ACCESS: CONTEMPORARY ISSUES IN EDUCATION
2011, VOL. 30, NO. 1, 68–77

Entity-Relation: Drawing into space

David Griffin

The Glasgow School of Art OCAD University Toronto

ABSTRACT

The author considers the implications of a graphical application of certain technological tools of measurement and inscription, applied to the geometry of space itself as support, and marking-up a network of impossible proportions. Toggling between depictive and descriptive representation, entity-relationship graphs enable researchers in technical disciplines to work with seemingly irresolvable conditions, allowing data to interact with theory both through cognitively tuned and conventional activities. Through a direct application of the simplest of visualisations—a graph writ large—we may derive an object-lesson about irresolvable scales, and a multi-disciplinary focus for creative collaboration and knowledge generation, in support of a gesture whose existence is equally a matter of time and space.

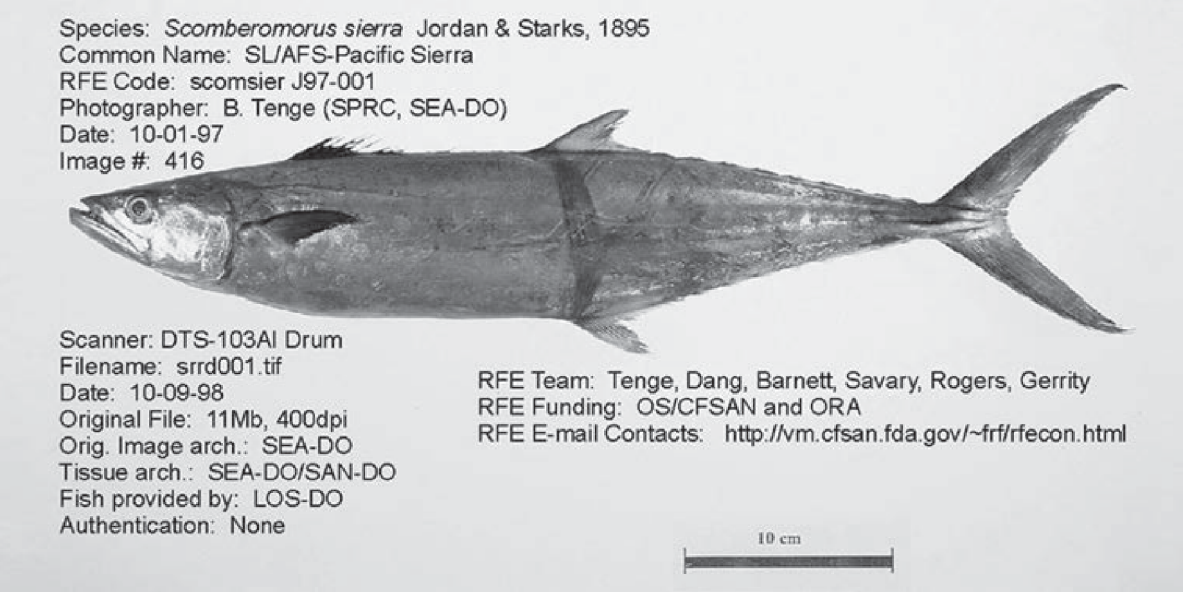

Figure 1. Ut pictura poesis
Comsier, S (2010) The sierra; courtesy of the Regulatory Fish Encyclopedia: U.S. Food and Drug Administration, 1993-2010. Retrieved June 23, 2011, from http://www.fda.gov/ucm/groups/fdagov-public/documents/image/UCM060861.jpg

> We could, if we wished, describe the Sierra thus: "D. XVVOL.II-15-IX; A. VOL.II-15- IX;" but we could see the fish alive and swimming, feel it plunge against the lines, drag it threshing over the rail, and even finally eat it. And there is no reason why either approach should be inaccurate. Spine-count description need not suffer because another approach is also used. Perhaps, out of the two approaches we thought there might emerge a picture more complete and even more accurate that either alone could produce (Steinbeck & Ricketts, 1995: 3).

This fragment, pulled from a hybrid work of documentary and literary writing by the American novelist John Steinbeck and his partner, the marine biologist Ed Ricketts, seeks to exemplify a point of balance between the enquiries of art and science. It offers us a cascade of images that reflect the categorical requirements of the technician, the tinkering of the novelist, and finally, the desire to eat. It is a triangulation whose ultimate objective is understanding, communication and living. In these few sentences, Steinbeck shows us a map of the fish in the coded language of numeracy, but also a representation of experiential and physical dimensions: What is it to see, to struggle with, to haul in, and finally consume the animal? Ricketts might point out that statistical summations, or character-string notations, are conventional and powerful elements of our experience of things and the communication of those experiences, yet for Steinbeck and the fisherman, such descriptions cannot tell the whole story. They represent a specific kind of reasoning as much as they do a fish, and the novelist suggests that this incompleteness might be resolved by retrospective and analogical approaches from the mind's eye of the hunter. "Our disposition to language and mentation (reason, emotion and so on) is a disposition to commune," asserts Cubitt (1997: 43), and if it is true that the object of all formal enquiry is understanding, then Steinbeck and Ricketts—novelist and biologist—are simply engaged in dialectical extensions and admixture of their disciplines for that: to include the sea and the struggle to better know the fish.

