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Wires, Wirelessness, and the Morality of Form in "The New Machine Art"

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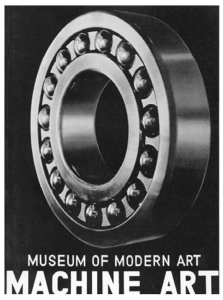
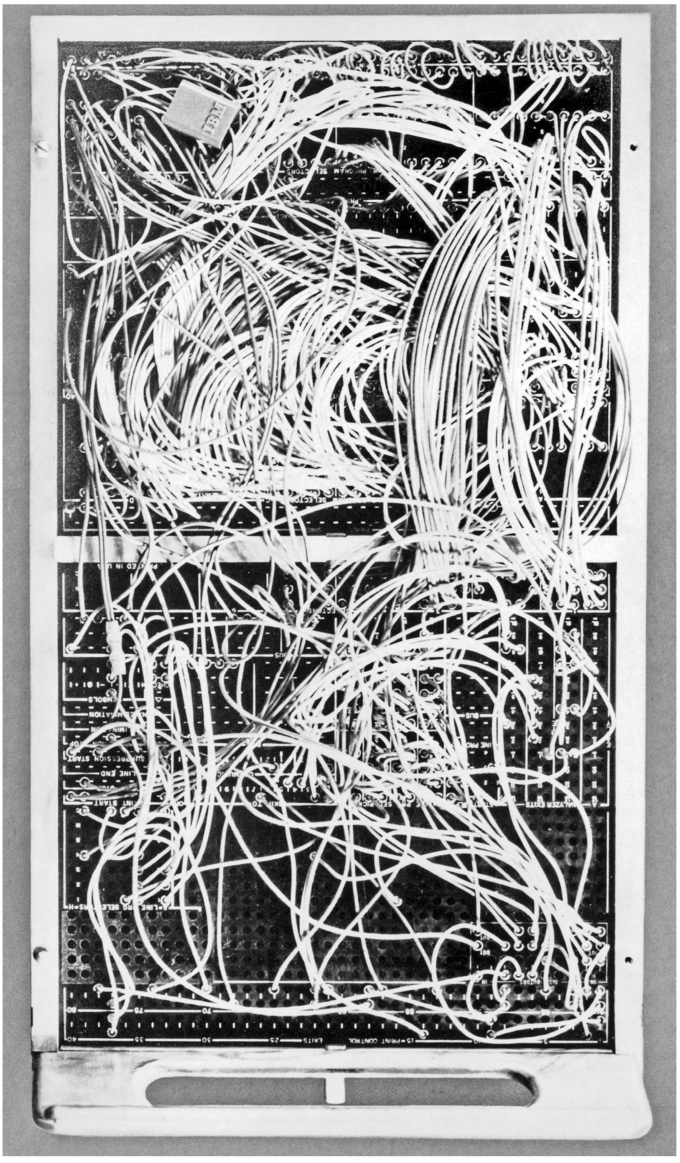
Note: Portions of this text have been published as parts of an article in *Media-N*; I thank the editors for their permission to republish certain turns of phrase in this new context. I also wish to thank Laurent Stalder and Moritz Gleich for inviting me to participate in a very stimulating conference, and Nicole Starosielski, Reinhold Martin, the media studies faculty reading group at Columbia University, and the Aggregate group for their constructive criticism on several versions of the text.

I concluded my last book, as so many historians and novelists do, with a discussion of a tangled skein. [1] There, I closed my attempt at a critical history of the design program at IBM in the post-Second World War era by remarking on the inability to date of art and architectural history to cope with the very language of technics and capital in the twentieth century. The crux of the problem remains to identify what, exactly, pits the technical against the aesthetic, the medium or apparatus against the work (a roomy set, that may be said to contain architecture as one of its many objects). Amongst other points of reference, I turned to the effort by Arthur Drexler to update the aggressively neo-Platonist and Thomist theses of Alfred H. Barr Jr. and Philip Johnson's 1934 exhibition at the Museum of Modern Art (MoMA), titled *Machine Art*, [f.1] with the rather lamely titled final entry, "The New Machine Art," in the museum's catalog of design objects of 1959. Whereas the 1934 exhibition had sought to stabilize the products of industrial civilization in aesthetic terms, claiming vociferously (if also anxiously) that a turbine, a lamp, a ball bearing, or a structural cable all deserved the status of object and artwork, [2] Drexler, illustrating his musings with the museum's recent and extraordinary acquisition of an IBM RAMAC control panel, reflected on what he saw as a fundamental redefinition of the status of the object in the face of the electrification of technics. [f.2] Then, as now, it is worth quoting him almost in full, precisely because





f.1 Alfred H. Barr Jr. and Philip Johnson, *Machine Art*, 1934.

f.2 IBM RAMAC control panel, 1958.

