

# Walk This Way: The Aesthetics of the Modern Flow Diagram

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## Facticity

The diagram, inhabiting a liminal space between word and image, is often considered a “transparent thought.” This presumes the nature of a diagram has no impact on its meaning and that diagrams somehow achieve the impossibility of a pure, unmediated idea. Nelson Goodman, distinguishing the “repleteness” of drawings from the “attenuation” of diagrams, suggests aspects of diagrams such as line weight carry no meaning.<sup>1</sup>

Toward the end of the nineteenth century, the diagram was accepted as a solution to the unending search for a universal language. Etienne-Jules Marey advocated the “graphical method” to produce images that were the “language of the phenomena themselves.” A German colleague of Marey’s concluded in 1895: “As modern civilization is impossible without railway lines, the telegraph and the telephone, so today research... is inconceivable without the use of the graphical method... Now mere assertion could no longer suffice, one wanted to see it *supported by a curve*.”<sup>2</sup> As the diagram became emblematic of scientific authority, architecture, emulating science to stake out its disciplinary status in the modern world, took up the diagram as well.<sup>3</sup> The factual scientific diagram was introduced in architecture in the early twentieth-century and promoted a (self) perception of the architect as having specialized tools for revealing objective facts. This modern view of the diagram as empirical fact probably developed in part from self-inscribing devices where the phenomenon itself caused marks to be recorded. Only after the middle of the nineteenth century did graphs become commonplace in scientific research. Prior to this time, they were derided as “useless play of the imagination.”<sup>4</sup>

This analysis of early modern flow diagrams will challenge the factual view by considering diagrams as active agents in generating and communicating ideas and visual expressions. If the flow diagram is not merely factual, how does this so-called “attenuated” drawing reserve a place for expressiveness that has aesthetic or rhetorical value? Was this understanding present in the early development of the architectural flow diagram?

## Scientific Management Diagrams

The substantial influence of scientific management on the development of modern architectural thought in the early twentieth century is well rehearsed. Scientific management separated planning from producing to identify the “one best way” to most efficiently complete a task. Influences on architecture include ideas about function and standardization, and representations

such as flow diagrams. Closer consideration, however, reveals a gap between scientific inquiry, Frederick Winslow Taylor, the father of scientific management, established efficiency standards for manufacturing tasks using a stop-watch and tabular recording of worker’s movements. Taylor’s “time studies,” substituting a stopwatch for his eye, were based more in time than space. Taylor’s primary concern was an individual worker’s task rather than a total production flow probably because Taylor began as a foreman in manufacturing. In Taylor’s approach, once each individual’s task was scientized into the “one best way,” they were simply combined. The material flow between workers was determined with a “routing,” “route,” or “routine” diagram. (insert Figure 1 here)[Fig. 1. Earliest Example of Taylor Route Chart (1896).] Taylor’s route chart, an influential model for many years, lacks any direct relation to the spatiality of work flow.<sup>5</sup> It represents neither actual nor ideal movement of workers or materials in space, but only the sequence of part assembly.

Henry Gantt, influential in applying scientific management to social issues, became particularly well-known for the “Gantt Chart.” (insert Figure 2 here)[Gantt Progress Chart (1919).] Gantt proposed “progress charts” to solve social ills through the ability to compare a myriad of information. Yet, progress charts were only simple bar charts with time as the x axis. Gantt’s charts were no advance for spatial imagination. Frank Gilbreth, who began an engineering career as a concrete contractor, together with his wife Lillian Moller Gilbreth, a pioneer of management psychology, were students of Taylor. The Gilbreths developed “motion studies” and were critical of Taylor’s time studies. Their much more spatial “process charts” were presented, however, as a novel innovation at the relatively late date of 1921.<sup>6</sup> (insert Figure 3 here)[Gilbreths’ Process Chart for Loading Rifle Grenades (1921).] Although separate from scientific management, another potential highly influential source of industrial “flow” thinking on architecture was Henry Ford. “Fordism” used assembly lines to achieve mass production and simultaneously increasing worker’s income while reducing production costs to create a large market for a standardized product.