Terms and overview

Inscription is a term borrowed from Bruno Latour (1986) as a summary expression, encompassing all modes and systems of mark-making. In his seminal theory of notations, the philosopher Nelson Goodman describes inscriptions as "any mark—visual, auditory, etc…" (1976: 131), but I will accept Ittelson's more practicable characterisation of a mark as being both an artefact of human intention, and located on, but not necessarily referring to a surface—that is, its "informational content is 'decoupled' from (is to some degree independent of) its real-world source" (Ittelson, 1996: 171). This decoupling or displacement is an aspect of our perception and the importance of mark-making as an instrument for understanding, not simply explanation. In Ittelson's terms, "The perception of markings is a pragmatic affair enmeshed in a complex of individual, social, and cultural processes applied to the interpretation of forms that always underdetermine meanings" (1996: 185).

The word 'interpretation' will be defined as in Goldschmidt (1988: 236) as critical readings of, and playful interactions between object and knowledge, leading to stability of meaning found "beyond the additive sum of that of its parts". The word 'representation' is defined here relative to Goodman, who characterised it as a "symbolic relationship that is relative and variable" (1976: 43). In the same spirit, Mitchell asks us to review the problems of representation, concluding it may best be defined as a dialectical relation—not some 'thing', but "a process in which the thing is a participant" (1994: 420). But representation is a product as well as a process, which distinction will be freely abused, as one follows from the other, and as context will be adequate to tell us which is which. In a commonly cited definition, David Marr writes that representation is "a formal system for making explicit certain entities or types of information, together with a specification of how the system does this" (Marr cited in Riley, 2010 : 1). I suggest that reading Marr, we are simply given a recapitulation of Goodman's crucial idea of efficacy, that is, "What matters with a diagram … is how we are to read it" (1976: 170).

The term 'external representation' will include pictorial, textual and diagrammatic entities, any of which may be made or experienced by an individual in Mitchell's dialectical relationship

(1994: 420). As a general definition, I accept Stenning and Lemon's view of a diagram as "a plane structure in which representing tokens are objects whose mutual spatial and graphical relations are directly interpreted as relations in the target structure" (2001: 36). This definition is accepted provisionally; however the drawing research project described here gives us two entity-relation diagrams (Ware, 2008: 23) in a puzzling, non-planar context, convoluting the relations between diagram and target.

I take an agnostic position on arguments in the cognitive sciences around the possible relations between internal and external visualisation (for discussion see Hegarty, 2004; for introduction, Pinker, 1997: 211-298). Note, however, the increasing interest in the use of diagrams and external representations of all kinds among researchers interested in their relative benefits in reasoning tasks, and their uses in "amplifying the mind's eye" (Fish & Scrivener, 1990).

In practice, any drawing is more or less schematic or conventional. While convention is understood here as "regularity … and recurrence" in execution and consumption (Lewis cited in Bull, 1994: 211), the researcher Bryan Lawson (1996) presents 'schema' as re-cognition, or pragmatic memory useful in the formulation of actual responses to perceptual and propositional information. E.H. Gombrich agrees that we should understand schemata as conceptual: visual formulae giving us an experience-based starting point, directed at representational ends: "the means to probe reality and wrestle with the particular" (Gombrich, 1977: 148).

Drawing into space

The focus of my creative research has been a study of notations as environments that integrate symbol systems, extending compositional logics to pictures, sounds and movements, permitting us to create the conditions for performance outside the frame of the notation. Our uses of external systems for representation provide us with scaffolds from which we can build, synthesise or even test out these speculations. They extend "our mind's ability to visualise" (Fish & Scrivener, 1999: 118). Out of this theoretical work, a drawing project is developing with intriguing possibilities for interdisciplinary action. These drawings will be graphical applications of certain technologically sophisticated tools normally used in measurement and industrial cutting or incising tasks: the coherent light of laser, here used for its linear values—a kind of pure line applied not to paper, but to the geometry of space itself as support, in what I regard as a seeking-out and marking-up of a series of impossible proportions.