1 John Harwood, *The Interface: IBM and the Transformation of Corporate Design, 1945–1976* (Minneapolis: University of Minnesota Press, 2011), pp. 224–7.

2 Alfred H. Barr Jr. and Philip Johnson, *Machine Art* (New York: Museum of Modern Art, 1934).

Drexler both admitted and denied the existence of an ontological horizon beyond which the very grammar and syntax of art history and criticism would no longer be admissible. As he wrote on the final page of the catalog,

"Most often the design of machines is not consciously guided by aesthetic considerations. But in technology as a science, the more limited aesthetic decisions may be, the more significant are their effects. For this reason Machine Art still offers important clues to emerging concepts of design, the word design being understood not only in its conventional sense but also as a broad approach to the making and organizing of objects.

Since the end of World War II electronics has altered our conception of how things need to be shaped in order to work, and of how they may be related to each other. ... [T]he new machines are incomprehensible unless one knows about the existence of invisible forces."

So far, so good. The tangle of wires that seemed to swarm over the surface of the panel, which was detached from the rest of the apparatus it controlled, screwed to the wall of the museum, and photographed behind museum glass, could be seen as visible effects of the otherwise "invisible forces" that animated the data processor. Yet what becomes clear all too quickly is that the famed architectural critic, historian, and curator is only prepared to confront this technical artifact as an image—he is not only forced to confine his interpretation of that image as a representation of technical fact, but also as a representation and confirmation of Barr and Johnson's earlier hypothesis. Drexler again:

"Perhaps the most striking characteristic of the new machine aesthetic is its dematerialization of finite shapes into diagrammatic relationships. Examples are the printed electrical circuits, which replace separate three-dimensional objects with groups of patterns printed on a flat surface. Such patterns can hardly be said to have precise boundaries, or to be complete in themselves. This is also evident in a three-dimensional design such as the control panel from a RAMAC computer, with its clusters of colored wires arranged on a panel according to the requirements of computer operations.

... Dematerialization and pattern relationships recall similar ideas in painting, most notably in the work of Jackson Pollock." **3**

This unconvincing and even embarrassing recollection, I would like to argue, is evidence of a persistent problem haunting an art and architectural historical understanding of technics. But rather than review the subsequent iterations of this refusal to think through the RAMAC panel (or any other technical

3 Arthur Drexler and Greta Daniel, *Introduction to Twentieth Century Design from the Collection of the Museum of Modern Art* (Garden City, NY: Doubleday, 1959), p. 94. My emphasis.

artifact) as anything other than an image/object after MoMA's effort to domesticate all technical artifacts as museum objects—and moreover as objects that secure the boundaries of a number of subjects who regard them from a safe distance, but with growing anxiety—I'd like to take up an opportunity that I could not in my book, which is to try to address exactly why Drexler cannot cope with the wires. What erupts into the image in the attempt to reduce the RAMAC panel to an image is the visible, not invisible—and material as opposed to immaterial or "dematerialized"—presence of the connective tissue of the technical artifact. The RAMAC cannot be understood, under these conditions, as an object. The object, considered as a whole, even as a metonymic index to the real, requires different conditions. Following Franz Reuleaux and others, we should rather address the computer or portions thereof as an apparatus composed not only of objects but the crucial "linkages" between those objects that set the machinery in motion, [4] in which the literal wiring both produces objective effects and evades easy objectification. By contrast, what is required by the terms of modernist aesthetic ontology is the invisibility of the wires. We continue to live with this gap in our languages.

Drexler's perplexity was wholly in step with the erasure of wiring that had been the modus operandi of MoMA for decades; this requisite invisibility was forcefully theorized in the 1934 *Machine Art* exhibit and its catalog. As scholars such as Jennifer Jane Marshall have pointed out, Philip Johnson's careful staging of the exhibit, with all of its buffing and polishing, sought to emphasize the Phileban qualities of the mechanical and electrical products on display. [5] This reductive approach to aestheticizing industrial products as objects viewable by a stable subject—who, both Barr and Johnson in their short introductory essays stated with no shortage of drama, would be threatened by encountering many of these products in their original contexts—was also accomplished by literally detaching these products from the linkages to power and communications apparatus. [6] The appliances such as stoves and electric lights were displayed, both in the museum and catalog, with their power cables removed. When, in the first section of the exhibition, cables and wires were displayed, they were first of all selected carefully by Barr and Johnson for their mechanical properties and uses rather than their communicative properties, and were displayed as individual components rather than as relational elements within a larger structure or apparatus. Nowhere is this more evident than in the decision to display a sliver-thin section of a 3.5" steel wire rope manufactured by American Steel & Wire Co. f.3 This crypto-orthogonal representation of the properties of the wire does not emphasize