Surprisingly, in the development of the assembly line, the flow diagram is invisible. Whatever the actual role of diagrams, the primary histories and first person reports read by architects throughout the USA and Europe give no significance to drawings in the development of the assembly line. Although there are many photos of interiors, there are no published diagrams. Ford himself seemed to prefer to work with actual mock-ups

rather than drawings.<sup>7</sup> If the primary flow diagrams of scientific management were not merely copied by architects, then what were their sources and do they reveal the diagram as expressive rather than merely factual?

## Aesthetics

Application of scientific management principles to the home was undertaken by women who experimented in their own homes. Christine Frederick's *The New Housekeeping, Efficiency Studies in Home Management* (1913), with frequent editions and several translations, achieved immediate and widespread success. Perhaps a key reason Frederick was so successful is that she alone grasped these new ideas in a diagram.<sup>8</sup> (insert Figure 4 here)[Frederick's Diagram of Badly and Efficiently Grouped Kitchen Equipment (1913).] In Germany, it was of such interest to architect Bruno Taut that he reproduced Frederick's diagram in *Die Neue Wohnung*. This flow diagram captured architects' functional imagination because for perhaps the first time, the focus is spatial relations. Frequent republication of Frederick's diagram in historical surveys has made her image iconic, a highly persuasive visual catch-phrase associated with functionalism but rarely critically examined. In the following close reading of the diagram, I hope to demonstrate how visual comprehension is an important aspect of architectural scholarship and in this case, provides insight into overlooked meaning that is the result of an expressive diagram.

The diagram compares poor and improved kitchen organization to achieve efficiency with rearranged equipment in the same room. The kitchen is represented as a separate entity isolated from the remainder of the house. Only functional adjacencies to other spaces are implied with partial cell and dining rooms. This is consistent with Frederick's purging of any use of the kitchen except for "preparation of food." Removing unrelated equipment and activities such as "lounges, flowers, and sewing" puts each activity in its own place and ostensibly makes them more effective. Frederick explains the diagram as follows: "I have drawn two diagrams which show the making of an omelet under two arrangements of equipment. One is a steady track from icebox to dining-room; the other is a crossing and recrossing like the tracks of a hound after a hare." It is evident by inspection that the improved arrangement has shorter total line length than the poor arrangement. However, her argument is not primarily the total length of line traversed. The lack of a scale indicates little emphasis on actual distances. Frederick's concern is "crossing and recrossing" which is compared to a bestial pursuit of food without rational thought and contrasts iconographically with the cooking of an egg. Of course, the intersecting lines cause no physical interruption in food preparation since the omelet-maker can't bump into herself. As an expressive, rather than factual diagram, the inferior arrangement shows straight lines awkwardly hitting each other at obtuse angles while the preferred employs curves to gracefully connect straight lines. The "proper" arrangement restricts itself to right- and forty-five-

degree angles, along with a piano curve. The bad arrangement even shows the line crashing through the wall to enter the living room. The diagrams are generally in scaled relation but the dining table is exceedingly diminutive. Its size seems to be determined by the width of the door so the improved arrangement can have straight lines curve around the table in a semicircle. Since the serving cart Frederick advocates could not follow either path, the line does not represent actual movement. The dining table is presented as a service loop, a pulley connecting the A and B threads in machinic harmony. The location of the table in the first arrangement is centered in the room following tradition rather than the second arrangement where it is so near the kitchen door that it impedes the swing. While the accuracy of her particular diagram is not my interest (I am neither trying to improve upon her scientific management nor critique it), it is important to note that steps left out of the improved arrangement would make the efficient solution appear more like the "crossing and recrossing" of the inefficient plan. For example, washing hands at the sink prior to cooking and taking dishes out to set the table. The reason, I believe, for all these inconsistencies which often go unnoticed is that the diagram does not represent so much "the one best way" to prepare a meal as it promulgates a certain aesthetic. Mary Douglas's important study of dirt revealed that there is no absolute, measurable standard of cleanliness; that dirt is "matter out of order," an aesthetic judgment based on community propriety.<sup>9</sup> Frederick's contribution in this light is not an absolute improvement in scientific kitchen operations, but demonstrating a new aesthetic sensibility of cleanliness. Bullnose corners, like Frederick's curves to join straight lines in her diagram, was visually popular and kept dirt out of corners. In Frederick's dashed line appear the forms of many modern house interior partitions. The diagram provides "evidence" more at the level of its aesthetic representation than as a record of scientific truth.

