

'The question always arose in the space of the relation between experience and the abstract, the senses and purity.'¹

Michel Serres, 1982. *The Origin of Geometry*

Maths Happens: Performativity in the Art of Numbers.

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Searching for an answer to the question of the origins of different modes of mathematical notation, philosopher Michel Serres speculates about whether the historical origins of geometry, which preceded the Greek alphabet and the development of algebra, evolved out of Egyptian hieroglyphics. What is of enduring interest to Serres is the implications of translation from one system of notation to another; a constant preoccupation in his writing.² In the context of commemorating George Boole, this focus on different symbolic modalities, and the relationships between them, can be seen as a leitmotif of his contribution to mathematics. It is also a question of central importance to this exhibition, in which the passages between drawing, diagramming and modelling, as well as the symbolic systems of numerical, algebraic and verbal notation are all explored in relation to both real and virtual space.

Whatever we choose to believe about the nature of mathematics; about whether it is an invented language used to explore and express the universe around us or whether it is a Platonic given, written in the stars; the fact remains that to communicate thought mathematically, it has to be exemplified; to be manifest in the world. And this is where, according to Serres, the trouble started. When the Pythagorean School made the discovery of irrational numbers; of numbers that could be both odd and even, mathematical expression very early on led to contradiction, controversy and even violence.³ It appears then, that when maths happens; when it is enters into the world of experience and action, it has consequences which are far from pure and neutral. This exhibition reveals how this aspect of mathematical expression; its performativity, instability and ultimately its capacity to affect us as embodied subjects has as much valency for artists as do its qualities of eternal and unchanging abstraction.

The observation that Serres makes about the fact that expression of mathematical content can take several forms, is what leads its abstract purity becomes ambivalent once it enters the realm of the senses in time and space. We only have to examine the exhibited fragment of mathematical exercises by George Boole to see that Maths can get messy. It is also here, in Serres's 'space of the relation between experience and the abstract' that artists operate; scaling the divide between ideas and their realization in visual terms—and often, like Boole, inventing new languages with which to do so. According to classic information theory, in any act of communication there is always static, or noise, against which the information stands out; but for Serres, noise is good. Noise, the excess created by any symbolic expression is, in his estimation, central to what makes that particular performance unique. The noise created by artworks in this exhibition then, manifests in the various ways in which artistic

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[1] SERRES, M. 1982. 'The Origin of Geometry' in: J.V. Harari and D.F. Bell, eds., *Hermes; Literature, Science, Philosophy*, Baltimore: Johns Hopkins University Press, pp. 125-134 (<http://mas.caad.arch.ethz.ch/mas1011/wp-content/uploads/2010/09/The-Origin-of-Geometry.pdf>, p. 3)

[2] Despite his initial training in science, Serres judged scientific reason as a whole, in the world after Hiroshima, to be grossly inadequate without the complimentary forms of knowledge that the arts can provide. His research not only focuses on the history of science but he is particularly interested in the possible links and interdisciplinarity between so-called hard sciences and social sciences. He therefore wrote his early philosophical works under the sign of Hermes, messenger to the Gods, and has since woven a complex and provocative series of connections throughout his writings between his specialisms of Physics, Classics and Communications Theory.

[3] Serres recalls the legend that haunts the discovery; 'Perhaps his name was Hippasus of Metapontum. Perhaps the sect had sworn an oath to divulge nothing. Well, Hippasus of Metapontum spoke. Perhaps he was expelled. In any case, it seems certain that he died in a shipwreck' (ibid, p.4)



expression can enhance our experience of mathematics. Some works, for example, thematise the simple acts of counting and measuring which are embedded in our day to day lives, and others reveal to us the complex systems of thought and calculation that underlie the post-Boolean digital and virtual worlds we now live in. By so doing, functional performances of computation are translated into acts of contemplation; eliciting affect rather than aiming for accuracy. In other words, these artworks allow us to explore our individual gut responses to mathematical languages and, whether resulting in pleasure or pain, ask ourselves, in the words of Bob Dylan, 'How does it feel?'⁴

This may seem like the wrong question to be asking of a show which includes the work of historical conceptualists Bochner, Darboven and LeWitt, the generation of post-minimalist artists whose turn to serial systems and mathematical computation in the mid 1960s was a part of the deliberate strategy to supplant both the aesthetic legacies of Abstract Expressionism and its theoretical defense in the formalist criticism of Clement Greenberg. As Luke Skrebowski recently observed;

