METAMORPH

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A decade of digital change has made 'metamorphosis' a keyword in our visual culture. The forms produced by mechanical technologies are fixed, stable and solid; those produced by electronic technologies are evanescent and mercurial. They change and morph relentlessly – sometimes by choice, sometimes by chance. This epistemic difference between forms of the mechanical universe and forms of the digital universe is inherent in the two technologies: the mechanical world produces objects; the electronic world produces sequences of numbers, which in turn generate objects.

According to the Neoplatonic philosophy of the Renaissance, ideas inhabit an orderly hierarchy of celestial spheres superimposed upon our sub-lunar world: each sphere corresponds to a planet and to a higher level of generality or abstraction. As ideas move through the lowest sphere to descend into the materiality of the terrestrial atmosphere, they embody an infinity of events that still share a common matrix – no longer a form but, according to Ficino and Pico, a **formula**, an attenuated idea. Digital files, like Neoplatonic essences, also inhabit celestial spheres to which we have no access, and in order to become concrete events they must negotiate their way through various mediators of sensory experience, which today we call interfaces. Each interface is different and the final result – the material epiphany offered to our perception – is never entirely predictable. It depends on machines, systems, networks and, within certain limits, on the user's own choices.

But no end product of any digital process is final. On the contrary, each is the occasional and ephemeral epiphany of an algorithmic process that can generate many different ones, deliberately or at random. The article that appears in the same newspaper on the upper left column of page A5, on the same day and in the same place is the same for all readers. But the same Web page opened simultaneously by the same browser on two different computers will produce, in most cases, two images that are more or less similar but not identical – even if the alphanumeric text may be the same. The font, size, pagination, colours and quantity of text that appear on the computer screen depend on so many parameters that two identical images of the same Web page are the exception rather than the rule. More and more frequently, the page content itself (for example, advertising) changes, as it automatically adapts to often unsuspecting users.

These unpredictable mutations are a creative stimulus for some, a working tool for others and a nuisance for many. Not all the avatars of a given digital content can be fully controlled by its maker, which, not without reason, some authors resent; and several technologies have been specifically invented to avoid this sort of random drift – for instance, in the visual domain, by freezing the image and forcing each user to view visually identical graphic compositions. The PDF format of Adobe Acrobat® essentially uses Web technologies to transmit electronic photocopies – faxes sent over the Internet. Not without success: clearly, our society cannot do without the iron inflexibility of the typographical page – a mechanical epiphany par excellence. A typographical page is also a topographical one: the standardized templates of a printer's matrix are vital to many operations that provide the foundation for the official predictability of modern life – forms, invoices, legal documents, postage stamps, banknotes, cheques, government seals or license plates. Tax forms must be identical for all (even when they are downloaded from a Web site) because Line 33A-14 must appear on page 7 on all tax returns. This also clearly shows how income tax returns could not have existed before the age of printing: even in the electronic era the Inland Revenue offices of most countries, when they go online, are forced to use the most sophisticated technologies to reduce the ectoplasmic variations of digital images to the mechanical fixity of printed pages. The Web sites of various ministries and national services that deal with tax returns are true works of electronic art, and Marshall McLuhan would have delighted in the digital emulation of Gutenberg's machine recently perfected by modern state bureaucracies: the typographical man is so integral to the modern state that the modern state, even after adopting electronic technologies, is forced to perpetuate a mimesis of the typographical world.[1]

Of course, the generative variability that is specific to digital technologies has already significantly altered architectural forms, industrial design and, more generally, the external and visible form of our built environment. And this is only the beginning. The history of the rise of computer-based design and manufacturing in architecture is still unwritten, and perhaps it should remain so for the time being. At the end of the last decade, designers initially

focused their attention on the formal possibilities offered by algorithmically generated continuous functions, which are easily manipulated by computers. The mathematics of these operations is essentially that of the infinite and of the infinitesimal – differential calculus; not surprisingly, this **prima maniera** of digital architecture is marked by curves, fluid and continuous forms, and by complex geometries (especially topological geometry) that can be described by mathematical functions, visualized on the screen and materialized in three dimensions by file-to-factory technologies (stereolithography, rapid prototyping and other such digitally controlled production tools).[2]

Consequently, in a digital production process one algorithm alone can generate an infinite number of mathematical functions as well as various forms or surfaces, all of which will share this invisible originating algorithm and, in most cases, carry some visible attribute that denotes their common matrix. Given the continuous variability of the generative process, the actual construction of a prototype requires that the process be halted at a static snapshot, and that only this still frame, severed from the sequence it belongs to, should materialize and be built in three dimensions. According to this logic, each product is one of a kind. However, if more segments of the same sequence are produced one after another, this turns into a logic of serial production – but of a series where each piece is different. This is precisely the opposite of the mechanical logic, in which serial production, by definition, replicates identical parts. Following the eponymous exhibition at the Centre Pompidou in Paris this past winter, this new mode of digital production is now often referred to as 'non-standard'.[3] Another recent and commonly used expression is 'mass customization', which similarly denotes the serial production of one-of-a-kind pieces.[4] This definition, an oxymoron with respect to the traditional principles of mechanical reproduction, aptly describes the new principles of electronic reproduction.