All the lines of the diagram whether wall, equipment, or movement are drawn in the same line weight. Rather than reducing expressiveness, it is a particular expression of clarity. A line at this time is often defined as a continuous flow, a gliding point. At the Bauhaus, Paul Klee described the line as a point "going for a walk" and Kandinsky explained line "is the trail left by the point in motion." Line is now in itself, in its very essence, movement. Le Corbusier recommended that a designer ought to "acquire the habit of strolling with one's pencil, step by step."<sup>10</sup> The line of "step-taking" in Frederick's diagram is dashed rather than solid. Dashed lines are a measure of marking, stepping, a stride. Consistent lengths of dash and space (expected of a competent draughtsman) are a measure of space and time. This is the very basis of Marey's graphic method: "As the pen comes in contact with the paper it leaves its record in the form of 'dashes' of various lengths; and by this means the sequence and duration are registered. If the "dashes" are equidistant, it means that the periods of contact follow one another at equal intervals of time."<sup>11</sup> (insert Figure 5 here)[Marey's comparison of simple and chronophotographic trajectories and chronographic record of

four walking paces (1894).] The dash enables Marey to measure movement by simultaneously recording space and time. This regulated movement of the line certainly doesn't lack expressiveness."

Alexander Klein was a German architect leading development of the flow diagram. Klein applied Marey's graphical methods to housing design. "The graphical method of analysis differs from former [subjective] methods of plan-valuation: [in that] the qualities of the plan can be determined in an objective and clear manner."<sup>12</sup> Catherine Bauer enthusiastically included Klein's diagram "Functional House for Frictionless Living" in her well-known 1934 book, *Modern Housing*. (insert Figure 6 here)[Klein's Diagram as it appeared in Bauer (1934).] The inferior and improved plans are presented above the flow diagrams as if portraits, showing the complex reality of building, while the flow diagrams below act as x-rays, revealing underlying conditions that allow "objective" evaluation. Robin Evans queried why unexpected encounters among family are cause for unpleasant "friction"?<sup>13</sup> The use of "friction" for human movement recalls the machinic metaphor of scientific management. Like Frederick, while Klein's argument is grounded in scientific management, his drawing is an aesthetic vision. Klein furthered Frederick's argument in claiming that abrupt turns are fatiguing. Klein even extended his study from physical to aesthetic exertion. He argued that unsystematically arranged areas interrupt free space and cause psychic exhaustion through disturbing the occupant's nervous system. While Klein justified flow diagrams as factual, he nevertheless used them in an expressive manner.

Like the concept of architectural circulation, the appearance of flow lines as physical movement on architectural plans is relatively recent.<sup>14</sup> Diagrammatic flow techniques were popularized in architectural journals such as *Architectural Record's* 1937 "Look to the Flow Analysis for Effective Solutions."<sup>15</sup> These diagrammatic techniques were promulgated as "standard" professional practice in planning handbooks such as *Time Saver Standards* emerging in the 1930s and through numerous editions are still found in every architectural library.

## Mundane Ideal

Alexander Klein traced the modern flow diagram of human movement as evolving from the ideal Renaissance axis.<sup>16</sup> He lamented the loss of the Renaissance axis but also criticized those who merely imposed that approach on the changing lifestyles of the twentieth century. Klein equated ideal neoplatonic lineaments suggesting a hierarchical movement toward the divine with the mundane physical patterns of bodily movement. The modern flow diagram was thus presented as the inevitable result of the great architectural tradition. Yet, in architectural design, the flow diagram is never merely the recording of footsteps since it is necessarily a future projection. If not the simple facts of movement, what precisely is being made visible by the dashed line of the flow diagram and what is its

significance?

