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In their seminal article 'The Dematerialization of Art' (1968), the critics Lucy R. Lippard (b. 1937) and John Chandler (b. 1932) identify two main approaches in the art of the 1960s for doing away with the materiality of art as object: 'In the first case, matter is denied, as sensation has been converted into concept; in the second case, matter has been transformed into energy and time-motion.'[1] The first possibility is relatively easy to refute: even the most subtle idea requires some kind of material support to be conveyed. As for the second, it poses a more complex problem. What Lippard and Chandler seem to be referring to are the dematerialized conceptions of matter that followed, first, the discovery of radioactivity in 1896 by the French scientist Henri Becquerel (1852-1908), and then, the equivalence between mass and energy in the theory of relativity. The avant-garde artists of the early twentieth century were particularly receptive to these notions. But their impact also lingered well beyond into the period of Conceptual art as witnessed by the visionary designer and theorist Richard Buckminster Fuller's (1895-1983) foreword to the catalog of the exhibition *Projections. Anti-Materialism* held at the La Jolla Museum of Art in 1970. It featured the works of Robert Barry (b. 1936), Barry Le Va (b. 1941), and Sol LeWitt (1928-2007), among others. To account for the 'anti-materialism' of the art presented, Fuller thus called on an energeticist conception of matter according to which '[m]ore than 99.9 percent of all the physical and metaphysical events (…) transpire within the vast non-sensorial reaches of the electromagnetic spectrum.'[2]

At the same time, from the very outset, the notion of energy as defined by modern physics was at the heart of the controversy surrounding the use of the term 'dematerialization' in reference to Conceptual art. In a letter written shortly after the publication of Lippard and Chandler's article, Terry Atkinson (b. 1938) of the Conceptual art group Art & Language contested the very idea of dematerialization on the grounds that:

> Matter is a specialized form of energy, radiant energy is the only form in which energy can exist in the absence of matter. Thus when dematerialization takes place it means, in terms of physical phenomena, the conversion (…) of a state of matter into that of radiant energy (…). But further, if one were to speak of an art-form that used radiant energy, then one would be committed to the contradiction of speaking of a formless form, and one can imagine the verbal acrobatics that might take place when the romantic metaphor was put to work on questions concerning formless-forms (non-material) and material forms.[3]

Contrary to Fuller, Art & Language considered the idea of making art from radiant energy as a paradox. However, in the same period, Barry himself contradicted this position by working with electromagnetic transmissions. Yet Barry's oeuvre provides its own refutation of the notion of dematerialization, one all the more interesting in that it is founded on the same energeticist basis as that of the anti-materialists. As the art historian and media theorist Douglas Kahn has argued, Barry's use of energy as a raw material for art was not predicated on the desire to render art immaterial, but rather 'contested solipsistic presumptions that materiality required human perception by poetically asserting the material reality of imperceptible energetic forces'.[4] Although

this approach might seem to stem from the same source as Fuller's, it is in fact almost the reverse, notwithstanding the fact that Barry's work was included in the La Jolla exhibition. Indeed, while Fuller's 'energy-based *ephemeralization*'[5] emphasized the energetic dimension of matter, Barry insisted upon the 'material reality of energy'.[6]

This being said, the problem remains in that conceptions of matter as energy always retain a proximity to immaterialism. In addition, energeticist readings of Conceptual art's materiality pose the question of the distinction between that chapter of art history and what the art historian Linda Dalrymple Henderson has defined as the 'vibratory modernism'[7] of the early twentieth century, a conception, which actually does appear to be making a comeback in our digital age's (re-)discovery of 'vibrant matter'.[8] Yet in the years directly preceding the emergence of conceptualism, another fascinating entity appeared on the scene, which further complicates the binary of materiality and dematerialization. This was antimatter, whose existence was demonstrated scientifically for the first time. Simply put, antimatter is matter in which all the charges are reversed. In our world, matter and antimatter were created in equal parts, but matter won the game. Matter and antimatter are indeed incompatible: when particles of matter and antimatter meet they mutually cancel each other out in a burst of energy. Yet, if antimatter 'is truly anti-matter',[9] it is not immaterial or anti-material. A mirror image of matter, it is, like matter, made up of substantial particles.[10]

The quantum physicist Paul Dirac (1902-1984) first predicted the existence of antiparticles in 1928, deducting from his theory of the electron the idea of the positron, a positively charged electron. In the early 1930s, positrons were also observed in cloud chambers by the physicist Carl Anderson (1905-1991) at Caltech and by his peers, Patrick Blackett (1897-1974) and Giuseppe Occhialini (1907-1993), at Cambridge.[11] But it was not until the mid-1950s that scientists provided definitive proof of the existence

of antiparticles. At the University of California, Berkeley in 1955, a team of physicists consisting of Owen Chamberlain (1920-2006), Emilio Segrè (1905-1989), Clyde Wiegand (1915-1996), and Tom Ypsilantis (1928-2000) produced an antiproton coupled with a proton using an accelerator known as the BeVatron. This discovery earned Chamberlain and Segrè the Nobel Prize for physics in 1959. In 1957, another team led by Oreste Piccione (1915-2002) discovered the antineutron. All the elements were now in place for positing the existence of antimatter and even of antiworlds.

Antimatter was thus very much in the news in the post-war period. Yet, despite several examples of artists referring to antimatter, little attention has been paid to this topic in relation to the art of these years.[12] Perhaps its association with science fiction discouraged serious scrutiny. But if artists did not necessarily adhere to scientific exactitude in their references to antimatter, nor, as I will show, did they entirely espouse particle physicists' definition of antimatter, this notion played an important role in their engagement with the question of matter. Indeed, antimatter, I want to argue, provides an alternative to the energeticist model for thinking about materiality in the context of the so-called dematerialization of art. Better yet, in several cases the notion of antimatter offered artists a means to reassert the importance of materiality. Not all the artists I look at fall under the rubrics of conceptualism or Conceptual art, and even among those who seem to do so, most dismissed the very notion of Conceptual art. But all of them were actively invested in the critique of the object character of art in their own ways. Moreover, these artists, ranging from Pinot Gallizio (1902-1964) and Piero Manzoni (1933-1963) to Robert Smithson 1938-1973), Mel Bochner (b. 1940), Dan Graham (b. 1942), and finally John Latham (1921-2006), each developed different interpretations of antimatter. All, however, shared a fascination with the profoundly paradoxical nature of antimatter as real and yet not matter in the ordinary sense.