In a non-standard series what matters is not the form of each product but the differences between them. As early experimentations in digital design and manufacturing in architecture relied primarily on differential calculus and topological geometry, many so-called non-standard architectural forms still tend to be round. However, roundness is by no means an essential feature of non-standard technologies, and it would be misleading to consider non-standard as a formal principle. The term 'non-standard' does not relate to forms but to a mode of production. Thanks to digital technologies, this mode of production generates series of different objects – rounded or angular, spherical or cubic, smooth or rough, flat or folded. The form of objects 1 or 2 or 3 in a series is irrelevant; what matters is that objects 1, 2 and 3 are different from each other, yet mass-produced. One of the most eloquent examples of non-standard production at the Paris exhibition, the famous teapot designed by Greg Lynn for Alessi, epitomizes many aspects of the new modes of production. But the display of just one object (at the Centre Pompidou, a lone teapot exhibited in a glass cabinet) may belie the spirit of the project; in fact, the prototype of a non-standard series is not one item in the series but the series itself – in this case, ninety-nine teapots that are all different, yet at the same time similar, because they were serially reproduced using the same technology and the same generative algorithm (as the author explained in voice-over in the exhibition, and as shown in the essays published in the catalogue).[5] (FIGS. 1–3)

The digital design and manufacturing of non-standard series has revolutionized our understanding of serialization, and the very notion of reproducibility in which we have lived for five centuries of mechanical culture. In the mechanical world, serial reproduction generates economies of scale, on the condition that all products in a series be identical. Identical reproduction is the price, so to speak, of economies of scale. Serial reproduction (as for example in an assembly line) delivers objects of constant quality and at lower unit costs. But all the products of the same assembly line are identical. This was one of the underlying principles of the modernist ideology, which inspired, positively or negatively, a large part of the twentieth century. One may or may not like identical reproduction, or 'standardization', as it was then called, and serial reproduction can represent for some an egalitarian ideal, for others a totalitarian nightmare. But in defending the logic of the standard, the modernists of the twentieth century could invoke an objective argument: at the time standardization was a moral imperative, independent of any ideology and personal taste. Standardization allowed for better products and at a lower cost. A standardized architecture would give everyone a house, just as in the United

FIGS. 1–3. Greg Lynn, Production prototypes for Alessi Coffee and Tea Towers (2001). © Greg Lynn Form.

States mass production was giving nearly everyone a car – incidentally, the same car for all, no longer custom-made but mass-produced. Henry Ford is credited with saying that the client could still choose the colour, provided it was black.

We can still love, or despise, identical reproduction for the same ideological, aesthetic or social reasons that have always existed and will continue to do so. But the moral justification for modernist standardization is no more. Thanks to digital technologies, today we can automatically mass-produce series of objects that may be all different or all identical or anything in between, but always at the same unit cost. In short, the serial production of different objects is no more expensive than the replication of identical copies. For the time being, this principle applies only to small objects and small series, but these material limitations are contingent. And in theory, at least, the principle is today largely acknowledged: the modernist logic of the standard, with its economic, technological and ethical assumptions is already obsolete. Worse, if applied to the current technological environment, the logic of modernism can lead to misguided decisions. But the moral obligation to maximize the potential of current technologies to produce better and at a lower cost remains. What are the benefits of non-standard technologies? What use can we make of them? Why and for whom?

NEW STANDARDS

All the products of a non-standard series are different, but within limits. Gilles Deleuze, who had anticipated this problem many years ago, in his book **Le pli: Leibniz et le baroque** (which, not coincidentally, was influential for an entire generation of American architects and theorists),[6] would have argued that variation in a non-standard series is inscribed in the **objet-objectile** paradigm: the same **objectile** underpins an infinite number of different objects that still retain a common matrix.[7] In addition to the limits of computer programming, variations in a non-standard series are determined by the type of mechanical tools that can be integrated in a digitally controlled chain of production. Such physical limits are temporary, however, and they will gradually disappear as machines become larger, more efficient and more versatile. By contrast, the inherent limits of computer programming are of an epistemic nature and probably specific to this mode of production: non-standard seriality, by definition, depends on an algorithmic matrix common to different forms. This condition of reproducibility implies an analogous and corresponding condition of recognizability: all products of a non-standard series are different but they are also in some way similar to each other. What do they have in common? Technically, a mathematical algorithm; perceptually, however, it is difficult to say. The similarity between two visual forms is a mystery that no technology can quantify, no cognitive science can describe and no philosophy can define.