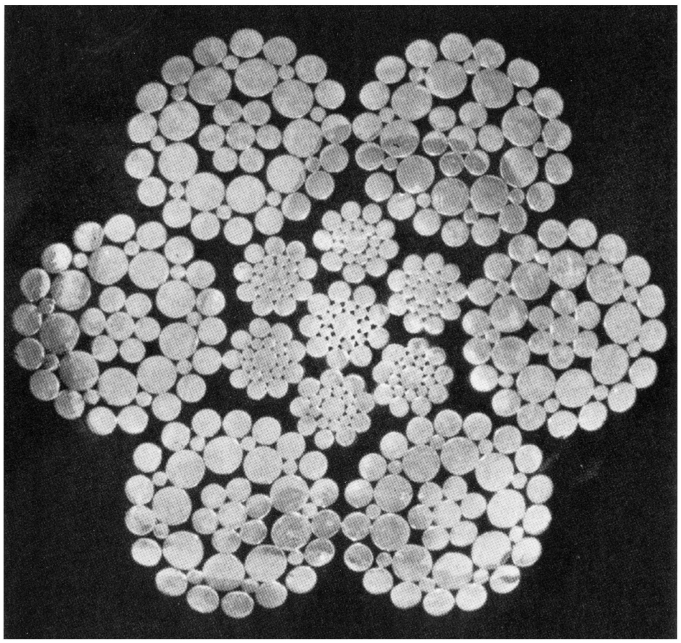
4 Franz Reuleaux, *Kinematics of Machinery: Outlines of a Theory of Machines*. Trans. Alex B. W. Kennedy (London: Macmillan, 1876).

5 On the philosophical aesthetics motivating Barr and Johnson and on the display and photographic techniques used to "simplify" the industrial products on show in the exhibition, see Jennifer Jane Marshall, *Machine Art, 1934* (Chicago: University of Chicago Press, 2012), esp. chap. 3.

6 The epigraphs of the catalog express clearly the stakes of rendering the industrial machine and its products "beautiful." From Plato's *Philebus*, 51c: "By beauty of shapes I do not mean, as most people would suppose, the beauty of living figures or of pictures, but, to make my point clear, I mean straight lines and circles, and shapes, plane or solid, made from them by lathe, ruler and square. These are not, like other things, beautiful relatively, but always and absolutely." From St. Thomas Aquinas's *Summa Theologiae* I, q. 39: "For beauty three things are required. First, then, integrity or perfection: those things which are broken are bad for this very reason. And also a due proportion or harmony. And again clarity: whence those things which have a shining color are called beautiful." And finally, from L. P. Jacks's *Responsibility and Culture* (New Haven: Yale University Press, 1925), p. 62: "Industrial civilization must either find a means of ending the divorce between its industry and its 'culture' or perish."

the intertwining of elements so much as reduce the wire to a series of circular or cylindrical elements independent of one another, arranged together in a fixed pattern.

This reductivism has had a lasting impact on the way in which technical "objects"—and in the context of a museum, such artifacts or products are always understood as objects—are excluded from analysis under the terms of art historical method unless they may be construed as belonging to a canonical "medium" such as painting, sculpture, or printing, and even then these tools are examined primarily for evidence regarding the hand and creative mind that wield them. The technical artifact—whether construed as object (tool), subject (automaton), element of a larger apparatus (organ), medium, or *dispositif*—unsettles and disrupts a neo-Platonic, even neo-Kantian desire to disaggregate the world into subjects and objects; and it does so in a way that provokes ethical and moral objections to liberalism and challenges the grammar and syntax of art history. [7] So, rather than move forwards from "Machine Art" and trace a historical legacy from that fundamentally conservative effort to tame the technical artifact, I propose moving backwards, genealogically. As Bernhard Siegert has shown in his in-depth study of the origins of the modern postal system, and in his later essays on the complex arrays of *Kulturtechniken* deployed in articulating other modes of telecommunication, infrastructures carry "meaning" from place to place, replicating themselves as they go. [8] It is in this way that, as Friedrich Kittler so provocatively stated, "media determine our situation." [9] Yet it is the specificity of the wire—its configuration as a particular form of network, carrying particular information—that matters most in this open-ended determinism. As Florian Sprenger noted in his recent studies of "immediate media," the cables and wires and other apparatus of electrical and electronic media are difficult and nearly always invisible as either subjects or objects; they are "in-betweens." [10] Yet what are these wires, that they must be removed from the image, from the analytical understanding of objects as understood by the history of art and architecture?



f.3 American Steel & Wire Co. (Subsidiary of United States Steel Corp.), section of wire rope, 3.5" in diameter, 1934.

7 Interestingly, in an effort to reestablish the methodological bases of art history in the wake of poststructuralist and postcolonialist critiques, Robert S. Nelson and Richard Shiff commissioned 22 essays on "critical terms." Neither "object" nor "subject" nor the term used to collapse one onto the other—"style"—are among the terms examined, although "style" was belatedly included in the revised edition of 2003. Amazingly, "medium" is also excluded. Nelson and Shiff (eds.), *Critical Terms for Art History* (Chicago: University of Chicago Press, 1996).

