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Abstract *The concept of the diagram has a rich history in many theoretical disciplines as well as in applied practices. This essay suggests that a dialogue between theory and practice can be used to explore the potential of digital platforms for developing an approach to writing and display that takes advantage of the semantically constitutive effects of format features. This approach would borrow from manuscript conventions, as well as those of print, and combine them with the specific affordances of newer media. In development of such an approach, and such a discourse, this article pursues a critical, descriptive language of the rhetorical effects of spatial relations that addresses graphical features (juxtaposition, hierarchy, interlinearity, proximity and so on) and their capacity to produce semantic value.*

Keywords Diagrams, format, layout, graphic features, page design, gestalt

The study of diagrams crosses many disciplinary lines: it plays a major role in twentieth-century philosophy, in the longer history of logic and mathematics, in the lineage of graphic forms in visual culture, and in applied practices. In philosophy and logic, the discourse of diagrams has an elaborate theoretical apparatus that engages questions of knowledge, representation, mathematical logic, and epistemological paradigms. In visual culture, the history of diagrams can be tracked to antiquity - to the design of schematic structures of knowledge modelling for accounting, geometry, architecture, astronomy, cartography and other fields that merge with practical arts. In applied fields, diagrams abound, never more abundantly than now, when information visualisations and visual schema proliferate. Yet explicit discussion of the ways diagrams work, and how their graphical organisation structures the relations on which meaning and knowledge are produced, whether as logical principles or as rhetorical devices within more applied domains, is conspicuously absent from codification in any systematic way. For those seeking a connection between the philosophical interrogation of relations and the applied domain of knowledge modelling and design, no explicit links or bridges exist. Hence, I will briefly sketch the condition on which this aporia exists, and some of the means by which it might be addressed, in order to proceed to my central concern with designing environments for digital writing practices that extend the capabilities and rhetoric of print realms through new affordances and media specific possibilities.

In the domain of philosophy, the legacy of Charles Pierce looms large in the theory of diagrams. His studies of logic as semiotic took the notion of sign

1. Sun-Joo Shin, *The Iconic Logic of Peirce's Graphs*, Cambridge, MA, MIT Press, 2002.

2. John Sowa, *Knowledge Representation: Logical, Philosophical, and Computational Foundations*, Pacific Grove, CA, Brooks Publishing Company, 2000.

3. Frederik Stjernfelt, *Diagrammatology: An Investigation on the Borderlines of Phenomenology, Ontology, and Semiotics*, Heidelberg, Springer, 2007.

4. Martin Gardner, *Logic Machines and Diagrams*, NY, McGraw-Hill, 1958.

relations as a fundamental principle, and though he used the word *graphs* to describe the visual formats in which he worked systematically, his work has been used by more recent philosophers, notably Sun-Joo Shin, as the basis of diagrammatic reasoning.¹ As a philosopher, Peirce was concerned with basic questions about the ways knowledge formations come into being and how the structural properties of relations among signs give rise to various potentialities for representing and understanding. This emphasis on relations is key to diagrammatic thinking in all domains. The notation system Peirce devised for his existential graphs was idiosyncratic, but relational principles at its core play a role in the interrogation of the apperception of knowledge. Peirce's semiotics focused on the grounds of knowledge production, rather than on knowledge produced. His work operates at a level of abstraction that often eschews connection to the study of literal graphical forms, though knowledge modelling and graph theory adapted in part from Peirce's work are central to the thinking of John Sowa and other computer scientists who use conceptual graphs as a key part of their intellectual approach to knowledge representation.² Semiotician Frederik Stjernfelt termed his crucial study *Diagrammatology*, putting the concept at the centre of his analysis of Peirce's writings on continuity, icons, relations, and the implications of these principles for biosemiotics, picture theory, and other fields.³ Diagrams, therefore, have a privileged and specialised status in the philosophical domain, as a set of organizing precepts and principles of a semiotic approach to epistemology.

In the fields of logic and mathematics, graphical forms of expression as means of manipulation, hypothesis testing, and proof creation play a substantive role in carrying out procedural and analytic operations. The notable historian and mathematical puzzle-maker, Martin Gardner, made a unique milestone contribution to the study of this activity in his *Logic Machines and Diagrams*, one of the few works focused exclusively on the topic.⁴ Gardner describes diagrams as drawings that work, that do things, thus distinguishing them from mere representations or static images. By 'work' it should be clear that Gardner does not mean 'move' in a literal sense, but rather, a sustained engagement in knowledge production by dynamic figures that operate relationally rather than representationally. The elements of a diagrammatic system create value in relation to each other, not as an image of or stand-in for something else. The point is close to the distinction between knowledge producing forms and the formal representation of knowledge that characterises Peirce's semiotics. The ways diagrams work and the things they do depend on the circumstances, of course, and the *volvelles* and combinatoric wheels of the medieval logician Raymon Llull operate on very different principles than the diagrams of the nineteenth century mathematician, John Venn. But in both instances, the men relied on graphical forms to perform their intellectual inquiries, not merely to express results. The diagrammatic forms were literally engaged in the operations, not functioning as figurative abstractions to depict logical relations or principles.

This notion of ‘drawings that work’ is the leitmotif in a recent study by John Bender and Michael Marrinan, *The Culture of Diagram*, an examination of the role of diagrammatic expressions in eighteenth century France.⁵ While their analysis may depend too heavily on an insistence that the Enlightenment was the crucible for diagrammatic thinking, they nonetheless make important connections between graphical forms and textual ones, engaging in a reading of the tree structure of the ‘Table de Matières’ of the *Encyclopédie* of Jean le Rond d’Alembert and Denis Diderot as a diagram. Such tree forms have a history that stretches into antiquity (they were used for knowledge organisation long before the French *philosophes* appropriated them for rational purposes), but the recognition that semantic value is carried by textual structures - layout and format features - is a crucial principle for the larger study of the diagrammatic properties of other examples of written language. Indeed, Bender and Marrinan provide a nice segue from the abstractions of semiotics to the grounded study of cultural activity. While they are intent on describing an intellectual formation with historical specificity, they also gain traction through critical engagement with visual artefacts whose formal properties matter to their analysis - things made and thought as graphical objects. Tree structures express relations of derivation and hierarchy through their relations, not as a picture of a pre-existing image or form. The value of any particular term in the hierarchy depends on where it sits in relation to the whole as well as to each other element. A table of contents can also be considered an example of diagrammatic writing, a form whose capacity to produce meaning is fundamentally dynamic and generative, not static and representational. Its relation to meaning is not fixed, but provocative and performative. Position, placement, and sequence are all graphically coded features that constitute semantic value.