The classical tradition has, over centuries, perfected the art of imitation, both literary and visual. What do the archetype and copy have in common? If the copy is well made, as shown by the famous topos of Zeuxis and of the virgins of Croton, no one can tell. The similarity between a copy and its archetype consists of an ineffable quintessence, a certain something, a **nescio quid**. A well-made copy resembles the model in the same way that a son does his father: clearly they resemble each other but it is unclear why or in what aspect. The nose? The mouth? Nothing in particular – it is the whole that matters.[8]

Like other earlier and current cognitive sciences, the psychology of form has, over the last century, attempted to clarify the question – without much success. The problem is vital to many contemporary applications of artificial intelligence: in spite of colossal investments: especially by the military industry, machines have yet to learn to recognize faces. Nor can they identify two similar images, or read an incomplete image, other than by extrapolating from some elementary geometric diagrams (as is done with fingerprints or the letters of the alphabet). Of course, we have known for several decades that parents and their offspring share a genetic imprint, but science still cannot account for the morphogenetic mystery whereby the same chemical code is transformed into two similar yet distinct faces. In the same way, albeit at a more elementary level, since it is manmade and not the work of nature, two objects produced and formed by the same algorithm resemble each other in some way that the trained eye can detect and mathematics can demonstrate – but the mathematical formula is not legible in the object nor does the object disclose it.

Several current car models were designed and built using the same digital technologies and, in some cases, the same software. In fact, at times the

