Exploratory Diagramming and Diagram Theory: Greimas, Peirce and Châtelet

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Exploratory Diagrams

In his survey of diagrams for graphic designers, Arthur Lockwood (1969) adopts the useful categories of statistical and explanatory diagrams. Almost all diagrams we encounter today are either statistical (quantitative data: bar graphs, pie charts, etc.) or explanatory (the way things connect: assembly instructions, flow charts, maps, etc.), or combinations of the two. The purpose of these diagrams is, largely, the efficient communication of pre-determined information. In other words, diagrams come after. I suggest the prefix exploratory for a mode of diagram production which is not primarily about relaying or manifesting existing knowledge or data, but is rather a mode of active real-time thinking and creative production leading to new thoughts, works and objects. Exploratory diagrams are generative devices and embodied modes of material experimentation by means of which hypothesis are set down and tested or vague notions provisionally concretised in an iterative process of development, often without any clear idea of what may result. It is this generative character which make diagrams particularly pertinent to education – not only in terms of a teacher’s classroom diagramming, but crucially as a form of drawing-based learning by the student (see Kenning 2015). If there is a politics here it resides in the question of agency. Knowledge is power up to a point, but ubiquitous visualisation of data (infographics) tends to positions us as consumers before the aestheticized ‘reality’ we absorb in congealed picture form. Furthermore, whilst we may ‘respond’ to personalised data captured by real time tracker technologies, these graphs and charts meant for us are impervious: the imperative is to optimize as we assume our position within the neuro-economic cybernetic system. We react
without being able to intervene. What room is there for the user to inhabit these algorithmic diagrams, to question and transform the rules of and the basis for their production?

Of course, diagrams have never been ‘innocent’, they always in some way produce the reality which they claim merely to describe, as Susan Buck-Morss has shown with respect to William Playfair’s original visualisations of the economy:

Because the economy is not found as an empirical object among other worldly things, in order for it to be "seen" by the human perceptual apparatus it has to undergo a process, crucial for science, of representational mapping.

The great cognitive power of diagrams is that they can make the invisible and non-apparent visible and intuitively graspable, also manipulable (in the mind or on the page) once laid out as a spatialized set of relations. One ‘discovers’ the economy e.g. as a set of national balance of payment differentials graphically arrayed in a timeline, rising and falling like waves or mountain ranges, cutting out definite shapes of ‘surplus’ and ‘deficit’. A dialectic operates in the diagram between subtraction and addition – between stripping down and dressing up. From a Peircean semiotic framework Frederik Stjernfelt describes how the diagram represents its object ‘through a skeleton-like sketch of relations’, abstracting from what is non-essential (Stjernfelt 358). From a material culture (or actor-network) perspective, Bruno Latour writes of how invisible phenomena, whether leptons, coastlines or GDP, ‘are never seen but through the “clothed” eye of inscription devices’ such as diagrams (Latour, 17). As an ‘immutable mobile’ (7), that is an inscription which by means of reproduction technologies can travel far and wide without changing form, such diagrams lend themselves to comparisons, so that general agreement can be reached or alterations suggested within
knowledgeable communities as to the truth of the ‘reality’ presented. John Bender and Michael Marrinan in *Culture of Diagram* also emphasize the material character of diagrams, the fact that they are ‘situated in the world like objects’, and as such, ‘foster many potential points of view’ (8). Agency is afforded to the user of the diagram once the latter is not viewed in terms of producing a definitive uniform, ‘stripped down’ version of reality (19), but as a thing in the world which can be applied and put to use. Whilst this material culture approach recognizes the active capacity diagrams proffer in their ‘ready-made’ (printed or on-screen) state, my own material approach is focused rather on the creative and cognitive agency afforded through physical mark-making and drawing-based diagramming.

My intention in this essay is to examine a set of theories of the diagram which, I believe, put the emphasis on exploratory diagramming practices. I write principally from the position of an artist and art educator who produces diagram artworks and uses diagrams quite practically as a common heuristic device to solve problems and develop ideas (e.g. in sculpture). My use of diagramming techniques within fine art education scenarios developed partly as a result of teaching often highly abstract theory and philosophy. Within theory books a lone diagram sometimes appears, like a visual oasis in a desert of text: a point of synoptic overview where dense pages of often abstract argument and conceptual architecture can be condensed, made intuitively graspable and available to mental experiment. Examples given, or developments made by the author later on in the text, can be retrospectively added to the schema by the reader, filling its abstract points with concrete terms and encouraging the trial of further examples, terms and points. But beyond official schematic illustrations of texts, I have developed techniques which place diagramming at the centre of processes of close philosophical reading and reflection, which graphically enable exploration and the delineation of theoretical frameworks within which student-artists can actively position
themselves, and which aim to collapse the institutional-disciplinary boundaries demarcating art ‘practice’ and ‘theory’. Conformity to a standard visual model, however useful, can’t be the ultimate criteria for the diagram’s pedagogical value. The *act* of drawing is not subservient to any idea or text it supposedly illustrates but surpasses it because, as Michael Taussig (2001) writes (in relation to his ethnographic fieldwork sketches) ‘drawings have the capacity to head off in an altogether other direction’. But this is not to lose the operative rigour of the diagram, its validity when discovering new logical connections and suggesting fruitful points of emergence. In my *Social Body Mind Maps*, for example, there is an ‘alienation’ stage whereby clichés and unconscious assumptions based on unacknowledged theoretical paradigms can be broken apart through schematic abstraction (Figure 1_half page). This is then followed by a more creative stage, for which Gilles Deleuze’s notion of diagrammatic ‘scrambling’ might provide the operative mode (Deleuze 2005, 110), whereby the artwork under consideration by the diagrammer is deformed and reconstructed visually in a singular and unpredictable way (Figure 2_half page).