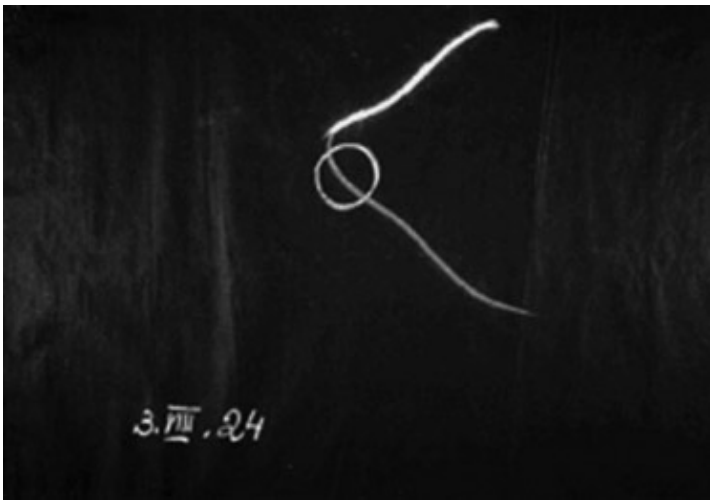

Figure 2. The Realm of the Angels, Steiner, R, (1924). Steiner visualised lectures on chalkboards. This drawing also happens to be a passable general diagram for the drawings proposed here. Reprinted courtesy of Collection of Rudolf Steiner achlassverwaltung, Dornach, Switzerland.

We should begin by remembering Ittelson's characterisation of a mark as an artefact of human intention, 'decoupled' from its real-world source (Ittelson, 1996: 171). Among other things, this drawing research project will show this decoupling to be deeply and perversely problematic. I have put the title "Ut pictura poesis" to the two principle drawings discussed here, after another ancient, analogical project, which considers the relationship of poetry to pictures, as an alternative to the sound-vision dialectic of the other drawing projects.

The first of the two drawings proposed is composed from a one-second burst of Laser, aimed at the centre of our Milky Way Galaxy.

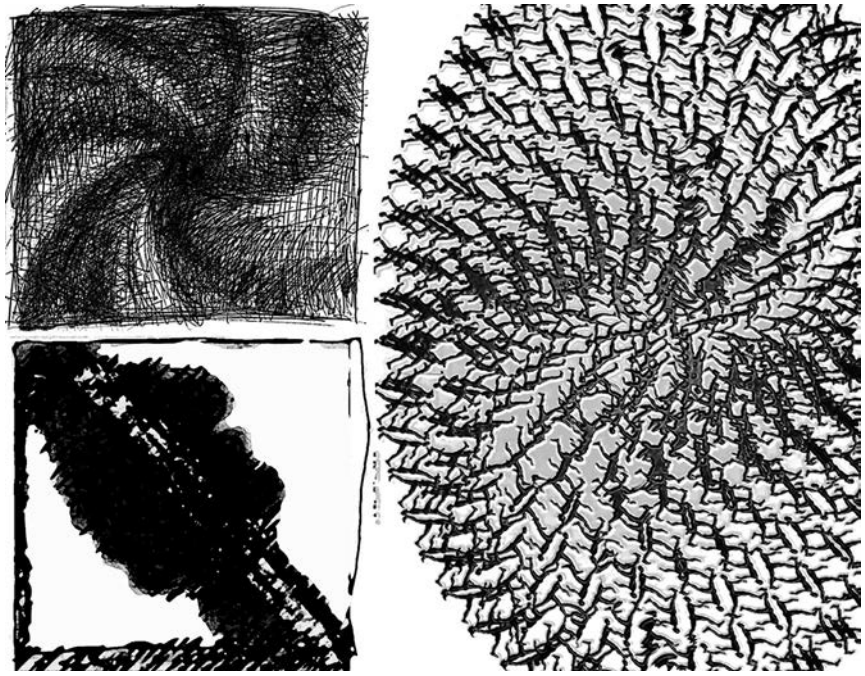

Figure 3. "Ut pictura poesis": Multi-view orthographic projection, from the research journals of author, Griffin, D. (2009-10)

The line drawn will thus have approximately 300,000 kilometres of length, and will result from a series of technical questions related to orientation, distance, and other physical matters, in support of an event that will take one second to begin, and something on the order of 25,000 light years to complete, assuming completion is possible.