Materia Prima

The topic of antimatter has a definite allure of mystery. And, indeed, it is under the guise of the 'marvelous' that antimatter appears to have made its artistic debut when the Surrealist artist Salvador Dalí (1904-1989) presented his antimatter paintings and 'Anti-Matter Manifesto' at the Carstairs Gallery in New York in late 1958.[13] As Dalí declared: 'If the physicists are producing anti-matter, let it be allowed to the painters, already specialists in angels, to paint it.'[14] Dalí in effect coopted antimatter as part of his turn to Catholic mysticism. But if the 'gelatinous'[15] particles of quantum physics inspired Dalí to create a new, syrupy brand of religious painting for the atomic age, the notion of antimatter was not necessarily synonymous with the ethereal, and, in fact, it could be seen as quite the opposite, as evidenced in the very same period by the 'situationist satellite'[16] Pinot Gallizio and his *Cavern of Antimatter*, an environment conceived in late 1958 and presented in Paris in May 1959 (fig. 5.1).

[PLACE ILLUSTRATION 5.1 (L) HERE]

According to Nicola Pezolet, Gallizio's interest in antimatter alludes to Dalí's example and, in this sense, is another token of the Italian artist's continued allegiance to Surrealism.[17] But, aside from the fact that Dalí's enthusiasm for particle physics was integral to his excommunication from the Surrealist movement,[18] there is a profound discrepancy between the left-wing anti-conformist Gallizio's conception of antimatter and that of the monarchist Dalí.[19] This difference hinges specifically on what I would like to call Gallizio's materialism.

In his review of the *Cavern*, the critic Pierre Restany (1930-2003) expressed the work's emphatic materiality quite well, declaring that '[a]s for antimatter, it's

antimatter by way of saturation.'[20] For the event, held in René Drouin's (1905-1979) Left-bank gallery, Gallizio covered the walls, ceiling, and floor of the space entirely, using several meters of his 'Industrial Paintings', works collectively produced in long rolls of canvas on a mock assembly line that were in fact industrial in name alone.[21] The paintings on the walls represented the interactions between antimatter, located on the space's ceiling, and matter, located on the ground. A young model simply clad in strips of these 'Industrial Paintings' paraded through the cavern, incarnating the 'provisional reality' generated by this meeting of forces.[22] There were also plans for filling the space with the uncanny sounds of a theremin (an early electronical instrument). Likewise, perfumes and incense, mixed with the resinous scent of recently dried paint, were to envelop the visitor, greeted with a cocktail of the artist's own recipe.

Whether these musical and odorous additions were actually part of the final environment has recently been contested.[23] Whatever the case, there are obvious parallels between Gallizio's plans for the cavern's mise-en-scène and the ceremony enacted by Yves Klein (1928-1962) for his so-called 'Exhibition of the Void' in Paris the year before. For the critic and curator Mirella Bandini, the impact of Klein's notion of 'immaterial sensibility' on Gallizio accounts for what ultimately proved to be the divergences between the Situationist program to overcome art as such and Gallizio's own project, as manifested in the *Cavern*, to 'dematerializ[e] art, which becomes exchange, idea, improvisation, concept, play, in an anti-economic and antifunctionalist society.'[24] Yet if the *Cavern* does emblematize Gallizio's desire to do away with 'the work of art as sale's sample' by creating 'situations of *non-value*',[25] how then to reconcile this approach with what, again, appears as the work's insistently material features? In the year following the Paris event, Gallizio presented a two-dimensional version of the *Cavern* in Venice. This gesture provoked one of the artist's admirers to complain to him

that the canvas on view, although interesting, no longer had to do with antimatter 'because it had become the object and was no longer its annihilation.'[26] But what if for Gallizio antimatter were neither equated with the 'annihilation' of the object, nor, for all that, with dematerialization?

Several scholars have made clear that the source for Gallizio's understanding of antimatter was not in fact the standard one, according to which matter and antimatter are irreconcilable opposites whose meeting results in mutual extinction.[27] Rather, based on the contemporaneous writings of an Italian physicist and chemist named Francesco Pannaria, Gallizio saw antimatter and matter as belonging to two separate but connected worlds, linked by productive exchanges of energy. The idea of an energetic exchange is in effect key to both Pannaria's theory as well as to Gallizio's art and writings. However, a closer look at Gallizio's source reveals that the fundamental issue is none other than the reassertion of the primacy of matter in the face of modern science. Indeed, with his notion of antimatter, Pannaria offers an intriguing example of the enduring esoteric attraction for the Aristotelean idea of prime matter in the very midst of the atomic age. In bringing to light this background, it may seem that I overemphasize the spiritualist aspects of Gallizio's work. Yet what I would also like to show is how these notions fed into the artist's political, economic, and social vision.

What Pannaria proposed was no less than a refutation of particle physicists' definition of antimatter. In his view, the physical world should be envisioned as a theater, with the events taking place on the stage, while in the darkness of backstage the world of particles unfolded. This backstage world was the 'antiworld', a reverse reality, separate from ordinary reality, yet connected to it by the theater's wings.[28] Pannaria insisted on this connection, which he saw as an essential difference with what he deemed to be the fundamental error of physicists then working on antimatter. Indeed,

basing himself on the idea that 'matter is not the daughter of the immaterial', Pannaria decreed that there was no possible annihilation between matter and antimatter, but rather a constant exchange of different aspects of matter.[29] Using an Aristotelean vocabulary, Pannaria thus defined antimatter as 'uncomposed matter' ('*materia incombinata*'), or better still, as 'prime matter' ('*materia prima*'), while ordinary matter belonged to 'composed matter' ('*materia combinata*').[30] To account for antiparticles, Pannaria elaborated what he termed the 'principle of exchange'. This 'exquisitely Aristotelean' principle explained the production of antiparticles as part of a larger scheme to preserve the physical balance of the world.[31] According to this view, antiparticles appeared from 'backstage' onto the 'stage' every time a great quantity of concentrated energy was produced that did not immediately find its own substratum of matter. Conversely, what physicists thought to be the annihilation of two opposing particles and their conversion into pure energy was in fact the result of antiparticles vanishing backstage and leaving our world immediately after having provided the new quantity of energy with its necessary material substratum.[32]

As Gallizio explained, the *Cavern of Antimatter* was an effort to translate the revelation of Pannaria's theatrical model of the physical world into art.[33] The three-walled structure of the *Cavern* does indeed resemble theater's traditional box set. Other traces of Pannaria's descriptions may be found in Gallizio's choice of 'backgrounds of all the different shades of darkness imaginable' for the *Cavern*'s Industrial Paintings.[34] This is reminiscent of Pannaria's insistence on the 'obscurity' of the backstage world. With the Industrial Paintings that went into the making of the *Cavern*, Gallizio also attempted to 'atomize' painting, thus echoing the notion that the antiworld is where particles dwell.[35] But, beyond these transpositions of Pannaria's imaginary scenography, what clearly inspired Gallizio the most was the 'principle of exchange', to which, however, he

also gave an unexpected twist, transposing it from the world of metaphysics to the world of economics.

