* strongly depend upon the available knowledge (not necessarily the scientific one) and the selected *observation level* In turn, the selection of an *observation level* depends upon certain attitudes which range from pure personal belief to established scientific paradigms.[5]

In considering a biological system, a tree for instance, as an *exemplar* to reproduce, it is clear that the selection of a mechanical

4 R Cordeschi, *La scoperta dell'artificiale* (Milano Dunod, 1998)

5 C Emmeche, S Køppe, and F Stjernfelt, "Emergence Towards an Ontology of Levels " *Journal for General Philosophy of Science* 28 (1997) 83–119

observation level leads to some possible *essential performances* which are very different from the ones coming from the selection of electrochemical, physiological or, perhaps, aesthetical, symbolical, or even religious *observation levels*

To sum up this point, if the current scientific community maintains that the *essential performance* of the kidney is that of filtering the blood according to certain modalities, it will decree the success of a reproduction attempt if it will consist of a machine able to generate that filtering function. On the other extreme—but in the same logic—if people think that the devil exists and has some features, then its reproduction in painting will be accepted—as it was in the Middle Ages for the one proposed by Coppo di Marcovaldo in the Florence Baptistery—if the painting exhibits those features.

Thus, one can answer our question ("What does an 'accurate knowledge' of some natural object or process mean?") first of all, only by indicating different *observation levels* in different units of time, and then by taking into account the more or less objective and shared models of that object or process as "seen" from the *observation level* he has selected.

The selecting role of the *observation levels* is very clear even in the seemingly simple activity of selecting an *exemplar*. Actually, in this case, man "decides" to bring something into the foreground, leaving the rest in the background. This is an observational strategy, consistent with our nature, which very often works fine. But it also is an intrinsically arbitrary strategy which, having to deal with the reproduction of natural objects, reveals all its critical aspects. While scientists may separate objects and processes for heuristic reasons—giving rise to ultra-specialized disciplines on the basis of more and more specialized *observation levels*—artificialists have to introduce separations for practical and concrete reasons, since they have to build up something, and not only to study it.

But which rules govern the selection of an *exemplar* from the perceptive background? As we know, the "ways of seeing" are, to some measure, imposed or prevented by the culture we live in But there also is a more objective problem before us, namely, that of the boundaries that separate the *exemplar* from the background.

Speaking of an artificial heart, we all refer to a well-known and recognizable *exemplar*, which is, at least apparently, well distinguishable from all that is not a heart. Obviously, to an engineer, the question is much more complex: which organic parts, vessels, muscles, subsystems, define the "boundaries" of the heart?

Besides our awarness of heart valves, today there are devices which assume as *exemplar* the left ventricle (the so-called *left ventricular assist systems*) and which should collaborate with the natural heart of the patient, and others which reproduce both ventricles. Only recently, the total artificial heart, able to completely replace the natural heart, has been considered an achievable target, but many problems remain, and many of them may be conceived as problems concerning the fixing of boundaries.

As another example, if we want to reproduce a pond, how should we establish its boundaries? On a topological level, should we include in the pond even the geological structure of its bottom and of its sides? As far as the flora and fauna of the natural pond are concerned, which degree of likelihood should we reach, for instance, along the range that includes, on the one extreme, ducks and fishes and, on the other, microbiological creatures? It is quite clear that different answers to these questions will give rise to different models and concrete achievements, depending upon the essential performance we have in mind.

In the field of artificial intelligence, this is a well-known and very often debated problem: how may we fix the boundaries of human intelligence with respect to the other functions of mind, such as memory or intuition, and fantasy or curiosity?

In the extreme, we could consider the case of the *exemplars* drawn from the animal field, e.g., a *holothuria* ("cucumber of the sea") that lives symbiotically with the little fish *Fierasfer acus:* how could we separate these two entities, first of all in representational terms, and then in terms of design and of reproduction?

It seems clear enough to us, that the task of outlining an *exemplar* is a somewhat arbitrary operation by which one isolates an object or a process from a wider context, which includes it, or from an environment which hosts it

Because of its philosophical and scientific tradition, Western civilization was highly capable of carrying out the analysis of the natural world, and gained great advantages from this operation. But analysis (significantly, the word derives from ancient Greek "to break down") surely is much more useful for scientific than for artificialistic purposes Actually, while the knowledge we may get through analysis is always to be considered as a potentially valid one—at least in descriptive terms and, sometimes, even in predictive ones—the concrete reproduction of an *exemplar* which, in nature, behaves specifically could require the cooperation of many of its constituent parts. In turn, this will require more *observation levels*, and the analysis, with its usual isolation strategies, may not succeed in rendering observable all of the levels required.