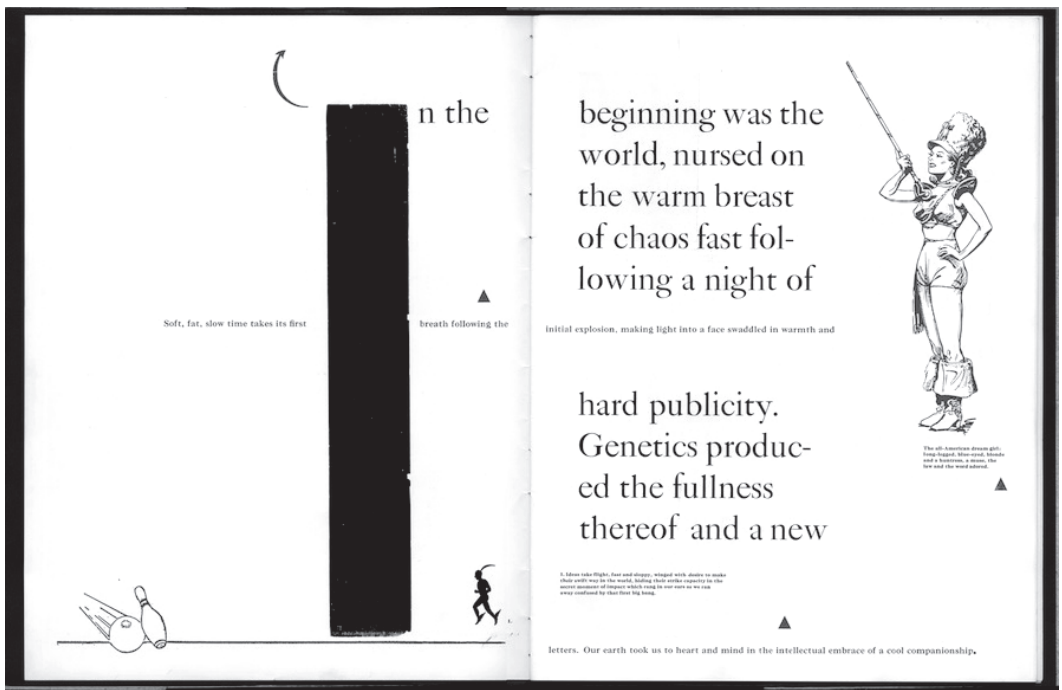
In our descent from abstraction to concrete artefacts, the final step is to go yet further than the art historians and move into an analysis of bibliographical and graphical objects. While no explicit articulation of ‘diagrammatic writing’ exists in the annals of the printing trade or graphic design manuals, twentieth-century textbooks on the ‘language of visual form’ are filled with expertise based on its principles. Layout, composition, and conventions of textual meaning-production are well understood in the design trade, but they are taken as heuristics, not as hermeneutics. This distinction is important, because I would argue that *the acts of making that form the basis of production are grounded in poetic expression and rhetorical argument rather than logic*. The conventions that code written texts through graphical means, separating headers from footers, paragraphs from each other, marginalia from footnotes, and other elements of texts and paratexts, are not governed by logical rules. Now, with the multi-dimensional potential of digital displays and interface, many new possibilities exist for extending the spatial organisation of written texts and the relations they embody. Developing a critical, descriptive metalanguage for graphical forms goes along with creating conventions and codes for

5. John Bender and Michael Marrinan, *The Culture of Diagram*, Stanford, Stanford University Press, 2010.

their design and implementation. The diagrammatic structures of written argument are not limited to trees and graphs, but are as varied as the many visual presentations of information in any graphical interface.

So the question ‘What is a diagram?’ can be answered differently depending on the disciplinary context: within a highly specialised debate, subject to esoteric considerations and reflections on epistemology; or in the vernacular realm, gesturing to a loosely defined but recognisable array of visual forms. All are relevant to this essay, which asks how written language provides semantic value in the very scaffolding of its graphical structure. The vernacular notion of a diagram - as a schematic graphic image that models knowledge relationally - has a resonance with Peirce’s concept of semiotic structures of sign relations that provide the foundations of meaning-production and representation. They are not the same concepts, but the philosophical abstraction finds an echo in the use of graphical means of meaning-production in the more ordinary, practical sense.

One final bit of context may be helpful here, connecting my own particular background and experience to these intellectual arguments. Awareness of diagrammatic features of written texts has been part of my writing and book design practice for decades, since the artist’s books I’ve produced have explored format features and polymorphous texts as a part of the writing practice that is at the heart of their design. My approach is focused on the reading possibilities potentiated by structuring the text through multiple lines and pathways, levels and hierarchies of relations, and by fragmenting text blocks into relations that alter the linear presentation conventionally assumed in the book format (figure 1). When I began my academic involvement with the study of writing as the visual form of language by reading the work of Jacques Derrida, Paul de Man, and others, I already had a decade of practical experience as a typesetter and book artist. I had been immersed in the daily activity of letterpress, copy camera, early digital typesetting equipment, and other materials that were the stuff of the 1970s print shop. Derridean *écriture* rarely addressed the mundane matters of the history of letters and fonts, or design precepts such as layout and composition. These physical materialities and the involvement with production appeared largely outside consideration, and almost irrelevant to the higher matters of a metaphysics of *différance*. The philosophical and practical realms appeared to remain separate from each other. Indeed, practical work is often still treated differently from theoretical work in the academy, as if the knowledge of hand and eye, embodied intelligence, and applied skills were somehow *not* theoretical. When questions of materiality and ontology bring theoretical and practical issues into dialogue, troubling the abstractions that sustain philosophical discourse, the craft-based knowledge of production is generally disenfranchised, as if the higher order of thought necessarily trumps the lower orders of material engagement. But practice is neither banal nor reductive, and no more literal and unthinking than metaphysical reflections are purely ethereal - the two



domains have much to say to each other. This leads to the crux of this essay. The coming into being of the grounds of meaning-production - through representational relations, formal structures, graphical expressions of logical and rhetorical principles - is deeply engaged with the intuitions that serve a single inquiry - how do structural relations participate in the production of meaning?