Gallizio freely associated the 'principle of exchange' with 'exchange value', turning this notion into the cornerstone of his utopian project to create an emancipatory 'anti-economic society'.[36] In this way, he imagined future modes of economic transactions based on a new 'spatio-temporal' currency, 'the exchanging of experience reckoned by the necessary amount of space-time with a variable of intensity determining the rate of exchange'.[37] This experiential conception of 'exchange' in effect was meant to dismantle the definition of exchange-value within a capitalistic framework. He may have echoed Karl Marx's (1818-1883) definition of commodities, which as exchange-values, 'are merely definite quantities of congealed labour-time'.[38] However, in his diametrically opposite view, Gallizio saw the principle of exchange as releasing creative energies, which, on the contrary, would bring about 'the decay of gold's value understood as energy congealed by the infamous bank system already in decomposition'.[39]

Like other Situationists, Gallizio also looked to the anthropological model of potlatch to define his program. As the art historian Frances Stracey (1963-2009) recalls in her study of Gallizio's Industrial Paintings, potlatch's gift-giving economy is indeed based on excess and as such offers a subversive countermodel to a capitalist mode of equivalent exchange.[40] However, for Stracey, the essential aspect of this subversion has to do with 'unproductive expenditure' and 'wastefulness'.[41] For example, in her analysis of Gallizio's experiments with gunpowder as a medium and the 'explosive destruction of the work at the moment of its formation', she identified 'an act of creative-destruction' in which matter is produced 'to be literally wasted, without remainder'.[42] While I agree with Stracey that in the Industrial Paintings 'the freely given creative act itself becomes

valorised as a sort of surplus of life or surplus of living', I would like to qualify this equation of surplus with waste.[43] Indeed, if we follow Pannaria's theory, then it becomes clear that in the gunpowder paintings matter only *appears* to be wasted, as the principle of exchange ensures perpetual replenishment of the material substratum. Such an approach is also in line with the alchemical nature of Gallizio's experiments. This, perhaps, also explains the fundamental differences between Gallizio and the Situationist International's leader Guy Debord (1931-1994), which crystallized significantly around the presentation of the *Cavern of Antimatter*. Although Debord himself had masterminded the event, soon thereafter he excluded Gallizio from the Situationist International on the grounds that the artist had succumbed to the art market.[44] The *Cavern* likely exposed the incompatibility between, on the one hand, Debord's somewhat puritanical suspicion that artworks are always commodities and, on the other, Gallizio's aspiration to transform the very material of art and reality. For Pannaria, antimatter, which, as mentioned above, he defined as 'prime matter', was in a sense more material than ordinary matter. Adopting these ideas in his own way, Gallizio did not aim to dematerialize matter, but on the contrary, to rematerialize it through a revolutionary reversal of values, so to speak.

Given the nature of his works, Gallizio does not usually figure in genealogies of Conceptual art. But his materialistic understanding of antimatter provides an exemplary introduction to the issues surrounding this topic in the context of conceptualism. As it is, there are comparisons to be drawn between Gallizio's approach and that of another Italian artist often associated with the history of Conceptual art, namely Piero Manzoni. Around the time Gallizio conceived *Cavern*, Manzoni began producing his series of *Achromes*, paintings and related objects made of a variety of natural and artificial materials, all selected for their 'colorless' quality (fig. 5.2). The series' generic title,

Achrome, is indeed generally understood to mean 'without color', from the Greek 'chroma' for color. However, as the artist and curator Gaspare Luigi Marcone points out, 'chroma' also signifies epidermis and by extension matter. Achrome, in this sense, also means 'matterless', or, more accurately, 'antimatter' as Manzoni himself explained.[45] Significantly, this explanation appears in an account of the genesis of the artist's *Lines*, single lines drawn in ink on long strips of paper that were rolled up and concealed from view in cylindrical cardboard containers, and that are customarily considered key examples of early conceptualism. The *Lines*, recounted Manzoni, were the 'outcome of [his] entire work as a painter, an outcome, which also explain[ed] [his] white paintings, which for [him were] not paintings of matter, but antimatter paintings, "achrome" paintings'.[46] In recapitulating the trajectory from *Achromes* to *Lines*, or, otherwise put, from antimatter to *Lines*, it would seem that Manzoni emphasized the immaterial nature of the latter. But this would be omitting the fact that, as in the case of Gallizio's *Cavern*, the *Achromes* are so striking in their obdurate materiality, which one commentator has even likened recently to a 'scatological whiteness' (fig. 5. 2).[47] Once more, antimatter appears here not as an agent of dematerialization, but rather as matter's obscure yet very real essence.

[PLACE ILLUSTRATION 5.2 (M) HERE]

Through the Looking Glass of Matter

'Perhaps "primary matter" and "antimatter" are the same thing', muses Robert Smithson in a 1965 essay on Donald Judd (1928-1994).[48] There is no evidence that Smithson was acquainted with the work of Gallizio. Nevertheless, there are intriguing links between both artists' conceptions of antimatter, which in many ways are antimodern. But

whereas Gallizio's approach rests on the idea of the plenitude of matter, Smithson's antimatter serves to reveal an 'uncanny materiality',[49] which paradoxically combines concreteness with insubstantiality. With Smithson matter in effect becomes antimatter in a play of mirror reflections.

At the root of Smithson's notion of antimatter is the physical concept of inertial mass. This idea informs his essay on Judd, in addition to that of antimatter. Smithson thus describes Judd's sculptures as 'built of "antimatter"' but also as 'disclos[ing] an awareness of physical "mass" in the form of regular intervals of bulk'.[50] In the same way, he opposes what he views as Judd's 'concept of physical mass' with the 'lack of consciousness of mass', which would seem 'to have caused the demise of "action-painting"'.[51] Following a rather unscientific method, Smithson conflates the definition of physical matter as inertial mass with the common understanding of inertia as a kind of lethargic resistance to movement, a motif which, importantly, recurs throughout the artist's oeuvre. Smithson in fact co-opts mass as part of his rejection of recent art forms that he criticizes for their dynamic approach, whether it be Abstract Expressionism, Assemblage, or Happenings.[52] More fundamentally, his insistence on matter understood as 'that which has mass when it is at rest'[53] is pointed against dematerialized conceptions of matter.