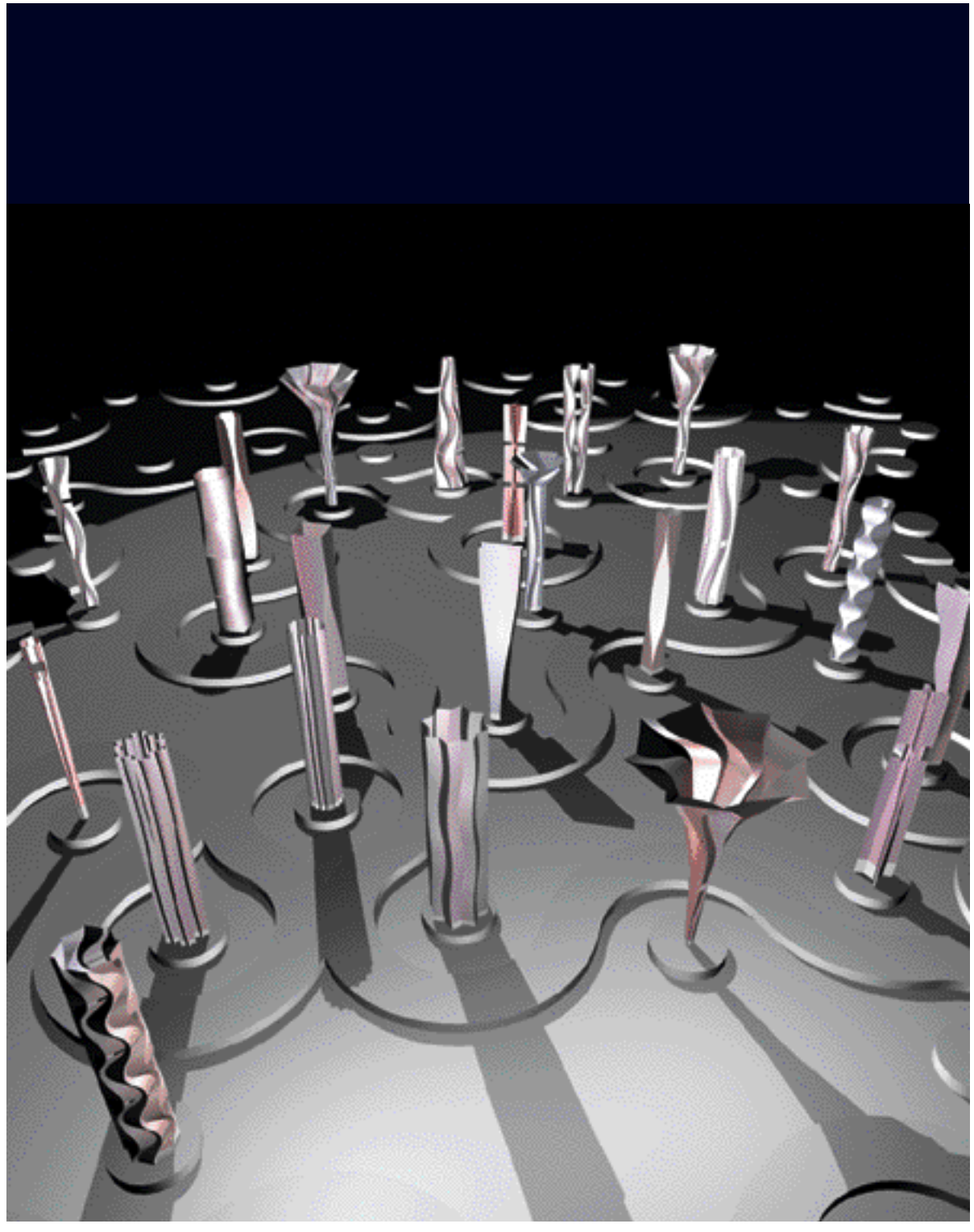


FIG. 4. Haresh Lalvani, *The Column Museum* (1999). From: Haresh Lalvani, 'Meta-Architecture', *AD (Architectural Design)*, vol. 69, 9–19 (1999), *Hypersurface Architecture II*, Profile 141, pp. 35 (fig. 4). © Haresh Lalvani. Computer modelling: Neil Katz; computer rendering: Mohamad Al-Khayer.

FIG. 5. Haresh Lalvani, *The Column Museum* (1999). From: Haresh Lalvani, 'Meta-Architecture', *AD (Architectural Design)*, vol. 69, 9–19 (1999), *Hypersurface Architecture II*, Profile 141, p. 34 (fig. 3). © Haresh Lalvani. Product development at Milgo: Bruce Gitlin and Alex Kveton; photography: Robert Wrazen.

similarity between cars, even those of different manufacturers, is apparent in the curves of certain metal or plastic panels – much in the same way as one could have said not long ago that two cars had the same 'line', or that they looked like they had been designed by the same hand. But what exactly does the similarity consist of? An engineer could probably trace or discover somehow the mathematical function common to a certain family of forms (for example, in this programme the third derivative of a certain curve, used in particular for . . . is always less than . . .); but in most cases similarities are primarily measured by sight, just as an expert recognizes the style of an artist, handwriting or two noses – real or painted. Pattern recognition: human intelligence recognizes an invisible generative structure shared by two visibly different forms. For the time being, this operation remains a human prerogative, one that machines have not yet mastered.

The new standards of digital production are not based on identical reproduction of visible forms but on the transmission of invisible algorithms. Consequently, the new digital environment will foster new modes of recognition based on similarity, not identicality. Considering the visual culture in which we were raised and with which we are familiar, this may seem revolutionary, but in historical terms it is not new. Prior to the early-modern standardization of mechanically reproduced images, we lived for centuries in a world that was algorithmic and normative, not visual and repetitive.

FROM THE ALGORITHM TO THE CLICHÉ AND BACK

In a celebrated article, first published in 1942, Richard Krautheimer discussed the many medieval replicas of a famous archetype, the Church of the Holy Sepulchre in Jerusalem, and concluded that these replicas were all different from one another and all different from the original. Yet during the Middle Ages they were considered similar and recognized as copies. Krautheimer argued that this phenomenon had to be seen in relation to an abstract and symbolic attitude that characterized medieval culture, and more particularly a culture of images where sheer visual identification was not conclusive: different signs could be recognized as symbols of the same thing.[9] It is in the work of Leon Battista Alberti, a modern humanist trained in the medieval tradition, on the border between two worlds, that the paradox of non-visual imitation (or reproduction) in the domain of the visual arts assumed a particular, and in some cases almost dramatic, relevance.

Attributed to Alberti, the Shrine of the Holy Sepulchre in the Church of San Pancrazio in Florence appears to have been built between 1456 and 1467. The ambition of the patron, Giovanni Rucellai, to recreate a sepulchre 'similar' to that of Christ (in fact, of Joseph of Arimathea) in Jerusalem is corroborated by the inscription over the entrance ('sacellum ad instar iherosolimitani sepulchri'), dated 1467. Alberti knew very well what an identical replica was: the search for exact reproducibility is one of the ideological and theoretical cornerstones of his entire corpus in the sciences, technologies and arts. And yet, as in many of the cases studied by Krautheimer, here too, despite some proportions, geometrical diagrams and a name in common, the archetype and the copy do not resemble each other. Nothing indicates that Alberti ever visited Jerusalem, and we can assume that practically no one in Florence had seen the original: pilgrims of the period did not send picture postcards (and they did not return from the Holy Land with illustrated notebooks: the earliest images of the buildings of Jerusalem were published in Rome and Florence at the beginning of the seventeenth century). Nor should we surmise, however, that Alberti and his patron might have intended to deceive the public with a fake facsimile. If no one had seen the original Shrine in Jerusalem, many must have seen the countless copies that were built in the West (just as Alberti would have been well-acquainted with the fourteenth-century replica of it in the Church of Santo Stefano in Bologna). And these copies were all different. Hence it would appear that even on the threshold of the early-modern age the symbolic value, the identification and the recognition of architectural forms did not necessarily depend on visual conformity. All of these replicas were visually different and yet – even for Alberti, one of the first moderns and founders of the modern culture of images – all of these different forms could represent the same thing.[10]