The philosophers I will discuss in what follows place exploratory diagramming processes at the heart of their thinking. Whilst holding different conceptions and describing different uses, they nevertheless share a view that diagrams do not merely communicate what already exists, but provide a method of discovery and invention.

*Greimas: Oppositions*
‘the creative faculty [...] proceeding from the simple to the complex, from the
general to the particular, makes its way, through a number of determinisms,
toward an exaltation of liberty’ (Greimas & Rastier, 86).

The ‘semiotic square’ or ‘Greimas square’ has famously been described by Fredric Jameson
(one of its foremost advocates and users) as offering ‘a kind of “discovery principle”’ (350).
Influenced by the great structuralist diagrammer Claude Levi-Strauss, A.J. Greimas and
Francis Rastier in their seminal paper ‘The Interaction of Semiotic Constraints’ present a
structural machine which, against any humanist faith in either conscious artistic intent or pure
chance, draws on the deep oppositions which condition and constrain the singular products of
culture. The authors take Strauss’ fundamental Culture <-> Nature dichotomy and open it
out into a square by adding the contradictory of each of these contrary terms (93). If
‘Culture’ and ‘Nature’ sit at the top corners of the square (along the ‘complex’ axis), then
‘not-Culture’ and ‘not-Nature’, the simple negations of the positive binary terms, are set
beneath them at the bottom corners of the square (along the ‘neuter’ axis). This arrangement
sets up a third pair of relations or ‘implications’ between Nature <-> not-Culture and Culture
<-> not-Nature. Greimas and Rastier give an anthropological example of a patriarchal
society with respect to prescribed i.e. ‘cultural’, and forbidden i.e. ‘natural’ sexual relations
within a society. In drawing out the ‘contradictory’ points (simple negation), the square opens
to the further possibility for relations which are ‘not prescribed’ and ‘not forbidden’. If
matrimony is prescribed and incest and homosexuality forbidden, then adultery by a man is
not forbidden whilst adultery by a woman is not prescribed – and so we have the basic
diagram of a (patriarchal) society, determining its particular laws and expressions of value.
But, of course, the diagram precisely encourages us to fill in, or solve the problem of, the
points in between: what would constitute a synthesis of the prescribed and the forbidden
(incestuous marriage?) or a synthesis of the forbidden and not-prescribed (adultery between two married women?)

Jameson has emphasized that the semiotic square, beyond its pedagogical value as a map of interpretations, has a primary heuristic value which is a function of ‘operative decisions’ made in its construction (Jameson 2019, 351). The semiotic square is a temporal map of a thinking process as much as a virtual diagram of a sematic universe, and a key moment that will determine its destination is its point of departure. As have others, Jameson has made incisive use of the semiotic square within the remit of cultural investigation. Specifically, the square enables the critic to discover the dialectal contradiction lurking beneath and amidst the more clearly apparent contrary (for example a fundamental dichotomy around which a novel is structured), and so to ‘find a way out of its intolerable closure and […] produce a “solution”’ (Jameson 2002, 153). Thus, the semiotic square functions to reveal what Jameson calls a ‘political unconscious’, the unseen but real, determining factors out of which a modern-day myth-maker (such as a novelist) can construct ‘an original and unique work’ (Greimas and Rastier, 86).

I first came across the semiotic square in Rosalind Krauss’ landmark essay ‘Sculpture in the Expanded Field’ (1979), and it seems to me now that it had a great influence in terms of my interest in diagrams. With wonderful dexterity Krauss constructs an entire hermeneutic framework with which spatial art practices from the 60s and 70s can be judged and understood (the ‘field’ of her title referring both to specific ‘earthworks’ as well as the wider cultural field of meaning). In the process she demonstrates the workings of the semiotic diagram, and its power as an instrument for cultural analysis. Her target is the ‘eclectic’ label applied to spatial practices which don’t conform to the paradigm of modernist sculpture. It is
interesting that Krauss begins her diagrammatic unfolding not, as is usual, with a pair of contrary terms (complex axis), nor in the naming of a positive term’s contradictory, but with the synthesis that occurs at the bottom of the square between the two negative terms (neuter axis); the space, as Jameson puts it, ‘in which all the privations and negations are assembled’ (350). According to Krauss’ argument, this is the space of ‘sculpture’ (Figure 3_half page). Krauss starts by relating how, by the early 50s, sculpture’s exploration of its own formal autonomy – the medium specificity definitive of modernist aesthetics – had reached a state of exhaustion, and was being ‘experienced more and more as pure negativity’ (34), a negativity summarized in Barnett Newman’s famous quip that ‘sculpture is what you bump into when you back up to see a painting’ (34-6). According to Krauss, by the early 60s, ‘sculpture had entered a categorical no-man’s land’, a state expressed by Robert Morris’ minimal works which imitated the ‘white cube’ gallery architecture, or the mirrored boxes that he placed outside galleries: sculpture ‘was what was in or in front of the building that was not the building, or what was in the landscape that was not the landscape’. And with this purely negative definition of sculpture, Krauss is offered enough to construct an entire semiotic square, because ‘not-landscape’ and ‘not-architecture’ imply their positive or ‘contradictory’ terms, which themselves form a contrary: ‘landscape’ vs. ‘architecture’ (corresponding, of course, with Nature vs. Culture). Thus, a square is formed, opening up the logical possibility that three new terms can be ‘found’ to replace the question marks that have now appeared in the rectangular schema. In going beyond modernist autonomy, in bringing into view the ideologically excluded terms ‘landscape’ and ‘architecture’, sculpture’s doubly-negative designation within the diagram has, structurally speaking, expanded the field in which we can conceive of spatial works beyond the category of ‘sculpture’. As Krauss’ puts it, ‘one has gained the “permission” to think these other forms.’
We can imagine it like this: the diagram (the thinking which constructs and results from the construction) puts questions to the theorist, which are subsequently posed rhetorically to the reader. If sculpture is what is neither landscape nor architecture, then what is both landscape and architecture? Krauss’ answer is ‘site-construction’ – works which recall the art of gardens, labyrinths and mazes (e.g. Mary Miss’ earthworks). What then lies between the contradictory poles of ‘landscape’ and ‘not-landscape’? ‘Marked sites’ says Krauss, filling in the diagram (e.g. Richard Long’s lines made by walking). Finally, that which is both architecture and not-architecture is designated by the term ‘axiomatic structures’ (e.g. Bruce Nauman’s ‘corridors’). Hence, the suspicion levelled against a sloppy, ‘anything goes’ eclecticisim by those who see art objects through modernist tinted spectacles, turns out to be ‘rigorously logical’ from the ‘postmodern’ perspective whereby:

‘practice is not defined in relation to a given medium – sculpture – but rather in relation to the logical operations on a set of cultural terms, for which any medium – photography, books, lines on walls, mirrors, or sculpture itself – might be used’ (42).

The case is made, there is nothing arbitrary about it. Its rigorously logical development is crystallized on the page as the virtual or structural or ‘unconscious’ diagram of postmodernist art is ‘discovered’: a ‘universe of meaning’ (Greimas and Rastier, 87) which determines, within the context of a shared culture, the significant choices open to individual artists, and within which affordances are granted in terms of how such choices are singularly manifested. Artists do not literally draw up the square as a blueprint, yet their works intuit and collectively constitute it in seeking cultural relevance, innovation and rigour. Formal invention requires material grounding if it is not to evaporate into the merely random. As
Krauss puts it, ‘the field provides for an expanded but finite set of related positions for a
given artist to occupy and explore’ (p.42).

This sense of the felicitous act of diagramming immediately invites the reader to collaborate
and extend: to try out different examples within the square, add images or attempt to expand
the fields of other artistic disciplines. Jameson, proselytizing for the square’s practical use,
encourages us to ‘blacken many pages’ (351) in order to get the hang of it, to draw out the
most appropriate, most useful, most logically creative set of relations. Crucially the semiotic
diagram is not an algorithm, but a dynamic aid to active intellectual inquiry, an exploratory
device that always involves construction and iterative alteration on the part of an alert
subject; it may be a ‘black box’ (Jameson, 349) but only to the extent that chosen material
can be entered in order to suggest solutions and instigate hypothesis which are beyond our
immediate consciousness, and in the process manifest all sorts of ‘aberrant or marginal,
minor, eccentric entities’ which should not be excised ‘since it is their place in the scheme of
things […] which is the most interesting of the problems the square can be called upon to
solve’ (Jameson, 351). A radical Deleuzian approach would want to move the diagram
entirely away from the structuralism epitomized by Greimas and Levi-Strauss, which appears
to imprison us within language and merely ‘negative’ differences, taking insufficient account
of sensory and extra-cultural functions and matters, and the ‘positive’ differences these things
promise. However, the semiotic square offers an escape from prevalent ‘spontaneous’ notions
of artistic creation by focusing in on those points in which cultural phenomenon touch upon
material forces which might otherwise remain unrecognized. In this sense the semiotic square
is an ‘alienation’ device, offering the possibility for an entirely new orientation with regard to
habitual understandings of artworks and socio-cultural norms. Whilst grounding artistic
processes in real world constraints, we should always keep in mind the ‘exaltation of liberty’
that Greimas and Rastier believe in, the index of creative and critical agency which arises from its material contexts.

**Peirce: Relations**

experiments upon diagrams are questions put to the Nature of the relations concerned (Peirce 1906, 493).

While there are philosophers and thinkers who develop or make extensive use of diagrams as tools for conceptual elaboration and discovery, there are others who have constructed full blown theories of the diagram and prepared the ground for contemporary ‘diagrammatology’. Alongside Deleuze (whose counter-intuitive and highly abstract diagram theory is beyond the scope of this paper), the most celebrated figure is Charles Sanders Peirce, who gives diagrams a special place in his system of logic. Well known as the father of semiotics, it is necessary to position Peirce’s theory of signs within his overarching ‘synechistic’ system which holds *continuity* between all things as its principle doctrine (e.g. the laws of physics and the laws of mind). To enter this universe is, at any point, to learn to count in threes. ‘Firstness’ is *quality without relation*; possibility, ‘the embryo of being’ (Peirce 1998, 268-9). ‘Secondness’ is *hard fact*, action-reaction, instantaneity; ‘the compulsiveness of experience’ (268). ‘Thirdness’ is *regularity*, habit, law; the ‘bring[ing] about of a secondness between two things’. Thirdness is characteristic of thought, although all three states are present in mind and can’t be separated out. What Peirce calls his ‘speculative grammar’ is likewise triadic, consisting of sign, object and interpretant: ‘A Sign, or Representamen is a First which stands in such a genuine triadic relation to a Second, called its *Object*₂ as to be capable of
determining a Third, called its *Interpretant* (272). In contrast to Saussure’s hermetic structuralist model of sound-image and concept (signifier and signified constituting the sign autonomously from any external object), Peirce’s sign is dynamically embedded in external relations insofar as a representation of an object determines a response which itself constitutes a sign: ‘the Sign produces in the Quasi-mind that is the Interpreter by determining the latter to a feeling, to an exertion, or to a Sign’ (Peirce 1906, 505). Interpretation, for Peirce, is not limited to ‘language’ but can encompass sensation and actions (an idea taken much further in the field of biosemiotics).

