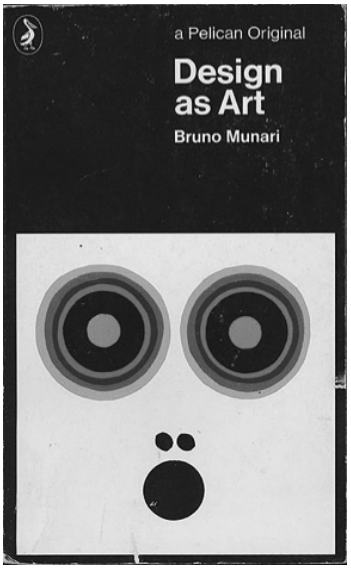
This bulletin began as a talk in The Classroom, organized by David Senior at the New York Printed Matter Art Book Fair in September 2013. It was originally delivered, and might even be read, in the company of two small metronomes set to 88 and 124 bpm. That talk will be repeated this September (2014) in the same space.

Thank you to Brit Eversole for the translation of "The Form of Disorder," to Massimiliano Mollona for background on Olivetti, and to Francesca Bertolotti for much of the primary material.

Cover Image: Tetracono (1965), Bruno Munari, an "object for the purposes of programmed art" manufactured by Danese

Lots of people know of me as "You know, the man who made the useless machines."

This is how Bruno Munari began the preface to *Design as Art*, a collection of occasional articles he wrote for the Milan newspaper *Il Giorno* in the years around 1962. Munari was more than a useless machine maker, he was also a designer, an artist, a writer, an editor, a teacher, an inventor, a didact, a curator.



Each of Munari's *Il Giorno* newspaper columns addressed an aspect of design in society. The eponymous essay, "Design as Art," was the most directly polemical. In it, Munari calls for his fellow artists to turn their talents toward design. He writes,

Culture today is becoming a mass affair, and the artist must step down from his pedestal and be prepared to make a sign for a butcher's shop (if he knows how to do it). The artist must cast off the last rags of romanticism and become active as a man among men, well up in present-day techniques, materials and working methods. Without losing his innate aesthetic sense he must be able to respond with humility and competence to the demands his neighbors may make of him. The designer of today re-establishes the long-lost contact between art and the public, between living people and art as a living thing.

Munari was trained as a fine artist, but practiced in multiple ways. He made speculative products pointed toward an imagined market; he worked under direct commissions with a brief, a goal, and a "solution"; and he also worked freely, without either purpose or context. He made little distinction between these categories. Working like this was financially precarious and he required sympathetic clients for his investigations. He found one close by: a typewriter company based in Ivrea, just west of his studio in Milan, that had recently expanded into making programmable calculators and computers.

I. OLIVETTI

After completing an electrical engineering degree in 1892, Camillo Olivetti left Italy for not-yet-Silicon Valley to assist in the engineering department at Stanford University. While in the United States, he first encountered typewriters and was introduced to the mass manufacture of various new technologies. He returned to Italy in 1903, and, with two friends in his hometown of Ivrea, set up a new company called Centrimetro, Grammo, Secondo (Centimeter, Gram, Second), to manufacture precision measuring instruments. After several years, he went back to the United States to learn more about typewriters, then, in 1908, returned to Ivrea and established Olivetti. The company's first product, the M1 typewriter, was released three years later. By 1912, a workforce of 100 was producing four typewriters a day.

Camillo was an engineer and rejected the idea of copying existing typewriter designs, insisting instead on redesigning the machine completely from the mechanism up. The result was precise, efficient, and economic. Around 1911 he wrote that

A typewriter must not be a showpiece for the salon, overloaded with tastelessness. It must look sober, and at the same time work elegantly.

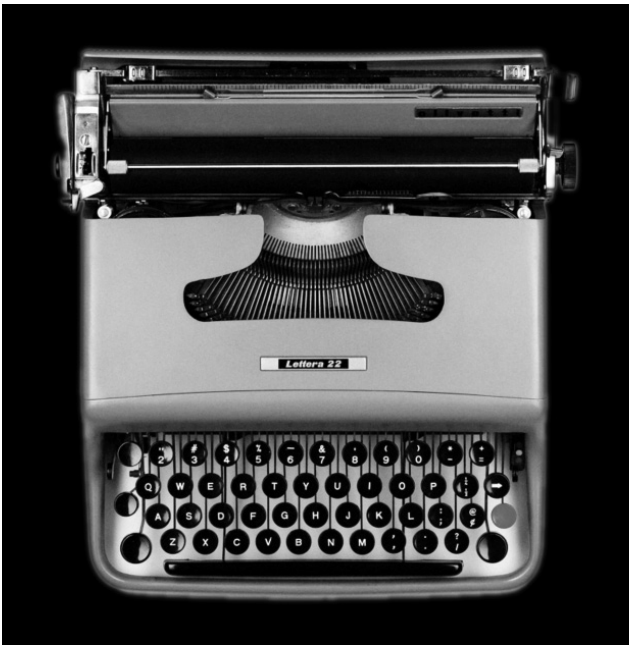
After two years of development, the Olivetti M1 debuted at the World's Fair in Turin, where Camillo exhibited not only the finished typewriting machine, but also the tools he and 30 employees had used to develop it: the production process as well as the product.

