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Industrial Materials, Industrial Forms

If one considers a work of art such as Carl Andre's *144 Steel Square* (fig. 1), first shown at the Dwan Gallery in New York in December 1967, and now in Frankfurt, one could say that it consists in a material – steel – that has been given a form – a square. This square is comprised of smaller squares, each twelve inches by twelve inches, arranged in a twelve-by-twelve pattern. In terms more general than art, the giving of form to a material may be seen as corresponding to a particular definition of labour if one remembers Andre's use, in various statements, of a formulation appropriated from Karl Marx's *Grundrisse*: «Labour is the living fire that shapes the pattern; it is the transitoriness of things, their temporality, their transformation by living time.»[1] In this text, living labour exists as subjective potentiality, as «forming activity», a natural force that Marx compares to fire, or to fermentation.[2] When considered in terms of production, labour may be distinguished from nature by its intentional structure, involving a form that exists in the imagination prior to its realization, in the sense that the process is oriented according to a purpose, a use-value.[3] The material that labour works on is, from the side of labour, without form and indifferent to form. This material, which is always subject to natural processes, to disintegration, as when steel turns to rust, only loses its indifference when it is the material for living labour.

Despite his reference to the *Grundrisse*, it is difficult to see Andre's work as corresponding to living labour as a ‹forming activity› in this sense. According to Philip Leider, in a review of a second exhibition of Andre's work at the Dwan Gallery in 1969, the ‹forms› of the works shown, which were the same as the earlier *144 Steel Square* except that this time the materials were magnesium, lead and copper, consisted in «passive shapes, the only active elements being the properties of the materials of which they were made.»[4] The form was that of mere arrangement – the twelve by twelve square pattern. The size and shape of each square, specified by Andre according to standard measurements in general use, does not correspond to any particular use of the material. This exchange of attributes between active form and passive material was intended to reveal the differing ‹properties› of the materials themselves, such as the lightness of magnesium when compared with lead. The relative absence of form in Andre's works may be said to correspond, still in a Marxist register, to an absence of living labour, and so to a loss of particularity under the conditions of capital, where labour becomes generalized, and consists in, as Marx puts it, a «mechanical activity, hence indifferent to its particular form; a merely *formal* activity, or, what is the same, a merely *material* [*stoffliche*] activity».[5]

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1 Carl Andre, *144 Steel Square*, 1967, steel, 365,8 × 365,8 × 1 cm, Museum für Moderne Kunst, Frankfurt am Main

When labour is generalized as the material for capital, the form and the material that are the terms of the process become separated, each indifferent to the other.

The material used for *144 Steel Square* was, furthermore, an industrial material. Despite the mere arrangement that constituted its exterior shape, it nevertheless has a form as a material. As a raw material, steel would have already been subject to several constitutive processes involving labour – mined, purified and materially altered, rolled, cut, and so on. Some of these processes produce a form that is interior to the material, producing its ‹properties›, not only in a phenomenal sense but also in an industrial sense, relating to use. This interior form is crystalline, which in the natural form of iron contains different possibilities that are realized according to what is taken away or added to it, such as carbon. The natural crystalline form is changed according to a further interior forming. Many of these processes, which determine the existence of a material such as steel, have a long history, but from the time that Marx was writing onwards were increasingly dependent on large-scale industrial processes, such as that effected by the blast furnace, and on machines.

Living labour, the material that is given form, and the technical objects used for that purpose, such as tools or machines, together constitute what Marx called, in the 1859 *Preface*, «material productive forces».[6] The «relations of production», on the other hand, constitute the social and economic form of the arrangement of labour in production, and the historicity of this form is defined according to the technical forms involved and the varying distribution of these forms, including according to property.[7] In a first historical shift, according to Marx, labour as it exists, and the technical objects and materials, are merely included in the process of capital, without themselves being altered. The form changes but the material remains the same. This shift is that of the merely formal subsumption of already existing forces of production under relations of production determined by capital as a process. Marx writes, in *The Results of the Immediate Production Process* (from a draft of *Capital* from 1861–63), that such formal subsumption is the «general form of every capitalist

process of production».[8] This form is determined by capital, and does not necessarily refer to any particular form that the forces of production might take. «[C]apital is in itself indifferent to the *particular* nature of every sphere of production.»[9]