The choice of an *exemplar* is a sort of literal "radication" of some region of nature, and this can happen, as we saw, both in terms of its concrete isolation in space, and of modeling its structure.

Science and Artificialism

Here, science and artificialism exhibit some discrepancy and some analogy. In fact, while science proceeds analytically, step by step, but without any hope of getting a definite knowledge at all possible levels, designers of an artificial device (let us call them "artificialists") have to construct something real. Therefore, they set up "pieces of reality" *as if* they would know all that is necessary for "replicating" the *exemplar*.

Nevertheless, what cannot be wholly known, cannot be wholly reproduced. Just as it is conceptually impossible for scientists to synthesize a natural object through a bottom-up strategy, which could put together all of the possible observation levels, artificialists cannot expect their devices to possess all of the possible performances exhibited by natural *exemplars*, just because they proceed through a multiple-selection process *observation level, exemplar,* and *essential performance*. On the other hand, while a scientist can write a book with chapters that deal separately with the mechanical, electrochemical, and physiological aspects of a tree, an artificialist who wants to make an artificial tree cannot build four or five artificial trees and put them together in one and the same device. Perhaps he could do so, but, he thus would build a gadget or a toy, rather than a "replica" of the tree. The main reason is that the relationships among different *observation levels* would require new *observation levels*, in a sort of hopeless *petitio principii*.

Replicating something is an autopoietical enterprise reserved to nature (or to man in very special and unnatural cases, e.g., when he reproduces man-made objects like in mass production or in cloning pure informational systems), while making the artificial means to build something on the basis of some (more or less) refined model of the *exemplar* and of its *essential performances*, assuming some clear-cut "profile" or *observation level*. This is a matter of analytical strategy—which has no rational alternatives—which prevents science from capturing the synthetic "core" of the whole system and, therefore, prevents artificialists from reproducing it.

In fact, what we name the *essential performance* of a natural *exemplar* always is "essential" with reference to some specific *observation level*, and not in ontological terms.

The selected *essential performance* can be very complex, and it even can include several sub-performances, but these must allow a manageable model because, otherwise, the problem of coordinating two or more *observation levels* would arise.

Since this is a rather general problem, empirical evidence can be drawn from several, different fields. John Young, a biologist involved in the sixties in understanding some aspects of the sensorial functions of the *Nautilus,* wrote.

> Another fascinating problem is the relationship between visual and tactile learning. [...] Since the two systems overlap in the vertical lobe, maybe there is some kind of coordination between them. However, it has been demonstrated that the objects detected by sight are not recognized by touch.[6]

6 J Z Young, *A Model of the Brain* (Oxford Oxford University Press, 1964), tr it , *Un modello del cervello* (Torino Einaudi, 1974), 278

The attempt to reproduce in a bionic system the coordination between tactile and visual learning will imply the discovery of the whatever stuff it is based on, and, thus, a selection and even the creation of a third *observation level.* On the other hand, if we know the basis of the coordination performance, we have to make tactile and visual performances able to work according to its rules. This could introduce some additional problems which we did not face when we only had to reproduce the two performances as stand-alone functions.

If these additional problems can be solved, then the resulting artificial system will work well at the *observation level* described by the coordination performance if, and only if, its working is locally determined. That is to say if, and only if, the subsystem is a rather locally self-sufficient one which does not involve a linkage of any other subsystem with the coordination performance, and this is, of course, a very rare case. The basis on which the coordination works—as a truly new *essential performance*—could impose a complete redesigning of the two performances, visual and tactile learnings, in accordance to the needs of other systemic levels that govern the coordination as such

The Artificial at Work: Inheritance and Transfiguration

Artificialist deals with concrete materials—not only with concepts—which involve material complexity Whatever material has to be conceived as a reality observable from an illimitate number of *observation levels,* and, therefore, nobody can claim that he or she knows them completely. Scientists and artificialists share the same human basic rational limits, and this means that both, when considering some material, select some observation level Thus, artificialists will select the *observation level* most coherent with their reproduction goal.