To better understand this, it is useful to turn to *The Mystery of Matter* (1965), an edited volume of popular science that Smithson owned, and which seems to have inspired parts of the Judd essay.[54] In it we find a section devoted to how 'the physics of the twentieth century has dematerialized matter', giving rise to the question whether matter is 'substance or form'.[55] This problem is addressed in particular in an essay by Erwin Schrödinger (1887-1961) entitled 'The Importance of Form', in which the quantum physicist explains how 'when you come to the ultimate particles constituting

matter, there seems to be no point in thinking of them again as consisting of some material. They are, as it were, *pure shape*, nothing but shape'.[56] It is against such a formalist approach that Smithson, ventriloquizing Judd, declares that the sculptor '[brings] into question the very *form* of matter'.[57] This context also explains his otherwise cryptic assertion that Judd 'permute[s] the facts of Modern Reality', a phrase that immediately precedes the first mention of antimatter in the Judd essay.[58] Rather surprisingly, it appears that Smithson embraces antimatter not as a concept derived from the latest advances in science, but that, on the contrary, his references to this topic betray a resistance toward modern physics.[59]

Indeed, the 'primary' (anti-)matter, which, according to Smithson, is put in evidence by Judd's sculptures, owes a great deal to pre-modern conceptions of matter and mass. An important source of inspiration seems to have been Max Jammer's (1915-2010) *Concepts of Mass in Classical and Modern Physics* (1961), in which the physicist posits a singular origin for the modern scientific notion of inertial mass. According to Jammer, this concept, although now purged of spiritualist associations, originates in 'the Neoplatonic idea of the inertia and inactivity of matter as opposed to the vitality and spontaneity of mind'.[60] As Jammer recounts, matter in Neoplatonism is conceived as inert and passive above all. Such qualities do fit the common notion of matter as stuff or bulk. But this inertia is also what makes matter 'an impediment to the realization of form', meaning, in the Neoplatonic view, this is what in fact deprives it of reality.[61] As the Neoplatonic philosopher Plotinus writes in a passage quoted by Jammer:

> Matter is a fugitive bauble, and so are the things that appear to be in it, mere shadows in a shadow. As in a mirror the semblance is in one place, the substance

> in another, so matter seems to be full when it is empty, and contains nothing while seeming to contain all things.[62]

Thus, matter is an antithetical combination of ponderousness and lack of substance, an idea that Smithson adopts in his own way when describing Judd's sculptures as made of antimatter: 'The concept of "antimatter" overruns, and fills everything, making these very definite works verge on the notion of disappearance. The important phenomenon is always the basic lack of substance at the core of the 'facts'. (…) The work seems to have no natural equivalent to anything physical, yet all it brings to mind is physicality.'[63] But whereas the Neoplatonists condemned matter for its degradation, Smithson embraces materiality for this very reason, in a way that is reminiscent of the philosopher Georges Bataille's (1897-1962) celebration of the Gnostics' '*bas matérialisme*', that is, of this ancient religious and philosophical sect's profoundly anti-idealist conception of matter as the radically debased principle of all reality. [64] At the same time, Smithson differs from Bataille in that he nurtures an attraction for the ghostly and incorporeal nature of matter in the same measure, or, in other words, for matter revealed 'as in a mirror' as antimatter.

Smithson's understanding of antimatter is in effect inseparable from his deep fascination for mirror symmetry or enantiomorphy.[65] Enantiomorphs are pairs of objects, which, although identical in all other respects, cannot be made to coincide due to their opposing left-handedness or right-handedness. The idea of asymmetry is contained in the very notion of antimatter. The term 'antimatter' quite literally means matter's antithesis or reversal. Moreover, physics, as we know, tells us that matter and antimatter cannot occupy the same place and time. But there is also a more complex sense in which antimatter is linked to mirror symmetry, which also reconnects

Smithson's interest in this topic to the scientific discoveries of his time. In 1957 physicists discovered that in the case of weak interaction force (one of the four fundamental types of forces governing the universe) the physical law of the conservation of parity is violated, meaning that left-right symmetry is not an absolute law of physics, as was believed until then, and that nature has a handedness. This surprising revelation, known as the fall of parity, raised in turn a new set of questions regarding matter.[66] As the popular science writer Martin Gardner (1914-2010) explains in *The Ambidextrous Universe* (1964), a book dedicated to the meaning of left-right symmetry that was seminal for Smithson's understanding of this theme, scientists were quick to relate the fall of parity to the mystery of the existence of antimatter. The discovery of antiparticles did not in itself violate the law of parity. Particles and antiparticles do not display any left or right bias. At the same time, it is possible to diagram a particle and its antiparticle as mirror images of one another. But with the fall of parity physicists began contemplating in all seriousness whether an antiparticle may not actually *be* the mirror reflection of its corresponding particle, and antimatter ordinary matter reversed as through a looking glass.[67]

There were probably several reasons why these ideas appealed to Smithson. The fact that the overthrow of parity is observed only in weak interactions must have pleased the artist, who was enamored with inertia and who would have made an association between the physical concept of weakness and the lay notion of a lack of energy. This interpretation, in fact, would not have been so far off the mark. In *The Mystery of Matter*, the physicist Philip Morrison (1915-2005), commenting the fall of parity, wonders whether this discovery might not prove the law of energy conservation to be wrong and provide new arguments for 'the hypothesis that matter may arise spontaneously from a space containing no energy'.[68] Similarly, Smithson, for whom the

irrational and the incommensurable were key words, must have appreciated the fact that the fall of parity, and its attendant explanation of antimatter, permanently disrupted the symmetry of nature, making irrationality and incalculability into an incontrovertible scientific *fact*.[69]

Smithson's reading of Judd's sculptures as permeated by the notion of antimatter is no doubt debatable.[70] But turning now to his own works, we can detect several traces of his infatuation with this concept, whether it be in his early mirror pieces or in his *Alogons*, a series of sculptures whose title borrows from the Greek word for speechless and irrational.[71] But it is in the 'nonsites', with their dialectic of physicality and absence, that the model of antimatter is most explicit. The structure of the name 'nonsite' is in itself an obvious echo of the structure of the term 'antimatter'. Smithson in fact described the nonsite as 'a kind of equivalent of antimatter, the negative world — which is essentially not negative'.[72] Indeed, the nonsite always refers back to the site of which it is the negation to the extent that it signals its absence. Nonsite and site are thus interlocked in a constant play of mirror reflections and reversals in which fact and fiction, materiality and illusion continually trade places. Although the site is by all appearances firmly anchored in reality, it is no more than a fiction to the visitor of the gallery or museum, whereas the nonsite, despite its tangible and even ponderous materiality, is denied full existence because it is merely an inverted double of the site.

[PLACE ILLUSTRATION 5.3 (M) HERE]

Perhaps the best example of this vertiginous structure is *Nonsite (Essen Soil and Mirrors)* (1969, fig. 5.3) The piece is composed of a square mirror set on the floor, with four vertical mirrors on top forming a cross and dividing the floor mirror into four corners. In these corners, the artist deposited piles of soil collected around the German city of Essen. As the philosopher Céline Flécheux demonstrates, this nonsite's very

materiality rests on a mirror-based illusion. When discovering the work, the viewer is trapped into thinking he or she sees one single pile of soil on one complete square mirror when in fact only one corner can be properly viewed at a time. The mirror reflections create the illusion of transparency and the impression that the pile continues beyond the surface of the said mirrors.[73] Matter here is converted into antimatter under our very eyes: truly shown 'as in a mirror', deprived of substance, yet insistently corporeal in its density and formlessness. 'Haunted matter', one might want to call it with a nod to the philosopher Jacques Derrida (1930-2004).[74] But never, in any way, dematerialized matter.