In a second shift, however, the forces of production themselves undergo a change in form. This is not a change where form is imposed from outside, but one where the material productive forces, labour and technical means, take shape from within. Since capital is oriented to the appropriation of value, it entails a separation of living labour, the real origin of value, from the process of production. This shift is that of a real subsumption of forces under relations. On the side of the technical means, this separation of labour is achieved through the use of machines. The important statements by Marx concerning the relationship between technical reality and capital may be found in the so-called *Fragment on Machines* in the *Grundrisse* and in chapter fifteen of *Capital*. «The development of the means of labour into machinery is», Marx writes in the earlier text, «the historical reshaping of the traditional, inherited means of labour into a form adequate to capital».[10] This reshaping is actually an inversion of the inherited means of labour, where the tools and individual machines that hitherto constituted the means of individual and collective labour in manufacturing become, in large-scale industry, the subject of the process. Labour is positioned to the side of the process of production, and loses all of its particularity, since the process and technical means that define it have been mostly replaced by a mechanical process. «No longer does the worker insert a modified natural thing [*Naturgegenstand*] as the middle link between the object [*Objekt*] and himself; rather he inserts the process of nature, transformed into an industrial process, as a means between himself and organic nature, mastering it. He steps to the side of the production process instead of being its chief actor.»[11]

The result is that the form adequate to capital is, in the phrase appropriated by Marx in *Capital*, that of a «vast automaton», a system of machines, or moving organs, propelled by a self-moving force, such as that produced by a steam-engine.[12] «[T]he automaton itself», Marx writes, «is the subject, and the workers are merely conscious organs, co-ordinated with the unconscious organs of the automaton [that is, the machines], and together with the latter subordinated to the central moving force».[13] The prior «solid crystallization» of the means and arrangement of labour characteristic of manufacturing is «dissolved» into a cloud of undifferentiated labour that is completely subordinated to the changing technical basis characteristic of large-scale industry.[14] The effect of this change in the form of technical means on labour is, on one hand, to make the latter increasingly superfluous, and on the other, to increase its intensity. This intensity is in turn related by Marx to the actual forms and materials of machines themselves, where these involve, for example, improvements in the speed of movement or reduced friction.

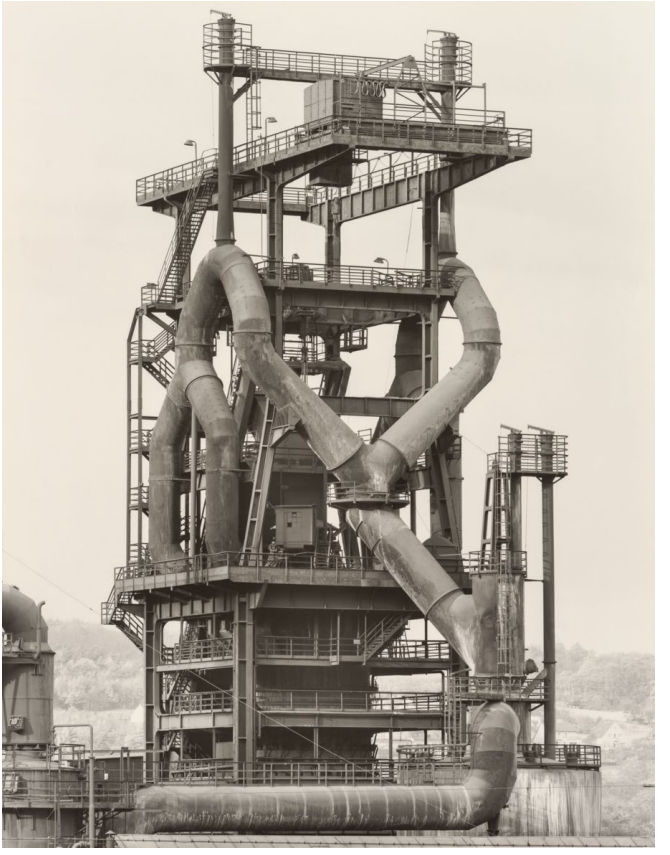
We may seem to have moved a long way from the particular approach to form and material that we see in *144 Steel Square*, but the detour is necessary if one is to account for the mode of existence of an industrial material such as steel, in its interior form, which depends on large-scale processes and machines, as Andre was well aware. The industrial involves a change in a relation of production, and produces a new unity. Prior to industrial production, according to Étienne Balibar in his contribution to *Reading Capital*, «a ‹*technique*› was the *indissociable ensemble* of a means of labour or tool, *and a worker* [...] The technique is essentially individual [...]».[15] When, however, the subject of production shifts from the individual worker to a system of machines, a ‹vast automaton›, the technical process becomes