From the start, "design" was understood broadly at Olivetti — emphatically in a typewriter's mechanism and form, but equally in the essential task of product planning. The cycle of development and manufacture, labor organization, and even the entire corporate structure were considered aspects of design. One product, the M1 for example, could be seen as a *model* of the relations designed into it: internal relations of part to part in its mechanical design; formal relations between its mechanism and casing; labor relations organized to manufacture the product; and even social relations extending from the typewriter outwards. Camillo insisted that the machines ought to be understood in the context of writing as a cultural activity, and must ennoble the act through sensitive design. He believed that corporations were obligated in this way to the society in which they operate.

Olivetti was a family business anchored in the culture and economy of northern Italy. From 1929, Camillo's son Adriano became increasingly involved and eventually took over operations. Adriano expanded considerably his father's ideas of how a company might relate to society through the design of its products and he identified the fundamental problem: machines and humans are hostile to each other. Machines were fast becoming essential for working in a developed industrial economy, so the issue was urgent. Adriano's goal was to make a positive social impact by easing this relationship between machines and their users, and this provided Olivetti a corporate motivation beyond the brutally reductive logic of merely maximizing profit. The company commissioned projects from

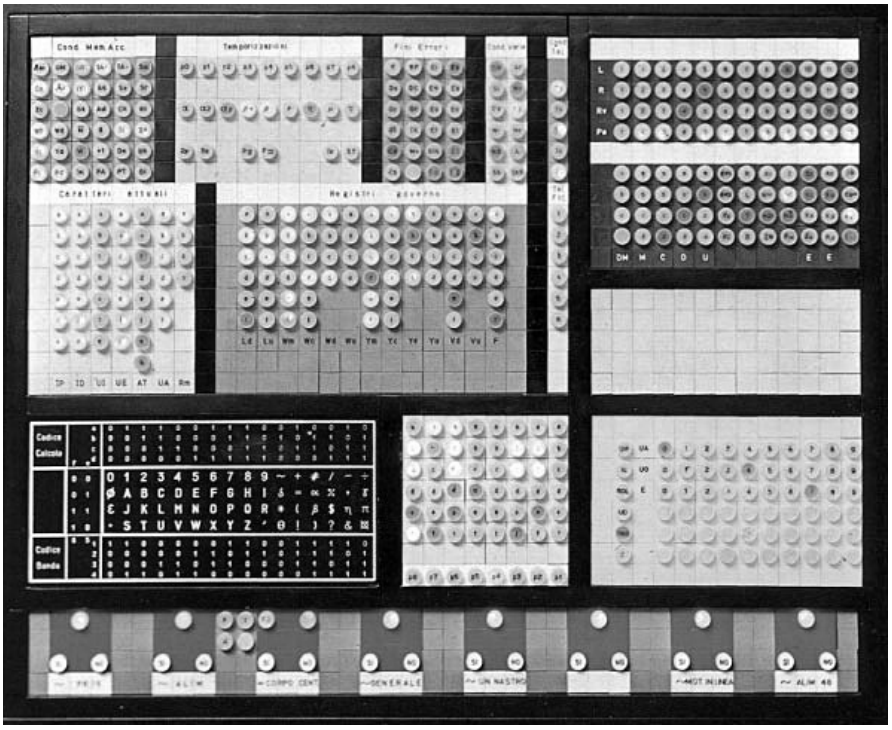
leading designers including Alvar Aalto, Le Corbusier, Enzo Mari, Bruno Munari, and Ettore Sottsass with the tacit understanding that these would result in products and communications that contributed to culture rather than preyed on it. Design wasn't motivated only to sell more typewriters, more physical goods, it was considered a *good* in itself. For Adriano, design was both an expression of and a medium for unity between living and working life, and offered the possibility of a reconciliation between people and technology.

Adriano also valued the alternate points of view that artists provided and considered it Olivetti's responsibility to facilitate and utilize this thinking. One artist he worked with closely was sculptor Marcello Negozzi, who became Director of Design. Over his 50-year tenure, Negozzi developed some of the company's most successful products, including the Lettera 22 typewriter, a portable writing machine whose form anticipated the laptop computer. The Lettera 22's keyboard is a collection of mostly equivalent, round black keys, each with a discrete white letter in its center, except the "return" key: given its functional distinction, this key was left blank but painted bright red. The product is instantly recognizable, useful, and the visual-functional delight of that one red key is, according to Olivetti, an example of design's social dividend.