In the search for a discursive ground other than the immanent criteria of taste and subjectivity advanced by formalist aesthetics, artists as well as theorists seized upon a number of different approaches from extra-artistic disciplines.⁵

And yet if we turn to the other branch of analytical aesthetics formulated at that time; namely the expressive theories of philosopher and curator, Nelson Goodman, we find that this negation of formalism on the part of conceptual artists also has a more affirmative side. Goodman's aesthetics followed R.J. Collingwood (and ultimately Benedetto Croce) who maintained that mathematics and logic are forms of expressive communication, just as much as are poetry, music and visual art. Collingwood's influential work *The Principles of Art* (1938),⁶ had proposed a broad understanding of 'expression' as a fundamental part of the life of the mind, and something that we all do constantly, in order to understand the world. He also saw imagination as something not limited to artists, or even confined to specific activities and his understanding of emotion and expression was that they are both fundamental to all conscious experience. Collingwood proposed then that all languages, including scientific and intellectual reasoning, are to some extent expressive. 'Symbolism is thus intellectual language; language, because it expresses emotions; intellectualized, because adapted to the expression of intellectual emotions' (Collingwood, 1938, p. 269). Intellectual thought, in Collingwood's theory, cannot be separated in kind, from other forms of human expression. From this perspective then, there is no antagonism therefore between expression in mathematics and poetic or artistic expression.

[4] DYLAN, B. "Like A Rolling Stone" in the album: *The Essential Bob Dylan*. Copyright © 1965 by Warner Bros. Inc.; renewed 1993 by Special Rider Music. Vid. <http://www.bobdylan.com/us/songs/rolling-stone>

[5] SKREBOWSKI, L., 2006 'All Systems Go: Recovering Jack Burnham's "Systems Aesthetics" ' in: *Tate Papers Issue 5*, 1 April 2006, unpaginated. Vid <http://www.tate.org.uk/research/publications/tate-papers/all-systems-go-recovering-jack-burnhams-systems-aesthetics> (last accessed 26/07/2015)

[6] COLLINGWOOD, R.G., 1938. *The Principles of Art*. London: Oxford University Press. Paperback ed. 1958.

The consequences for the alliance of artistic and other forms of communication and knowledge developed by Collingwood were actively pursued by Goodman, who founded an inter-disciplinary arts and education programme called *Project Zero* at Harvard in 1967.⁷ Artists of Bochner and LeWitt's generation contributed directly to manifesting this broadening of aesthetic criteria in visual art, interacting with a range of disciplines including philosophers, mathematicians, engineers, musicians, dancers and architects. For example, Bochner's inaugural exhibition, *Working Drawings and Other Visible Things On Paper Not Necessarily Meant To Be Viewed As Art*, 1966, included 100 photocopied drawings, plans, diagrams and notations sourced from a variety of artistic and extra-artistic practices. The piece acted as a kind of litmus paper for testing the waters of that moment; LeWitt's complex sculptural permutations being a case in point, necessitating assistance from mathematician Babakhanian.⁸

Critic and curator Lucy Lippard characteristically pointed out that 'Numbers and scientific gobbledygook are hedonism for geeks!'⁹ but these artists were never interested in the aesthetics of mathematics *per se*.¹⁰ More to the point, they aimed to interrupt the accepted artistic categories and responses of that time, but as Luke Skrebowski again observes;

...there is always a slippage in any interdisciplinary borrowings. Processing systems are never neutral—to use a metaphor from information theory, noise is introduced into any communication at the channel.¹¹

Curator Richard Field observed that the *Working Drawings*

propose a conceptual art of process, a process art located in the development of an idea. Bochner's conceptualism emerges as a dynamic model, a thought activity occurring in the gaps between language and things.¹²

From this point onwards, for Bochner, this slippage which occurs during the performance of translating thought into something visible or tangible, became the focus of his practice. This essay began with Serres's search for the origin of geometry in myth and legend, so in order to illustrate this dynamic model and provide a context for Bochner's work in this exhibition, I continue with a story.

In the summer of 1971, Mel Bochner, a young conceptual artist from New York made his way down the spine of Italy, leaving sparse measurements drawings and sculptures on floors and walls behind him. As word got around, these gallery exhibitions and private commissions led to further opportunities,¹³ and so the artist resumed this itinerary the following year. After installing a piece in the church of St Nicola in Spoleto and a show

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[7] Goodman was directly involved in intermedia art projects (often in collaboration with his wife, painter Katherine Sturgis) and is also known for his curatorial work in the Walker-Goodman Gallery, Boston. (<http://plato.stanford.edu/entries/goodman-aesthetics/>) last accessed 26/07/2015.