Alberti was one of the inventors of the modern system of the architectural orders. But the orders that Alberti defined in his treatise on architecture, **De re aedificatoria**, are by no means visual models. Intended to circulate as a manuscript, the text of **De re aedificatoria** is not illustrated nor, as Alberti insisted, should it or could it have been. Posterity did

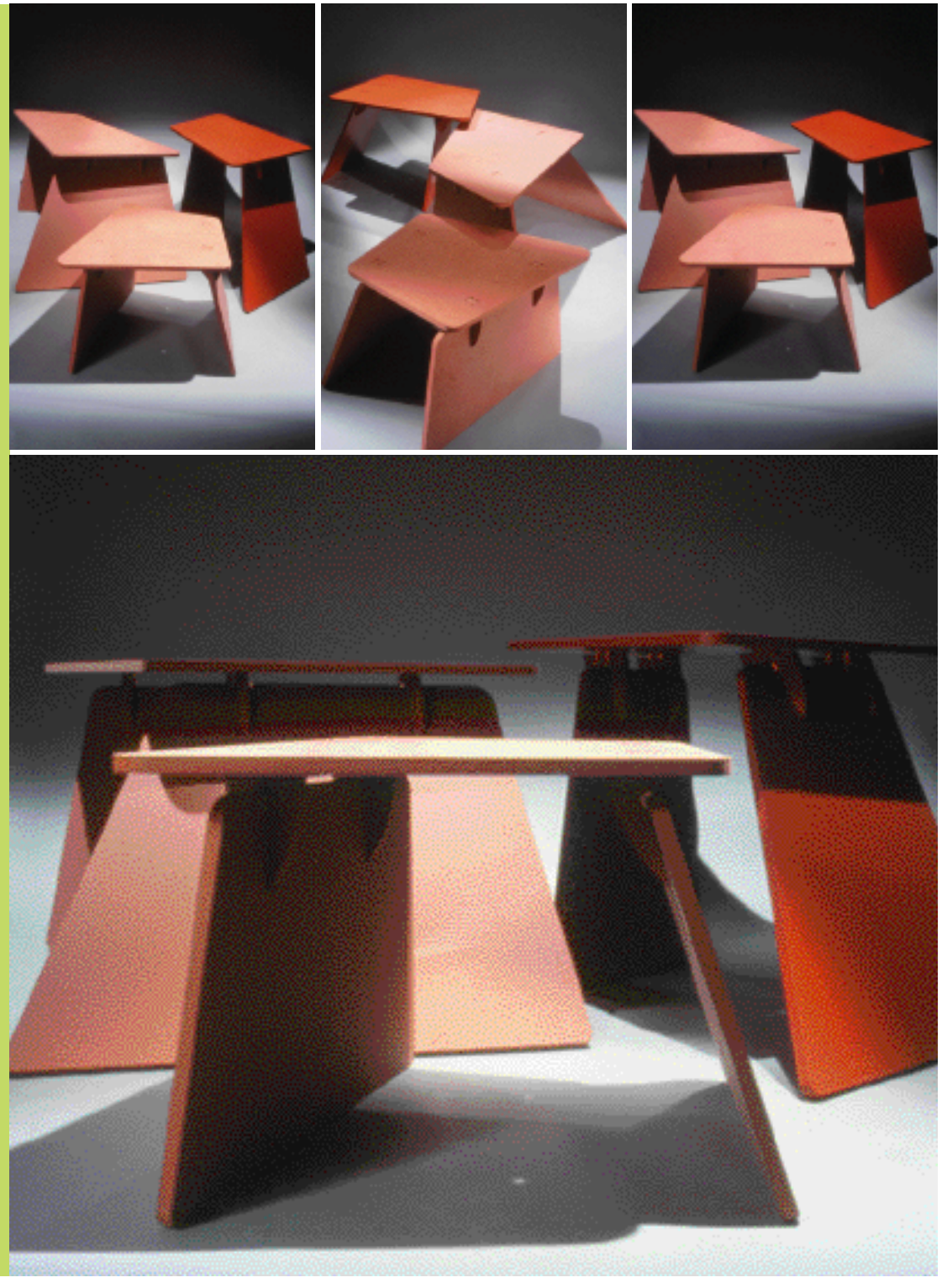
not heed him; yet for Alberti, in keeping with the spirit and letter of the rhetorical and architectural method described in the treatise, the architectural orders are not images: Alberti's orders are chiefly a normative definition and a series of compositional, morphological and proportional rules – in today's terminology, an algorithm. The resulting visible form remained, to some extent, undefined, since the same norms can determine partially different architectural forms: in Deleuze's terms, one **objectile** in many objects; in Aristotelian terms (with which Alberti would have been more familiar) one form in many events, or different species of the same genus. A few years later, but still in a cultural and technological environment not dominated by the diffusion of the printed image, the so-called architectural treatise by Francesco di Giorgio (several versions of which are extant, elaborated over more than a decade) clearly illustrates the visual consequences of a similar algorithmic and generative approach: the parts of the orders illustrated by Francesco di Giorgio are presented in capricious disorder, an accrual of examples that, theoretically, could continue ad infinitum – forms that are all different and yet identified by some common attributes. (FIG. 4) Only a few decades later, in the illustrated printed manuals of the sixteenth century, the rule of orders would become a catalogue of standard architectural forms – predesigned and ready-made.[11]