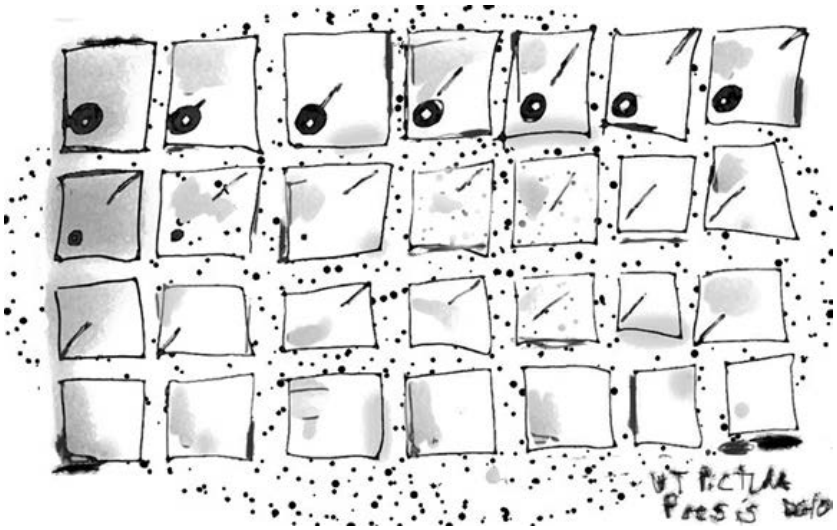

Figure 4. "Ut pictura poesis": developmental cartoon, from research journals of author, Griffin, D. (2010)

Remember that researchers in technical disciplines, as users of data and information visualisation systems, are often tasked to describe what seem to be irresolvable conditions and an array of processes that are far easier to enumerate than to illuminate, and which tabular approaches do little to clarify. Key studies in visualisation practices have established that simple node-link graphs are critically useful in such tasks: their portability, flexibility, and collaborative qualities make them most persuasive and probing tools, bridging theory and practice, and extracting some measure of sensible reality from otherwise invisible entities (see Ware, 2008; Tufte, 2001; Smith et al, 2000; Krohn, 1991). Bruno Latour has written that "the simplification of the universe, both in terms of the qualitative diagram and in terms of the small and well-regulated language, makes inspection of the entire universe possible. Hence, generality is made possible" (Latour, 2008: 454). The drawings proposed here will test this observation: they are node-link diagrams, meant to enable graphical thinking on complex problems, but here placed in contexts where their pragmatic utility is met by senselessness; the simplest of modelling systems, in other words, drawn to scales that are actually incomprehensible.

The second and much smaller (briefer) drawing will draw a semantic network between our planet and the other planetary bodies in our immediate space.