Hole Theory

Among the American artists traditionally associated with the conceptualist nexus, Smithson was probably the most explicit about his interest in antimatter. However, there are indications that this topic also inspired several of his colleagues. In 1967 Mel Bochner made an untitled sketch for a group of unrealized works bearing the inscription 'Holes (for Direac)' (fig. 5.4). **[PLACE ILLUSTRATION 5.4 (M) HERE]** These words reference — with a spelling error — the quantum physicist Dirac, who, as mentioned above, first predicted the existence of antiparticles in the late 1920s. Bochner's drawing shows several grids, some with one or more square holes in or near their center, and one rectangular shape divided into two parts, also with a square hole in each section. Some of the grids are regular square grids, others evoke a perspective grid, and in one case, both types are superimposed on each other. One of the grids also has serrated edges, as if squares had been cut out of its sides, while another appears to have had a square taken out at the bottom. In some cases, the grids are drawn in

perspective to show that they have volume. A note from the artist indicates 'laminate'. Indeed, these drawings are projects for photo-based pieces and might have been meant to be mounted to a hard back, as Bochner's photographs typically were, and perhaps even to be hung projecting from the wall. Such an installation would have underscored the presence of the holes.[75]

While Bochner might have misspelled Dirac's name, his drawing demonstrates that he had more than passing knowledge of the physicist's theory. Obviously, this sketch is in no way meant as a scientific illustration. It is the fruit of Bochner's transliteration of Dirac's ideas into art. But as such it also shows how scientific conceptions of antimatter can bring into relief aspects of Bochner's own thinking. In this case, the artist was alluding to what is known as Dirac's hole theory, the founding thought experiment, which enabled the physicist to hypothesize the existence of a new kind of particle. Dirac's question was how to solve the problem of negative energy that arose from his attempt to fuse Einstein's equation of relativity with quantum theory. In working out his own equation, Dirac realized that it implied that electrons could have negative energy. But if such was the case, the untenable consequence was that matter was unstable. To solve this conundrum, Dirac relied on the exclusion principle, which established that no two electrons can occupy the same quantum state. The physicist then postulated that all the negative states of energy are filled, suggesting that what we call the vacuum is not actually empty, but could be conceived as a bottomless pit with a ladder, each rung corresponding to a possible quantum state. If all these levels were filled, then no electron could fall into a negative energy slot. On the surface, the pit appears like the smooth surface of a calm sea as long as nothing disturbs it. But if an electron is ejected from the sea, it leaves a hole. However, this absence of a negatively charged electron with negative energy would appear as a positively charged electron

with positive energy, what later would be termed a positron. Thus, the stability of matter would be preserved.[76]

Dirac's theory relies on notoriously complex mathematics. Yet for a clear introduction to these ideas, Bochner could also turn, like his friend Smithson, to Gardner's *Ambidextrous Universe*. In the chapter on antiparticles, Gardner explains the hole theory using the simple image of Sam Loyd's 15-puzzle, a game whose object is to slide squares around by continually pushing a square into a vacant hole. The structure of this game strongly suggests comparisons with the grids of Bochner's sketch of 'holes'. But the definition of emptiness in Gardner's description is more instructive than these morphological analogies. As the mathematician observes, in the puzzle the hole behaves like the squares. It can therefore be considered a 'thing' that moves about within the frame. Likewise, in Dirac's theory the vacuum is not really empty and the 'hole' left behind by the dislodged negatively charged particle is also a 'thing'.[77]

The year before Bochner drew his sketch, he concluded a review of the *Primary Structures* exhibition of sculpture held at the Jewish Museum in New York in 1966, which triggered the public recognition of Minimal art as a movement, with the statement, 'Art is, after all, Nothing'.[78] However, Dirac's hole theory elucidates that for Bochner, nothingness was not equated with the absence of reality. This is particularly apparent in the photographic works made between 1966 and 1968, which combine the illusory quality of photography with the solidity of "real" objects. A good example is *H-2* (1966-1967), a piece whose structure is reminiscent of the Dirac projects (fig. 5.5). **[PLACE ILLUSTRATION 5.5 (L) HERE]** To make this work, Bochner, deploying a method used in several photographs from this period, started with a picture of cubes that were stacked according to a mathematical diagram. In this case, the cubes' arrangement evokes a cross-window, with the wooden blocks framing four empty

spaces like four transparent window panes. In a second stage, Bochner cut out the photograph, following the contour of the cubes, as was his practice. He then mounted the silhouetted image on Masonite and hung it at a small distance from the wall, producing an optical illusion of three-dimensionality. However, a more interesting aspect than this trick — which is easily dismissed — is the way in which Bochner, as the curator Scott Rothkopf points out, brings about the collision of two contradictory realities: the tangible reality of the photograph as an object situated in real space and the realistic representation of the cubes within the image. Indeed, a closer look at the picture reveals the presence of shadows that, while contributing to the volumetric rendering of the cubes *within* the photograph, compete with the shadows projected by the mounted photograph itself.[79] The piece is so intriguing because it vacillates between concreteness and illusion, being and non-being.

In this respect, it is important to recall that Bochner's photography originates in sculpture. His first fully realized photographic piece, *36 Photographs and 12 Diagrams* (1966), was originally meant to document ephemeral sculptures made of cubes stacked in accordance with mathematical diagrams. The move to photography is generally viewed as deriving from Bochner's critique of the literalness of the Minimalist 'object'. According to Rothkopf, Bochner's work demonstrates the seminal role played by photography in the shift to Conceptual art.[80] All this is very true. But it is also necessary to underscore the fact that Bochner's photographs, while resisting reification, never lose their connection with the physicality of sculpture. Rather, they are the result of Bochner's experimentation with another kind of materiality than that usually available to sculpture: the 'antimatter' furnished by the very medium of photography. Indeed, it might be said that with the inversion of the negative photography automatically

produces antiworlds. Bochner liked to make use of this feature, printing on several occasions the negative version of a photograph.

In *The Psychology of Imagination* (1940), the philosopher Jean-Paul Sartre (1905-1980) writes of the 'phantom objects', which, according to him, constantly surround consciousness. He counts the work of art among them, because it presents itself not as an escape from actuality, from our everyday cares and worries, but 'as an anti-world'.[81] As I have argued elsewhere, Sartre's writings appear to have played a not negligible role in Bochner's thinking. In particular, there is a proximity between the artist's approach and the philosopher's definition of nothingness as having an ontological status.[82] In this respect, it might be said that Bochner envisaged antimatter as the very *matter* of the nothingness that is the artwork.