But at the beginning of the early-modern age, and on the eve of the diffusion of the printed book, the mode of production of architectural forms still favoured algorithmic and generative models, not iterative or facsimile-like. The identification of architectural signs still depended on the recognition of similarities, not on the individuation of identicalities. Pattern recognition: this is the operating principle that inspired Western visual culture from classical antiquity to the diffusion of printed images at the beginning of the early-modern age. And the printed image did not limit itself to standardizing the language of architectural orders. To a certain degree, it is the whole human ability to associate meanings and images (to identify, and thereby to confer meaning on, non-alphabetic signs) that was standardized. Within the same print run, and allowing for accidental or marginal variations, a printed image is the identical replica of the same printer's cliché or block – always the same, the same for all. But from this it follows that if the image changes a little, the meaning may change completely. In the algorithmic world the search for similarities or the recognition of hidden structures (pattern recognition) allows us to confer the same meaning onto different signs that have something in common; in the world of facsimiles, where every replica is by definition visually identical to its matrix or mould, if a sign has one meaning then another sign, even if it is only marginally different, has another meaning – or no meaning at all.

As in the case of architectural orders, printed images have transformed devices, coats of arms, emblems and the escutcheons of families, cities, corporations and other medieval institutions into visual stereotypes: intended for identical reproducibility, they lose all meaning if their form is altered. The heirs of this typographical metamorphosis are the logos, trademarks and factory brand names that distinguish contemporary corporate branding – and even the flags and national emblems that identify a state or an army in wartime. There is a certain logic in the fact that the graphic design of a country's passport today can be copyrighted and registered as a trademark – that is, a visual standard. After all, the term 'standard' derives etymologically from 'étendard': a standard was originally a banner that identified a group of armed soldiers. This is still true today, even though soldiers must now pay attention to the exact graphic reproduction of every banner or national emblem, including the font used for the licenses of military vehicles, the badges or decorations found on uniforms, and of course the precise design, colour and cut of the uniforms themselves (which, as the term 'uniform' suggests, do not allow for individual variation: a soldier without a recognizable uniform is not protected by the Geneva Convention).

The pre-typographical world was largely unfamiliar with the standardization of visible signs. The Roman Senate and People did not legislate the design of their legions' banners, on which fowls of various shapes and forms easily fulfilled the same symbolic function: in any event, everyone knew that the banner of the Roman legion was an eagle. Likewise, the post-typographical world will lose a considerable part of the semiotic (and in some ways almost totemic) value that our current market-driven culture continues to attribute to identical reproduction. Digital reproductions will probably re-establish an algorithmic universe similar to what preceded the diffusion of printed images: in this case, we will have

FIG. 6. Francesco di Giorgio Martini, Codex Saluzziano, Turin, Biblioteca Reale, MS Saluzziano 148, fols. 15v–16r. Photo © Biblioteca Reale, Turin. Courtesy Ministero per i Beni e le Attività Culturali.



FIGS. 7–10. Objectile (Patrick Beaucé and Bernard Cache), Living Factory Project, *Table projective* (2003). © Objectile.

to reacquire some basic skills in pattern recognition that five centuries of typographical culture have nearly made us forget. Once again we will have to learn how to recognize similarities, analogies and visual approximations; and we will have to forget, at least in part, the fetishistic cult of identicality that is still perpetuated today by the culture industry. History proves that this shift is to some extent a return, therefore not **a priori** impossible. It remains to be seen whether it is necessary.

ECONOMY OF NEW STANDARDS

Non-standard production today is often considered a fad, an extravagance or pointless luxury. The industrial customization of a mass-produced object may seem to be a waste of technological and creative resources. On the contrary, with respect to mechanical technologies of the past, non-standard logic can in many cases already lead to better, cheaper products.

Obviously it is difficult to prove that the serial production of ninety-nine different teapots involves meaningful economies of any nature. But that series, as I have suggested, is a prototype. Often creators are forced to anticipate on a purely demonstrative scale the logic of a mode of production that has yet to mature. Similar technologies could soon be applied to large engineering structures rather than to tea services. Today, the prefabricated components of bridges and vaults are for the most part oversized, because prefabrication allows for economies of scale and ease of assembly only on the condition that all, or most parts be identical: consequently, the dimensions of the section subject to the greatest stress determines all the others, and in all remaining sections of the same structural component much of the material is wasted. But thanks to a new generation of mass-produced but custom-made structural components, each structural section of a large engineering structure could be manufactured no larger than necessary and use no more material than is required. At the same time, structural forms could better conform to stress diagrams and follow different and more complex geometries than the post and lintel of prestressed concrete (or, in the United States, metal I-beams) that we are used to.[12] Large structures could once again become works of art, as they were a century ago, when building material was rare and intelligence abundant (now the reverse is the case).