Still, "technology" was rapidly gaining the upper hand. So, in 1955, Olivetti set up an electronics research center in New Canaan, Connecticut, together with support from the University in Pisa. Adriano hired Mario Tchou, a brilliant young engineer, and appointed his son Roberto to run the initiative. Mario and Roberto became quick friends and by 1958, Tchou was asked to move to northern Italy to run the all new Olivetti Electronics division. Tchou and his team of engineers worked feverishly over the next two years to develop Olivetti's first computer, the Machine Zero.

Following soon after was a more compact, fully-transistorized mini-computer named the Elea 9003. (This computer was still room-sized, but a smaller room.) Adriano hired Ettore Sottsass to give this new machine its form, and what he created was surprising — the main user interface was an ecstatically organized panel of buttons and switches, grouped in brightly colored constellations according to function. This man-machine "interface" offered a visual model for brokering the increasingly complicated relationship between humans and computers, and became a prototype for future Olivetti products.



By 1962, a small group of engineers in the Electronics Division had started developing a much smaller "computer" that would become the Programma 101. This machine was the mirror opposite of the Elea 9003: where the Elea was big, powerful, expensive, and given a radically new form by Ettore Sottsass, the Programma 101 was compact, affordable, and pragmatically designed by Mario Bellini to look like the office calculators Olivetti had produced for the last 50 years.

But the machine would be able to do quite a bit more than its relatively restrained form suggested. The Programma 101 could not only perform arithmetical operations on a string of numbers at the whim of its operator, it could also be *instructed* how to perform these same operations. These instructions could be sequenced, stored, and used to operate on previous calculations. The instruction sets were called *programs.*

instruction	*comments*
→AV	label to allow the program to be started by key, V
S	wait; enter A from keyboard into M
↓ or ↓M¹	A value goes to A register
S	wait, enter B from keyboard
+M	a register contains A + B
S	wait, enter C from keyboard
×M	a register ×C or (A + B) × C
S	wait, enter D from keyboard
÷M	a register has expression
A◇	print A register
—V	jump back to beginning label to recalculate expression for new variables

The Electronics Division was short-lived. Adriano died unexpectedly on a train between Milan and Lausanne in 1960, and Tchou died in a car crash the next year. Coupled with a radical change in the Italian economy (the end of the "economic Miracle"), Olivetti decided to prune the Electronics Division and sell it off to General Electric. Caught in the middle was the Programma 101. The project was, however, shrewdly reclassified as a calculator rather than a computer so that it would administratively remain at Olivetti instead of being absorbed by G.E. and (likely) canceled. The Programma 101 team continued in semi-secret, working in a nearby garage to avoid raising eyebrows. The machine finally debuted at the 1965

Industrial Fair in New York to a strong response; Olivetti's booth had to be roped off from an ecstatic public, orders were taken, and it was clear that the first desktop personal computer had come to market.

By 1962, Bruno Munari was consistently working for Olivetti as a consultant on graphics and products. At the beginning of that year, Munari invited Olivetti's art consultant Giorgio Soavi on a field trip. Soavi was the locus of an ambitious cultural commissioning program at Olivetti at the time, which had expanded from design commissions to more broadly artistic and cultural products. He was responsible for producing short films, aesthetic research, writing, publishing, illustration, and performances. Soavi maintained a extensive list of international contacts across artistic disciplines, and was always looking to expand his circle. Munari took him to meet a collective of young artists called Gruppo T:

Had we asked him to produce an example of vitality we couldn't be more satisfied. Munari is not a temperamentally introspective artist; that morning he was on the move, like the objects of Group T he was showing us. Each of the young artists extracted, from a mountain of wires and boxes, the presentable piece, the one in the best shape. It was a delicate confusion, befitting the youth of the artists. I seem to remember that at a certain point one of them said, "There, you see, this object is mine … No excuse me, that one's mine, yours is down there." A wall of expanded plastic cubes moved like an excited sinuoid; then, an instant later, the crisis: burnt out tubes, pliers, switches, screwdrivers, limping motors, iron dust, magnets. All objects for our amusement. The first impression was joyous and positive. It was then decided to hold a small exhibition of these objects in motion.