At the start, the materials and the technologies which usually are adopted for an artificialistic enterprise are taken from current conventional technologies, exactly as they are available in their own area. We may refer to the enthusiasm of Jacques Vaucanson, who was involved, in the eighteenth century, in a project to reproduce the digestion process of a duck, when he heard of the new rubber materials coming from India. Also today's researchers in the field of the artificial are, of course, always looking for conventional materials suitable for their enterprise For instance, "The life-saving heart surgery, often relies on a polymer originally developed for women's fashions or a plastic meant for insulating electrical wires." Thus, the search for application-specific improvements of the materials which have been originally taken from other applications, soon becomes a central concern in meeting the increasing pursuit of *essential performances.*

What should be clear is that the adoption of materials for replacing parts of a natural *exemplar,* or for getting some natural

7 The Whitaker Foundation, *Annual Report Tissue Engineering* Internet Website (http //fairway ecn purdue edu/bme/whitaker/95_annual_report/tissue95 html) (1995)

essential performances from the artificial device, may generate unforeseable situations. The reason is that, very often, only one feature of the selected conventional material will overlap the properties of its correspondent material in the natural *exemplar.* But, as a principle, all of the features—known and unknown—of the material adopted will be unavoidably *inherited* As a consequence, they will interact in an unpredictable way both with other parts of the artificial system, and with the hosting context (body, environment, landscape, etc.).

Surely, the most spectacular instance of this phenomenon is the bio-incompatibility which leads to the so-called "rejection" of allogenic substances or elements in biological organisms.

Nevertheless, it is a matter of a much more general tendency, which characterizes whatever artificial device or process when it is concretely realized and put at work in whatever environment. Every artificial device, object, or process, (be it an artificial muscle or a flower, an intelligent software program or a robot, grass or rocks, or whatever else) works fine only within a rather narrow spectrum of internal and external configurations: the ones matching the situation in which it was designed and constructed. In other terms, the artificial can exhibit an acceptable approximation of the natural *essential performance* it wants to reproduce only if the original *observation level* is respected, and if no relevant side effects due to unpredicted material interactions, arise. If we move even a little from that spectrum, then we get unpredictable behaviors or "sudden events" from the artificial, not belonging to the spectrum of performances normally exhibited by the natural *exemplar.*

To sum up, in an artificial device, the *transfiguration* of the natural *essential performance* may depend on four main reasons:

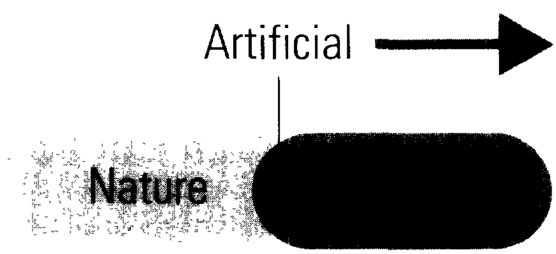
1. The "eradication" of the exemplar and, therefore, of its *essential performance* from the whole natural system, thanks to the unavoidable selection of a single *observation level.*
2. The interplay among the features inherited from the materials used in building the parts or components of the artificial device.
3. The interactions between these features and the host environment, and its features and requirements.
4. The growing amount of conventional technology which, as a rule, is needed to improve the essential performance, or simply to control and minimize the side effects.

Thus, the unavoidable and paradoxical destiny of the artificial is that, starting from nature, it develops towards conventional technology (see figure 1) while trying to preserve an *essential performance* which may be impoverished or, sometimes, even improved, but always is transfigured in comparison with the natural one. A growing amount of conventional technology, means that the more an artificial device develops, the more its *essential performance* tends to represent a smaller proportion of the total amount of the performances exhibited, actually or potentially, by the device. By the way, this explains why artificialists often give up their original projects and start a new ones suggested just by the "novelties" coming from their development.

Our discussion is not only academic: it deals with well-known real problems in bioengineering, where, in order to avoid transfigurations, i.e., troubles coming from the interplay of different *observation levels*: "Until recently, most research in the field [of cell transplantation] has focused on minimizing biological fluid and tissue interactions with biomaterials in an effort to prevent fibrous encapsulation from foreign-body reaction or clotting in blood that has contact with artificial devices. In short, most biomaterials research has focused on making the material *invisible* to the body."[8]

The artificial results from the overlapping of nature with conventional technology. The arrow pointing to the right suggests that the artificial, in its concrete achievements, cannot but develop towards conventional technology, and this fact pulls it further and further away from nature.