The gap between practical and theoretical knowledge is glaring. Plagued by seemingly irreconcilable vocabularies, different problems, and unmatched positions in the social worlds of intellectual life, these varied communities of practice are nonetheless connected by their shared investigations into the graphical expression of knowledge production. I can point to numerous examples, but will let one suffice as the final bit of preamble.

Walter Crane, the Arts and Crafts illustrator, designer, socialist activist and guild advocate, made the following statement in the opening lines of his brilliant 1900 publication, *Line and Form*: 'Outline, one might say, is the Alpha and Omega of Art'.⁶ He goes on to say that 'the function of outline [is]... the definition of the boundaries of form'. The act of definition, inclusion and exclusion, enclosure, is the basic act of distinction on which all other forms depend. By forms, Crane does not mean *shapes*, but rather, something closer to *distinctions*, or the basis on which form may be both made and perceived. Crane was far from the realms of philosophy, logic, and high theory, but the principle echoes Peirce's notion of the cut, the separation, that will find its fuller development in 1969, in George Spencer Brown's much cited *Laws of Form*.⁷ Brown's opening lines in 'Chapter 1, The Form',

Figure 1, Johanna Drucker, *The History of the/ my Wor(l)d, page of letterpress printed work, 1990, courtesy of the author*

6. Walter Crane, *Line and Form*, London, G. Bell and Sons, 1900, p1.

7. George Spencer Brown, *Laws of Form*, NY, E.P. Dutton, 1969, p3.

state ‘that we cannot make an indication without drawing a distinction’. An intellectual orthodoxy that requires these realms to be kept separate, as if Crane were a mere mechanic and Peirce and Brown pure thinkers, blinds us to an understanding of the productive connections to be made across these domains. Diagrammatic reasoning is an applied realm of metaphysics, not merely an abstraction. Of course, substantive differences must be noted between Peirce’s logic and semiotic and the rhetorical, poetical character of applied practice. The foundations of logic will be muddled (necessarily and productively) by the embodied, instantiated specificity of practice focused on persuasion, argument, and poetic expression. Still, the parallel between a metaphysical approach to diagrams, with the emphasis on the structuring principles of representation, knowledge, and form, and the practical application of diagrammatic activity, should be understood as a resonant rhyme, not a relation of identity. The particularity of material instantiation is not a debasement of idea, but an enactment. From these particulars theoretical principles can arise, but the categories of metaphysics will always be unsettled by its actualities, and therein a whole host of cultural conflicts and politics resides. But that is not my focus here, instead, now, with this background in place, I want to sketch an outline of what I call diagrammatic writing.

In common usage, the concept of the ‘diagram’ is often vaguely defined, used to refer to a broad variety of schematic images - graphs, charts, anatomical images, wiring drawings and so on. A more precise definition might focus the term to refer to a specific category - those graphical expressions that take advantage of spatial organisation to structure semantic relations. These graphical expressions are themselves meaningful *as forms* - they are a kind of poetics, or *poieisis*, a bringing into being of meaning through making. The specific properties of graphic forms, their tractable, perceptible materiality, makes it possible to analyze formats and features - to get at, to grasp, to read, see, describe, elaborate the particulars of diagrammatic expressions. Even the abstract principles of Peirce’s existential graphs are worked out in graphical terms whose visual specifics create logical relations. The columns in a spreadsheet, or the graphic conventions of doing arithmetic sums or long division, are dependent on diagrammatic scaffolding that underpins their meaning-production. The spatial arrangement of values on a surface is integral to the values produced in ways that seem self-evident because they are so fully naturalised by convention. The principles that seem commonsensical in describing these spreadsheets or math operations are less intuitive and familiar in the domain of written language. But the graphical organisation of *texts* also depends on diagrammatic workings. Across the full range of analogue and digital media, format features of layout, composition, and graphic design are integral to the production of semantic value. The words of a chapter header or title read with a different inflection and value than when the same words are embedded in a linear sequence or tucked into a footnote. We read according to these visual cues and though we depend on them, we rarely stop to describe

or discuss their structuring principles or effects.

The long history of print conventions is now challenged by the opportunities of the digital environment, with its potential for flexible and extensible writing spaces. This challenge might be met in part by developing a more explicit understanding of the possibilities of diagrammatic writing, those compositional techniques that make use of graphical organisation in meaningful ways. In particular, my focus here is to consider whether - and how - the potential of digital display can be put at the service of imaginative and scholarly tasks. The precedents from analogue media, the format features of manuscript and print page design, combine with the flexibility of digital media (sliding or swiped panels, expanding menus, resized windows and so on). By looking at a number of examples, I hope to offer insights for designing such a space.

Some of the earliest examples of written language provide a useful precedent for diagrammatic writing. The scribes who created cuneiform tablets, dating to the third millennium before the Common Era, used scored lines to divide their surfaces into segments. These dividing lines segmented the clay surface into bounded units. Like property lines or fences, the divisions maintained distinctions among different types of information that comprised the written record on the tablet. Quantities could be separated from names for things, or, in the more elaborate column structures of inventories, owners from entities, and so on. The tablet known as Plimpton 322, for instance, is marked into individual columns in order to display Pythagorean triples, quantities that satisfy variables in specific equations (figure 2).⁸ The columns separate the values for each variable with striking clarity, allowing the mathematical structure of the analysis to be read. The structuring character of those lines is echoed in the columnar structure of accounting balance sheets and the marshalling of entries into their proper arrangement for purposes of tracking sums and values, names, or other items. Such structuring can be considered *performative* because the format enacts value production, it does not represent it, but allows it to be carried out, performed. The temptation to slip from the description of content typing that made those clay tablet grids work so effectively to the analysis of database structures is, of course, irresistible, and not without justification. Any graphical artefact has to be understood within the specific contexts of its production and reception, but shared similarities and continuities link basic elements of diagrammatic writing across these historical and cultural circumstances.