one that is enacted by a new ensemble, a new unity in Balibar's terms, comprising technical means and material.[16] The worker has ‹stepped aside›. There is a dissolution of the techniques that characterized manufacturing, but one could say that a new ‹crystallization› emerges on the side of this new unity, the ensemble of machines and material worked on. This new unity brings together the form of the machine and the forms of materials, and produces standards and types. The three-eighths of an inch thick steel plate that Andre worked with was a standard industrial material in this sense, rolled to a particular gauge, its interior and exterior form being determined by the historical development of large-scale processes and machines (and, later, by bureaucratic standardization, on the part of the American Bureau of Standards for example).

In industrial production, machines and other technical objects become themselves standards and types, and in this way take on form. A machine can be defined as a mechanism or an arrangement of mechanisms where, as Georges Canguilhem put it in his 1952 text, *Machine and Organism*, in the movement of their parts they do not «threaten the integrity» of the whole.[17] The machine or mechanism propagates movement (the energy comes from elsewhere, from a natural force), which is limited by degrees of freedom (where, for example, a threaded screw has two degrees of freedom), which can be measured and conforms to a mechanical schema. The purposiveness of machines, Canguilhem writes, is realized «within narrowly defined limits, and these limits become all the more rigid with the practice of standardization».[18] This is a ‹crystallization› (or perhaps an organic process, given the title of Canguilhem's essay) that is not only produced by an ensemble of machines and the material worked on, the unity identified by Balibar, but by an arrangement of form interior to the machine itself, as Marx already recognized in his remarks on how the solving of technical problems produced forms determined by mechanics rather than labour (one of his examples was the improved blowing apparatus of a blast furnace, which no longer resembled bellows).[19]

A question is thus raised concerning the determination of the form of the industrial object, given the interiorization of form (its separation from labour as form-giving) in the real subsumption of forces under relations. One means of approach, again from within the realm of art, is to consider the photographic work of Bernd and Hilla Becher (fig. 2), who typically photographed, using a large-format camera and in black and white, industrial buildings (a blast furnace in this case) as individual objects detached from their surroundings, which they usually arranged in series to bring out variations in form. Carl Andre's text, *A Note on Bernhard and Hilla Becher*, published in *Artforum* in 1972 and widely credited as bringing the Bechers to the attention of the anglophone art world, provides a simple description of their work.

> «The photographs of the Bechers record the transient existence of purely functional structures and reveal the degree to which form is determined by the invariant requirements of function.
>
> A partial catalogue of the typological subjects of Bernhard and Hilla Becher includes: structures with the same function (all water towers); structures with the same function but with different shapes (spherical, cylindrical, and conical water towers); structures with the same function and shape but built with different materials (steel, cement, wood, brick, or some combination such as wood and steel); structures with the same function, shape and materials; comparative frontal and perspectival views of pithead towers, high tension electrical pylons, blast furnaces, and factory buildings.»[20]



2 Bernd and Hilla Becher, *Hüttenwerk Hagen-Haspe, Ruhrgebiet*, 1968, gelatin silver print, 40,5 × 31,4 cm, Photographische Sammlung/SK Stiftung Kultur

The privileged term is function, which determines the forms and materials, which in turn may vary. The Bechers' first book, *Anonyme Skulpturen*, published in 1970, is organized according to different kinds of industrial buildings such as cooling-towers, blast-furnaces, gas-holders, and so on.[21] The ‹anonymity› of these buildings is attributed to mere function, and yet function also produces what they refer to, in their first presentation of *Anonyme Skulpturen* in *Kunst-Zeitung* in early 1969, as the «manifold forms» that provide the material for a classificatory mode of arrangement.[22] Industrial buildings performing the same function can be different shapes, or the same shapes can be built with different materials. In the same text, they write that what they want to do is «to produce a more or less perfect chain of different forms and shapes».[23] And in order to do this, they continue, «the objects must be freed from their environment, from associations – as it were, neutralised».[24]