8 See Bernhard Siegert, *Relays: Literature as an Epoch of the Postal System*. Trans. Kevin Repp (Stanford, CA: Stanford University Press, 1999); and Siegert, *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*. Trans. Geoffrey Winthrop-Young (New York: Fordham University Press, 2014).

9 The full statement from the preface to Friedrich Kittler, *Gramophone, Film, Typewriter,* trans. Geoffrey Winthrop-Young and Michael Wutz (Stanford: Stanford University Press, 1999 [1986]), p. xxxix, reads: "Media determine our situation, which—in spite or because of it—deserves a description."

10 See Florian Sprenger, "Between the Ends of a Wire: Electricity, Instantaneity and the Globe of Telegraphy," in Michaela Hampf and Simone Müller-Pohl (eds.), *Global Communication Electric: Actors of a Globalizing World* (Frankfurt: Campus, 2013), pp. 355–81; and Sprenger, *Medien des Immediaten: Elektrizität, Telegraphie, McLuhan* (Berlin: Kadmos, 2012).

A good place to start pulling on the end of the wire is with the beginnings of the usage of wires as key components of telecommunications media. As the first scientifically (as opposed to alchemically) minded commentator on the role of metals in modern culture, Georgius Agricola wrote in defense of the mining and metallurgical arts of "the arguments which may be used against this art, and against metals and the mines:" [11]

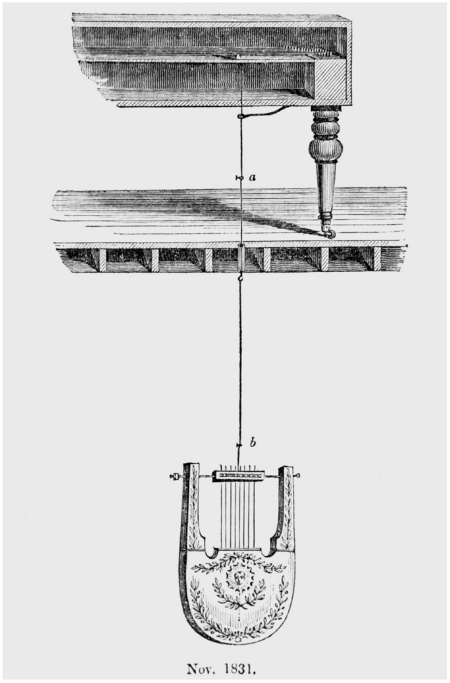
"If we remove metals from the service of man, all methods of protecting and sustaining health and more carefully preserving the course of life are done away with. If there were no metals, men would pass a horrible and wretched existence in the midst of wild beasts; they would return to the acorns and fruits and berries of the forest. They would feed upon the herbs and roots which they plucked up with their nails. They would dig out caves in which to lie down at night, and by day they would rove in the woods and plains at random like beasts, and inasmuch as this condition is utterly unworthy of humanity, with its splendid and glorious natural endowment, will anyone be so foolish or obstinate as not to allow that metals are necessary for food and clothing and that they tend to preserve life?" [12]

The argument is plain enough. The sophistries of those who would object to mining and metallurgy or manufacture and medicine risk plunging contemporary society into chaos. But the argument also claims that metals actually are constitutive of the relations between people in a civilized society, and this is both more important to Agricola's project to recuperate and perfect the sciences and techniques of mining and metallurgy, and more relevant to the pocket history of wires that follows. Agricola depicts a metallurgical society that is shot through with metal artifacts which make possible greater specialization of labor, cultural variation, advances in medicine and other sciences, and so on. The bonds that knit the "beasts" of the wild into the "humanity" Agricola identifies in his sixteenth-century present, however, are wireless. First used for making basic tools, then for making jewelry, then for making money, then for more advanced machinery (including weapons)—throughout history, Agricola reminds us, metals were constitutive of community and communications: they allowed ever more sophisticated and intimate cultural relationships to act over distance. In other words, metals are always already media.

As the first "short history" of telephony written after the invention of the Bell system relates, the "ear trumpet" and "speaking trumpet" were early instances of communicating sound at great distance, allowing sound waves to travel further through the medium of air because "the walls of the tube reduced the loss of

11 Georgius Agricola, "Preface," in Agricola, *De Re Metallica*. Trans. Herbert Clark Hoover and Lou Henry Hoover (New York: Dover, 1950), p. xxix.