George Howe was one of few who wrote theoretically on the flow diagram. While dissolving his partnership with William Lescaze that resulted most notably in Philadelphia's PSFS building, Howe experimented with flowing space in house design and its representation in plan. For "Square Shadows," the William Stix Wasserman house (1934), Howe explained that "the lines of human circulation on the plans are curvilinear axes of actual movement which replace the old rectangular axes of theoretical movement."<sup>17</sup> (insert Figure 7 here) [Plan of Square Shadows with curvilinear lines of actual movement by Howe (1940).] He clearly distinguished between two sorts of axes yet in the drawing inverts the curvilinear lines of "actual movement" as invisible and the rectilinear walls as materially actual. The single overlap between flow diagram and physical building is the spiraling entrance 'stair. Howe described the essence of this room as the "sense of passing through" suitably making this room the key to invisible curvilinear flow lines. The ideal of flowing is manifested not only in the curving form but in the stair's construction. This innovative design used the handrail as structure, making the stair literally float. In "Flowing Space" (1949), Howe contrasts ideal space (man's image of the cosmos) and real space (economic).<sup>18</sup> Acknowledging the dominance of diagrams, he suggests that today "the very life of social man has come to be projected graphically along curves of probability." Referring to Heraclitus, Howe notes the idea that all is in flux is now a fact. Flows of people and equipment are essentially the same: "flow of traffic, flow of production, flow of people." Bidding farewell to Janus as guardian of the threshold, Howe notes that since flowing space cannot be enclosed, only "directed," the oak door has given way to clear plastic. The ideal space of the imagination is, according to Howe, one with real space. It is unclear if this implies that ideal is reduced to real or that both exist simultaneously. The contrast in his diagram between flow and wall may suggest the later. In any case, the "actual" flow of people is identified by Howe with ideal space and curvilinear in form. For Howe, the "functional" unlike the "traditional" designer inaugurates ideal space. His flow diagram is explicitly not reductive but expressive.

While Bruno Taut reprints and develops Frederick's diagrammatic approach to home design, he also emphasizes that "Americanization" must be avoided. For Taut this meant avoiding treating architecture as merely a utilitarian or remunerative consideration.<sup>19</sup>

Taut's plan for his own house reveals this sensibility in his use of three distinct dashed flows. (insert Figure 8 here) [Plan with lines of movement by Taut (1926).] A straight line with long dashes suggests a visual, metaphysical movement to the sun and the earth that organizes the primary volume of the building but only primary shared rooms in the interior. A dotted line suggests movement of food from refrigerator, looping out to touch the table, and returning to the sink as a beautiful spiraling form. An intermediate line of short dashes with straight segments joined by curves suggests human habitation as movement

from garage to bathroom (equipmentally from car to sink) and implies a relation with the exterior service wing and interior partitions. The same line is used for a folding kitchen counter. While Taut's intentions are unclear, it seems to imply that American equipmentalization is held distinct, yet in-between the more public straight line and the sensuous appetitive line.

In design, "flow" is necessarily a projected a future state. It is of course, impossible to determine how people will actually move at any time since individual tactics may violate planning strategies.<sup>20</sup> The lines drawn in plan seem to have been intended to project an imaginary future habitation as an ideal life with\_in the physical world. In this sense, the lines may have more to do with the projective geomancy of dots in sand than scientific determinism. When Bruno Taut advised that "residential habits should be observed and gradually improved so that family life can proceed without the slightest friction and disturbance," he demonstrated how in the modern world an ideal aesthetic became coincident with the mundane real world.<sup>21</sup> I suggest that the diagrams participate in "scientific" facticity as metaphorically representing human movement, but actually remain imaginary states now conflated with physicality.