II. ARTE PROGRAMMATA

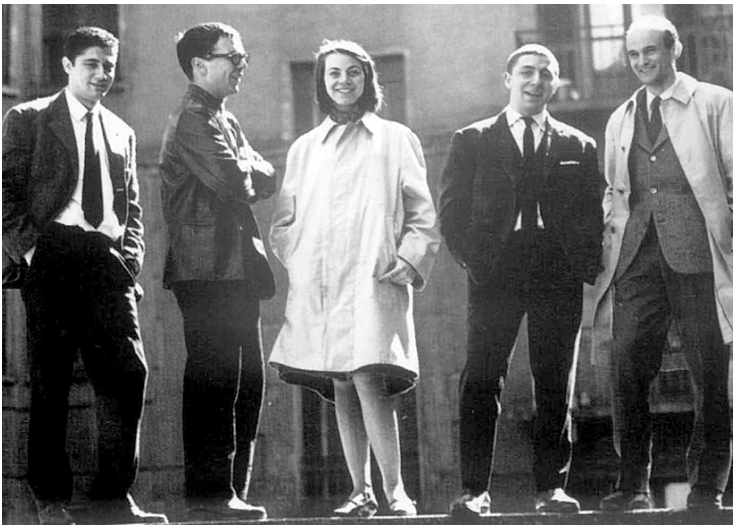
The exhibition was titled *Arte Programmata*, (Programmed Art) and organized by Munari and Soavi with theoretical framing courtesy of writer and critic Umberto Eco. In addition to works by Gruppo T, the exhibition also included works by Gruppo N, a similarly motivated and equally young collective based in Padua; graphic designer Enzo Mari; and Munari.

The exhibition opened in spring 1962 at Olivetti's Milan showroom in a shopping arcade called the Galleria; the showroom was emptied of its usual products and filled with these new machines. The public response was overwhelming at the opening, and, during the next two months of the exhibition, Galleria shoppers persistently stopped into the showroom to watch these useless machines.

In the summer of the same year, the exhibition travelled east to be shown in Olivetti's brand new Venice showroom as part of the Biennale. Adriano had commissioned local architect Carlos Scarpa to design the space in an existing building on Piazza San Marco right in the middle of the city and, as with many of Olivetti's commissions, the result was as much a display for Scarpa's architectural talents and Olivetti's enlightened commissioning program as it was a showroom for Olivetti products. The interior of the small space was a jewel box, every inch well-worked in Scarpa's particular vernacular that merged international modernism with local materials and building traditions.

Inside the showroom, Olivetti's crisply designed typewriters and calculators were arranged one after the other on long shelves — absolutely high-tech and eminently covetable. It was a 1962 Apple Store, stacked with the latest products in a shimmering retail environment, but in place of Apple's ahistorically sheer surfaces and glass staircases were Olivetti's textured concrete, inset brass, and beautifully worked walnut. New and old at once, it must have looked bracingly modern and absolutely fantastic when it opened in 1960.

The artworks included in the exhibition were like products themselves — the artists insisted on this rhetoric. Members of Gruppos T and N worked collectively; they signed their works together; they described their work as research and their works as products; they preferred "aesthetic operator" or "designer" to "artist"; and they oriented their work towards society at large, rejecting the narrow lines and privileged social makeup of the art market.



The works were explicitly conceived as multiples, and designed for industrial manufacture. The result was clean and precisely repeatable, like a product, but also used the existing industrial armature to reveal something about itself. These multiples don't simply critique, replace, or negate this production logic, but USE it to offer another idea of how art might relate to mass-production. Art can infiltrate consumer culture and retool its manufacturing and distribution mechanisms to its own purposes,

offering alternative points of view and projective models AS consumable products. Cumulatively, these decisions also had a net practical effect: the works had a price tag much closer to a product than a sculpture.

As in Milan, these artworks temporarily replaced Olivetti's regular product line. Each was self-contained, of approximately the same size, industrially manufactured, and generally employed some kind of moving mechanism, such as electric motors, fluid pumps, levers, cranks, and magnets.

Bispazio Instabile by Gruppo N was typical—a glass-sided vertical box containing something like 400 small red and white balls with a handle on the side intended to mix the arrangement and produce a new composition. The handle read immediately as something to turn, to manipulate, and this was the point: the artwork provided an explicit invitation to remake the work, to shuffle the balls, produce a new constellation, and in so doing, to intuitively understand what it is to rearrange reality, to change the current situation, to move forward in time.

Other works in the exhibition embodied a similar promise, rejecting the conventional wisdom that use is the enemy of art. Use is inscribed in these objects, though the precise nature of that utility is open to negotiation. Borrowing a term from symbolic logic, Umberto Eco identified this as the work's "propositional function." In place of the expressive, representative,

or poetic function more typically attributed to an artwork, Eco suggested that what these works had to offer was a proposal, an adjustable relation, an *if this, then that.*

Arte Programmata's theoretical outlines were first described by Eco in the 1962 *Almanacco Letterario Bompiani*. At the time, he was the non-fiction editor at publishing house Bompiani, while Munari was designing covers and contributing to its yearly publication. Over the course of 1961, the two shared a conversation around a group of artists whose thinking paralleled what Eco was then writing about in what would soon appear as his 1962 book, *Opera Aperta* (The Open Work). In it, Eco argued for the "open" work as the authentic artform of the time. Open works presented themselves as fields of possibility where an audience works in concert with art to produce its meaning.