Figure 1



On the other hand, the tacit ideal of artificialists to get, even in the distant future, a "replication" of the *exemplar* is prevented not only from a logical viewpoint—if something is replicated, then it is not artificial—but also, as we said, from the impossibility to take into account all of the observation levels of the reality. Once again, a bioengineer clarifies the situation saying that, "If we want to engineer a material that has the characteristics of soft composite biomaterials, we have to understand the interactions at all scales, from the molecules up to the cells, and up to the macroscopic properties of tissues."[9]

It should be added that, in this field, the most advanced research trend is now on active biomaterials and, therefore, on devices which begin to be named as bioartificial: those materials which, in other words, are able to interact in a controlled way with some specific aspects of the body, rather than remaining intentionally separated from it. This means that, if the items we have discussed have some likelihood, they will enter the scene very soon because it is very difficult to imagine a biocompatibility at all the possible *observation levels*. Really, this would be the image of a replica rather than of some artificial device.

8 A.G. Mikos, R. Bizios, K.K. Wu, and M.J. Yaszemski, *Cell Transplantation*, The Rice Institute of Biosciences and Bioengineering, Internet Web site (http://www.bioc.rice.edu/Institute/area6.html) (1996).

9 W. Hoffman, "Forging New Bonds" in *Inventing Tomorrow* (Minnesota University of Minnesota Institute of Technology, Spring, 1995).

The Intrinsic Fiction Component of the Artificial

The "invisibility" of the artificial is a very general constraint. The artificial has always to be "defended" from what comes from the neglected *observation levels*, that is to say from all the possible *observation levels* of the environment apart from the one which was assumed for the reproduction enterprise.

This is why "realistic" landscapes built for contemporary zoos have to be carefully maintained, in order to avoid degenerations due to the interactions among their components and with the hosting environment. This also is true for the Japanese *domes*, the well-known and big remakings of European or American landscapes, where people can spend their time in virtual holidays, or for the famous Paul Getty's Roman villa (the *Villa dei Papiri* of Ercolano, buried by an eruption of Vesuvio) near the Pacific Ocean.

Surely, these problems were well-known in the past. For instance by the Venetian doge Caprese who, in the twelfth century, asked the architect Nero Faggioli (founder of the *Scuola di Lattuga* from which some great masters including Filippo Brunelleschi and Lorenzo Ghiberti came) to build an artificial landscape with a mountain, a garden, a zoo, and even a stream moved by a pump which flowed down from the mountain.

But the same occurs in very different projects, such as artificial intelligence or robotics, where the *essential performances* can be obtained only within "paces of interactions" very carefully delimited by formal boundaries, concrete walls, and other controlling procedures which make artificial intelligence "purified" from all psychological and physical features which constitute it in humans.

In principle, an artificial device needs a sort of artificial environment, or, when this is impossible, it has to be "encapsulated" in such a way that, as said by twentieth century artificialism pioneer Willem Kolff concerning the artificial heart, it can be perceived by the environment only in its main function, that is to say in its *essential performance*. Said differently, an artificial heart has to "cheat" the organism.[10]

10 Personal interview with W Kolff, reported in M Negrotti, *The Theory of the Artificial* (Exeter Intellect Books, 1999) See also M Negrotti, "From the Artificial to the Art A Short Introduction to a Theory and Its Applications," *Leonardo* 32 3 (1999) 183–9

Figure 2
Eighteen century automata

Thus, we discover that even fiction and illusion play a central role in the growing history of the artificial

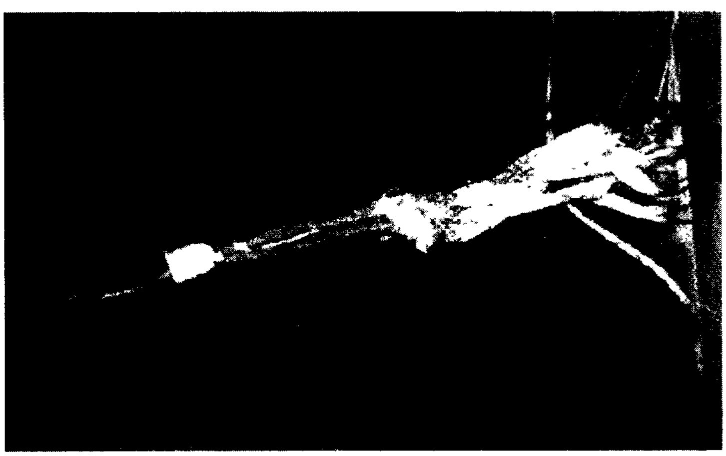
Artificial cavities, or nests, for some animal species; artificial flavors or turves; flight simulators or artificial bodies for testing safety devices for cars, teaching or surgical techniques; artificial fertilizers, or gravity, and many other devices, are objects or processes which, like artificial organs, have to be "accepted" by their environments—users included—and this is possible only by some "illusory" strategy which is not, of course, a pure fiction game. Rather, artificialists try to force the environment or the hosting organism to orient themselves only towards the same *observation level* taken in the design and in the building up of the artificial device.