One of the criticisms made of the Bechers' work is that their mode of presentation of the ‹manifold forms› of industrial objects, their formalism, conceals the historical content of industrial production, its material forces and relations. There is no sign of labour in their photographs. It is the automaton or its organs, or rather the buildings that provide certain of its material conditions, that are shown, often at the end of their life. And yet industrial objects cannot be anything other than the productions of labour, even when machines produce machines. «Nature», Marx writes in the *Grundrisse*, «builds no machines […] These are products of human

industry; natural material transformed into organs of the human will over nature, or of human participation in nature.»[25] In both the *Fragment on Machines* and in *Capital*, a distinction is always maintained between technical objects per se and their exploitation as a means by capital.[26] Such objects may be reshaped, given form by capital, but this does not necessarily explain how the forms of the objects themselves come into being.

In order to approach this question from the other side, we can turn to Gilbert Simondon's book *On the Mode of Existence of Technical Objects*, first published in 1958. Simondon was critical of Marx's definition of labour as form-giving for its reliance on the form-matter distinction, a long-standing philosophical figure of thought which itself derives, according to Simondon (writing elsewhere), from the dependency of ancient Greek society on the labour of slaves, where form is imposed on material by those giving orders.[27] Labour is defined by a figure of thought that is derived from itself. Even in its simplest form, as Simondon argues, it is already alienated with respect to the interiority of its own process, prior to any alienation that one might associate with the exteriority of the social relations of production. In *On the Mode of Existence of Technical Objects*, Simondon was not only concerned with the nature of technical process, more general than labour, but also with technical objects such as machines. Technical objects may be seen as the materialization of technical process, but defined in terms of their ability to enact the interiority of the process, regardless of intentionality, and to take form accordingly, rather than according to the exteriority of labour as giving form, or of any historical category, such as the mode of production. For Simondon, the mode of existence of the technical object, whether it is a spring, an engine or a coal mine, is defined by a coming into being, an ontogenesis, of the technical, a process or tendency he refers to as ‹concretization›.[28] In a technical individual such as an engine, this process is one that involves relations between its elements, each of which has its own form depending on its function. These elements increasingly inform each other in the individuation of the engine, which becomes more concrete, like a natural object. In this process, the same form can begin to combine different functions, as in the example Simondon gives of the cooling fins on a cylinder head in an engine which, as well as cooling, take on the structural function of withstanding pressure. The structural form, where the fins contribute strength, allows for a thinner metal to be used, which in turn further improves cooling.[29] There is an interior resonating of forms that were previously separate. Industrial objects may also take form in a relation to their conditions, but these conditions are not exterior to them. Rather, the conditions of existence of a technical object, whether natural or technical, arises with it, and is in a sense produced by it, as its «associated milieu» in Simondon's phrase.[30] There are natural conditions, such as the existence of coal, which only becomes a condition once the machine has been invented. And there are technical conditions as when a blast furnace, for example, is part of a large ensemble such as a steelworks. (The Bechers usually photographed individual objects, but they also documented entire industrial ensembles, such as the Concordia coal mine in Oberhausen.) In these ways, the technical object takes form. The mode of existence of such entities is thus not reducible to the social. It is not natural either, although it is like nature.

At this point, we can consider the extent to which this description of technical individuation corresponds to the «manifold forms» presented by the Bechers as

Anonyme Skulpturen.[31] With their earlier work, the Bechers often included a short text describing the function of the industrial objects they show, as in their photographs of blast furnaces. «In blast-furnaces crude-iron is extracted from iron-ore by means of chemical reduction.»[32] They go on to describe the chemical process itself and its materials, and the natural forces involved, such as gravity and the heating of air. Finally, they specify the materials used for the building itself and give a sense of its form, «fire-proof stone», a «sheet-steel case or… a steel scaffold».[33] The form of the building corresponds to the processes taking place within it. Some historical changes, such as scale, may be attributed to economic considerations but there are variations in form that are more interiorized in their determination, and are much closer to the process of ‹concretization› that defines technical individuation in Simondon's sense. An example of this, referred to by the Bechers, is the use of the gasses produced in the extraction process to heat the air, the ‹blast› of which is the cause of the process, a recirculation of energy which accounts for the various arrangements of exterior pipes. The Bechers sometimes considered such forms as resembling natural forms, such as those technical ensembles «which had grown over the years into huge shapes not unlike crystals in their structure».[34]