And on a more domestic scale, who can still afford the luxury of ordering custom-made furniture? Cabinet-makers no longer exist, or the few who do have become woodworking artists. In a not-so-distant past, furniture built on demand was still a possibility – and in some instances, a necessity. Yet the modular unit of measurement for the more or less permanent residence of today's scholar, from Vancouver to Moscow, is a bookcase from IKEA. If this trend continues, the apartments of scholars and students all over the world may soon be proportioned as unit multiples of the linear measurements of IKEA Billy shelves. But today's new digital technologies already allow for the serial but customized production of simple furniture like tables or bookshelves – mass-produced on an industrial scale and at industrial cost, but with variable and theoretically different parameters for each client. Indeed, the 'table projective' presented by Patrick Beaucé and Bernard Cache at the above-mentioned Paris exhibition is a slightly more sophisticated interpretation of this very principle.[13] (FIGS. 7–10) At the Centre Pompidou, Beaucé and Cache displayed the product and the production process side-by-side. The customer can select several parameters, including dimensions, from menus on a computer screen; the order is sent directly to the factory ('file-to-factory') and the piece of furniture is delivered the following day.

At opposite ends of the dimensional scale of production of the built environment, these two examples suggest that in some cases the new digital technologies are already more convenient than the old mechanical ones. At a certain point, the same principle will likewise be imposed on other scales of the production process: serial mass-production of differently formed and custom-made products will improve quality and reduce the cost of many architectural objects, technical objects and different objects of manufacture. In all likelihood this will include shirts, whose sizes will no longer be reduced to the notorious gamut of S, M, L, XL – a formula, as some may recall, that singularly influenced the history of architectural theories at the end of the last century. But the economic and functional advantage of non-standard technologies, seemingly demonstrated, is only one of the terms at issue.

A techno-social change of this magnitude can only occur if a collective economic benefit is accompanied by ideological consensus. The new forms

generated by non-standard technologies will have to be culturally accepted. A new condition of reproducibility will have to correspond to a new condition of recognizability, on which the ultimate value of objects in a market economy depends. In the mechanical world, the ability to recognize identical forms corresponds to the logic of exact reproducibility. In the algorithmic (pre-typographical or digital) world, the ability to recognize similarities and abstract or incomplete diagrams (pattern recognition) corresponds to the logic of production variance.

In William Gibson's latest book, **Pattern Recognition**, the protagonist, a publicity consultant, is afflicted with an unusual medical condition: an allergy to all commercial logos. As the novel develops, occasionally assuming the rhythm of a thriller, the protagonist tries to locate the authors of a mysterious work of digital art – a visual universe in which identifying signs are not identically reproduced forms but hidden or partially invisible algorithms – hence the title.[14] In an installation by the architects Elizabeth Diller and Ricardo Scofidio, recently on display at the Whitney Museum in New York, a kaleidoscope of commercial brands projected on a screen is subjected to a process of continuous deformation (morphing) that imperceptibly transforms one logo into another.[15] Several famous commercial brands appear briefly on the screen, cross-fading into a sequence of forms in continual motion. But in the subjective time of our visual perception the well-known logo lingers longer, as it is the only significant moment in a series of senseless images. Just when exactly does the sign reveal itself and emerge from the indistinct images that precede and follow its brief epiphany? When I visited the installation, a group of adults and, oddly, children in the same room was playing the same game – pattern recognition. Systematically, the children recognized the commercial logos (Coca-Cola, but also Nintendo, Intel, Microsoft . . .) before their parents did. A passing observation, and one that cannot be generalized, but it would not be illogical if the level of pattern recognition of today's youths had already surpassed that of their parents. Today's adults were raised in a mechanical universe of identical reproductions and consequently may be better trained to recognize identical forms. By contrast, today's children were raised in an electronic and algorithmic universe and are in all likelihood more accustomed to recognizing similarities among changing, morphing, imprecise or incomplete images.

The future of non-standard production will depend not only on the economic and technological advantages that will sooner or later phase in new systems to replace the old ones, but also on a new balance between form identification and pattern recognition that will likewise inspire a new visual universe. After five centuries of typographical culture, this balance is dominated today by the quest for identicality. In the new digital context the processes of pattern recognition will probably reacquire the same importance that they had in the pre-mechanical world. And there is a certain irony in the fact that the new culture of machines – but a culture of new machines, which Lewis Mumford would have called 'neo-technical' – will have, among many other consequences, the additional one of reforming perception. To a certain degree, perception will become once more what it always was, with the exception of a few centuries of typographical intermission: not a mechanical operation, but an organic extension of human intelligence.