Without formal scaffolding, writing would not function. A genealogical chart that lacked the means to track bloodlines or distinguish one generation from another would hardly perform its basic functions - to secure claims to property, identity, or power. The Tree of Jesse, like the ancient symbols for the Tree of Life on which its iconography is based, is not only genealogical and mythic in its power, but embodies assumptions about the organic integrity of derivation and inheritance, continuity and shared roots and systems, literally and figurative. These relations are not merely *expressed* in its form, they are

8. Eleanor Robson, 'New Light on Plimpton', <http://www.maa.org/news/monthly105-120.pdf>



Figure 2, Plimpton 322, Cuneiform tablet dated to about 1800 BCE. Columns separate variables that satisfy an equation and fit the description of Pythagorean triples. Columns each hold a distinct, identifiable value while rows are individual instances. The grid structure obviously organises the content and gives it value <http://blsciblogs.baruch.cuny.edu/plimpton322/the-tablet/>

made in its format. The images do not simply represent relations of derivation and inheritance, they constitute such relations through graphical means, just as the columnar formats used for accounting designate and confer specific characteristic values through their graphical means. For instance, in a railroad schedule the diagrammatic features are essential to distinguish arrival and departure times, or minutes from hours (figure 3). A number placed in a different column obtains a different value. Such features are so endemic to the processing of written and visual information, so pervasive in their presence and function, that their operational, functional, instrumental, and rhetorical force is rarely considered. Nor are their poetical dimensions, the way they *make* meaning through the very act of composition, given explicit attention.

I am now in a position to outline in more detail what some of the features of a diagrammatic writing space might be and how they might work. If a diagram is an image that *works*, that does something, as writers across the logical, historical, and philosophical spectrum suggest, then it provokes a reader's engagement through its structures and the relations they express. A diagram is a graphic expression whose specific spatial and visual features constitute the semantic values. Diagrams are performative, as is clear from the cuneiform tablet and railway schedule examples, rather than representational. They use graphical means to express relations that might be expressed through other means - mathematical formulae, textual description, logical propositions.

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Figure 3, Staten
Island Railway
schedule, 1867
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wikimedia.org/
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jpg/500px-
Staten_Island_
Railway_1867.
jpg](http://upload.wikimedia.org/wikipedia/en/thumb/7/7d/Staten_Island_Railway_1867.jpg/500px-Staten_Island_Railway_1867.jpg)

room instead of placed in a neat column and the supporting role of graphical organisation and scoring becomes quite evident.

All written forms can be described as diagrammatic, but so can approaches to composition. These operate at a level of textual organisation that supports branching narratives and multi-linear approaches. A conspicuous moment for such work came with the first wave of hypertext writing in the 1980s, which brought equal parts insight and exaggeration to the idea of exploiting diagrammatic features in imaginative works.⁹ Earlier visions of branching narratives appeared in the writings of Vannevar Bush, in his frequently cited 1945 paper, in Theodor Nelson's work first published in the 1960s, and in some of the experiments of innovative writers who played with alternative structures in analogue or digital work, such as Julio Cortazar in *Hopscotch* or the computationally generated text first published in 1984, *The Policeman's Beard is Half-Constructed*.¹⁰ Artists made projects that used alternative physical and graphical structures - decks of cards, collage techniques, cut pages, combinatoric processes - since early Dada experiments in the 1910s. Some critical claims tended to exaggerate the binaristic distinction between the linearity of print and the non-linearity of programmes like Hypercard. Designed for Apple and launched in 1987, the programme was a milestone, offering an easy to use platform for creating combinatoric works built in chunks whose sequence did not have to be locked into the single linear sequence. Branching and linking, the basic underpinnings of the web, were embodied in its programming. Hypertext could be rendered in a diagram that let readers see the story structure, but it could also be experienced as multiple pathways through the reading. Hypertext chunking allowed a conceptual separation between content types (such as footnotes, sources, citations, primary materials, and other elements) to be made more explicit in the storage, and thus manipulation, of these units. The modular quality of hypertext chunks could also serve to break a text into narrative units for combinatoric play, with relations specified in links, or in a database structure.

Conventional prose and print are only superficially linear, or course. The sequence of alphanumeric code follows line by line, letter by letter, but meaning is produced across a field of associations, rhymes, and references that are not only not constrained by linearity but come into being through the capacity for multiplicity of meaning and reading. Poetic forms, more obviously spatial, exploit diagrammatic elements quite conspicuously. Stéphane Mallarmé's 1896 designs for *Un coup de dés* may be the paradigmatic diagrammatic work, and certainly a touchstone for any graphically scored piece whose myriad of themes is spatialised relationally in dramatic ways. The sheer force of condensation and resonance that makes poems work embodies a diagrammatic engagement with relational principles and forces. Poems can be mapped as force fields of vectors, sinks and troughs of meaning, nodes of relation and repetition, reinforcement, or resistance. The dynamic language so crucial to diagrammatic thought springs from poetics quite readily. And

9. Jay David Bolter, *Writing Space: Computers, Hypertext, and the Remediation of Print*, New Jersey, Lawrence Erlbaum Associates, 2001; Michael Heim, *Electric Language: A Philosophical Study of Word Processing*, New Haven, Yale University Press, 1987; George Landow, *Hypertext 3.0 Critical Theory and New Media in an Era of Globalization: Critical Theory and New Media in a Global Era (Parallax, Re-Visions of Culture and Society)*, Baltimore, The Johns Hopkins University Press, 2006.