12 Ibid., p. 14.



energy from spherical action" [13] —that is, the increase in volume (or prevention of decay) of a given sound was accomplished through tectonic means. Even though many inventors can lay claim to the discovery of a means of telecommunication through a solid (as opposed to gaseous) medium well beforehand, the scientist, inventor, and entrepreneur Sir Charles Wheatstone deserves credit for picking up an often ignored observation from the preface to Robert Hooke's 1665 *Micrographia*. As Hooke boasted there, "I can assure the reader that I have, by the help of a *distended wire*, propagated the sound to a very considerable distance in an *instant*, or with as seemingly quick a motion as that of light, at least incomparably swifter than that which at the same time was propagated through the Air; and this not only in a straight line, or direct, but in one bended in many angles." [14] In the late 1820s, Wheatstone resuscitated these experiments in a sequence that would lead him to share in developing the first commercial electrical telegraph, in parallel with his ongoing research into the nature of sound as propagated via vibrations in the air.

After reproducing Hooke's experiments and devising his own, Wheatstone demonstrated that a "conducting-wire for transmission of sounds" could be attached to the sounding board of a musical instrument such as a piano-forte or a harp at a perpendicular angle, which would then transmit the sounds to a similar instrument via its sounding board at the other end. [f.4] Moreover,

"The sounds of an instrument may be at the same time transmitted to more than one place; ... it would be possible to extend a horizontal conductor through a series of rooms belonging to different houses, and (provided the instrument connected with one of its extremities be constantly played upon) to hear at pleasure the performance in any of these rooms, by merely attaching a reciprocating instrument to the conductor; on removing this instrument, the sonorous undulations would pass inaudibly to the next apartment." [15]

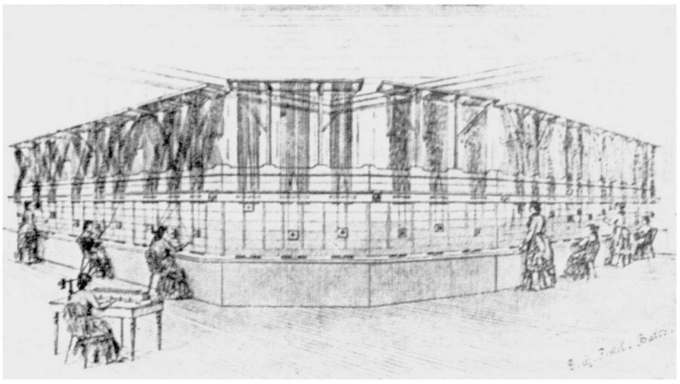
With this set of observations, the wired world was born, a mass media challenge to the primacy of print and other visual media (such as the optical telegraph), and Wheatstone was one of its most aggressive theorists. He noted that because

13 John E. Kingsbury, *The Telephone and Telephone Exchanges: Their Invention and Their Development* (London: Longmans, Green & Co., 1915), p. 7.

f.4 Sir Charles Wheatstone, "Conducting-wire for the transmission of Sounds," engraving, 1831.

14 Robert Hooke, *Micrographia; Or, Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses with Observations and Inquiries Thereupon* (London: Jo. Martyn and Ja. Allestry, 1665), n.p. Emphasis in original.

15 Charles Wheatstone, "On the Transmission of Musical Sounds through Solid Linear Conductors, and on their Subsequent Reciprocation," *Journal of the Royal Institution of Great Britain*, 2 (1831), pp. 223–38; here pp. 232–3.



f.5 "Multiple Switchboard at Baltimore," engraving, 1884.

sound travels roughly 17 times faster through "iron wire, glass, cane, or dealwood rods" than it does through the air, it would be "as easy to transmit sounds through such conductors from Aberdeen to London, as it is now to establish a communication from one chamber to another." All that was needed was a means of "communicating sounds produced in the air with sufficient intensity to solid bodies." [16] Microphones and amplifiers were some ways off yet, even if Wheatstone had developed the former device in a rudimentary way, but the conceptual organization of Wheatstone's experiments allowed for a full vision of communication from machine to machine over vast distances at high speeds.

16 Ibid., pp. 237–8.

The wired world, as even Wheatstone's interconnected musical instruments made clear, was one in which the relationship of architecture to telephony was inverted. Instead of serving as a direct means of bounding, reflecting, and projecting sound, architecture had to be penetrated by "solid media" of a different technical nature. A glance at a multiple switchboard from the 1880s is enough to carry the point for now: the intricate web of wires penetrates the architecture of the telephone exchange building according to its own logic, and requires the design of an interface at the scale of furniture in order to make it manageable for its female operators. [f.5]

In short, wires operated against the grain of the visual and spatial logic of architecture, and rearranged people and their activities. The tidy system of boundaries that Alberti prescribed to divide public from private, sacred from profane, and individual from family [17] —all of these would be called into question by a new method of delineation that would pass through architecture on a perpendicular axis. Nowhere is this more helpfully theorized than in one of the most famous texts on wiring, Adam Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations*. At the very outset of that treatise on liberal political economy, Smith famously called the reader's attention to the modern manufacture of a "very trifling" kind of thing, "but one in which the division of labour has very often been taken notice of": the pin.