Importantly, in the same period as Bochner, Dan Graham, whose work was even more profoundly shaped by Sartre, also created a piece that alludes to antimatter. Entitled *One* (1967), this 'poem-object'[83] offers a direct transposition of Gardner's explanation of Dirac's hole theory**[PLACE ILLUSTRATION 5.6 (L) HERE]** It is an actual 15-piece puzzle, but instead of the squares bearing Arabic numerals from 1 to 15 as in the normal game, this puzzle's squares all carry the same word spelled out in capitals: 'ONE'. The structure of the piece brings to mind Carl Andre's (b. 1935) carpet-like floor sculptures and might indeed be fruitfully compared with the sculptor's definition of 'a thing [as] a hole in a thing it is not'.[84] As is well known, Andre has often referred to atomism in describing his sculptural process. More research needs to be done on this, but the comparison with Graham along with the sculptor's own production of sculptures using negative space suggests an intriguing possible concern with antimatter on the part of one of the most avowedly materialist sculptors. At the same time, Graham's puzzle invites a second reading, which in fact beckons beyond sculpture. Thus,

the modification of the puzzle's typical 15 squares also recalls the binary code of information theory. Graham is famous for his pioneering use of information systems, specifically magazine pages, as artistic media. Yet just as significant as this artistic appropriation of channels of mass communication is what Graham says of the materiality of information: '(Systems of) information (in-formation) exist halfway between *material* and *concept*, without being either one'.[85] Similar to the hole that is at the same time a 'thing' in Dirac's theory of antiparticles, information then is an entity whose ontological status is profoundly undecidable. In fact, the question of the ontology of the digital troubled scientists and scholars early on, as demonstrated by the discussions that took place during the post-war Macy Conferences on cybernetics.[86] From hole theory to information theory, the model of antimatter thus adds another perspective on the 'information paradigm'[87] in Conceptual art, and perhaps more generally on the question of information's reality and materiality, an issue that still remains very much with us today.

Antitime

The very abstruseness of Dirac's hole theory is what appealed to artists' imagination. But for scientists themselves, Dirac's 'so painfully invented' artificial idea of a sea of negative energies proved equally painful to work with.[88] In order to replace the theory of holes, the theoretical physicist Richard Feynman (1918-1988) came up with a new explanation of the positron in 1949. Feynman's idea could be presented with simple diagrams. However, it was no less counter-intuitive for all that. In his solution, the positron was an electron temporarily traveling backwards in time. Although Feynman's calculations were focused on the positron, it was but a small step from this to

speculations that all antiparticles are particles moving back in time and that time might be reversed in galaxies of antimatter.[89] In this sense antimatter could be defined as antitime.

It is also from the point of view of time, I want to argue, that John Latham's work connects with the topic of antimatter. Of all the artists discussed so far, Latham is probably the one who resisted the notion of matter as substance most vigorously, conceiving instead an idiosyncratic cosmological system in which the notion of particle in the field of physics was replaced with a fundamental temporal unit called the 'Least Event'. For Latham, the concepts of physics remained too enmeshed in materialism even when they addressed reality at the subatomic level:

> [T]he concept 'particle' as a non-reducible element is discarded on the basis that it is not minimal with respect to time (…). In physics the minimal entity is still thought of as particle (…). A terminology that is so firmly embedded in the premise that 'matter' is somewhere a solid is in great difficulty (…).[90]

Yet Latham's approach is just as far removed from Lippard and Chandler's idea of the dematerialization of art 'into energy and time-motion'.[91] As Latham insisted, his 'time-base' conception did not in fact mean 'based on time'.[92] And although he did practice a form of performance art, he also stated that '[v]isual art is supposed to be non-moving. It's the best thing about it.'[93] Indeed, time in Latham's oeuvre does not correspond to empirical passing time. Discontinuous, often reversed, and even stilled, it is an antitime, in accordance with Latham's overall predilection for inversions.

A good example of this are the *Skoob Towers Ceremonies*, which Latham organized during 1964 and 1966 (fig.5.7). These were public events at which the artist

burned and detonated sculptures made of columns of second-hand books. The title *Skoob,* with which Latham designated all his book-based pieces, comes quite simply from the word 'books' spelled backwards. In the *Skoob Towers Ceremonies* the reversal also takes on a material signification. The art historian John A. Walker reports that in conceiving the *Ceremonies* '[o]ne of [Latham's] aims was to affirm the principle of anti-literature (by analogy with anti-matter)'.[94] Indeed, like a particle of matter colliding with its antiparticle, the explosion of the book towers creates a flash of energy. However, contrary to what happens in the meeting of the particle and its antiparticle, what is enacted in the *Ceremonies* is not an annihilation. Rather, Latham conceived the *Skoob Towers* as 'reverse-order sculpture', implying that, although these works deliberately contradicted the 'museum-inspired notion that sculpture has to aim at permanence', they were meant as no less real than ordinary sculptures.[95] Better yet, for Latham, 'in disappearing a sculpture in this way it will be more memorable — and therefore more permanent than if it was carved in granite or fabricated in polyester.'[96] Far from being iconoclastic, Latham's gesture creates a new type of sculpture, more solid in a sense than one made of ordinary matter. In fact, as the phrase 'reverse-order sculpture' indicates, the process involved is not the dematerialization of matter *into* time, but rather a temporal inversion in which antitime releases antimatter.

To fully grasp this pattern, a summary of Latham's ideas is necessary. Latham proposed that reality be considered as composed not of objects, but of events of varying frequencies, which appear solid only due to their recurrence or what he also called their 'insistence'. The term 'time-base' refers to the patterns of frequency that, according to Latham, form the structure of the different events comprising the world and which may be likened to the predetermined shapes and frequencies of quantum states. In working out his theory, the artist was inspired by two scientists, C.C.L. Gregory (1892-1964) and

Anita Kohsen (1925-1984), whom he befriended in the 1950s. An astronomer and an ethologist respectively, Gregory and Kohsen devised a cosmological system fusing ideas derived from cybernetics and quantum theory. Called the 'O-Structure', this system was based on the replacement of 'object language' with 'event language'. As the couple explained:

> On a long time-scale a tree is no more an object than is a 'wave' of green light — on a short time-scale no more than a vast and arbitrary population of atomic and sub-atomic events. Object and person language is convenient and, for some purposes, desirable and even perhaps necessary; but all reificatory processes are arbitrary, and depend upon the particular frequency band, or bands, selected by attention.[97]

To account for how we perceive continuity and solidity when in fact there is none, Gregory and Kohsen resorted to an interesting cinematographic simile:

> When we perceive an 'unchanging object' we combine a number of discontinuous 'glimpses' or other sense impressions, so as to form a relatively unchanging image; this is thought to be partly achieved by 'persistence of impression', and to correspond to what happens at the cinema.[98]

Similarly, as Walker recalls:

> Latham sometimes argue[d] that the character of film is homologous to the character of the cosmos: the latter consists of least events which — like the still

> images in a projected filmstrip— insistently recur at such a rate that they give human viewers the impression of a stable, continuous reality.[99]

But for Latham, who also produced a small but significant body of films, the fascination with cinema resided not only in its ability to create the illusion of a 'thing' enduring through time. Perhaps more important was the reversibility of cinematographic time. Indeed, if an object were no more than a succession of photograms impressed on a viewer's retina, would it not be possible to revert the process simply by rewinding the 'film'?