To arrive at diagrams, which are a particular kind of *icon*, let us see how the sign itself is broken down, initially into ‘icon’, ‘index’ and ‘symbol’, defined, in turn, as *resemblance*, *connectedness* and *convention* with respect to their object. These three categories of sign correspond respectively to Firstness (quality: e.g. the way a portrait resembles the sitter), Secondness (hard fact: e.g. the way a shadow is directly connected to the object which casts it) and Thirdness (regularity: e.g. the way algebraic symbols or words attain meaning according to *conventional* rules). Turning now to the icon, there is a further trifurcation insofar as the icon partakes in different modes of Firstness: ‘images’ resemble their Object in terms of *qualities* (i.e. First Firstness); ‘diagrams’ resemble their Object in terms of *relations* (i.e. Second Firstness); and ‘metaphors’ resemble their Object in terms of a *parallel found in something else* (i.e. Third Firstness) (1998, 274). Diagrams, then, are signs of the order of a Second Firstness: signs which are similar to their object in respect of a *formal analogy of the relations of its component parts*. Diagrams, writes Peirce, are icons of ‘intelligible relations’ (1906, 497). Diagrams ‘represent the relations […] of the parts of one thing by analogous relations in their own parts’ (1998, 274). Whether the Object is a physical entity, an abstract concept or an imagined world is of no relevance to its representability in diagrammatic form.
so long as the elements of which it is made up are logically possible and may be plotted so that, through careful attention and ‘experiment’, various relations may be revealed. This experimental function is defined in terms of logical reasoning, where the practical value of the diagram is central to Peirce’s innovations in this area. Deduction, he writes,

‘consists in constructing an icon or diagram the relations of whose parts shall present a complete analogy with those of the parts of the object of reasoning, of experimenting upon this image in the imagination, and of observing the result so as to discover unnoticed and hidden relations among the parts’ (1992, 227).

If the diagram is a legitimate formalization of the object in terms of related parts, then transformations performed on the diagram will reveal information which is implicit, even if unnoticed, just as in deductive reasoning where ‘the conclusion follows from the form of the relations set forth in the premise’ (1906, 497). In this way diagrams help to make necessary inference visible. As with Greimas’ specific diagrammatic tool, Peirce understands the diagram in general as constituting a process of ‘discovery’, one which unfolds in two (repeatable) stages of construction and transformation. In constructing a diagram, we ‘put before us moving pictures of thought’ (Peirce in Gardner, 56). These can then be experimented on to ‘discover new properties of the structure – properties not previously suspected’ (Gardner, 56). So long as the iconic analogue is accurate (rational), then insights can be obtained with regard to the object under consideration with a level of veracity which can only be compared to scientific experimentation upon material objects. This diagrammatic operation can take place in the mind, or by graphical means upon some surface:
‘one can make exact experiments upon uniform diagrams; and when one does so, one must keep a bright lookout for unintended and unexpected changes thereby brought about in the relations of different significant parts of the diagram to one another. Such operations upon diagrams, whether external or imaginary, take the place of the experiments upon real things.’ (Peirce 1906, 493)

The democratic facility of such a modest laboratory apparatus is not lost on Peirce when he writes that ‘experimentation can be multiplied ad libitum at no more cost than a summons before the imagination’ (495) – and, we might add, pen and paper. The manipulation of parts characteristic of diagrammatic discovery, is not arbitrary but, as Frederik Stjernfelt says, ‘rule bound’ (370), and it is this rigorously consistent mode of exploration that makes diagramming such a valuable mode of speculative thinking – the basis, as Stjernfelt insists, of Gedankenexperimente (370).

The distinct place Peirce offers for diagrams within his system of signs, and the capacity they offer for exact experimentation (their practical capacity to substitute for real things), is suggestive enough for exploratory practices. But what made diagrams something of an obsession for Peirce was the development of his own ‘logic machine’ (Gardner), the ‘existential graph’, which, despite his proselytizing amongst fellow logicians, never acquired the sort of general applicability of a Venn diagram, and which took on ever more elaborate and idiosyncratic form. Always aiming for the utmost generality (or Thirdness), Peirce’s goal, as Gardner suggests, was not to create a tool for solving specific logic problems, but to create ‘a method of analyzing in detail the structure of all deductive reasoning’ (56). Diagrams suit logicians because unlike the mathematician, who aims for speedy solutions by symbolic means, the logician aims for analytic clarity and, as Peirce puts
it, ‘wishes to make each smallest step of the process stand out distinctly, so that its nature may be understood’ (1906, 503). The diagrammer aims for a generally applicable form of relation which gets to the truth of the phenomenon, just as it is ‘not the particular sample that the chemist investigat[es] [but] the molecular structure’ (1906, 493). Peirce’s existential graphs were an attempt to construct a general diagrammatic method for representing logical propositions (starting with simple syllogisms), which, he felt, for all the reasons outlined above, were superior to algebraic notation.

For someone like me not familiar with logic (or the ways logicians entertain themselves), the sorts of propositions set forth by Peirce to illustrate the various rules of his diagrammatic method have a strange psychological suggestibility. For example, ‘There is some married woman who will commit suicide in case her husband fails in business’ (540) (Figure 4_half page). The rules themselves are somewhat confusing and, as is typical of Peirce, are replete with a whole array of novel terms. Whilst I have to admit to lacking full comprehension, Peirce’s exposition does provide a real sense of the way he was engaged in the act of diagramming. He describes a collaboration between two parties (and there seems no reason why these two cannot consist of one and the same person): a ‘Graphist’ who makes an assertion on a ‘plane’ (e.g. a piece of paper), and an ‘Interpreter’ who is to respond. The diagram or ‘graph’ constitutes a proposition and, in accordance with permissions deduced from the conventions of the diagram (the meanings attributable to various diagram elements), the Interpreter can make ‘erasures and insertions of the Graph delivered to him by the Graphist’ (1906, 525). The ‘pure diagram’ is a ‘type’ rather than a ‘token’, that is to say it consists in what the diagram represents at a general level, rather than how it might appear in any particular graphic ‘instance’ (Peirce 1906, 506). Stjernfelt, in his masterful exposition, clarifies this with the following example:
When seeing a geometrical figure drawn on a blackboard, we immediately prescind from the stripe of chalk having any breadth, from the line’s vacillating deviation from linearity, from the drawing having any colour, and so on (366).