17 Leon Battista Alberti, *The Ten Books on Architecture: The 1755 Leoni Edition*. Trans. James Leoni (Mineola: Dover, 1986), p. 2.

"[I]n the way in which this business is now carried on, not only the whole work is a peculiar trade, but it is divided into a number of branches, of which the greater part are likewise peculiar trades. One man draws out the wire, another straights it, a third

cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations; to put it on, is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, which, in some manufactories, are all performed by distinct hands, though in others the same man will sometimes perform two or three of them." [18]

Smith goes on, of course, to note that even a relatively limited degree of the separation of labor allowed these tradespeople, a factory of "ten persons," to produce 48,000 pins per day, when "they certainly could not each of them have made twenty, perhaps not one pin in a day." Therefore, Smith concludes proudly, "the effects of the division of labour are similar to what they are in this very trifling one." [19] Because of the division of labor, tradespeople became better at their more sharply defined tasks, time was saved, and machinery could be applied to the various piecework tasks. Q.E.D. What passes unnoticed by most readers of Smith, however, is that Smith's moralizing (remember that he and his university identified him as a moral philosopher, not a political economist) about efficiencies of labor, production, and exchange of manufactured goods is formulated through an obsessively woven and cut network of wires and threads. The pin may be a "trifle," but it is a very particular trifle, one worthy of a substantive entry in the *Encyclopédie* of Diderot and d'Alembert, from which Smith cribbed his facts. [20/f.6]

The irony that scholars have assumed dramatizes Smith's text is well known: look how simple the pin is; yet it requires such a complex aggregation of labor and technics to produce! But less often emphasized is another of Smith's conceptual and literary motives for narrating pin manufacture as the Trojan Horse of liberal capitalism. [21] The wire or its refined form as a pin is a connector, a *copula*: it holds things together in novel and temporary arrangements, as the linguistic or technical component that binds subjects to predicates in particular forms. [22] As such it provides a direct link to Smith's earlier writing in moral philosophy, in particular to his late addition to *The Theory of Moral Sentiments*: a "Dissertation on the Origin of Languages." There, Smith sought to bolster his arguments regarding the familiar concept of the "impartial spectator" by developing a theory about the distinction between ancient and modern languages. Ancient languages, per Smith, relied upon cases to define abstract relations between objects; modern languages, he argues, supersede ancient languages in one important way, which is that they supplant case with an increasingly vast array of prepositions:

18 Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (London: W. Strahan and T. Cadell, 1776), p. 6.

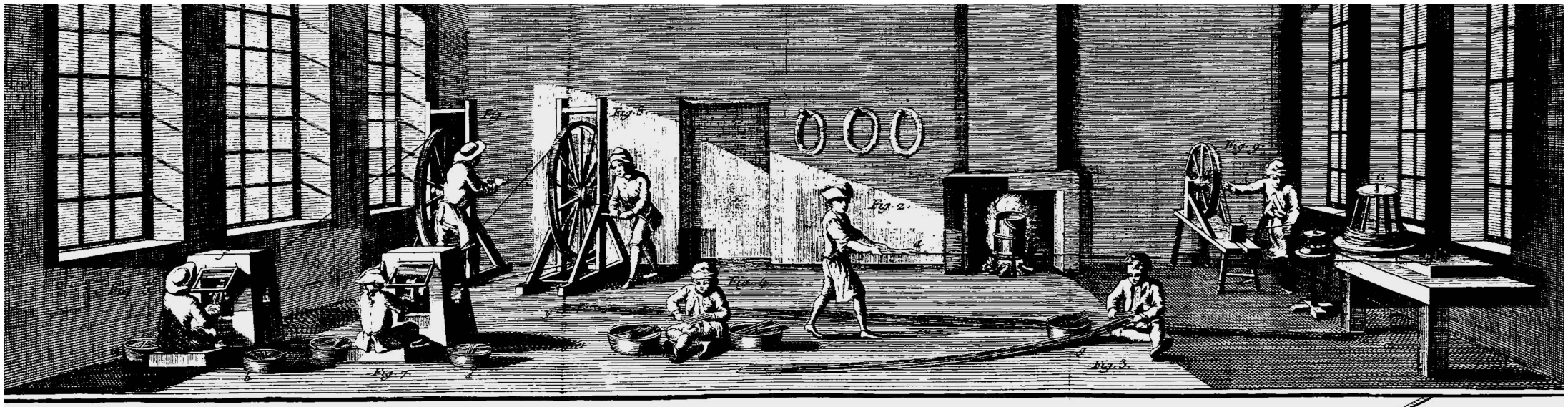
19 Ibid., p. 7.

20 "Épinglier," *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers: Recueil des planches*, 3rd ed. (Paris: Briasson, David, Le Breton, 1765), pp. 1–8.

21 For a decisive rereading of Smith's writings on political economy—so often considered in fragmentary and isolated form—in relation to his and others' writings in moral philosophy, see Mike Hill and Warren Montag, *The Other Adam Smith* (Stanford: Stanford University Press, 2015).