In the *Almanacco*, Eco presented a collection of such open artworks and contributed an essay that joined the dots, "The Form of Disorder," which described artists working in a world defined by statistical probability in place of Cartesian coordinates. This "group of painters (or are they painters? or programmers? or planners of form?)" included Munari, Mari, and members of Gruppos T and N. Eco identified a new ideal form proposed by these works based not on the most harmonious composition

from among all of the possibilities, but its inverse—all of the possibilities, equally probable, *as* the composition. He called it a "proportion achieved through negation, an inverted renaissance, an Unholy Disproportion," where "Boltzmann replaces Luca Pacioli."

Pacioli was a Franciscan Friar at the center of the Italian Renaissance in the 15th century who taught Leonardo da Vinci mathematics. He also wrote *The Divine Proportion*, which advocated a perfect proportional system rooted in the human body, implemented in rational geometry, and passed down from heaven. Ludwig Boltzmann was an Austrian physicist at the end of the 19th century, who first offered a statistical mechanical account of reality, asserting that matter's physical makeup was the consequence of the probabilistic combinations of its underlying atomic properties. Boltzmann also suggested that energy transfers pass through discrete rather than continuous steps, and this laid the basis for quantum mechanics. By 1962, quantum mechanics was well-established and its premise understood: at any one moment, physical reality is a function of its statistical probability among the possible options. This produces surprising consequences, such as the fact that an atom can be in two different places at once (most famously articulated in Erwin Schrödinger's thought experiment where the cat in a box is *both* dead and alive). According to Eco, Boltzmann's new reality required an art equal to it.

These ideas were even more counterintuitive in 1962 than they are today, and artists were beginning to produce models and develop new forms to think around and about them. Eco identified two approaches: one group of artists searched for new forms in mathematics, using geometric abstractions, seeking a Pythagorean, even mystical, and rational ideal of harmony; the second embraced the richness of chance, disorder, and random processes. Neither approach fully comes to terms with the new probabilistic accounts of reality. Eco describes an artist who "madly sprays tubes of colored paint onto the canvas laid on the ground," where "chance designs its figures and the painter gathers them as his own," but laments that this approach merely "domesticates" chance—giving it form rather than accepting its consequences. But he sees another way:

One can, however, also get at Chance in the opposite manner: forecasting it, programming it, not choosing the products of Chance after it has

happened but letting Chance play its course according to unbreakable rules of statistical probability in which maximum randomness coincides with maximum predictability.

Eco also wrote an essay for the *Arte Programmata* catalog, in which he returned to the "propositional function," or "continually attempted adventure," of work that is persistently, irreducibly variable. Crucially, this mutability occurs only within precisely determined limits. These limits are then the work's *program*—a definite set of instructions, an algorithm, a step-wise recipe whose product at any given moment cannot be predicted, but whose sum total possibilities have been absolutely defined. All variations are presented without discrimination, typically spread out in time.

The result is "not a form, but a film of a form in motion, or, the complimentary choice from among various forms," and its meaning is precisely in the co-presence of ALL of these possibilities. It doesn't represent anything, but rather the work is the thing in itself, a "field for happenings" that relies on a sympathetic viewer to witness its change and conjure its meaning; it is "something BECOMING while we watch it."

Thus we can speak of "programmed" art, and admire the kinetic sculptures that a man of a coming future will install in his house, in place of the old prints or the modern masterpieces reproduced. And if someone should observe that this is not painting, nor even sculpture, it should be of no concern. One could then start a contest to find a new name, but let us not be frightened by a question of names.

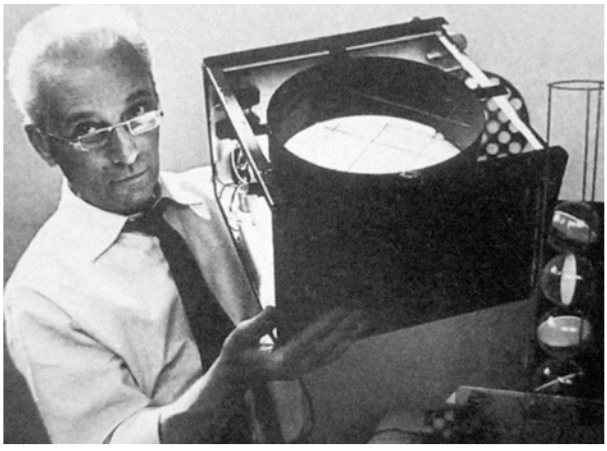
The word "program" itself would have already meant several different things in 1962. The term would have first referred to the assembling of instructions by code, as in a computer program. Principally housed in universities, corporations, and research institutions, computers were easing into the public imagination. "Program" also would have more generally suggested an attention to effect or behavior, as to program a certain result. Finally, the word would have resonated more ambitiously with the idea of a project for rearranging society: a social program. Shifting relations between the producer and the consumer, between the artist and the audience, between the subject and the object, and between an effect and its cause were all suggested by programmed art, and