The *token* embodies the *type* which follows (symbolic) rules. For example, what in an Existential Graph is called an ‘enclosure’ is a type which transcends its numerous token instances, signifying that what it encloses is negated (this is the rule or convention). In its empirical manifestation as a token, the enclosure could appear in various shapes or sizes (more rectangular, oval or circle-shaped, etc.), not to mention with different thicknesses, levels of wobblyness etc. – all qualities we can ignore (prescind) so long as it can be seen that the line encloses and therefore merely signifies the negation of that stated within. ‘The act of embodying [the graph type] in a *Graph-Instance* will be termed *scribing* the Graph […] whether the Instance be written, drawn or incised’ (Peirce 1906, 506). The sudden mention of incision is surprising, as if we were entering the realms of collage. Peirce’s diagrams begin with a simple graphic vocabulary of enclosures and lines which enable elements of the statement (subjects, predicates, etc.) to be related (connected and negated) in varying ways so as to accurately represent the logical proposition (‘there is some married woman …’). However, in order to include all logical permutations, Peirce explains not only how differently drawn lines (wavy, dotted, etc.) indicate distinct symbolic rules, but also how colour and heraldic ‘tinctures’ should be further utilized to indicate the three ‘modes of Being’: factual, possible and necessary truth (see Gardner, 57). The two sides of the ‘phemic sheet’, if differently textured, can be employed towards further possibilities:
Should the Graphist desire to negative a Graph, he must scribe it on the *verso*, and then, before delivery to the Interpreter, must make an incision, called a *Cut*, through the Sheet all the way round the graph-instance (the proposition to be denied), and must then turn over the excised piece, so as to *expose* its rougher surface carrying the negative Graph-instance’ (Peirce 1906, 528).

We can imagine Peirce sitting at his desk with orderly piles of differently textured paper and with pen, paintbrush, paints and scalpel at the ready, prepared to construct, and make experiments upon, logical propositions in all their manifold possible permutations. This may seem a cumbersome set-up for a practicing logician, but as an image of exploratory diagramming it is appealing. If Peirce’s graphs are, as he claims, a consistent and comprehensive way of visualizing logical propositions, then it should be possible to write a computer algorithm to generate Existential Graphs for any logical statement fed in – resulting diagrams could be attained almost instantaneously. But this would seem to miss the crucial point, which is that, through an intense, iterative process of inscription and erasure, diagramming produces in the diagrammer an understanding of the object which is qualitatively different from results achieved as a ready-made output in that it extends our analytic powers beyond information garnered from the immediate object under consideration. Lines on the page trace connections and patterns which, ‘partak[ing] of some overt character of its object’ (Peirce 1906, 496) are in a sense simultaneously inscribed also in our mind in ways which resonate and ‘cut in’ for future use through focused trial-and-error experiment. If thought as such is in some way diagrammatic, then the act of diagramming enables one to observe and extend thought before one’s own eyes, and the diagram is in fact an ‘index’ of this very process of mental probing and cognitive growth.
Whilst the iconic construction of propositions ‘draw out’ inferences and so formalize deductive reasoning as such, they also engage (to complete another of Peirce’s trichotomies) *inductive* reasoning (tests made on the diagram with respect to the object it claims to represent) and – crucially for exploratory as against merely communicative processes – *abductive* reasoning, which Peirce defines as ‘the provisional adoption of an explanatory hypothesis’ (Peirce 1906, 511). Abduction is the primary mode in which a diagram gets constructed in the first place, in a process of feedback between object and icon, as the diagrammer ‘makes a guess about how to formalize a given phenomenon’ (Stjernfelt, 372). In my experience this abductive process can last for long and interrupted periods of time, as one attempts to clarify and bring into being an often vague object, or one with multiple possibilities of description, through an appropriately useful delineation of relatable parts. Peirce’s Existential Graphs of course display the pared down structures of logical statements, but his theory holds for any object represented through an analogy of its parts. Even the most purely iconic of diagrams includes symbols (rules telling us how to ‘read’ drawn elements such as circles or lines) and indices (such as arrows or ‘keys’ connecting us positionally or with respect to information elsewhere).9 Diagrams are also, as we have seen, embedded within material ‘tokens’ whose suggestibility in terms of what its aesthetic qualities or figurative potentialities might offer to the Interpretant (a wobbly line perhaps indexing nervousness, for example), should be prescinded for the sake of the purely iconic form. Exceeding Peirce’s definition, we can envisage semiotic hybrids sprouting metaphorical and allegorical signs from the branch-like icon of relations. Beyond Peirce’s own diagrammatic ‘madness’, and following a more ‘aesthetic’ line of thought, a final triad might be productive. Whilst Peirce in his ‘Prolegomena’ describes the diagram in terms of the ‘type’ and the ‘token’, he also very briefly brings in a third term, the ‘tone’, although with no further elaboration. Tone is defined as ‘an indefinite significant character such as tone of voice’
It seems to me that the type-token-tone triad might prove fruitful from an exploratory point of view in describing the ways diagrams can signify with respect to the meanings and interpretations different instantiations might proffer beyond the generally applicable, regulative (symbolic) meaning of the type. We can consider contingent and idiosyncratic manifestations of basic diagrams, and take account of how the way something has been drawn might not merely be a specific distraction from the general meaning aimed for, but productive of new meaning, of new interpretations, whilst not collapsing entirely into the Firstness of aesthetic qualia and pure potential, but retaining an iconic ‘skeleton’. There are an infinity of ways in which a diagram could determine an Interpretant to a feeling or an action, as well as to another sign.