Despite the widespread acceptance of functional diagrams as a presentation of reductive empirical facts and the suspicion that modern flow diagrams attempt to mold everyone to "walk this way," I have shown instead that through the rhetoric of scientific management, architects created a modern aesthetic which was intended to be present in the everyday. My aim in this work is not for another criticism of functionalist architecture, nor for how to advance functionalism. Instead, I attempt to demonstrate that as Heraclitus reputedly said in his (inefficient) kitchen: "There are gods present even here."<sup>22</sup> Within the complex set of notions clustering around the word "function" the mythic also resides. In even the most mundane habits of life, there is always already an excess beyond mere function that spills over into the expressive and meaningful. Within the flow diagram can emerge a round dance that is magically real.

#### NOTES

- <sup>1</sup> Nelson Goodman, *Languages of Art* (Indianapolis, Indiana, 1968) 229-30. For a similar argument in the field of art history, see James Elkins, *The Domain of Images* (Ithaca: Cornell University Press, 1999). On facticity, see Martin Heidegger, *Ontology: The Hermeneutics of Facticity* (Indiana University Press, 1999).
- <sup>2</sup> Etienne-Jules Marey, *La Methode Graphique Dans Les Sciences Experimentales et Particulierement en Physiologie et en Medecine* (Paris, 1878) vi. Lorraine Daston and Peter Galison, "The Image of Objectivity" *Representations*, 40 (Fall 1992) 81-128. T. Beer, "Carl Ludwig" *Wiener klinische Wechenschrift* 8 (1895) 354, quoted in Soraya de Chadarevian, "Graphical Method and Discipline: Self-Recording Instruments in Nineteenth-Century Physiology" *Studies in the History and Philosophy of Science* 24 (1993) 273.
- <sup>3</sup> Hyungmin Pai, *From the Portfolio to the Diagram: Architectural Discourse and the Transformation of the Discipline of Architecture in America, 1918 - 1943*. (Cambridge: MIT Ph.D. Dissertation,

1993). Significantly, Christopher Wren is credited with inventing the first self-recording device, probably influenced by Vitruvius' tenth book. Laura Tilling, "Early Experimental Graphs" *British Journal for the History of Science* 8 (1975) 195-6.

- <sup>4</sup> Jacques Peuchet, *Statistique elementaire de la France* (Paris, 1805) 33 quoted in H. G. Funkhouser, "Historical development of the graphical representation of statistical data" *Osiris* 3, Pt. I (1937) 295.
- <sup>5</sup> Taylor expended little effort on the route chart and did not publish them. The route chart included here was published by Hathaway. Frederick W. Taylor, *Scientific Management* (New York: Harper, 1911). H. K. Hathaway, "Control of Shop Operations" in *Scientific Management in American Industry. The Taylor Society*, edited by Harlow S. Person (New York: Harper, 1929) 357.
- <sup>6</sup> Henry Gantt, *Organizing for Work* (New York: Harcourt, 1919). Frank Gilbreth and Lillian Moller Gilbreth, "Stop-Watch Time Study: An Indictment" *Bulletin of the Taylor Society*, 6 (June 1921) 99-135; and *Process Charts, First Steps in Finding the One Best Way to do Work* (New York: American Society of Mechanical Engineers, 1921).
- <sup>7</sup> Henry Ford, *My Life and Work* (Garden City, NY: Garden City, 1922). Allan Nevins, *Ford. The Times, The Man, The Company* (New York: Charles Scribner's Sons, 1954). Charles Sorenson, *My Forty Years with Ford* (New York: W.W. Norton, 1956). Horace Arnold, "Ford Methods and the Ford Shops" *Engineering Magazine* 47 (1914) 1-26. David Hounshell, *From the American System to Mass Production 1800-1932* (Baltimore: Johns Hopkins University Press, 1984).
- <sup>8</sup> Christine Frederick, *The New Housekeeping. Efficiency Studies in Home Management Garden City* (New York: Doubleday, 1c913); *Household Engineering: Scientific Management in the Home. A correspondence Course on the application of the principles of efficiency engineering and scientific management to the every day tasks of housekeeping*. (Chicago: American School of Home Economics, 1915, 1919). The later adds many new and more developed diagrams.
- <sup>9</sup> Mary Douglas, *Purity and Danger. An analysis of concepts of pollution and taboo* (London: Routledge, 1966) 2. The aesthetic quality of Frederick's diagram is easily perceived when compared with a very similar diagram without the same aesthetic pursuit such as phrenologist Osgood Fowler who used dashed lines to show the benefits of octagonal houses in reducing walking distances. Orson Fowler, *The Octagon House. A home for all* (New York: Dover, 1973 reprint of 1853 edition) 98.
- <sup>10</sup> Paul Klee, *Pedagogical Sketchbook*, translation by Sibyl Moholy-Nagy (London: Faber, 1953) 16. Kandinsky, "Point and Line to Plane. A Contribution to the analysis of pictorial elements" (1926) in *Kandinsky Complete Writings on Art*, edited by Kenneth C. Lindsay and Peter Vergo (New York: Da Capo, 1994) 572. The idea of the point in motion generating a line is presented by Aristotle, *De anima* I, 4, 409 a 4. Le Corbusier, *Precisions on the Present State of Architecture and City Planning with An American Prologue, a Brazilian Corollary, followed by The Temperature of Paris and the Atmosphere of Moscow*, translated by Edith Aujame (Cambridge: MIT Press, 1991) 132.