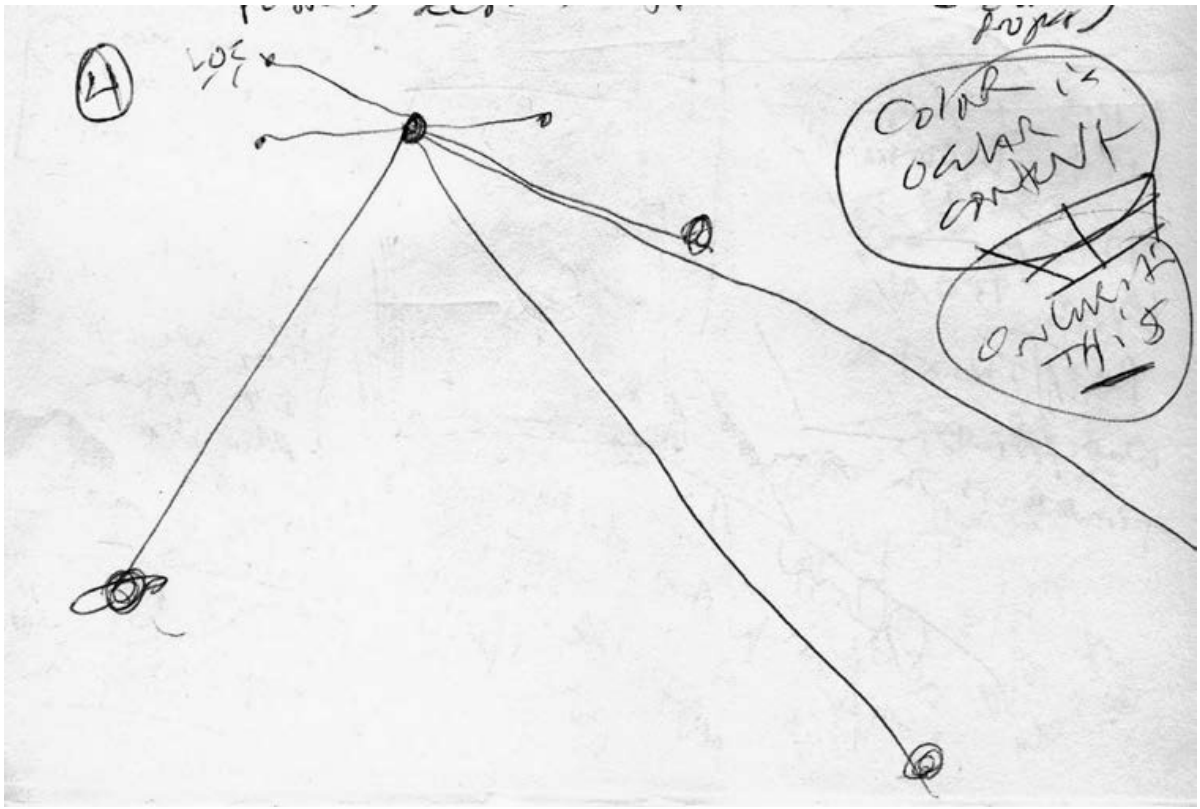

Figure 5. "Ut pictura poesis 2:" Developmental sketch for the second of two drawings, from the research journals of author, Griffin, D. (2009-10).

This is also an absurdity in fact, delivered in the soft fiction of metaphor. As a coordinated, collaborative drawing, each of the lines drawn will link us directly to those seven familiar, mythically charged entities with which we share our local physical space, and this semantic network will have the additionally absurd property of 10 billion kilometres of linear length. Among other things, the very idea of scale and scaling is thus muddied, as we must seek refuge in a cascade of diagrammatic, numerical and literary views on the problem, all of them facilitated by line.

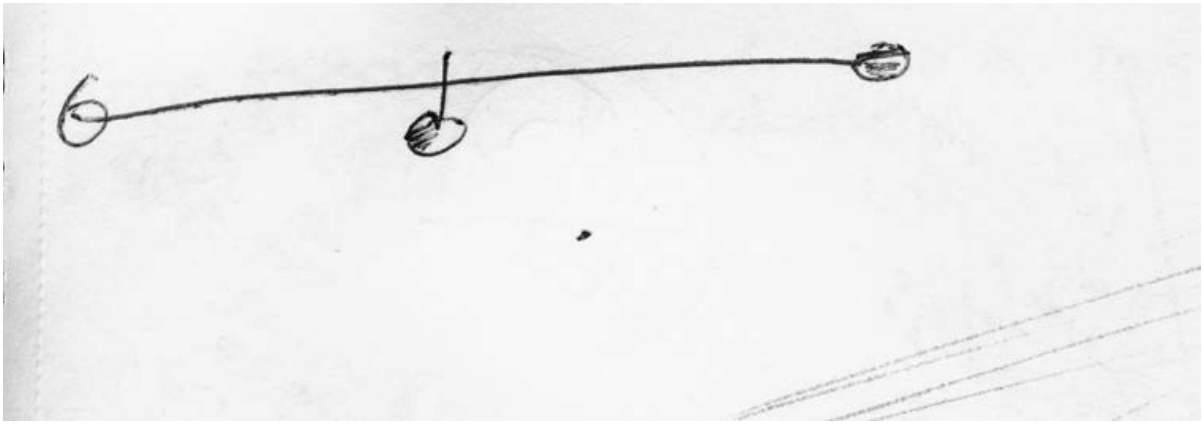

Figure 6. "Ut pictura poesis 2:" Developmental sketch for the second of two drawings, from the research journals of author, Griffin, D. (2009-10).

Topologically inscribed, in conversation with scientific and mathematical enquiries, these drawings will become diagrams with impossible phenomenal and conceptual characteristics— lines made on surfaces, but the sum of those lines and surfaces will be decisively uncertain. They can be seen only in retrospect, in the mind's eye, as tests of intuitive thinking on unattainable dimensions, thereby generating a number of questions about the relationship between artistic and scientific knowledge, and how these disciplines can actually engage. Through the use of the simplest of data visualisation strategies—a graph, writ large—we may derive an object-lesson about irresolvable conceptual realities; and as drawing research, the project will encourage interactions with other fields in support of a gesture whose existence is equally a matter of time and space.

Word and image

W.J.T. Mitchell offers Lessing's *Laocoön* as a text that seeks to illuminate the relationship of time and space in the sister arts of painting and poetry (1998: 95-115). Held in the head, so to speak, such graphics amount to interleavings of time and space, soiling Lessing's well-known literary distinctions between the dimensions of representative action that distinguish the visual and verbal arts. They are intended as programs of creative practice that push to an extreme the values of inscription as a mechanism of exchange between dimensions, acknowledging that, as with Steinbeck's and Ricketts' fish, no representation can tell the whole story. Although not absolutely fixed, even for Lessing, Mitchell reviews the philosopher's distinctions, which are bound to an opposition of idealisations: in Lessing, painting and sculpture are spatial arts, primarily of the eye and directed in their significance by our perceptions of the spaces in which we move; while poetry is an interior art of time and passage. Dismissing this as a categorical mistake, Mitchell writes:

> Works of art, like all other objects of human experience, are structured in space- time, and…the interesting problem is to comprehend a particular spatial-temporal construction. A poem is not literally temporal and figuratively spatial: it is literally a spatial-temporal construction (1998: 103).