[8] See FIELD, R., 1995. *Mel Bochner: Thought Made Visible 1966-1973*. New Haven: Yale University Art Gallery, p.98. A page of Babakhanian's mathematical notations was included in Bochner's *Working Drawings* as were some of LeWitt's own calculations.

[9] GOLDSTEIN, A. AND RORIMER, A., eds. 1996. *Reconsidering the Object of Art: 1965-1975*. Cambridge, Mass.: London: MIT Press/Los Angeles: The Museum of Contemporary Art, p.30

[10] On the aesthetics of thought, a topic for another discussion, it is worth mentioning here Thomas McEvilley's 1985 article 'I Think Therefore I Art,' *Artforum*, 23, Summer 1985, pp 74-84) which identifies a history of the privileging of conceptual activity as aesthetic experience, beginning with 'A Greek genre of philosophical literature (which) was called the *Paignion*, or game; it was a special place for the construction of paradoxes, infinite regresses, circular arguments, both and neither arguments, yes and no arguments, and other delicacies of an art that isolated the effects of different types of thought for essentially esthetic appreciation.' (ibid p. 75)

[11] Skrebowski, 2006, unpaginated

[12] Field, 1995, p. 102.

[13] For example, the impromptu installation in a disused factory in Milan. Bochner commented on the freedom he found in Europe compared to New York, where exhibition opportunities were slim for younger artists. (Skype interview with author 06/05/2011).

in Galleria Marilena Bonomo in Bari, he continued right to Metaponte on the southernmost coast to the site of a ruined temple dedicated to Apollo, which was associated with the cult of Pythagoras. Bochner recalls:

I was in Bari, Italy in 1972, staying with some friends. They told me that in a town called Metaponte, there was a Pythagorean temple. Pythagoras was a forerunner of Plato, possibly his teacher. He believed that all of reality was based on numbers and their relationships... So I went to visit this site which was a ruined Doric temple. It was a very hot day. There was no one there. It was in the middle of a field. And it was a really haunting place. I thought I'd like to do something there, a little homage to Pythagoras. To his "spirit." I thought that the obvious thing was to do the Theorem of Pythagoras... $25+9+16$. So I picked up 50 pebbles and laid them down and had three left over... suddenly it dawned on me what was happening. On the one hand you have theoretical space where points are defined as having no dimensions. And on the other hand you have a real space where the three corner-points overlap. So, of course, it only took 47 stones. It was a kind of epiphany for me... because it was my realization that sculpture exists in the space where mental and physical overlap.¹⁴

Bochner's discovery consolidated the premise of a series of floor installations he had been working on since 1970, collectively named *The Theory of Sculpture*.¹⁵ which juxtaposed numbers chalked on the floor and stones, in various configurations. Bochner wrote in 1990:

Number constitutes a mental class of objects. Numbers do not need concrete entities in order to exist. In Latin, the word for counting is "calculus," which translates, literally, as stone. By juxtaposing the numbers with the stones *A Theory of Sculpture* forces a confrontation between matter ("raw" material) and mind (categories of thought).¹⁶

As if to re-inforce the contingency of each iteration of these works, Bochner uses materials that are literally 'ready-to-hand'¹⁷ and so for *Meditation on The Theory of Pythagoras* he has also used hazelnuts and more recently, coloured glass¹⁸ as the 'raw material' of matter; drawing attention to the centrality of temporal sensual experience as the bridge between matter and mind. In this exhibition, all three iterations are exhibited at once, re-enforcing the contingency of particular stones/nuts/pieces of glass, which co-exist with us in real time and space, as we move through each floor of the exhibition. At the same time we grasp the purity and immutability of the numbers that they fail to represent, musing over those troublesome corners where mental and physical overlap.

I tell this story in order to emphasise how much the body is implicated in our experience of maths, and not just because it is, obviously enough, the

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[14] From "About my prints: A Conversation between Mel Bochner and Richard Field" unpublished typescript of an evening at Betsy Senior Gallery, New York, December 1993, (cited in Field 1995, p.73n)

[15] A series of drawings documenting these works was published as *Primer: The Complete Catalog of Twenty-One Demonstrations from "A Theory of Sculpture"* (1973) but the series has not been exhibited in its entirety until the recent exhibition *Mel Bochner, Proposition and Process: A Theory of Sculpture (1968-1973)* showed in 2013 at Peter Freeman Gallery, New York.