22 On the linguistic and syntactical theory of *copulae*, see Andrea Moro, *The Raising of Predicates: Predicative Noun Phrases and the Theory of Clause Structure*. Cambridge Studies in Linguistics, 80 (Cambridge: Cambridge University Press, 1997), esp. chaps. 1 and 4.

f.6 "Épinglier," *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers*, 1765. → 90/91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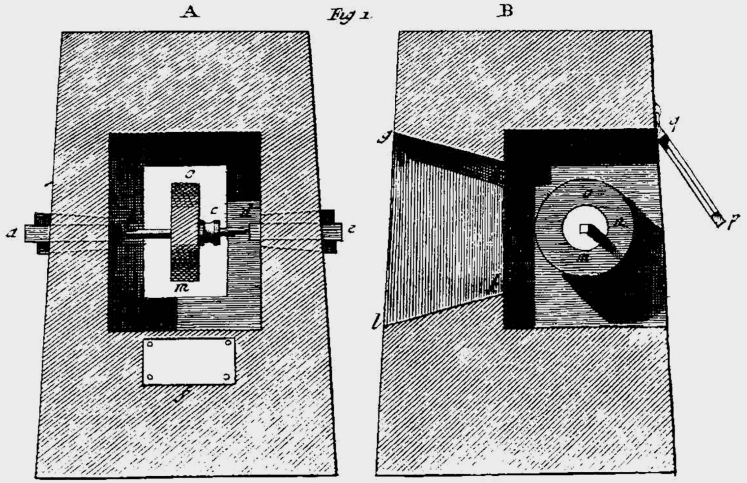
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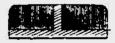
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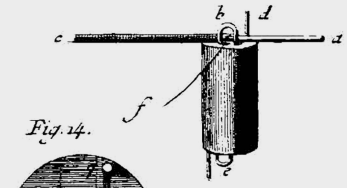
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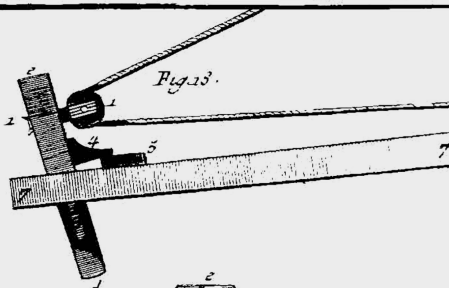
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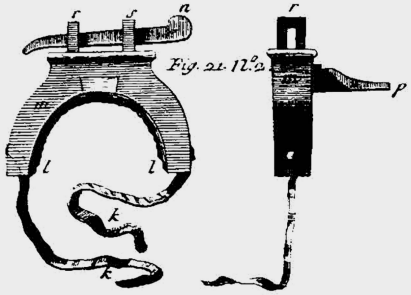
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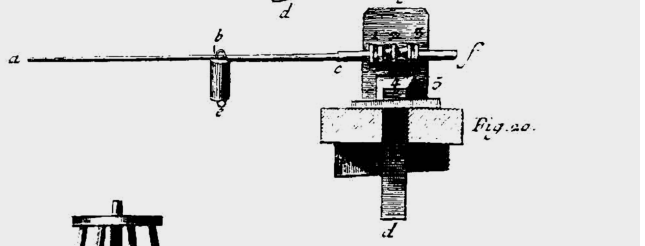
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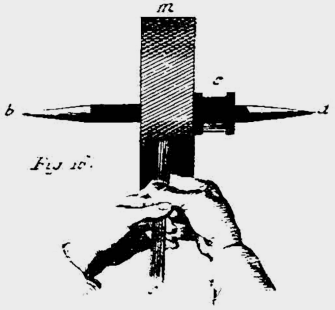
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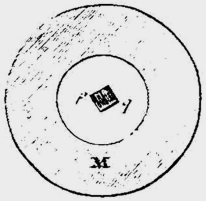
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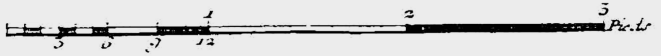
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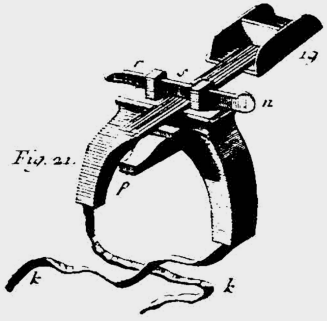
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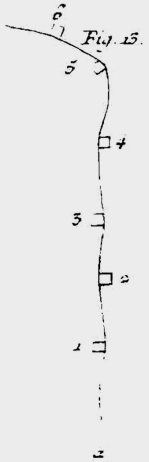
Fig. 19.