the works attempted to use their internally dynamic relations to model these corresponding changes. In a catalog essay from 2000, Arte Programmata's most insightful critic, Marco Meneguzzo, describes concisely how these works work:

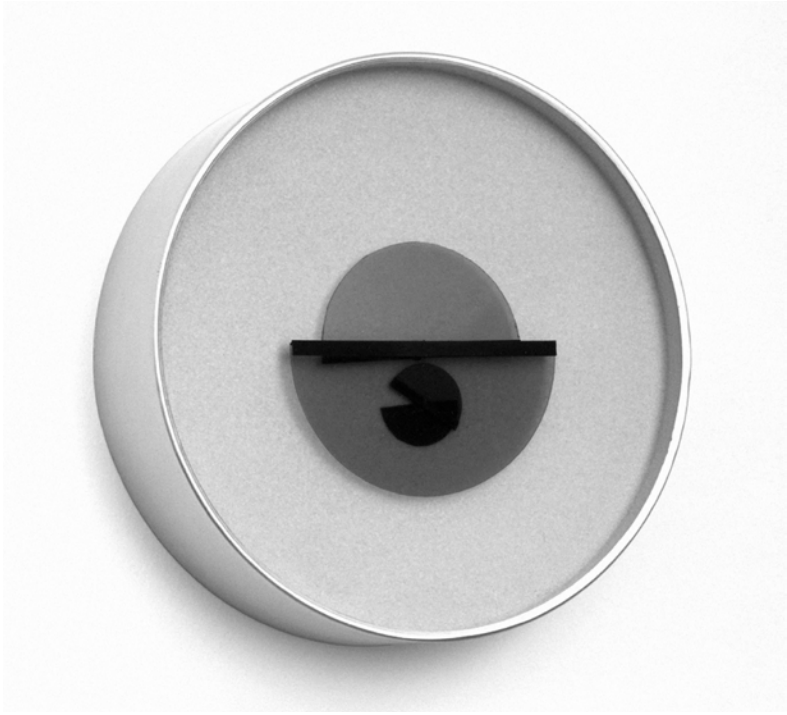
It was not a question of putting technology up on the pedestal of legend, but of the indispensable use of the "future" — rendered visible by movement — to create a form adequate to the future of the world.

III. MUNARI

Munari was a full generation older than the artists of Gruppos N and T and had been working for 40 years already, exploring many of these ideas. By 1962, he was collaborating with Milan-based manufacturer Danese to produce a range of multiples.



One of these was a clock called L'ora X (The X Hour). A rough prototype of L'ora X in 1945 used a standard brass alarm clock whose arms were fitted with colored cellophane semi-circles. Hour, minute, second, and alarm hands were each extended and fitted with different colors (yellow, blue, red, green) so as the clock proceeded through the day, it also produced a constantly evolving color composition. The Danese clock was produced in an edition of 50 with acrylic disks and an aluminum chassis. L'ora X was a fully operational clock, yet it was also loaded with a surplus function much less clearly defined. It straddled the line between product



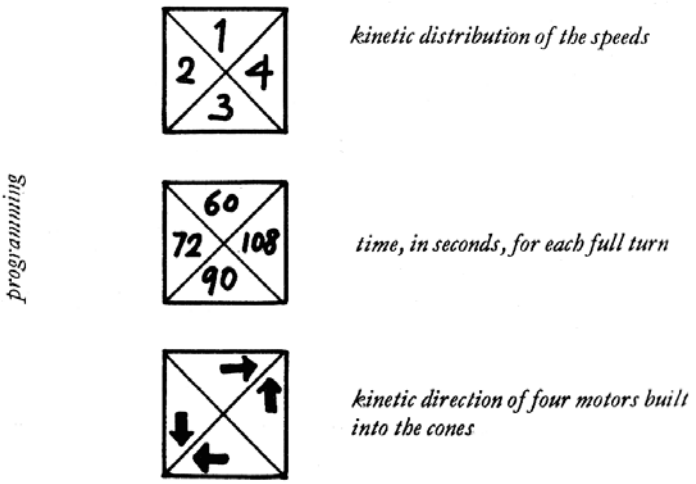
and artwork. Munari wrote a poem, "But What Is This X Hour?," in order to tease out some of its ideas:

It's the mechanical birth of a form
It's the mechanical diminuation of a form [...]
It's time divided by millimeters
It's space divided by seconds [...]
It's a continual present [...]
It's the hour of rest
It's the X hour

In 1963, Munari installed a collection of 24 of these clocks in Danese's Milan showroom, each set to a specific time zone. Looking around the room, each would have displayed a related but unique color composition. The X Hour clock could be properly called a work of programmed art because it had a prescribed set of possibilities, all built directly into its structure, and continuously displayed as a changing form. Instead of relying on chance or circumstance, though, in this case the sequence of programmed possibilities followed a regular and familiar loop, advancing through arrangements dictated by the offset tempos of hours, minutes, and seconds.

Also around 1962, Munari was working on a more ambitious multiple for Danese called Tetracono (eventually released in 1965). This was an electric mechanical device composed of four cones oriented with their points at the center. The cones were housed in a small box open on two

sides, and the relations of the sizes of the cones to the box was precisely determined according to a rationalized geometric scheme. Each cone was painted half-red, half-green, and engineered to turn in a particular direction at a specific speed. When plugged into an electric current, motors rotated all four cones, which produced a constantly changing display of color. Over the cycle of its program, the Tetracono slowly evolved from all green to all red, morphing over 18 minutes as the cones spun. Munari identified the program of this work in determining the speed and directions of each of its movements, and drew this diagram to describe it:



The Tetracono demanded a viewer's attention. The color combinations are "at first perceived one by one, but if one watches longer the effect becomes that of a continuous transformation." The artwork-product was designed to work in opposition to art of the past whose discrete images "had accustomed us to seeing nature as static: a sunset, a face, an apple." Instead, the Tetracono offered a corrective, a model for seeing that helps us to recognize an apple as "in fact a moment in the process from apple seed to tree, blossom, fruit." It's a lot to ask from four spinning cones, and yet Munari presented the idea with absolute conviction. Although it was not in the first two versions of the *Arte Programmata* exhibition, Tetracono was a product of this same thinking. Once manufactured and released, it became a central part of the show as it toured the United States in the coming years under the auspices of the Smithsonian Institution.

Munari also co-founded a small film studio around 1962 called Studio di Monte Olimpino. The first film he made there was a documentary of the *Arte Programmata* exhibition. Film was a native medium for Munari's ideas, and now that he had direct access to its tools, he began to exploit the medium's nature. In 1963, he made another short film, *I Colori della Luce* (The Color of Light), followed by *Inox*, which explored similar perceptual territory, and *Moiré*, a three-minute film of visual interference produced by changing frequencies of overlaid dot screens. These explore the themes of programmed art and don't fit comfortably in any existing film category—neither fiction, nor documentary, nor essay. They are instead a kind of visual research, using the process of filmmaking to study a particular phenomena and reveal aspects that would be difficult to investigate in other media. Munari made another in 1964 which addressed the same subject in a characteristically warm manner: *Sulle Scale Mobile* (On Escalators) featured footage of the title's mechanism in a Milan department store, offering up the constantly changing parade of shoppers as so much programmed art.

Munari explored all kinds of temporal techniques in films that included research shorts for Omega and Fiat. One film in particular, *Tempo nel Tempo* (Time in Time), from 1964, exploits the technological possibilities of the medium to expand our perceptual abilities. It's a three-and-a-half-minute film produced with the assistance of Milan Polytechnic that records an acrobat performing a back flip. First, the acrobat poises himself on a red cube then launches into the flip; a soundtrack of an amplified watch ticking in realtime plays over the top. Next, this footage, shot with a very high shutter-speed camera, is slowed way down and stretched to last the rest of the film's running length. As we watch what we have just seen on the screen repeat in excruciatingly slow detail, the soundtrack's ticking clock does not slow down, but rather remains synched to our *regular* time, gradually joined by instruments that multiply and mutate its rhythm.

The effect is immediately recognizable as slow-motion photography, but also surprisingly strange. The combination of this audio cue, a ticking watch marking seconds at normal speed, together with this super-slowed footage produces a temporal disjunction, a suspension. We understand that the acrobat will complete his flip (of course), but because his body's movement is slowed down beyond the usual limit of our perception,

we also can't predict EXACTLY what we will see next. In other words, the film demands the viewer's attention to carefully register this sequence of changes that, in the global picture, are absolutely determined, but in the local, particular moment, impossible to precisely predict. This film is not programmed art, but it IS a kind of *cipher* for it, a diagram of how programmed art works. The first flip played in our familiar realtime can be read as the film's "program," its instructions or limits, while the slowed down footage is what plays out according to these. The film requires close focus, and as a result the viewer is implicated in its action — it is almost as if the movement on screen is conjured as a consequence of the viewer's attention. Watching the film then, we both *remember* but also *predict* the movements of the acrobat as he flips through time.