- <sup>11</sup> Etienne-Jules Marey, *Movement*, translated by Eric Pritchard (New York: Arno, 1972) 4, 54-55. Etienne-Jules Marey, *Le Mouvement* (Paris: 1894).
- <sup>12</sup> Alexander Klein, "Judging the Small House" *Architectural Forum* 55 (August, 1931) 166.
- <sup>13</sup> Robin Evans "Figures, Doors, Passages" in *Translations from Drawing to Building and Other Essays*, (Cambridge: MIT Press, 1997) 55 - 92.
- <sup>14</sup> Adrian Forty, "Spatial Mechanics: Scientific Metaphors in Architecture" in *The Architecture of Science*, edited by Peter Galison and Emily Thompson (Cambridge: MIT Press, 1999) 213-231. Eugene-Emmanuel Viollet-le-Duc, *Lectures on Architecture* (New York: Dover, 1987) Vol. II 277-278.
- <sup>15</sup> *Architectural Record*, 82 (Aug. 1937) 107. Later articles applied industrial techniques to other building types: "Apply Factory Technique to Office Planning" *Architectural Record*, 82 (Dec. 1937) 113S.
- <sup>16</sup> This argument is made both visually and in the text. Alexander Klein, *Das Einfamilienhaus Sudtyp. Band I*. (Stuttgart: Julius Hoffmann, 1934).
- <sup>17</sup> George Howe quoted in James and Katherine Morrow Ford, *The Modern House in America* (New York: Architectural Book, 1940) 61. Although the stair is usually a focus of discussion about the house, this interpretation has not to my knowledge been previously offered.
- <sup>18</sup> George Howe, "Flowing Space: The Concept of Our Time" in *Building for Modern Man. A Symposium*, edited by Thomas Creighton (Princeton: Princeton University Press, 1949) 164-169.
- <sup>19</sup> Bruno Taut, *Modern Architecture* (London, 1929) 133.
- <sup>20</sup> On the differing lines of tactics and strategy, see Michel de Certeau, *The Practice of Everyday Life*, translated by Steven Rendall (Berkeley: University of California Press, 1984) xviii.
- <sup>21</sup> Bruno Taut, *Die Neue Wohnung, Die Frau als Schopferin* (Leipzig: Klinkhardt, 1926) 107f; partially translated in Bruno Taut, "The New Dwelling: The Woman as Creator" in *The Weimar Republic Sourcebook*, edited by Kaes Dimendberg and Martin Jay (Berkeley: University of California Press, 1994) 462. For a similar interpretation of Taut's work generally, see Iain Boyd Whyte, *Bruno Taut and the Architecture of Activism* (Cambridge: Cambridge University Press, 1982).
- <sup>22</sup> Martin Heidegger, "Letter on Humanism" in *The Existentialist Tradition: Selected Writings*, edited by Nino Langiulli (New Jersey: Humanities Press, 1981) 238.