Such is the idea that guided Latham's definition of 'NOIT', a key concept in his system. The term NOIT was derived from the suffix '-tion', with which verbs are made into substantive nouns. By inverting these four letters as in a film played backwards, Latham obtained a new term that translates as 'NO IT'.[100] But the most representative example of the artist's cinematographic antitime is probably *Time-Base Roller* (1972, fig. 5.8). **[PLACE ILLUSTRATION 5.8 (M) HERE]** This roller painting is composed of a long wooden cylinder on which three canvases of different lengths are mounted like roller blinds. They are painted with vertical stripes and letters, and the piece revolves with the aid of an electric motor. For Latham, the horizontal dimension of the cylinder constituted a scale divided into 'time-based bands', corresponding to events of different frequencies ranging from the most minimal (the initial 'Least Event') to maximal (the universe) and that included human perception somewhere in between. The vertical dimension, on the other hand, is ascribed to the passing of time, figured in this case by the slow revolving of the canvases. This vertical scrolling is also not unlike that of the film strip in a projector, a comparison reinforced by the fact that the motor activating the cylinder was an electric motor used for cinema screens.[101] But what is most

revelatory is the way in which Latham combines backward and forward direction in the same time. The canvases are unrolled with the cylinder turning in reverse motion, so that to go forward they in fact have to go backwards. Moreover, because of the way they are oriented, the canvases reveal their backs rather than their fronts as they unfurl. Conversely, they are rolled up with the cylinder going forward. In effect, Latham alludes to the model of a film playing in reverse, while complicating it. The result is a disconcerting piece that moves yet bears little resemblance to kinetic sculpture, that is temporal yet keeps turning about time's arrow.

In fact, it may be more accurate to describe Latham's antitime as revealing the oscillatory nature of the apparent materiality of reality as opposed to dissolving it. According to Latham, the starting point of his 'time-base idiom' was in 1954, when he created a mural painting by spraying marks with a spray gun. He then retained the technique of spray painting for smaller surfaces, in this way creating instantaneous abstract constellations of black paint on white backgrounds (fig. 9). **[PLACE ILLUSTRATION 5.9 (M) HERE]** There is a temptation to relate these works to the gestural tendencies of postwar painting, but Latham was wary of such comparisons:

> When a painter takes a swipe across (…) his canvas, the result is an establishment of the plane and THE STUDIO EVENT. Now if a vanishing-small black dot is caused to fall on the white canvas the results are opposite: 1)It comes and goes. 2)It has a variable time-coordinate. The fact that a dot pulses and RECEDES is a pure optical effect of enormous importance which has been missed entirely (…).[102]

Once more, the temporal nature of the work is associated not with time as flow, but with time as moving in reverse, or, more accurately, as a pendulum in which the weight's backwards movement is emphasized. Caught up in this antitime, the black dot, which stands in for the Least Event or micro-unit of the cosmos, does not so much dematerialize as perpetually 'oscillat[e] between existence and not'.[103]

In a review of the philosopher Gilles Deleuze's (1925-1990) *Difference and Repetition* (1967) and *The Logic of Sense* (1969), his colleague Michel Foucault (1926-1984) salutes the emergence of

> a philosophy of the phantasm that cannot be reduced to a primordial fact through the intermediary of perception or an image, but that arises between surfaces, where it assumes meaning, and in the reversal that causes every interior to pass to the outside and every exterior to the inside, in the *temporal oscillation* [my emphasis] that always makes it precede and follow itself — in short, in what Deleuze would perhaps not allow us to call its 'incorporeal materiality'.[104]

To be sure, it would be a simplification to cast Latham as Deleuzean, although it is also worth pointing out that both the artist and the philosopher placed the 'event' at the heart of their thinking.[105] But it is interesting to note how Deleuze's redefinition of Being as 'the recurrence of difference'[106] coincides in time with Latham's conception of reality as composed of 'insistently recurring' oscillatory 'events'. More directly, the Foucauldian/Deleuzean idea of an 'incorporeal materiality' invites comparison with the various ways in which, not only Latham, but all the artists considered here resorted to antimatter as a trope for a new paradoxical kind of materiality. In this way, antimatter

in the art of the 1950s and 1960s ultimately appears as corresponding to a larger shift in thinking about materiality and reality. Differing from the energeticist notion of dematerialization handed down by the historical avant-garde movements, this approach must equally be distinguished from the postmodern immaterialism, which a few years later would be encapsulated by the philosopher Jean-François Lyotard's (1924-1998) important exhibition *Les Immatériaux* (an event held in 1985 at the Centre Pompidou in Paris, which focused on the changes wrought by new technology on the definition of materiality). Neither dematerialized, nor immaterial, this 'antimateriality', as I would like to call it, seems in fact more relevant than ever in the context of today's new materialisms.