[16] 'Thoughts Re-installing A Theory of Sculpture' press release for Mel Bochner: Sculptures, Galeria Primo Piano, Rome 1990 (published in BOCHNER, M. 2008. *Solar System and Rest Rooms: Writings and Interviews 1965-2007*. Cambridge Mass/London: MIT Press. P. 144)

[17] Bochner gave instructions for the materials for the three iterations to be sourced locally. The glass was obtained from Crawford College of Art and Design; the stones and hazelnuts from local retail suppliers. When showing in Lisson Gallery in 1970, Nicholas Logsdail recalled how Bochner made him drive to Brighton to obtain some chalk stones which would evoke the 'White Cliff of Dover.' (Symposium *Banging Your Head Against a Wall* at Whitechapel Gallery, London, during the Mel Bochner exhibition *If The Colour Changes* 16/11/2012).

[18] In 1991 Bochner was invited to show at Sergio Casoli, in Milan. He recalled 'I always wanted to find a way to use colour in my sculpture... I was baffled until I was invited to do this show in Milan in the early nineties, and to cut a long story short, the gallery had occupied Fontana's old studio, and in the back room was a box filled with glass that Fontana glued onto his paintings. That was perfect because what's glass? It is ground up rocks that have been melted and had turned transparent and added pigment to give it colour, so there it was. It was what I had been waiting for, without knowing I was waiting for it. (Skype interview with Author, 06/05/11).

container of the mind—the site of thought, so to speak. The body is also in itself a repository of its own knowledge of being in the world. In the same text, Bochner also reminds us that the latin word for number is digit (which translates as finger) and somehow we are back in the agora, performing a maths exercise by counting (on our fingers) and crouching to draw things out in the dust. Perhaps it is not surprising then, that it was the bodily engagement of kneeling on all fours, in the process of re-installing this work for a show in Rome in 1990, that prompted Bochner to write about it.¹⁹

Certainly the performance of counting and measuring, as works in this show testify, are as central to our bodily negotiation of time (Darboven) and space (LeWitt) as they are abstract tools of the mind. Hanne Darboven befriended both LeWitt and Bochner when she worked in New York from 1966–1968 during her studies at the Hochschule Fur Bildende Kunst in Hamburg. Influenced by Conceptual and Minimal art, calendar dates became the basis of her work, a theme that would go on to dominate her art for the rest of her life. The piece exhibited, *Kalendar 94*, was made by repeating the same notational exercise on a sheet of A4 yellow paper, recording each day from the 1st to the 13th of each month, followed by the 21st and the 29th (excepting February). As with the numbers paintings of the Roman Opalka and On Kawara's date paintings, the overwhelming cumulative effect of Darboven's reductive methodology, the laborious production of one body between the hours of 4.00 and 11.00 in the morning each day, is of a melancholic dance to the music of time.

Darboven's obsessive script is echoed by LeWitt's wall drawing opposite, his lines plotting space rather than time. In line with his dictum that 'In conceptual art the idea or concept is the most important aspect of the work'²⁰ but also because he believed in supporting the collective endeavor that these complex wall drawings require, the work of LeWitt's own hand was never a part of what we see. His instructions for these drawings, even during his own lifetime, were usually carried out by others. In a healthy disregard for LeWitt's further statement that 'When an artist makes a conceptual form of art, it means that all of the planning and decisions are made beforehand and *the execution is a perfunctory affair*'²¹ (my italics); this exhibition gives audiences access to the process of making the drawing during the month of September.²² This emphasis on the performance of writing and drawing as repetitive and exacting manual labour, is continued in the intimate and immaculate drawings on parchment by Lynne Woods Turner, which are in fact closer to the more biomorphically inflected work of Eva Hesse than to those of LeWitt.²³ Woods Turner's works, like the drawings of Alison Turnbull or Rachel Whiteread, engage with repetition, symmetry and complexity in a

[19] Serres would go further, arguing that the body comes first, before language; that our knowledge of the world comes through the senses and through inhabiting a bi-lateral body with ten fingers and ten toes. He sees the body as a repository; a memory bank of information held beyond consciousness, without which language (expression) would not be possible. (See SERRES, M., 1982. 'The Origin of Language: Biology, Information Theory, and Thermodynamics' In J.V. Harari and D.F. Bell, eds., *Hermes; Literature, Science, Philosophy*. Baltimore: Johns Hopkins University Press, pp 71-83)