When this strategy is possible, the artificial realizes the *essential performances* which, in the natural world, are generated in the global interplay of the reality levels. When this strategy is impossible, the artificial realizes *essential performances* which are, so to say, at the disposal of and open to the environment. In both cases, the artificial generates *essential performances* which transfigure the natural performances it has to reproduce.

The degree of transfiguration, both in terms of quantity and quality dimensions, strongly depends upon the disposition of the natural *exemplar* to be eradicated from its context without any significant loss of its *essential performance*. In turn, all this depends upon the amount of relationships which, in nature, make possible the *essential performance*, and, even more, upon the quantity of *observation levels* involved by these relationships

This explains why two different artificial devices referring to two subsystems of a whole system, like the human body, each working acceptably on their own, cannot easily be made to work together, when they reproduce two different *exemplars*, according to two *essential performances*.

Figure 3
Artificial Arm
(Biorobotics Laboratory at the University of Washington)



As a rule of thumb, while this remains an open question, one has to think that the more the two natural *exemplars* and *essential performances* are functionally close to each other, the greater the difficulty, and vice versa. On the other hand, the knowledge of the "functional distance"—and of the *observation levels* involved by it—between two or more subsystems of a natural system is not always available, and this poses the greatest challenge to the work of artificialists. Therefore, the work of the artificialists, in every area, is truly an exploratory one.

Many researchers, for instance, appear to be persuaded by strictly analytical strategies. On the contrary, others seem to follow the idea that, in many cases, the problems of the materials is secondary, because the real problem in reproducing natural *exemplars* or, rather, natural *essential performances* is to find the right organizational plan. This was a central point in the study of artificial intelligence in the eighties, and in artificial life in the following decade,[11] both founded on the doctrines of the so-called *emergence*, a term coined by G. H. Lewes in 1875 According to this doctrine, in many real systems, the high level properties cannot be explained by the properties of lower levels.[12] In this approach, the main goal was the search for the "right organizational plan," neglecting the fact that a concrete artificial object or process, in contrast with pure informational systems, must adopt real materials and fit real environments.

More generally, these problems strongly emerge when we consider the possibility of combining and putting to work, in one and the same organism, two or more artificial devices. In this case, the inheritance of the materials adopted will explode exponentially, giving rise to a much more complex network of unpredictable interactions (on this point, see Negrotti, 1999)

11 C G Langton, C Taylor, J D Farmer, and S Rasmussen, eds , *Artificial Life II*, Volume X of *SFI Studies in the Sciences of Complexity* (Redwood City, CA Addison-Wesley, 1992), xiii–xviii

12 C L Morgan, *Emergent evolution* (London Williams and Norgate, 1923) See also F E Yates, ed , *Self-Organizing Systems The Emergence of Order* (New York Plenum Press, 1987), idem

Figure 4 (below)
The search for a kind of essentiality which could be shared by people (Matthew Brand, MIT Media Lab)