NOTES

1. In 1967 McLuhan noted: 'This process whereby every new technology creates an environment that translates the old or preceding technology into an art form, or into something exceedingly noticeable, affords so many fascinating examples I can only mention a few.' Marshall McLuhan, 'The Invisible Environment', *Perspecta*, 11 (1967), pp. 163–67 (p. 164).
2. See Mario Carpo, 'Ten Years of Folding', in Greg Lynn, ed., *Folding in Architecture*, preface to the 2nd edn (London 2004), vii–xiii.
3. Frédéric Migayrou and Zeynep Mennan, eds., *Architectures non standard*, exh. cat. (Paris 2003).
4. See William J. Mitchell, 'Antitectonics: The Poetics of Virtuality', in John Beckmann, ed., *The Virtual Dimension: Architecture, Representations, and Crash Culture* (New York 1998), pp. 205–17, esp. pp. 210–12 ('Craft/Cad/Cam') and notes; idem, *E-topia: 'Urban Life, Jim – But Not as We Know It'* (Cambridge, MA 1999), pp. 150–52 ('Mass Customization') and notes.
5. More precisely, a tea and coffee service (Alessi Coffee and Tea Towers). See Greg Lynn, 'Variations calculées,' in Migayrou and Mennan, *Architectures non standard* (see note 3), p. 91. The original project included fifty thousand variations, of which ninety-nine were made in addition to the three author's copies (according to commercial information furnished by Alessi SpA).
6. Gilles Deleuze, *Le pli: Leibniz et le baroque* (Paris 1988); translated by Tom Conley as *The Fold: Leibniz and the Baroque* (Minneapolis, MN 1993).
7. Deleuze, *Le pli* (see note 6), p. 26.
8. See Pliny, *Historia naturalis* 35.64; Cicero, *De inventione* 2.1; Xenophon, *Memorabilia* 3.10.2. The topos of Zeuxis remained central to the aesthetics of Renaissance classicism and visual arts at least until Giovanni Pietro Bellori (*Idea*, 1672).
9. Richard Krautheimer, 'Introduction to an "Iconography of Medieval Architecture"', in *Journal of the Warburg and Courtauld Institutes*, 5 (1942), pp. 1–33; revised in idem, *Studies in Early Christian, Medieval and Renaissance Art* (New York 1969), pp. 115–50. Some contemporary medievalists dislike Krautheimer's arguments.
10. Giovanni Rucellai writes in a letter that he sent at his own cost an engineer and a team of assistants to Jerusalem so that they would return with the 'correct design and measurement' ('giusto disegno e misura') of the Shrine of the Holy Sepulchre in Jerusalem, with the aim of having another one built 'similar to that one' ('a quella simiglianza') in the adjacent church of the family *palazzo*. This letter is now believed to be false, but for centuries it was thought to be authentic, which proves that even if it was not, it must at least have been believable. See Mario Carpo, 'Verbatim: Paradigmi dell'imitazione architettonica ll'inizio dell'età moderna', paper presented at the conference Palladio e le parole, Centro Internazionale di Studi di Architettura Andrea Palladio, Vicenza, September 2002, forthcoming; idem, 'Alberti's Media Lab', paper presented at the conference Perspective, Projections, Projet: Techniques de la représentation architecturale, Centre d'études supérieures de la Renaissance, Tours, June 2003, forthcoming.
11. See Mario Carpo, *L'architettura dell'età della stampa: oralità, scrittura, libro stampato e riproduzione meccanica dell'immagine nella storia delle teorie architettoniche* (Milan 1998); revised English translation by Sarah Benson as *Architecture in the Age of Printing: Orality, Writing, Typography and Printed Images in the History of Architectural Theory* (Cambridge, MA 2001).
12. See Greg Lynn, 'Classicism and Vitality', in Anthony Iannacci et al., *Shoei Yoh: In Response to Natural Phenomena* (Milan 1997), pp. 13–16, 67–70.
13. See Objectile (Patrick Beaucé and Bernard Cache), 'Vers une architecture associative', in Migayrou and Mennan, *Architectures non standard* (see note 3), pp. 138–39. The authors note 'we experimented with situations where the implementation of this compositional logic within a non-standard project was able to generate increases in productivity by a factor of 100 [. . .]. On the other hand, it is only because of the explicit condition of increased productivity of this type that the expression "non-standard architecture" has any meaning' (ibid., p. 138; trans. RB).
14. William Gibson, *Pattern Recognition* (New York 2003)
15. Elizabeth Diller and Ricardo Scofidio, *Pageant* (1997); see Aaron Betsky, ed., *Scanning: The Aberrant Architectures of Diller + Scofidio*, exh. cat. (New York 2003).

Translated from the Italian by Rachel Bindman and the author