WORKSHOP 2. Friday 20th May 2011, 11:30-13:30

Supervised by Nick Hopwood and Klaus Hentschel

Aaron Wright (University of Toronto). "Visual reasoning and the 'Renaissance' of General Relativity, 1955–1975".

How do you draw a black hole? Or an entire universe? Beginning in the 1950s physicists interested in Einstein's theory of gravity, General Relativity (GR), developed new ways of understanding the complex, counterintuitive features of the theory. And the field flourished. Physicist Clifford Will has referred to this period as the "Renaissance" of GR, but he attributes the field's growth to new experimental and astronomical findings. In this paper I argue that progress in GR owed more to theory than to experiment or observation. I focus on the role of new mathematical methods from geometry and topology and new diagrammatic ways of seeing GR's abstract objects. Before Roger Penrose introduced his new maths and diagrams in 1962 there was no rigorous way to understand, for example, what "infinitely far away" meant in GR. Penrose's work made infinity tractable. He made it possible to represent an entire universe on a page.

These new developments were almost immediately integrated into advanced physics pedagogy. Less than a year from when Penrose's results were published, he lectured on his techniques at the 1963 Les Houches summer school in theoretical physics on "relativity, groups, and topology." They were used extensively in lectures by one of Penrose's co-workers, Brandon Carter, at the Les Houches school on black holes in 1972. The ability of the diagrams to solve problems in research and in pedagogy attracted students to them, and helped grow the field of GR.

But how exactly did Penrose diagrams solve problems? The diagrams were not aids to calculation; rather they were drawn after the calculations. Drawing from Wittgenstein's later work, I argue that the diagrams were "surveyable representations" that allowed physicists to relate the difficult concepts of GR to one another. The diagrams showed the connections between "causality," "event horizon," "infinity," and "singularity." So, the "Renaissance" of General Relativity was more than just a general flourishing; like the original Renaissance, it involved the intertwining of new ways of knowing with new ways of seeing.

Ari Gross (University of Toronto). "Of Sausages and Skeletons: Kekulé and Cum Brown's diagrams, and the desirable features of chemical visual representations"

The question of how to visually represent a scientific object is a non-trivial one. Whether the representation is intended for one's peers or the public, scientific visual depictions must be at once accurate, meaningful, and aesthetic. They must not only convey relevant information in a comprehensible manner but must also embody the particular scientific views of their users while conforming to socially acceptable standards of presentation.

This paper will address the question of the forms that scientific representations take by examining two distinct, yet contemporaneous historical methods of representing chemical compounds: Kekulé's "sausage diagrams" and Crum Brown's skeletal structural formulas, both used in the field of chemistry during the early 1860s. In examining how both chemists used and conceived of their diagrams as well as how their reasoning was enabled or constrained by the forms that their representations took, we shall gain insight into the importance of form for scientific reasoning. Furthermore, by analyzing Crum Brown's critiques of Kekulé's diagrams, we shall gain insight into some of the essential and desirable criteria of chemical representations, such as necessity of one-to-one correlations between diagrams and chemical kinds, and the historical importance for mid-19th century chemical diagrams to be capable of being used to reason structural-heuristically and to be conceived of in a quasi-physical manner.

These findings will be analyzed in the context of contemporary philosophical debates over the nature of scientific representation. I shall argue that a naturalistic approached to the philosophical subject of representation, as adopted in this paper, is best suited for understanding not only the essential characteristics of scientific visual representations, but also desirable features of such representations as well.

Anindita Nag (Max Planck Institute for the History of Science). "Images of Hunger, Appeal of Emotions: Famine Photography and the Spectacle of Suffering"

My paper offers an insight into the visual representations of famine in colonial India. I focus on the period from 1870 to 1920, a phase when famines grew in frequency and dimension, precipitated by agricultural commercialization, environmental changes and fluctuations of a wider capitalist economy, engendering a political and moral crisis for the colonial state. My paper starts with the question, how did famine photographs acquire their authority as evidence – and what is the relation between photographic composition and emotional response? To this end, my paper highlights the visual archive of famine, both as an epistemology – a way of viewing the world – and as a material fixture comprising texts, objects, points of access and rituals of circulation.

The paper focuses on the complexities of photographic authorship and intentionality, on the spatial and temporal dimensions of photographic witnessing that had implications for shaping individual and collective memory, and on the role of photographs in making suffering of others real to the distanced yet engaged spectator. The paper will draw upon archival photographs such as the Joseph Robert Sheffield Collection, the Lechmere-Oertel Collection and the Dunlop Smith Collection at the British Library and the Victoria and Albert Museum in London, and the Alkazi Collection of Photography in Delhi. The larger goal of the paper is to associate the emergence of a visual culture of famine to the historical realties of imperialist expansion, the production of colonial knowledge on famine, and the discordant forms of subjectivity that found expression in this cultural arena.

Tom Schilling (Massachusetts Institute of Technology). "Geoinformatics and Indigenous Representation: Visualization and Conflict over Uranium Exploration in the Arctic"

In the Kiggavik region of Nunavut in Arctic Canada, protests against uranium exploration have exposed gaps in the ways different forms of evidence are being treated in the mining regulatory process. Between 1988 and 2010, mining companies successfully expedited environmental impact assessment reviews during exploratory work by pointing to the minimal drilling and soil sampling required by contemporary methods for computerized geophysical simulation and ore body visualization. Meanwhile, improvements in aerial survey methods, drilling techniques, and statistical algorithms for processing geochemical data obtained from soil samples have improved the precision of speculative exploration projects while lowering costs, reducing surveyor impact on the physical environment, and facilitating surveys over vast areas in increasingly fine detail. In my paper, I will contrast the different uses of visual materials in industry-, government-, and activist-led efforts at community education about uranium. Rules for certifying land claims now focus on assessing immediate, quantifiable environmental impact, thus making the burden of proof for protests a matter of collecting, organizing, and making visible experimentally-obtained data.

Whereas early conventions for representation in the geological sciences were informed by personal encounters and modes of apprehension (Rudwick 1976), contemporary conventions for data reduction, computer simulation, and visualization in many of the fields relevant to uranium mining now rely on virtual assemblages of visualized data (Daston and Galison 2007). Hydrogeology, mining engineering, risk assessment, cartography, and aerial radiological surveying each have their own histories of deployment, enrollment, and legibility in the Arctic (Latour 1990). The process of compiling maps for mineral speculation, planning, and political representation is increasingly driven by computerized methods and constrained by aesthetic criteria with substantial implications for future interpretation and use. My paper will address the translations required to incorporate experiential information into geoinformatics, and the visual strategies used to render spectroscopic data in tangible form.