The critic argues against Lessing's schismatic relation as an ideologically motivated trap, and a utopian hectoring directed at those working with aesthetic theories. The critic also notes that the word-image dialectic sustains itself as a matter of interest in a range of contemporary contexts, informed by digital practices and theoretical currents, which tend to dissolve the kinds of artificial boundaries Lessing proposes, in spite of demands for coherence and consistency.

Nelson Goodman's project in "Languages of art" (1976) suggests that there are, in any case, few resolute distinctions to be drawn between pictures, diagrams or words qua inscription. In his analysis, representation is always a mixed engagement: words and pictures mingle unbidden, and any attempt at a 'pure' expression is problematised from the outset. As a matter of practice,

then, how might we reconstitute Lessing's dichotomous relationship from a post quantum-mechanical perspective which he could not have anticipated? Such a question is enough, from the point of view of the artist-researcher, to begin to explore working processes that might take into account the strangely enhanced horizons opened to us by new technologies, the deeply integrated technical and computational perspective through which we may re-view them, as well as renovated notions of what constitutes an image worth considering (for discussion see Elkins, 1995). Such a start may also allow for something of the kind of wandering, heterogeneous art-making which is at the core of Nicolas Bourriaud's conceptions for contemporary art discourse (2009).

Entity relations

Science theorist Leonardo Peusner has asserted that a key method in visualising non- visual information has been the node-link graph: its entity-relationship modelling provides a tool for recording and understanding relationships, from "molecular skeletons in chemistry, (to) particle interaction, and thermodynamic networks" (2002: 33). Peusner describes their usefulness in plain terms as allowing us to represent structural, logical or sequential information without the need to use 'real' math. Meanwhile, behavioural scientist Laurence Smith (2000: 85) has written, citing Lynch that "Graphs are "revelatory objects that simultaneously analyse what they reveal". And despite an absolutely essential *in-visibility*, the set of drawings I am proposing here are graphs in this sense. Through their application onto the tangle of distortions and misrepresentations, which have grown in the spaces between what I know and what I do not—or cannot know—those who see the drawings have an opportunity to examine intuition as a rational response to unreasonable quantities. This is Steinbeck's notion of a cascade of representations applied to a kind of absence, rather than a kind of fish.

At the scale of human experience—best measured in handfuls, and footfalls—it may not be possible to comprehend those distances at either end of the range between atomic and astronomic spaces. Our very scale seems to prohibit the direct mapping of physical behaviours from our experience onto subatomic structures. We are prisoners of this incomprehension such that it is problematic even to apply metaphorical terms to our situation (Dawkins, 1999). However, as a useful external aid, we can hold in our hands and look upon diagrammatic representations like Bohr's model of the atom (Miller, 1995: 185).

In the task of bringing physics and perception together, the scholar Arthur Miller has observed thoughtfully that Bohr's notation gives palpability to ideas with troubling implications, allowing an intuitively grasped physicality for what may never be anything more than a theoretically inscribed entity. "Clearly, any visual imagery of atoms could not be of the sort produced by a combination of our perceptual systems and cognitive apparatus" (Miller, 1995: 186). The Bohr metaphor nonetheless remains lodged in our imaginations as a spent image, a traction-free argument, now recycled as a simple display graphic or iconic logo in corporate or industrial contexts, which allows us to see a truth about things we can never perceive as factual, but only in estimation.

Since the shiver of uncertainty has had to be incorporated into the aims and expectations of the physical sciences, those of us who wish to grasp the operative principles of matter and light have had to abandon Bohr's schematic representations. In the wake of quantum mechanics other models have developed which take a node-link graphical turn to order questionable logical relations.

The Feynman diagram (see Feynman, 1949) named for the physicist who developed the reductive, chalkboard graphism from his quantum mathematical figuring, visualises the non-intuitive interactions of atomic things. Through its use we may engage with relations that are more reliably described in the arcane proofs of mathematical discourse, but which are made tangible—more real, even for Feynman—in his spatialised inscriptions. Quantum mechanics, after all, provides an infamously bizarre set of questions to be addressed. Crossing bridges in Königsberg, as Leonard Euler attempted to do without doing, is the least of our problems in this particular problem set

(Carlson, 2009). But as in Euler's solution, the diagram becomes both analysis and argument. Seeming to refer directly to the word and image dialectic in the context of a Feynman diagram, the physics professor Milan Jaros writes that "paradoxically, both theoretical physics and poetry not only share the common origin (in divination and cosmogony) but—as it turns out—the common fate in that today they both explore 'credible impossibilities' via narrative structures" (2005: 7).