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[1] Lippard & Chandler 1968, 31. For a detailed discussion of 'dematerialization' and Lippard and Chandler's text, see also Christian Berger's essay in this volume.
[2] Fuller 1970.
[3] Atkinson 1999, 53-54.
[4] Kahn 2013, 224.
[5] Kahn 2013, 223.
[6] Kahn 2013, 226.
[7] Henderson 2002.
[8] Bennett 2010.
[9] Close 2009, 2.
[10] Close 2009, 65.
[11] Fraser 2002, 65-76; Close 2010, 50-59.
[12] A recent exception is Riccardo Venturi's essay on the Italian artist Francesco Lo Savio (1935-1963) and antimatter. In her illuminating study of Japanese conceptualism, Reiko Tomii also mentions the artist Matsuzawa Yutaka's (1922-2006) interest in antimatter. Contrary to Tomii, however, my focus is not on the 'non-sensory' aspect of antimatter, but rather its materiality. Venturi 2017; Tomii 2016, 61; 69; 183. For Matsuzawa, see also Yoshiko Shimada's essay in this volume.
[13] Dalí 1998, 366.
[14] Dalí 1998, 366.
[15] Dalí 1998, 366.
[16] Pezolet 2010, 64.
[17] Pezolet 2010, 81.
[18] Parkinson 2008, 201.
[19] Gallizio himself insisted on the difference between his own method of 'critical ignorance' and Dalí's 'paranoia-critical' method. Gallizio 1974b, 60.
[20] Restany 1959.
[21] Up until recently, and based on the exhibition's announcement card, it was believed that Gallizio covered the gallery space with 145 meters of canvas, making the environment sound like a huge, labyrinthine installation. In her well-documented study of the cavern's history, Sophie Cras convincingly debunks former descriptions, recalling at the same time that Drouin's gallery occupied in fact a very small space. Cras 2018, 78-82.
[22] As per the announcement. Cat. Alba 2005, 64.
[23] Cras 2018, 82-83.
[24] Cat. Turin 1974, 20-21.
[25] Gallizio 1974c, 64.
[26] Bertolino 2001, 130.
[27] Cat. Turin 1974, 19; Gioioso 1991; Corgnati 1992; Jeanpierre 2007; cat. Alba 2005, 29.
[28] Pannaria 2016, 388-389.
[29] Pannaria 2016, 404.
[30] Pannaria 2016, 54.
[31] Pannaria 2016, 54.
[32] Pannaria 2016, 408.
[33] Gallizio 2005, 60.
[34] Gallizio 1974b, 59.
[35] Gallizio 1974b, 59.
[36] Gallizio 1974c, 65.
[37] Gallizio 1974a, 61.
[38] Marx 1990, 130.

[39] Gallizio 1959/1974, 62.
[40] Stracey 2005, 401.
[41] Stracey 2005, 405.
[42] Stracey 2005, 398-399.
[43] Stracey 2005, 402.
[44] Pezolet 2010, 82. For a subtle and thorough analysis of Debord's part in the Drouin exhibition and of his consecutive quarrel with Gallizio, see Cras 2018. [We never used passim – alright to leave it out?] OF COURSE!
[45] Marcone 2014, 32-33.
[46] Manzoni 1997, 111.
[47] Kazarian 2016, 11.
[48] Smithson 1996c, 5.
[49] Smithson 1996c, 6.
[50] Smithson 1996c, 4.
[51] Smithson 1996c, 5.
[52] Smithson 1996c, 5.
[53] Young 1965b, 6.
[54] Young 1965a.
[55] Young 1965a, 67.
[56] Schrödinger 1965, 123.
[57] Smithson 1996c, 5.
[58] Smithson 1996c, 5.
[59] This reticence may be compared with Smithson's diatribe against Einstein in 'The Iconography of Desolation', an unpublished text drafted around 1962. Smithson 1996b, 322.
[60] Jammer 1961, 5.
[61] Jammer 1961, 53.
[62] Jammer 1961, 31.
[63] Smithson 1996c, 6.
[64] Bataille 1930. Bataille, however, distinguishes between Gnosis and Neoplatonism, the latter being too idealistic in his opinion. For a comparison of Smithson and Bataille's materialisms, see also Rahtz 2012, 49.
[65]See in Smithson's archive the list of different examples of mirrors in art and literature, which includes antimatter. Robert Smithson, 'Notebook 3', Robert Smithson and Nancy Holt Papers, Archives of American Art, Smithsonian Institution, Washington D.C., reel 3834, frame 0093.
[66] Gardner 1964, 237-253.
[67] Gardner 1964, 231-234.
[68] Morrison 1965, 269.
[69] Gardner 1964, 250-251.
[70] As Judd himself tersely put it in a letter to the editor of *Arts Magazine* in February 1967: 'Smithson isn't my spokesman.' Judd 1967, 8.
[71] See the list of meanings of 'Alogon' in Smithson's archive. Robert Smithson and Nancy Holt Papers, Archives of American Art, Smithsonian Institution, Washington D.C., reel 3835, frame 0236.
[72] Smithson & Wheeler 1996, 230.
[73] Flécheux 2009, 240-241.
[74] For an illuminating comparison between Smithson and Derrida's approaches to matter, see Rahtz 2012, 48.
[75] In 1969 Bochner returned to Dirac's hole theory as part of his *Measurement Series*: works in which either a space or an object are marked with their own measurements. Bochner made one these pieces, *Measurement: -256" Square*, based on a sketch entitled *Holes (for Direac)*. The work consists of a rectangular piece of corrugated cardboard with one square substracted from one of its edges, leaving a hole. The measurements of the empty square's two remaining tangible sides are indicated on the cardboard with letraset.
[76] Close 2010, 43-44.
[77] Gardner 1964, 224-25.
[78] Bochner 2008, 10.
[79] Rothkopf 2002b, 20-21.
[80] Rothkopf 2002a, ix-x.
[81] Sartre 1948, 193-194.

[82] Dryansky 2013.
[83] Lippard & Chandler 1968, 33.
[84] Lippard & Chandler 1968, 40.
[85] Graham 2009.
[86] Bernhard Siegert, 'Codes as Cultural Techniques', lecture, Centre Pompidou, Paris, 6 November 2015, https://www.centrepompidou.fr/cpv/ressource.action?param.id=FR_R-6b875f2e5623a0d5585719406928fde3&param.idSource=FR_E-22df4bdcc63db8a4d13ab852d8df71 [accessed 4 April 2018]. The Macy Conferences were a series of interdisciplinary meetings of scientists and scholars that were sponsored by the Josiah Macy, Jr. Foundation and took place in New York between 1946 and 1953. The discussions focused on the new disciplines of cybernetics and information theory and their impact on human behavior and society.
[87] Drucker 2004.
[88] Fraser 2002, 92.
[89] Gardner 1964, 252, n 1.
[90] Latham 1970.
[91] Lippard & Chandler 1968, 31.
[92] John Latham, letter to Norman Reid, director, Tate, 28 November 1979, John Latham Archive, Flat Time House, London.
[93] Latham *et al.* 2010, 5.
[94] Walker 1995, 77.
[95] Latham & Harrison 1968, 261.
[96] Latham & Harrison 1968, 261.
[97] Gregory & Kohsen 1959, 36.
[98] Gregory & Kohsen 1959, 38.
[99] Walker 1995, 59.
[100] Latham 1970.
[101] *John Latham in Focus*, video interview, December 1, 2004, http://www.tate.org.uk/context-comment/video/john-latham-focus [accessed 4 April 2018].
[102] John Latham, copy of letter to 'Bill', 20 April 1964, John Latham Archive, Flat Time House, London.
[103] Walker 1995, 24.
[104] Foucault 1970, 169.
[105] A common source perhaps is Alfred North Whitehead's (1861-1947) philosophy, which was influential for both men.
[106] Foucault 1970, 187.