Châtelet: Gestures

A diagram can transfix a gesture, bring it to rest, long before it curls up into a sign, which is why modern geometers and cosmologers like diagrams with their peremptory power of evocation. They capture gestures mid-flight; for those capable of attention, they are the moments where being is glimpsed smiling (10).

The philosopher and mathematician Gilles Châtelet also emphasizes the experimental capacity of diagrams, but unlike Peirce the focus is not on revealing relations through iconic representation, but on reconfiguring reality through embodied modes of thought. His book Figuring Space is a literally close-at-hand telling of scientific discovery as diagrammatic thought experiment. Diagrams are of course familiar from popular science books, but are almost always illustrative of pre-existent models. To give a contemporary example, the third
of Carlo Rovelli’s *Seven Brief Lessons on Physics* is told through a series of diagrams that represent the altering conceptions of the universe and our place in it over the course of human history. Introducing his use of diagrams, Rovelli writes that ‘before experiments, measurements, mathematics and rigorous deductions, science is above all about visions’ (21). Whilst Rovelli’s justified intention is to reinstate the often-neglected status of images and drawings in physics as a creative and explanatory power, his methodological intention is quite in contrast to Châtelet, for whom experiment, logic and mathematics are entirely imminent to diagrammatic ‘vision’ rather than separate from and following after it. Crucially, for Châtelet, diagrams manifest a continuously evolving material grappling with physical dimensions rather than the sort of synoptic overview of shifting paradigms that Rovelli presents. Châtelet’s purpose with diagrams is not to give us a posthumous and reader-friendly graphic overview of cosmic enigmas, but to get inside and up close; to palpably inhabit the thinking of spatial transformation.

There are examples in science where we catch a sublime glimpse of diagrammatic thinking in action: Darwin’s field notebook where an ‘I think’ is followed by a rudimentary ‘evolutionary tree’ spilling out on the page and interrupting a text unable to contain the concept. Darwin’s modest gesture in ink condenses in embryonic form the entire theory of natural selection that would be written up more than twenty years later in *The Origin of Species* (Christianson, 136-7). Châtelet, who abhors scientific clichés, is attracted to the practical, embodied visions of physicists, like Einstein travelling alongside a photon, or free falling through space in an enclosed elevator, *feeling* himself suddenly back on solid ground as the elevator is winched up by some ethereal being. Such thought experiments propel the physicist into the beating heart of the problem; they are ‘allusive devices’ whereby ‘the physicist-philosopher takes upon himself to lose his bearings’, ‘to let himself float between
mathematics and physics’ (11). For Châtelet diagrams are preeminently embodied and haptic forms of exploratory thinking. Once a diagram is used retrospectively to seamlessly illustrate an operation such as a geometrical proof, its gestural becoming and ‘roughness’ (7) is forgotten and a mystification occurs: ‘the “hand” seems to become increasingly invisible and the “application” very quickly forgets the gestures that it mobilizes’ (1). Far from a ‘clarifying’ imposition of reason – a Kantian schema or Cartesian grid – scientific diagramming, for Châtelet, marks an intuitive procedure whereby ‘gestures and problems […] guide the eye and hand’, as reality is unfolded into ‘new dimensions’ of being’ (3).

Châtelet’s philosophical ambition for science is, he insists, ‘irrational’:

a confused desire to take up again in the flesh of what is perceived as a whole that has been mutilated by technical dispersement, a genuine nostalgia for magical power (3).

Such promethean powers are nevertheless patiently and modestly inscribed in the diagrammatic process itself, which Châtelet describes as follows: a gesture unfolds or ‘cuts out’ a new dimension of reality which the diagram immobilizes, captures ‘mid-flight’, so as to ‘set down an operation’, an articulation which itself constitutes another ‘cutting’ gesture (10). Diagrams function then as ‘relays’, as Kenneth Knoespel says in a Deleuzian context (Knoespel, 147), passing on the ‘devices’ necessary for the ongoing development of new visions. If the instructional diagram ossifies and forgets the gesture that brought the new reality into being, and the popular cliché ‘soften[s] the technical nature of the operation and its “cold” exteriority by a warm confusion’, Châtelet’s diagrams propel us into the pulsating materiality of the mathematical universe. As Alain Badiou emphasizes, Châtelet’s goal is not to ‘construct any history of the sciences’, but rather ‘to rediscover and write the subjectivity
of knowledge, the gestures it makes not when it is being taught or imposed, but when it is alone at home’ (Badiou, 169).

‘At home’ for Badiou means that science is caught up in the dialectic. To get a sense of this living pulse of scientific thought, I will briefly go through some of the stages of diagrammatic unfolding with respect to the emergence of electromagnetic theory in the nineteenth century (the subject of the final chapter of *Figuring Space*). Familiar personages and inventions are present, but the focus is elsewhere than on biographical detail or historical ‘progress’, as Châtelet pulls us into a vital process of gestures and articulations which describe the production of a new ‘electrogeometric space’. What we witness – the ‘triumph of the lateral’ (150) – may sound abstract but it could not be more material, as the dead distances of Newtonian interaction come alive with pulsing energies, and the indifferent extensions of Cartesian coordinates become filled up with active figures, ejecting us from our comfortable, disembodied vantage posts (both scientific and historical) and dragging us into new fields of force. This diagrammatic unfolding begins, typically enough, with an opposition, one sketched out by Schelling: magnetic polarization intuitively appears as ‘paralysed direction’ (e.g. in a metal bar), and thus refers to length and stretching; electric polarization, by contrast, appears as a separable charge, and thus refers to width and spreading. How is this opposition resolved?