Taking a measure

In the modeling of physical knowledge, as in the inscriptions of Bohr or Feynman, or the life- drawing studio, or even the use-free casting of a number of lines of coherent light which are described here, it is difference rather than depiction that is the thing. There will need to be a range of consultations and computations undertaken for these differences to be integrated into the drawing research context—for the lines to be enacted; and moreover, there must be a pragmatic recognition of some essential impossibility built into the work. This futility reflects some measure of the general condition of representation, at least from the perspective of either the painter or the poet (I am unable to speak for the cosmologist). Certainly if there is beauty in them, it is in their very impossibility. As components of a drawing-research project, the actual inscriptive acts will be events measured in time: they are thus works of visual art that are, contra Lessing's distinction, equally temporal as spatial, and like the Bohr model, may retain some form of existence in the mind's eye only if luck prevails, long past their post date.

We may enter into additional flows of metaphor, asking questions about the relative direction of "the centre" of the Milky Way Galaxy, both here and now, and so long from the moment of the line's enaction. Where and when, exactly, shall we point our line-maker into space- time? How long must each line be in order to form a continuous connection between us and any of our planetary neighbours (a question with at least two correct answers)? Exactly where is this drawing? What is the significance of an external representation, with which we are prohibited from interacting not because it is hidden away, but because it is beyond us? Moreover, what is the relationship between such a drawing and its putative object? Is it good? Is it a hypothesis? Does it provide variables and experimental frameworks for discourse? Are these entirely rhetorical drawings? How are we to judge its success or failure as plan, as idea, as proposition? How, in other words, can such a thing become an integrated component-practice of research?

More practically, is there a window of opportunity through which we might connect ourselves to all the planetary bodies on the same evening, opening up the possibility of another conclusion devoutly to be wished—that is, a multi-national coordinated drawing activity? Finally, leaving aside any earth-bound obstructions, we must answer questions about diffusion, or what might interfere with line-formation and coherence in those spaces lying between the nodes of these enormous edges. Furthermore, what are the odds of such an occurrence? And of course, there is the sweet likelihood that our current state of knowledge is simply inadequate, which will reveal the project as a mere phantasm of a worldview. The spine-count of Steinbeck's Sierra can be adequately measured, after all, with the edge of a knife, but how to apply the knife to something which dimensions we cannot see, nor even really intuit?

In an informal response to a presentation of these drawings at the RMIT/UAL *Drawing Out 2010* conference in Melbourne, Australia, the painter Stephen Farthing described them as 'rhetorical', and while possibly true, the drawings nonetheless suggest a rich vein of epistemological as well as merely technical questions, with intriguingly unstable answers— certainly a vexed condition to which any productive art practice aspires. But they are not merely rhetorical—they will be drawn in fact; and then the meaning of that expression is confounded, joining others in the wake of this drawing research. They are pictures, but are free of aesthetic qualities insofar as they cannot be directly apprehended, or at least not for long; but they are also free of use, that is, they are not representative, cannot exemplify or denote anything but some view on our own limitations, and of

Figure 7. Griffin, D. (2010) Dot, mixed media: A node link graphic derived from key diagrams from the Isometric projections project.

course they may be utterly wrong. As external representations with which we cannot interact, they will represent things that are quite un-representable.

"Pyramids, cathedrals, and rockets exist not because of geometry, theory of structures, or thermodynamics, but because they were first a picture" wrote technology historian Eugene (1977: 827). Now if we recall Steinbeck's suggestion that, "Perhaps, out of several approaches, there might emerge a picture more complete and even more accurate that any could produce on its own" by means of mapping operations with both visual and literal properties—and the hub of which is 'us'—there might emerge an opportunity to give voice to unsayable things, and perhaps to say by showing. As drawing research, the project will rely on technical and social interactions and communication, in support of a gesture whose existence, such as it may be, is equally a matter of time and space, and moreover, of fantasy as a function.

References

Bourriaud, N. (2009). Altermodern Manifesto, Postmodernism is Dead. *Tate Modern|Past exhibitions|Altermodern*. Retrieved January 4, 2010, from http//www.tate.org.uk/britain/ exhibitions/altermodern/manifesto.shtm

Bull, M. (1994). Scheming Schemata. *British Journal of Aesthetics*, 34(3), 207-217, http//bjaesthetics.oxfordjournals.org

Carlson, S.C. (2009). Königsberg bridge problem. *Encyclopædia Britannica. Encyclopædia Britannica 2009 Ultimate Reference Suite*. Chicago: Encyclopædia Britannica.