. . .

Munari died in 1998. By this point, Olivetti had withered to one-fourth of its 1962 size. Typewriting and calculating were not the growth industries they once were, and the company's computer efforts were not gaining any traction against their dominant rivals. In 1999, already part-owned by Pirelli and Benetton, Olivetti attempted a hostile takeover of the formerly nationalized giant Telecom Italia and succeeded, only to realize that all they'd taken over was a mountain of debt. The relationship was soon inverted, with Telecom Italia retroactively swallowing Olivetti. Since then, Olivetti has halfheartedly entered the tablet computer business. A similarly lackluster fate attended the company's Venice showroom. By 1998, it had been sold and refashioned as a tacky tourist souvenir shop.

Ten years later, though, the Olivetti foundation had reacquired the original showroom space and was working to restore it to its previous state. The renovation of Scarpa's exquisite architecture was immaculate, involving a total overhaul of all of the original structure, surfaces, and details in order to house a complete collection of Olivetti products from around the time it was first opened. It was as if the space and everything in it was simply *reset* to circa 1962.

Then, to mark the reopening of the showroom, and in concert with the 2012 Architecture Biennale, the *Arte Programmata* exhibition was reinstalled in the space. This new version was titled *Programmare l'Arte* —a pun that shifts the past tense of the original title to an infinitive verb ("to program art"). In the intervening 50 years, although the showroom and the exhibition were materially the same as they were in 1962, everything else around them had changed. The space, initially built to showcase Olivetti's most current technology, now functioned as a museum of antiques, products from the 1960s. Typewriters and calculators are presented exactly as they were, although now with contextualizing labels so that we can read their original function from this temporal distance.

The works from *Arte Programmata* were also installed in the space, only this time in-line with the typewriters and calculators, as if simply more Olivetti products. Many of these works were either rehabilitated or reconstructed to match the originals.

In the meantime, the functional distinction between these artworks and Olivetti's products had reversed—like a switch throwing the direction of an electrical current, swapping its positive and negative poles. The products were no longer functioning products, but historical artifacts, and so ostensibly *useless.* The artworks, on the other hand, had become more explicitly instructive and so, *useful.* Imagine returning to Munari's Tetracono now, 50 years on—motors still running, patiently spinning its cones, turning their complementary colors, and articulating an excruciatingly slow transition from green to red. Having had more time to assert themselves, these works of programmed art have become even more resonant models for perceiving and thinking about the way things change.

Writing in the original exhibition catalog, Umberto Eco described an apparently random sequence of events—the sequence of numbers produced by a roulette wheel—understood in reverse: "in the vicissitudes of chance one can A POSTERIORI distinguish a kind of program." You can imagine sitting down at that roulette wheel and realizing it is both entirely random (for now), and entirely predictable (in the future). Its program is clearly laid out in 37 numbered slots (half red, half black, plus one green zero), but you can't say what the croupier's next spin will bring. Compress an evening in the casino to the length of a wink, say, and the entire sequence becomes imminently legible. In real time, placing your bet produces the event and offers a kind of gambler's solace, something like that peculiar mid-flip conflation of both recalling *and* predicting what's going to happen to the suspended-protracted acrobat in *Time in Time*: it's only a matter of tempo. This temporal sensitivity is what programmed art modeled for us fifty years ago.

Munari understood it already, writing in "Growth and Explosion" from somewhere right around 1962:

Driving one day down one of the big motorways I happened to see a big bush in the middle of a meadow, and this set a whole train of ideas going in my mind. Whether or not they might have some practical application must be left for the future to decide. In any case, here they are. That big bush in the meadow looked to me like an explosion caught and fixed at its point of maximum expansion. If I were to take a photo of that bush,

slightly out of focus, and show it to you side by side with a photo of a hand-grenade exploding, the two things would have the same form. One might say that a firework is nothing other than a tree or a big artificial flower that grows, blooms, and dies in the course of a few seconds. After that it withers and falls to the ground in unrecognizable shreds. Well then, let us take this firework and make it last a month, stretching the time element but leaving everything else as is. What we get will be a flower, with all the visual characteristics of other flowers. Or let us imagine the seed of a tree might explode like a bomb. In such a case we would have a tree in a matter of minutes, rather as we can watch the growth of a flower on film by running the film through quicker. Our tree would have straight branches, as in an explosion the bits fly off in straight lines before describing a parabola. In the normal way the explosion of a tree happens very slowly and the branches, instead of being straight, grow crooked for a number of reasons: atmospheric conditions, the course of the sap, the prevailing wind and many others. But of course there are small fireworks that describe trajectories not unlike the tortuous growth of a vine or olive.

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