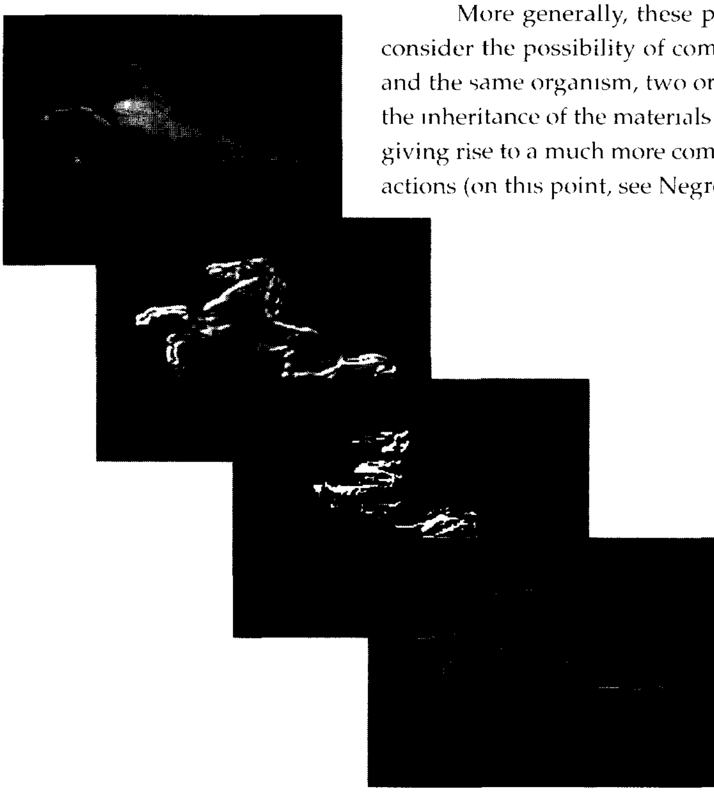


Figure 5 (above)
Artificial eyes improvement of aesthetic performance The "feigned" eye moves along with the natural one, thanks to a special substance which allows muscles to adhere to the rear of the artificial eye (Bio-Vascular, Inc Seen in "Movements on-line,"
Internet Site http //www ioi com/index/html)

Conclusions

However, as a final general rule, one can say that "something will always happen": no artificial device will work *only* according to its designer's intention. In other words, the reality of the artificial is not less rich in levels than any other real object. This means that, in the end, every artificial object or process will behave according to its complex interplay of levels, and not only according to its design. This is, of course, a rather general rule that could also apply to conventional technology objects or processes. But, when the target is the reproduction of some natural *exemplar* and of its *essential performance*, the transfiguration—i.e., performance degenerations, sudden events, and side effects—cannot but assume a special meaning, not always dangerous and not always promising, but always "new" as compared to what nature exhibits.

These kinds of intuitions have started to appear in several fields of the technology of the artificial. For instance, in his 1994 doctoral dissertation, T. W. Hall at the University of Michigan highlights the limits and the "transfigurations" of artificial gravity (needed for the space journeys) as compared to the natural ones. He maintains that, beyond the machine which generates gravity, the environment in which natural gravity works and human beings live also should be studied and designed. We should, in other words, design the artificial environment surrounding the artificial objects. Hall concludes:

> The goal of environmental design in artificial gravity is not to fool people into thinking they're on Earth but, rather, to help them orient themselves to the realities of their rotating environment.[13]

In this sense, the realm of the artificial truly consists in a "third" reality, that lies between nature and conventional technology. It

13 T.W. Hall, "The Architecture of Artificial-Gravity Environments for Long-Duration Space Habitation." (Doctoral dissertation, University of Michigan, 1994).

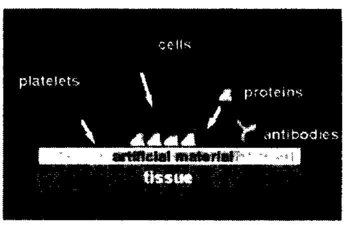


Figure 6 (above)
Mixing artificial and natural structures

Figure 7 (right)
Japanese architectural remakings of landscape for leisure

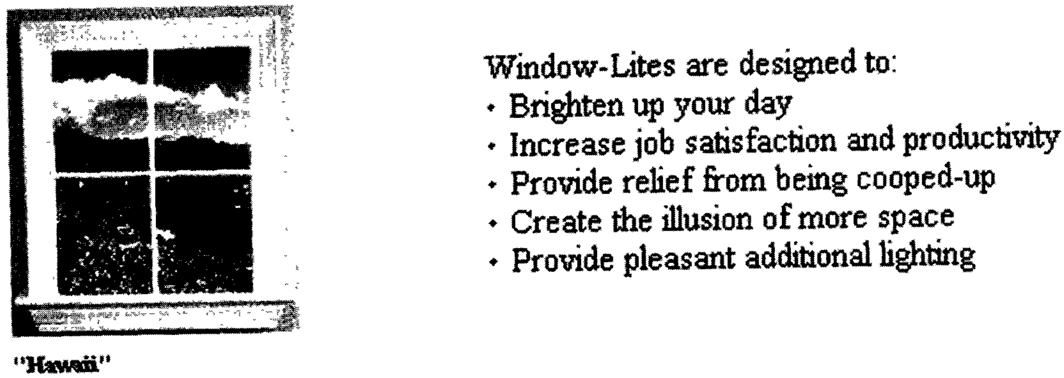


Figure 8
Two dimensional artificial landscapes (Advertising for the American Brio-Brite company.)

cannot but "swing" between these two realities, since it can overlap neither the former nor the latter unless it loses its peculiarity. It is a matter of a new reality, coming from very far in the history of human civilization, which is destined to grow a great deal in the near future. We cannot face it in terms of pure common sense understanding or with a fragmented, nonunitary, conceptual frame.