‘Schelling is driven to bring in a third dimension which makes it possible, through penetration, to articulate the ‘stretching’ with the ‘spreading’, and heralds the arrival of the electrogeometric space of nineteenth-century physics’ (150).
The stakes in this geometrical adventure are to overturn the ‘hegemony of the longitudinal’ (North Pole – South Pole; attraction – repulsion) and liberate the lateral in order to ‘engage space completely’ (150). Length, for Châtelet, constitutes a sort of immateriality stretching out from an origin point – a line (spatial or temporal) ‘along which my look can travel’ (150). The linear dominates, as with a ruler – a bar with intervals – whose width is merely something length joins itself to; but its stretching has ‘little to tell us about the gesture that unfolds it; it dismisses and flees the point zero from which it arises’, as if $O$ were a nail ‘on which a length can be hung’ (151). Now, in order to facilitate an articulation to break the dominance of the linear, Châtelet asks us to imagine a manual device – a pair of compasses or pincers. The compasses substitute an active middle point or origin for the forgotten origin point from which the lengthening line flees, allowing us to intuit the birth of a dynamic line, its two sides spreading out simultaneously from the fulcrum (rather than travelling from one point of a ruler to another). The pincers act in this instance as the crucial ‘allusive device’ (2) and demonstrate what Châtelet means by a mobilizing gesture, opening out like a hinge to generate new embodied dimensions on a virtual plane. The compass device is a mode of active thinking insofar as it ‘give a point of view to the hand’ as ‘the angle incites the hand to open out into two sides’. The angle thus embraces the sides and ‘invites a second dimension, another world where the geometer may virtually propel himself’ (151). Gestures, for Châtelet, have agency – they ‘invite’ and ‘incite’; and the geometer is no longer an abstracted external observer but someone who ventures within, who activates and is drawn into, the newly forming spaces.

Châtelet continues with magnetic bars, which resemble the linearity of rulers in that they are frozen pieces of space. Zero as the middle point, where polarities might be expected to neutralize, remains ‘prisoner of […] matter’: cut a magnet in half and it reconstitutes its
opposed sides (N ---- S = N --- S N --- S, etc.). The charges are not isolable, they do not attain autonomy, but are ‘pinned to matter like an orientation label’ (152). Point zero is ‘the fulcrum of nothing and neither carries away or propagates anything’ (152). Electricity, by contrast, ‘with its charges that are separable by experiment, produces diagrams that are very different from those of magnetism’, diagrams that spread out and create width, as already intuited with the pincer arms. Because electricity splits zero into opposite polarities, creating an equilibrium where current can flow, zero gains its own spatiality which Châtelet calls an ‘around’ (154), a fact demonstrated in the diagram of Volta’s battery, where a wire enables current to travel in a wide loop between positive and negative metal plates (153). This new figuration of space, delineated by the technological device itself, has far reaching consequences: ‘A new around has been grasped diagrammatically in nature and thought’ and ‘the era of the circuits has begun’ (154).

The next historic gesture occurs when the physicist Orsted notices how a conducting wire is causing a magnet’s needle to swing off course; a moment which constitutes, for Châtelet, ‘the irruption of a fierce laterality’ (156), and with it the birth of electromagnetism. When Ampere builds on this discovery, folding the conductor into a helix, the solenoid diagram is created, ‘capturing’ the new dimension. To illustrate the direction of forces, Ampere draws a little man, a ‘bonhomme’, electrified with current running up his body, whilst extending his left arm to the side to indicate the direction of the magnetic field it creates (Figure 5_half page or smaller). Châtelet compares this new articulation graphically with another little man drawn on a plane, observing at a ‘safe’ distance the current that spins in a circle on the same plane (Figure 6_half page or smaller). But in order to follow the current helically, the observer must penetrate through this circle; his or her entire body must be mobilized. Hence Ampere’s
*bonhomme*, or what Maxwell later imagined through his own heuristic analogy, as a corkscrew:

‘Ampere’s *bonhomme* must turn *himself* from *his* right to *his* left in order to follow the circuit with his gaze, the corkscrew *transforms a flick of the wrist into a penetration* or, what amounts to the same thing, a progressive spreading out into height’ (158).

The series of gestures related so far show that polarity is not found by moving along a line, but is produced laterally or axially, whereby poles emerge simultaneously within a field. The old icons of linearity, the North and South Poles, which seemed to have their respective polarities geographically sunk into them, have become ‘scars of the old imagery’ (160).