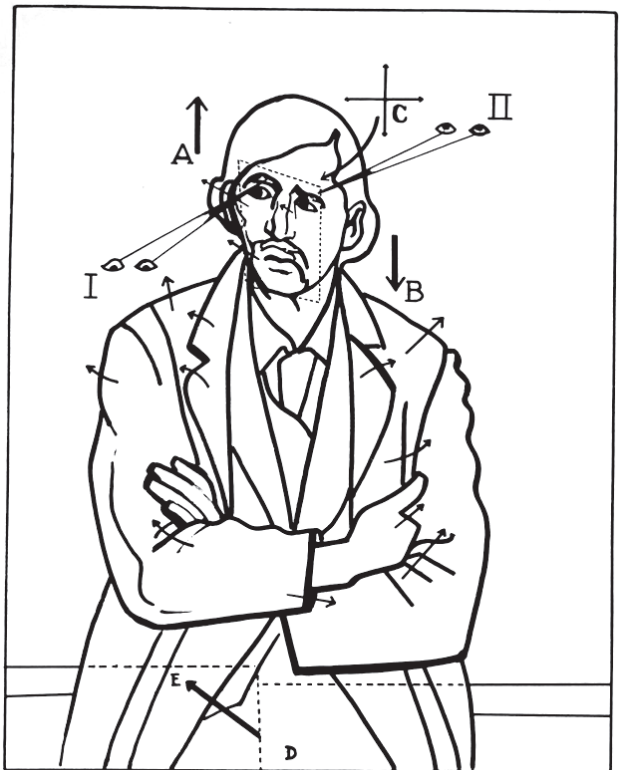
10. Vannevar Bush, 'As We May Think', *Atlantic Monthly*, July 1945; on line at <http://www.theatlantic.com/doc/194507/bush>; Theodor H. Nelson, 'A File Structure for the Complex, the Changing and the Indeterminate', *Proceedings of the ACM 20th National Conference*, 1965, pp84-100; Julio Cortazar, *Hopscotch*, NY, Pantheon, 1966; and Racter, Joan Hall, and William Chamberlain, *The Policeman's Beard is Half-Constructed*, NY, Warner Software Books, 1984.

the analysis of poetry, as well as that of many aesthetic artefacts, exposes the fields of relations produced in and across such complexities (no matter how refined, reduced, or apparently simple the artifact might be). The diagrams of Erle Loran, developed for studying the work of Cezanne, for instance, almost as clichéd-seeming at this moment as the analytic schematics used to show the triangles underlying the composition of the great Renaissance madonnas and so on were wonderful demonstrations of the dynamic principles at work (figure 4). Diagrammatic methods of analysis do their work in the study of musical pieces, staged drama, film structures, and elaborate narratives, just as the practice of diagramming sentences was used to expose structure of composition.

Picking up the thread dropped above, the binarism stressed by early hypertext writers and theorists suggested that the compositional techniques that took up Jorge Luis Borges’s image of the ‘garden of forking paths’ heralded the arrival of a new era of literary liberation from the tedium of linearity imposed by regimes of print. Such fallacies and follies, trivial in their perception, and short-lived in their traction on imagination, were not so much wrong as simplistic, as intent on selling the virtues of new media as other hawkers of the digital. But what elements of that early shift in compositional mode, grafted onto the study of graphical expressions, connect diagrammatic principles across a continuum of manuscript to print and to digital expressions? The question is not merely answered by an assertion that writing’s diagrammatic quality inheres in a database’s combinatoric ability to produce modular reworked products customised for each new reader. That may be, and may come to be, but will benefit from a higher degree of specificity about kinds and types of diagrammatic thinking expressed in graphic features and formats. Graphicality is neither essential nor incidental - it is a convenience for making relations legible, available to perception, and analysis. The graphic field also provides material evidence for analysis of its particular qualities, a notion better integrated into calligraphic traditions than those of print.

At the most abstract and fundamental level of meaning-production, the distinction between a

Figure 4, Erle Loran diagram analyzing the point of view system in a Cezanne still life http://4.bp.blogspot.com/_sTvHtDRhr5Y/SGacW61EWNI/AAAAAAAAAGYc/H4xQ3g8eBtg/s400/figure-333.png



DIAGRAM

mark and a non-mark, a signifying entity and an incidental trace, depends upon the force of a frame. Such a statement can be made without recourse to graphical expression, as a proposition that holds in the abstract, (e.g. a logical principle in Peirce's concept of the cut or separation). But tractable form immediately gives specificity to such propositions, as the citations from Walter Crane and George Spencer Brown each suggest above. Any mark might communicate meaning or value, but when it is presented on a piece of paper, within the space of a screen, on a canvas or parchment, it performs differently in response to our expectations. Delimitation of domain creates meaning. Without differentiation, the graphical has no value. Such insights were the stuff of semiotics, structuralist analysis, and post-structuralist thought.¹¹ That legacy provides a theory of trace as the coming into being of the possibility of meaning whether within a literal graphical comprehension of such processes or on a more abstract plane in which an ecology of semiotics points to more fundamental conditions of knowing and being.¹² But the inventory of graphical features that assume the form of conventions in written language, and then enact diagrammatic possibilities, begins with the play of figure and ground, edge and field of inscription, along lines of basic organizing effects.¹³ These offer the chance to engage with the also familiar but still useful principles of gestalt psychology, with its analysis of perceptual tendencies provoked by visual forms.¹⁴ The principles arise from clinical observation, perception studies, that assume a kind of normative subject and a predictable, even mechanical, relation between stimuli and response. So, *continuity*, *grouping*, *proximity*, *emergence*, *invariance* and so on are graphical features whose effects can be counted on, more or less, in most visual processes.

The relevance of these principles to the design and study of graphical formats depends on the subtlety and finesse with which they are applied. The elaborate study of the *mise en page* of medieval manuscripts shows how nuanced the notion of 'proximity' between one column of text and another can be.¹⁵ The careful calibration of proportions is a dance of subtle metrics, of the division of a page through allocation of one portion to bottom margin and another to the top, to the decisions that keep a book unified across a gutter or throw its portions outward as if by some chaotic force of centrifugal abandon. The differences of proportion that make a design work or not don't resolve through formulaic principles, and the gestalt inventory lacks refinement. Proximity, for instance, becomes laden with attributes and values in the workings of Raymon Llull's diagrams for calculating the attributes of God or the mesh of connections generated by Athanasius Kircher (under Llull's persistent influence) in his magnificent graphical elaborations of the 1669 *Ars Magna Sciendi* (figure 5).

Diagrammatic writing structures became conventionalised in medieval manuscripts to create relations of text to commentary, text to paratext, and apparatus to the whole space of the book. Notes also point outward

11. Jacques Bertin, *Semiology of Graphics*, Madison, University of Wisconsin Press, 1984; Fernande Saint-Martin, *Semiotics of Visual Language*, Bloomington, Indiana University Press, 1990.