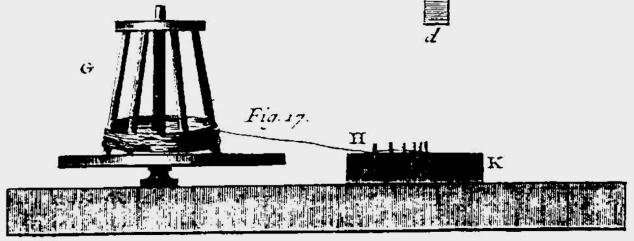
Fig. 17.

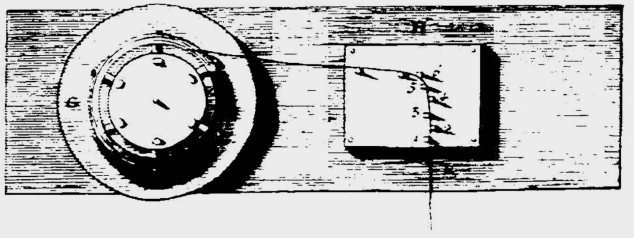
Fig. 17. N°2.

"A Preposition denotes a relation, and nothing but a relation. But before man could institute a word, which signified a relation, and nothing but a relation, they must have been able, in some measure, to consider this relation abstractedly from the related objects; since the idea of those objects does not, in any respect, enter into the signification of the Preposition. The invention of such a word, therefore, must have required a considerable degree of abstraction." [23]

Although I have no intention of embracing Smith's linguistic theory—certainly we cannot accept the notion that the novel invention of prepositions would be sufficient to the work of describing the complexity of modern technics—the value of his observations on language and his efforts to retheorize political economy as a matter of seemingly invisible interconnections is profound. What Smith asked his readers to rethink, in both the *Theory of Moral Sentiments* and the *Wealth of Nations*, was precisely the valedictory wave of the human subject as the crucial centerpiece, syntactical and productive, of history. Smith's theory of the *copula*—regardless of its diminished power to convince as a linguistic theory—anticipates the work of figures such as Barr and Johnson, Drexler, and their contemporaries, as they appealed not to a new form of abstraction adequate to the job of describing complex relations, but rather an archaizing form of abstraction that sought comfort in the mythic stability of the subject/object dyad; more importantly, it appears that a technical regime of description that would specify either through language or other cultural techniques the precise nature of the relations at stake was anathema to the arch-modernist and arch-capitalist curators of "industrial art." As Barr concluded his foreword in the catalog: "we must assimilate the machine aesthetically as well as economically. Not only must we bind Frankenstein—but we must make him beautiful." [24]

Insidious notions such as this are behind the baseless claims, made from the late nineteenth century onwards, that electrical technologies are transforming our cultures from "wired" to "wireless," that machines are becoming "dematerialized," that we live in a "network society," and so on. But if one regards the wire, not as an object but as a prepositional function within a very decidedly material but rapidly changing apparatus, it becomes plain that it is necessary to change our grammar and syntax in art and architectural history. Radio, the so-called first (and enduring) "wireless" medium, in fact required an amount of wiring an order of magnitude greater than the geographically scaled telegraph and telephone networks. [25] The miniaturized personal computer is but an interface for massive, nearly urban

23 Adam Smith, "Considerations Concerning the First Formation of Languages, and the Different Genius of original and compounded Languages," in Smith, *The Theory of Moral Sentiments: To Which Is Added a Dissertation on the Origin of Languages*, 3rd ed. with dissertation (London: A. Millar, A. Kincaid and J. Bell, 1767), pp. 437–78; here p. 449.

24 Barr and Johnson, *Machine Art* (see note 2), n.p.

25 For the best theoretical consideration of radio yet published, see Rudolf Arnheim, *Radio*. Trans. Margaret Ludwig and Herbert Read (London: Faber & Faber, 1936).

scale architectural enclosures filled with even more wires. And the wires themselves are the site of extraordinary conflicts and manipulations: whether discussing the viability of something called "neuroaesthetics" as a means for figuring out how we are "wired," or the creation of miles-long loops of wire to delay a competitor's efforts to purchase derivatives, what is certain is that there are people for whom much is at stake in preserving the invisibility of wires. **26**

26 The wire, in fact, is the "smoking gun" in a recent work of popular non-fiction: a small box containing 38 miles of wires surreptitiously installed by investment bankers in a rival's telecommunications apparatus in order to slow and interrupt his ability to trade in "real time." See Michael Lewis, *Flash Boys* (New York: W.W. Norton & Co., 2014). For an excellent scholarly analysis of the geopolitics of wiring and cables, see Nicole Starosielski, *The Undersea Network* (Durham: Duke University Press, 2015); and for a more theoretically driven examination of the "materiality" of the "medium of mediums" that "bind the world," see Daniel Gethmann and Florian Sprenger, *Die Enden des Kabels: Kleine Mediengeschichte der Übertragung* (Berlin: Kadmos, 2015).