It is evident that Châtelet’s concept of the diagram moves way beyond conventional notions, extending to embodied imaginings, the (virtual or real) use of instruments, and the physical indexes of laboratory experiment and technical invention insofar as any of these constitute significant gestures which articulate, open up, capture and create space. Maxwell’s corkscrew is a ‘robot’ flung into action (although appearing today ‘ossified’ as a universal educational heuristic). Even physical effects are diagrams insofar as they capture unseen material gestures, as such harboring a virtual potential for instigating new gestures. And so, the pattern of iron filings around a magnet are witnessed by Faraday not as a curious secondary effect of remote forces, to be passively observed, but as ‘incitements to provoke space, as diagrams, as *dotted-line experiments* alluding to “real” experiments that manifest latent actions’ towards the envisioned presence of invisible, elastic webs of energy (166). The work leading to Faraday’s electric motor is described by Châtelet not in terms of coolly applying a theory (the axial rotation of current in relation to a magnetic field that loops through it) but, in the most
immersive and implicated of terms, as a way of conspiring with these unseen forces, ‘to stage the rotational and the lateral in order to saturate himself with self-evident facts’ (164). From this perspective, Faraday’s world-changing technology, whereby charged metal rotates around a magnet, delineates a gesture as an answer to the physico-mathematical problem of linearity and fixed poles: it ‘demonstrate[s] the autonomy of the axis-loop system by showing its capacity to capture and […] reproduce certain gestures at will’ (165). At a cosmic level, this vision of invisible electromagnetic forces is given graphic form in a hand-drawn diagram accompanying a letter Maxwell sends to Faraday showing the sun in the shape of a comet. The sun’s ‘lines of force’ radiate outwards, spreading then narrowing, to create what looks like a curvilinear ‘tail’ around a planet – an effect of the planet’s own electromagnetic field. Maxwell’s modest diagrammatic rendition of Faraday’s intuitive, lab-informed hypothesis captures, prior to physical evidence as to its object, the reality of what Maxwell will later theorise symbolically (mathematically) in his unified wave theory, and which more advanced instruments will eventually reveal as indexical traces of radiation. The mechanical universe of action at a distance has been replaced by a material universe thick with pulsating energy. As Châtelet writes, ‘Faraday was the first to see electrogeometric space throb’ (167).

Certain inventions change the course of history, but at a more subterranean but consistent level they describe gestures that reconfigure the dimensions of time and space; they are gestures that can be reactivated and developed, ‘picked up’ again in an ongoing process of thought. Alain Badiou remarks on the way Châtelet goes against the grain of much philosophy of science and its obsession with discontinuous breaks, instead emphasizing continuity, which is much more profound because old problems do not go away so much as get reconfigured. As Badiou poetically expresses it:
Thought sleeps in temporal continuity. There are never anything more than singularities that can be reactivated and creative virtualities that nestle in the folds of time (174).

Epochs are marked not by technological and theoretical ‘revolutions’, but, as Chatelet emphasizes, by ‘gestures and problems’ which, ‘unknown to geometers and philosophers guide the eye and hand’ (Châtelet, 3). And therefore, beyond the official channels of knowledge transmission, ‘initiates’ tune into ‘a whole network of allusions interlaced with the literal text and continually overflowing it’ (7). We are clearly very far from the notion of the diagram as a rationalizing tool, imposing order on chaos, organizing matter to produce scientific knowledge.13 But if we might imagine gestures to be the dreams the ‘sleep of reason’ throws up, then diagrams have, for Châtelet, a practical modesty and precision which make them operational objects of experimentation – and in this respect at least there is a strong affinity with Peirce’s conception. Where Châtelet clearly departs from Peirce is in his appreciation of the non-representational gestural moment of embodied diagramming, and the ways such gestures carry the association – even sexual at times (‘lengthening’, ‘spreading’, ‘penetrating’) – of other imaginary, metaphorical and tool-based gestures as a means to arouse and conquer new dimensions of physical space. The ‘virtual’ defines not the ideal diagram ‘type’ corresponding to its object’s related parts, but the (physical) object itself which can only be unleashed through a developing series of embodied gestures.

References


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1 I would like to thank David Burrows, John Cussans and Mary Yacoob co-members of the Diagram Research Group for conversations throughout the period of research for this paper. I’d also like to thank the editor Claire Scanlon for giving me the opportunity to finally examine a number of diagram theories in some depth.

2 The point here is to indicate a direction of travel rather than lay down strict borders. Many statistical and explanatory diagrams are exploratory in various ways (traces of discovery and invention remain) whilst more strongly exploratory diagrams do not necessarily dispense with information or explanation.

3 For a reading of my Metallurgy of the Subject diagrams see Weeks (2019).

4 Greimas and Rastier’s semiotic square appears to be based on Aristotle’s logical ‘square of opposition’ system of ‘contraries’ and ‘contradictories’ as presented in ‘On Interpretation’ (2001, 49-52), although this is not cited. Aristotle’s rectangular plotting of the four qualities (hot, cold, moist and dry) as a set of two contraries standing opposite each other, ‘gives rise to’ the four elements (Fire, Air, Water and Earth) as points located in between: ‘For Fire is hot and dry, whereas Air is hot and moist’ etc. (Aristotle, 511). Notwithstanding its utilization as a fixed model of the elements, it is the creative capacity of Aristotle’s logic machine which the semiotic square develops and which seems to mark the former as ‘exploratory’ compared with Plato’s ‘explanatory’ descriptions of tabulated hierarchies (e.g. Forms – physical things – images and shadows).


6 As Peirce is a realist, ‘real things’ extend much beyond empirical objects.

7 If one would devote several hours a day for a week or two to practicing with the graphs, Peirce wrote, he would soon be able to solve problems with a facility "about equal" to that of any algebraic method yet devised, including one such system of his own (Gardner, 56).

8 Peirce was himself a trained chemist and experimental physicist and his logic graphs were inspired by chemistry diagrams showing, in a notation of spots and lines, how elements combined to form compounds (See Roberts, 17).


10 The many diagrams in Châtelet’s book are drawn in a generic style, which has the function of equalizing the diagrams whether they exist in the world as actual sketches or geometrical drawings, or as technical devices,
thought experiments, written description, etc. This equalization also guards against the intrusion of biography (historical documents) and thus maintains the intense immanence of the diagrammatic unfolding.

11 This gives us a nice example of Peirce’s icon-index-symbol triad in combinatory action.

12 See however Williams (2007) for an account of how Maxwell misinterpreted Faraday’s conception of ‘force’, aligning it with Newtonian action at a distance. Williams reproduces Maxwell’s diagram, although unfortunately at low resolution.

13 ‘Organized material is knowledge and knowledge is organized material’. Denis Diderot, *Encyclopedia* (1751) quoted in Welcome Collection (2016, 8).