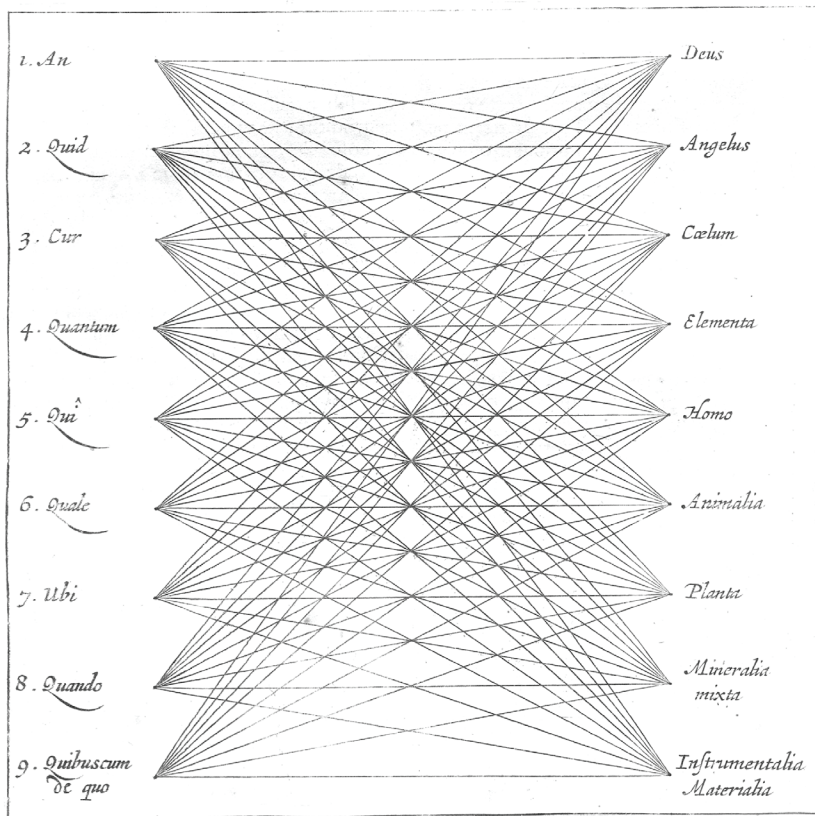
12. Jacques Derrida, *Of Grammatology*, Baltimore, Johns Hopkins University Press, 1976.

13. Johanna Drucker, *Figuring the Word*, NY, Granary Books, 1998.

14. Rudolf Arnheim, *Art and Visual Perception*, Berkeley and Los Angeles, University of California Press, 1954.

15. Henri-Jean Martin and Jean Vezin, *Mise en page et mise en texte du livre manuscrit*, Paris, Editions du Cercle de la Librairie-Promodis, 1990.

*Typus universalis, omnibus de quacunque re proposita questionibus
formandis, aptus.*



*Figure 5,
Athanasius
Kircher, Ars
Magna Sciendi,
1669, diagram
following
the tenets of
Raymond Llull*

to the discourse field of textual production in the broader sense. They are adopted for print formats and then find their way into the sidebars, hyperlinks, and headers that allow us to read and author effectively in digital environments. The navigational functions of graphical expressions are most conspicuously diagrammatic - the relational structures that make a header distinct from a phrase in a paragraph, a footnote other than an entry in the table of contents are vivid demonstrations of the ways spatial specificity organizes written language (or multimedia texts, for that matter). So conventionalised are the elements of texts and their codified relations that writing is produced with those structures in mind - the footnote segments itself from the main line of argument, the aside, the comment, the marginal note, the index, and chapter heads or subheads. Though hardly natural features of the intellectual landscape, these are so naturalised that they are prompted even in the process of composition (and certainly employed in the processes of editing). That they guide reading is obvious, of course. Similarly, conventions have quickly arisen in the organisation of screen space that guides its allocation to different purposes according to positions (figure 6).