Cox, R. (1999). Representation Construction, Externalised Cognition and Individual Differences. *Learning and Instruction, 9*(4), 343-363. Retrieved December 12, 2010, from http//linkinghub. elsevier.com/retrieve/pVol.II/S0959475298000516

Cubitt, S (1997.) Online Sound and Virtual Architecture (Contribution to the Geography of Cultural Translation). *Leonardo Music Journal, 7*, 43-48. Retrieved February 23, 2011, from http//www.jstor.org/stable/1513244

Dawkins, R. (2006). *The Blind Watchmaker*. London: Penguin.

Elkins, J. (1995). Art History and Images That Are Not Art. *The Art Bulletin, 77*(4), 553-571.

Farthing S (2010). Palin and the Bear. Keynote address at *Drawing Out 2010* Festival and Conference of Drawing, conference proceedings, RMIT University, RMIT Press, Melbourne, Australia.

Feynman, R.P. (1949) Space-Time Approach to Quantum Electrodynamics. *Physical Review, 76*(6). 769-789.

Fish, J. & Scrivener, S. (1990). Amplifying the Mind's Eye, Sketching and Visual Cognition. *Leonardo*, *23*(1), 117-126. Retrieved December 12, 2010, from http//www.jstor.org/stable/1578475

Goldschmidt, G. (1988). Interpretation, its Role in Architectural Designing. *Design Studies, 9*(4), 235-245. Retrieved December 12, 2010, from http//linkinghub.elsevier.com/retrieve/pVol. II/0142694X88900099

Gombrich, E.H. (1977). *Art and Illusion*. London: Phaidon Press.
Goodman, N. (1976). *Languages of Art*. Indianapolis: Hackett Publishing Company.
Hegarty, M. (2004). Diagrams in the Mind and in the World, Relations between Internal and External Visualizations. In A. Blackwell, K. Mariott & A. Shimojima (Eds.), *Diagrams 2004, LNAI 2980* (pp. 1-13). Berlin: Springer-Verlag.
Ittelson, W.H. (1996). Visual Perception of Markings. *Psychonomic Bulletin & Review, 3*(2), 171-187.
Jaros, M. (2005). Materia Poetica, Models of Corporeality and Onto-poetic Pataphysics of the Post-mechanical Age. *Technoetic Arts: A Journal of Speculative Research, 3*(1), 3-12
Krohn, R. (1991). Why Are Graphs so Central in Science? *Biology and Philosophy, 6*(2), 181-203.
Larkin, J. & Simon, H. (1987). Why a Diagram is (Sometimes) Worth Ten Thousand Words. *Cognitive Science, 11*(1), 65-100. Retrieved December 12, 2010, from http//linkinghub.elsevier.com/retrieve/pVol.II/S0364021387800265
Latour, B. (1986). Visualisation and Cognition, Drawing Things Together. *Knowledge and Society, Studies in the Sociology of Culture, 6*(1962), 1-40. Retrieved December 12, 2010, from http//www.bibsonomy.org/bibtex/2e7c194b3d964ec7c5a790e356b2a10b2/clachapelle
Latour, B. (2008). Review Essay: The Netz-Works of Greek Deductions. *Social Studies of Science, 38*(3), 441-459. Retrieved January19, 2011, from http://sss.sagepub.com/cgi/ doi/10.1177/0306312707087973
Miller, A.I. (1995). Aesthetics, Representation and Creativity in Art and Science. *Leonardo, 28*(3), 185-192. Retrieved January 7, 2010, from http//www.jstor.org/stable/1576073
Mitchell, W.J.T. (1986). *Iconology, Image, Text, Ideology*. Chicago IL.: University of Chicago Press.
Peusner, L (2002). A Graph Topological Representation of Melody Scores. *Leonardo Music Journal, 12*, 33-40.
Riley, H. (2010). Drawing as Transformation, from Primary Geometry to Secondary Geometry. In XVOL.III *Generative Art International* conference. Retrieved December 12, 2010, from www.generativeart.com/on/cic/ga2001_PDF/riley.pdf
Smith, L.D., Best, L.A., Stubbs, A., Johnston, J., Archibald, A.B. (2000). Scientific Graphs and the Hierarchy of the Sciences, A Latourian Survey of Inscription Practices. *Social Studies of Science, 30*(1), 73-94. Retrieved September 24, 2009, from http//www.jstor.org/stable/285770
Steinbeck, J. & Ricketts, E. (1995). *The Log from the Sea of Cortez*. London: Penguin Classics.
Stenning, K. & Lemon, O. (2001). Aligning Logical and Psychological Perspectives on Diagrammatic Reasoning. *Artificial Intelligence Review, 15*(1-2), 29-62.