[20] LEWITT, S., 'Paragraphs on Conceptual Art', in Sol LeWitt, ed. Alicia Legg (New York: The Museum of Modern Art, 1978, p. 166)

[21] *Ibid.*

[22] This emphasizes the historical nature of LeWitt's work, revealing how it is currently iterated from an archive of drawing instructions, by authorized technicians from

[23] (After all, it was the death of Hesse that led LeWitt to move from strictly geometric abstraction and produce his first curvy line)

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Hanne Darboven
Kalendar 96,
postu,m op 42 A B C D (detail)
 Bläserquintett, 1994, ballpoint pen
 on pre-printed form, 192 sheets,
 12 panels

contemporary minimalist idiom that pays attention to materials such that the execution is far from 'perfunctory.' Looking at the delicacy of these, or conversely at the delicious weight of the paint Darren Almond has used to literally wrap his black and white figures around the canvas panels of two new grid paintings in this show, we might agree with Bochner when he stated that 'certain art looks back at you with the time that the artist has spent looking at it.'²⁴

This is literally true of the work of Aisling O'Beirn, whose length of Fabriano paper cascades down the wall next to her sculpture, recording the precarious process of its construction. A system of Boolean Venn diagrams has been devised to record the variables that can occur each time the artist added a piece of timber to the construction, which itself is balanced upon a blackboard easel.²⁵ Ultimately, both Goodman and Bochner were influenced by the linguistic theories of Ludwig Wittgenstein, whose model of language games provided a precedent for a procedural, rule based theory of communication, the conventions of which were agreed through practice, and this idea is played out again in O'Beirn's piece. The self devised rules (e.g. whether a timber length touches another, falls to the floor or collapses the whole structure) both prescribe and record a performative approach to making which examines the nature of entropy, failure and eventual equilibrium.

The evidence of bodily labour in several of these works immerses us in the time of its making, recalling Darboven's words (written to LeWitt) about her own working process which seemed to function as a kind of emptying out of subjecthood—the process itself becoming self-propelling:

I write
I don't describe
Writing writing
There is nothing to describe
Writing writing²⁶

Conversely, being lulled by the almost creaturely pulse of Miyajima's lights, or trying to follow the lines of flight in Matthew Ritchie's wall drawings, or the algorithms that govern the interaction of Gerard Byrne's avatars as they navigate a simulated desert landscape, there is a sense of being immersed in the complexity of systems that reach beyond the index of an individual mind or body.²⁷ Our relationship to these artworks, for all their rigour and rationality is not of necessity limited to a cerebral response. Le Witt famously opened his 1969 *Sentences on Conceptual Art* with the assertion that; 'Conceptual artists are mystics rather than rationalists. They leap to conclusions that logic cannot reach' and recently Eve

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[24] BOCHNER, M., 'About Eva Hesse: An interview with Joan Simon' first published in *Eva Hesse*, Galerie Nationale de Jeu de Paume, Paris 1993.

[25] Perhaps recalling Boole's teaching career in University College Cork but certainly like all her materials, sourced using Bochner's non-hierarchical method of whatever is ready to hand.

[26] Letter to Sol LeWitt, dated Oct 19 1973. (Vid. Hanne Darboven *Untitled*, 1976, Fig. 35. In: FER, B., 2004 *The Infinite Line*. New Haven and London: Yale University Press, p.62).

[27] Reflecting perhaps what Jeremy Rolfe has termed the Techno sublime in which a geographical idea of limitlessness has given way to a technological one. (See GILBERT-ROLFE, J., 1999. *Beauty and the Contemporary Sublime*, New York: Alworth Press

Meltzer's work on systems and affect proposes that conceptual artworks provide 'the opportunity for new attachment... even as that attachment disavows, just as it announces, the loss and disaffection of subjectivity at its core.'²⁸

and thus we might leap to conclude that the excess that art offers in its translation of mathematics into aesthetics is itself a leap, but not of the mind so much as of the heart; the body's intuitive response to beauty wherever it is found.

[28] MELTZER, E., 2013. *Systems We Have Loved: Conceptual Art, Affect, and the Anti-Humanist Turn*. Chicago: University of Chicago Press. Eve Melzter, 2013, p.26.

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