The process effected by the blast furnace is the first stage in the production of steel. As such, we can consider the object shown by the Bechers as registering the form of the industrial process that produced the material used in *144 Steel Square*. At the same time, the mere arrangement of industrial material per se, prior to any use, which is characteristic of Andre's work, gives a sense of the mode of existence of the material used to construct an industrial building such as a blast furnace. Each can be seen to provide a cause of the production of the other. The work of Andre and the Bechers may be said to occupy different positions within the unified ensemble of material and technical object that defines industrial production (although the work is art, of course, and so has a different intentional structure, which positions it outside of this production). Labour becomes either «a merely *formal* activity, […] a merely *material* activity», mere arrangement that is indifferent to form, and separated from its process, or it is simply not shown, as in the Bechers' photographs.[35] Industrial form is interiorized in its determination. It no longer depends on the intentional structure that defines labour but on a cause of production that is interior to the industrial.

Notes

1 Karl Marx: Marx's Grundrisse, translated by David McLellan, London 1971, p. 89. Carl Andre's quotation is in: Sonsbeek 71. Sonsbeek buiten de perken, Part 2, exhib. cat., Arnhem, Park Sonsbeek et al., Deventer 1971, p. 5. A more extended discussion of Andre's work in these terms is in Dominic Rahtz: Metaphorical Materialism. Art in New York in the Late 1960s, Leiden 2021.

2 Karl Marx: Grundrisse, translated by Martin Nicolaus, Harmondsworth 1973, p. 298.

3 Karl Marx: Capital. A Critique of Political Economy. Volume 1, translated by Ben Fowkes, Harmondsworth 1976, pp. 284, 287.

4 Philip Leider: To Introduce a New Kind of Truth, in: New York Times, 25 May 1969, sec. II, p. 41.

5 Marx 1973 (as note 2), p. 297.

6 Karl Marx: Preface to a Contribution to the Critique of Political Economy, in: idem.: Selected Writings, ed. by David McLellan, Oxford 2000, p. 425.

7 Louis Althusser/Étienne Balibar: Reading Capital, London 2009, pp. 185, 191.

8 Marx 1976 (as note 3), p. 1019.

9 Ibid., p. 1012.

10 Marx 1973 (as note 2), p. 694.

11 Ibid., p. 705.

12 Marx 1976 (as note 3), p. 502.

13 Ibid., pp. 544–545.

14 Ibid., pp. 590, 616–617.

15 Althusser/Balibar 2009 (as note 7), p. 267.

16 Ibid., p. 271.
17 Georges Canguilhem: Machine and Organism, in: Jonathan Crary/Sanford Kwinter (eds.): Incorporations, New York 1992, p. 46.
18 Ibid., p. 56.
19 Marx 1976 (as note 3), p. 505, n. 18.
20 Carl Andre: A Note on Bernhard and Hilla Becher in: Artforum 11, 1972, no. 4, p. 59.
21 Bernhard Becher/Hilla Becher: Anonyme Skulpturen. A Typology of Technical Constructions, New York 1970.
22 Bernhard Becher/Hilla Becher: Anonyme Skulpturen, in: Kunst-Zeitung, 1969, no. 2, n. p.
23 Ibid.
24 Ibid.
25 Marx 1973 (as note 2), p. 706.
26 See, for example, Marx 1976 (as note 3), p. 547.
27 Gilbert Simondon: On the Mode of Existence of Technical Objects, trans. Cécile Malaspina/John Rogove, Minneapolis 2017, pp. 247–248; Gilbert Simondon: Individuation in Light of Notions of Form and Information, translated by Taylor Adkins, Minneapolis 2020, pp. 35–36.
28 Simondon 2017 (as note 27), pp. 25–27.
29 Ibid., pp. 27–28.
30 Ibid., p. 59.
31 Becher/Becher 1969 (as note 22).
32 Becher/Becher 1970 (as note 21), n. p.
33 Ibid.
34 Hilla Becher: Documenting Industrial History by Photography, in: Industrial Archeology. The Journal of the History of Industry and Technology 5, 1968, no. 4, p. 373.
35 Marx 1973 (as note 2), p. 297.

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1 © VG Bild-Kunst, Bonn 2024; MUSEUM^{MMK} FÜR MODERNE KUNST; photo: Axel Schneider, Frankfurt am Main
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