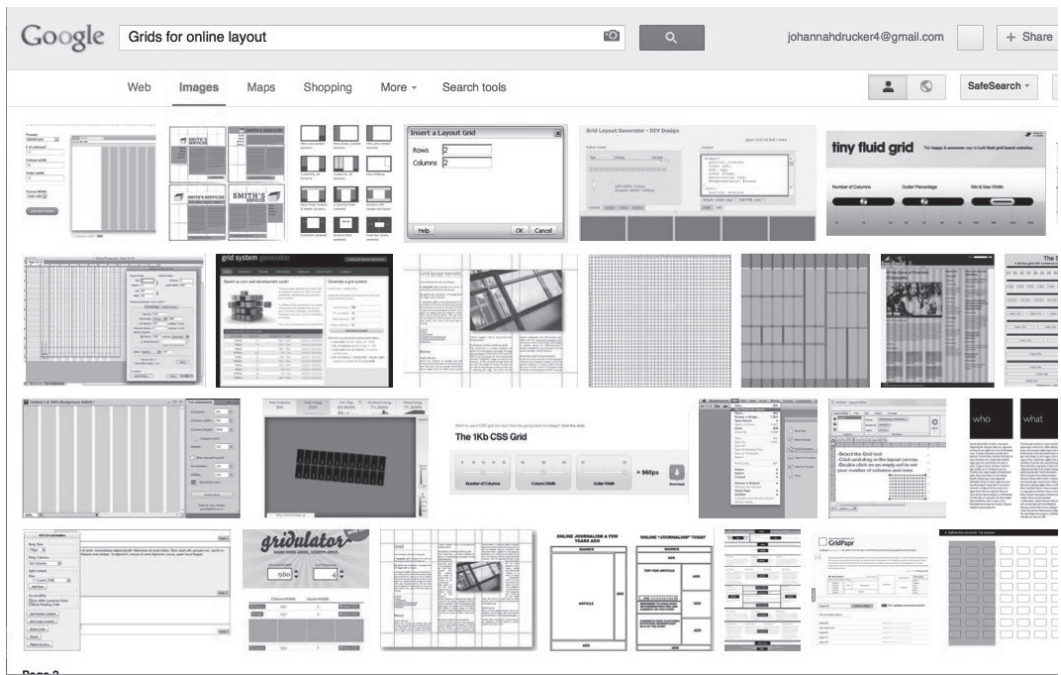


Figure 6, Web design showing allocation of space by content type and convention

The major distinction between the space of a manuscript page and that of a printed page is that the technology of print reinforces tendencies towards squareness (quadrature) and invariant type size and style. These are not absolute requirements for printed pages, but production means - letterpress, linotype, phototype, and digital typesetting - were all designed to support these conventions. Manuscript pages, by contrast, have to be created with demanding attention if their lines are to remain evenly sized and spaced. The affordances of each medium are fundamentally different. The lower limits of micrographia are determined only by the ability of a scribe to manipulate the point of a pen, and insertion of one line after another into the space between two pre-existing lines of text is governed only by a principle of elasticity, not strict decorum. Embedding and entangling texts is not only easy in manuscript form, it is almost irresistible - and in handwritten drafts of contemporary texts such practices continue to be the norm. Wandering lines, insertions, deletions of branched options, thoughts that begin and end, are dropped, aborted, abandoned, their unfinished lines broken partway through their expression. At every point in composition, a text suggests directions that cannot be followed in a strict linear pattern, pruning and editing keep the rhizomatic tendencies in check because convention has asserted this should be so. In the elaborated commentaries that decorate the pages of manuscripts in the middle ages, when conventions of navigation, reading, and writing

were being established as customs for use, the origins of convention exist alongside the opportunities that had to be let go within the constraints of printed forms. Artists and innovative writers may have played with visual and spatial writing within the avant-gardes of the twentieth and twenty-first centuries, but the design of digital platforms for daily use has hardly begun to accommodate the imaginative possibilities of diagrammatic composition. The design of digital displays arose at the intersection of the capacities of code (mainly html), the desire to optimise the use of screen real estate, and the rush towards conventions and standards to improve efficiency.

In pausing to think about the ways authoring absorbs and depends on provocations coded into the graphical space that maps relations among one bit of text and another, questions about the authoring platforms and potential/*poetential* of electronic space come into view. Formats in electronic space have reprised some of the older textual modes of production, even as these are interpenetrated with the now ubiquitous structure of cross-references and linking. Blogs are scroll forms, social media sites are galleries, a list of tweets has some peculiar resemblance to those archaic cuneiform inventories. The diagrammatic codes that structure a Wiki, dividing its screen display into topic, introduction, overview outline, and other features does not mimic any particular script predecessor, but preserves the footnote and reference conventions of print resources. Scrolling texts, pop up windows, rapid refresh in screen displays all introduce a more rapid temporal rate of re-inscription than print allowed, but the flat space of display to which most screen writing is reduced is, if anything, far less diagrammatically sophisticated than the spaces of a three-dimensional codex. In terms of the screen, most writing space unfold the downward, along the vector of the scroll, to extend the writing space and the infinite sidebar as a way of navigating. Gauging a place using a sliding sidebar does not necessarily provide a good sense of the overall size or scope of the whole text. The accumulating tail of a blog seems even less constrained, as if it were simply unrolling over time, its chunks lopped off, to be archived by month or week or day. This is writing without constraint, a mode of production that has no limits in terms of quantity and frequency, and yet is very constrained in its appearance and rhetorical structures. Such unbounded, non-delimited, forms pose difficulties for logicians as well as designers, since the open-endedness makes it difficult to fix values.

But the potential for diagrammatic writing to express compositional possibilities that make use of the screen's flexible and fungible display space exists, not just as a place in which the forking paths metaphor or hyperlinked network is constantly invoked, but as a fully n-dimensional space. This possibility, to be enabled and enacted graphically, takes several forms: a kind of visio-logico-compositional authoring that engages mind-mapping, grids, matrices, lattices, and other spatialised structures whose semantic value as forms inflects and informs the production of meaning in the works they enable. Will conventions develop for thinking and writing along rays, arrays,

subdivisions and patterns of thought? Can the flexible morphology of screen display enable framing, enframing, embedment, entanglement, hierarchy, listing, and other schematic strategies of composition? These involve the production of multi-linear discourse as well as non-linear modes (so long as by non-linear we understand that alphanumeric sequence will remain at the level of word, phrase, sentence, and other units of discourse). In addition, the generation of automatic processing of intellectual material, texts in particular, into concordances, word lists, visual formats and n-grams, mined as 'data' and expressed visually will add other graphically specific conventions to the field of text production. Tag clouds, topic maps, other displays of textual material are now in common use and the hierarchy inscribed by size and frequency are readily understood. But the distribution of words across the space of screen real estate in these artefacts is often simply an effect of an instruction in the algorithm that is optimizing display and legibility. Deliberate use of the forms of graphical expression requires other conventions and understandings.

The list of characteristics of flexible morphology can be elaborated to describe structuring principles and compositional possibilities. The primitives of diagrammatic writing are: *hierarchy*, *juxtaposition*, *embedment*, *entanglement*, *enframing*, *interjection*, *branching*, *recursion*, *herniation*, *extension*, *penetration*. Each is a spatial logic (in a mathematically precise sense that distinguishes it from the other primitives). But each has rhetorical implications when used to make an argument. Finally, each can be described, abstractly, as a term that describes a relation between one text and another, between a zone of discrete activity and a relation to it. So, hierarchy suggests subjection, an ordering of authority, in which the claim to greatest significance is announced by the position of a text at the top of a page or area. Hierarchies subdivide quickly, and require at least two elements - one that asserts itself over another by size, scale, placement, or other graphic feature. Hierarchies can be elaborately detailed, as in the case of classification systems that go from step to step of ever-finer granularity. Hierarchies frequently structure the semantic field, whether in headlines, title pages, on menus and announcements. Any basic textbook of graphic design from the twentieth century will show thumbnails and have pointers for how to organise and use hierarchies to reinforce the content of a visual communication.

But other elements of diagrammatic writing are less codified. The structures of parallel arguments, of juxtapositions as a way to level hierarchies and replace them with dialogue or complement, are rarely used. When a text is distributed across four quadrants in a design, how do left/right and top/bottom zones assert different values? (figure 7) When a text is surrounded by another, embedding the initial expression in a commentary, has an act of strategy been performed, a military manoeuvre in which one flank of argument has positioned itself to dominate another? Is the embedded text protected or subdued? When a comment works itself around another, to enframe, it is claiming that it supersedes the original? When a line is inserted between others and then extends outward, bulging with ideas that swell the text into a balloon in the

margin, is it producing a herniation in the argument, a burst of impassioned verbal energy needing space to expand, breaking through implied constraints or protesting limitations? And when interjections are pointed into the text, anchored with small points in the stream of the whole, are they attributes, adding refinement and qualification? Or small darts of attack into the body of the argument? I'm deliberating indulging in vivid language here, metaphoric and dynamic, to emphasise the rhetorical force of compositional practices rather than simply relying on the old bromides of design composition that call attention to balance, symmetry, and dynamism on the page. Thinking about graphical composition as a set of manoeuvres for engagement in electronic space permits reflection on arrangements and moves that are strikingly different from those that occur on stable material supports.

As already noted, prose and poetry, print and manuscript, are only superficially linear. The production of meaning occurs across a field of text as references replay and resonate even if the inscription is a linear sequence of alphabetic signs. The notion of a field is complicated by the shift from page to book and from book to networked text. In all instances, the many roles of textual and graphical elements participate in producing a navigation system as well as meaning across gaps, spaces, gutters, margins, turned pages, and recollected chapter titles, headers, and so on. Seen in that light, a book has something in common with a landscape or built environment in which signage operates to designate meaning, guide behaviour, orient a person finding their way, identify a place or building, or perform any of the many activities of signs in space. Web environments combine the surface organisation and structure of pages and the distributed complexity of landscapes, using both the schematic compositional techniques from print-based graphic design, the knowledge gleaned from human-computer interaction studies, and (perhaps not often enough) lessons learned from signage design. But they still do not take full advantage of the n-dimensionality of digital

Figure 7, *The Talmud's layout organises a hierarchy of commentary within commentary according to very strict conventions and guidelines*
<http://jewishcurrents.org/wp-content/uploads/2010/06/talmud.gif>



space, or e-space and current conventions have too quickly constrained the design possibilities. We are still in the incunabula stage of digital design. Gestalt principles and the knowledge of basic graphic variables distilled from semiotics have been systematically employed for analysis and production of web site design, but these stop far short of the rhetorical and poetic engagements that would form a suggestive foundation for diagrammatic writing practices. Characterizing spatial relations among textual elements to discern the force fields and vectorial power of these dynamics is one part of understanding diagrammatic work. The other is to imagine a space in which the flexible elasticity of screen space could be optimised to support writing practices that don't conform to conventions set by print and reinforced by the wireframes that structure web environments. Activating the implied z-axis is one part of this. Thinking in terms of writing as a constantly bifurcating, associative, combinatoric, accretion rather than a linear distillation is another. Creating a graphic language and a support for its implementation is also essential, but the conceptual barriers are more difficult to overcome than the technical. Taking inspiration from manuscript modes of free-form writing in combination with the capacity for computational processing will produce alternative approaches to interactive arrays and displays in the interface.

The enthusiasm for databases was a harbinger of a combinatoric and diagrammatic approach to writing in electronic spaces, but the mechanistic division of content in advance of composition imposes a fixed structure on the types of text and their relations that can be generated from the semantic material entered into the fields. As topic maps and other semantic network visualisations have become more familiar, the rhetoric of their presentation seems to be filtering into common perception as a way of writing, not merely a way of displaying information. The free-form notion of a diagrammatic writing suggests a more associational structuring of argument, one that gives rise to relations and organisation that may, in turn, be captured, extracted, studied as a schematic form, but is not the determining mechanism or structure of composition. The flexibility of variable spacing, the ability to change scale and insert lines within lines, commentary wrapped around commentary, discursive strategies marshalling arguments with the spatial dynamics of a battle campaign or a move in a complex dance are all features of the manuscript page that are so difficult to enact within the technologies of print production for all the reasons discussed above. So far, screens have remained stuck in print imitation; making them responsive to the combination of manuscript and digital potential to produce a new hybrid, fluid and n-dimensional, is an as yet unrealised possibility.

Diagrammatic writing makes use of graphical organisation for semantic effects. It engages principles that are integral to logical and philosophical

reflections on the processes of meaning-production, but employs them in the rhetorical and poetical spaces of applied design. This shifts the discussion from abstractions to particulars, from discussions of matters of *distinction* or *difference* to descriptions of specific practices. Diagrammatic techniques used in note taking express associative thinking about ideas and arguments. The diagrammatic imagination emerges in handwritten doodles and whiteboard sketches, in marginalia and commentary, in outline forms and elaborate lists. But the potential of the electronic environment to create those multiplicities of argument structure that are possible within the digital spaces of an n-dimensional screen has not yet been activated. How does a line become a bridge, a rib of text across which a rhetorical gesture stretches to extend a track of thought? What happens when an argument divides, following all of its details and possible branching, refinements, or qualifications into intimate detail so it reveals the minutiae of thought and refinement? A text or idea can be unravelled through contrast with all its other versions, witnesses, and evidence of its production. In such an image, the wandering manuscript commentary of medieval scribes would be revived in electronic form, tracing thought trails wherever they go, into and out of the spaces between paragraphs, lines, or words. In electronic displays, a table of contexts (rather than contents) might be generated through associations data mined from a concordance, or from phrases highlighted in reading, or from commentary that promotes dialogue across many exchanges among readers. The running heads might actually run, streaming across a frame, pitched forward, changing to create their own commentary in anticipation, on reflection, or with retrospection. When these activities appear, the 'page' on the screen will be able to reconfigure and regenerate. The elaborating possibilities of the embroidered argument will be released from their latency. A tool set of moves will become as familiar as footnotes and paragraphs, as bullet points and paraphrases, as marginalia and discourse fields to which our references serve as vectors and points. The diagrammatic potential of writing would be fully engaged. With all this in view, a material poetics of diagrammatic writing enabled by graphical possibilities of expression might be envisioned. Whether or not such potential is ever realised depends on many other factors, not least of which is the resistance of conventions that stabilise meaning to the forces of change, and the entrenchedness of communities of practice, their attachment to familiar forms of knowledge production, and, of course, of knowledge itself.