Quintessence: The Clumpy Matter of Art, Math and Science Visualization
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Conference Notes prepared by David Ribes

Introduction and Themes
Sara Diamond
Anthony Zee

The division between the arts and sciences has been produced and reproduced in a variety of forms during the course of the modern era. At times each side has attempted to formulate its differences and erect barriers, at others these boundaries have been questioned and pushed. This conference, *Quintessence: The Clumpy Matter of Art, Math and Science Visualization*, can perhaps be taken as a stand-in of a new configuration, emblematic of high modernity. The participants included both scientists and artists, but also designers, social scientists, cultural critics and not a small handful of individuals with feet in more than one camp. The purpose of this conference was not to attempt to bring these diverse fields together, for this is inherent in the new paradigm, but to communicate and bring forth the particular relations now emerging. What were once attempts to bridge the sciences and the arts, has now become fait accompli in a variety of senses: the arts are now more than inspired by the sciences, but often integrate its knowledge within its representational practices; the sciences, now moving beyond the boundary work of differentiating itself *from* arts are now turning to the arts for inspiration and recognizing its particular expertises.

"Quintessence" was taken as the guiding metaphor for this conference because in cosmological physics it is a substance, or phenomena, with an astounding property: unlike most forms of energy, such as matter or radiation, which cause the expansion to slow down due to the attractive force of gravity, Quintessence causes the expansion of the universe to accelerate. It is a poorly understood, and understudied phenomena, much as the kinds of contemporary productive interactions between art, design and science remain somewhat shrouded. Sara Diamond -- Artistic Director of the Banff New Media Institute, but more importantly the moderator and host for the Quintessence conference -- describes "Quintessence" as pointing both to the blind spots and the particular ways in which we "bang up against each other in often productive ways" that the boundaries between art and science, now a historical artefact, still impinge on us resulting in both "us seeing the light and then having it disappear". Quintessence can permit us to explore in a non-humanist manner, at times setting aside our anthropocentrism, and acknowledge both as artists and scientists the existence of intelligences, systems and processes that are not necessarily within our perceptual range and be able to abstract and model these. From this perspective another "cut" between the sciences and arts falls away, as we acknowledge the aesthetics, or politics of representation, within the devices of visualization.

Tony Zee, in his keynote address, brought out several of the key themes which would be repeated, in various forms, throughout the conference. His discussion centered around the notion of symmetry, and he takes this concept across its use within theoretical physics and the arts. He points out that symmetry has only come to be taken seriously within physics in the last three decades; previously physicists had asked "why worry about symmetry when the world is not" and yet today symmetry is recognized as a guiding principle. By postulating symmetry the science has been advanced: a "half-knowledge" of phenomena can serve to deduce the other. And yet this points to the living tension within physics today which asks "is there symmetry in the world, or symmetry in the laws of physicists". Tony Zee falls on the side of symmetry, but his talk reflects the open debate in subtle ways. Science visualization is fraught with a similar tension: as new visualization techniques are introduced each device sparks a small controversy as to the production of artefacts, it is the tension between pragmatic use of visual techniques to achieve scientific advances and the concern over representational relations to reality. In speaking of art history, Zee points out that the most symmetrical of art is often boring: displaying various examples of mostly symmetrical art with subtle distortions. The principle of symmetry is useful to art only in so far as it is ruptured in the details of practice. What can be useful to guide the production art, may be fatal to its generative potential if followed to the letter.

Tony Zee also introduced what would become an important common reference point for the rest of the conference: Antonio Damasio now classic popular neurobiology account *Descartes" Error*. This book challenges a long tradition of understanding, running at least back to Descartes" which attempts to separate rational thinking and emotional experience – Damasio argues that portions of the brain which are involved with emotional processing are also involved in rational decision making, and furthermore that one form is seminal to the other. Putting aside the details of Damasio"s book, for this conference this book serves as a placeholder for informatic and visualization work that stands between the common categories of rationality and emotion. Catherine Richards imagines a device which monitors and affects emotional states, Laura DeDecker discusses colour and its effect on emotions, and Jayanne English speaks of the importance of incorporating both scientific meaning and aesthetic appeal within astrophysics data visualization. Affect no longer sits as the exclusive domain of the arts, entering science only at the margins of psychological research, but through more sophisticated understandings of human interface now has become a central concern in the production of representation.

Sara Diamond, in discussion, notes that in the Social Sciences recent emphasis has been placed on investigation local interaction and specificity rather than universality, or as in the case of Actor-Network Theory, how universality is established through the circulation of particulars – she asks Zee if this conflict has a homologue in theoretical physics and if so how it has played itself out. Zee responds that these sorts of debates are rampant and are often the fodder for inter-disciplinary conflict, but also the material for professional conflict. That is, where physicists come down on the line of the study of specific phenomena versus more macro discussions of quintessence, grand-design of the universe, and string theory could make the difference in getting tenure. Zee notes, somewhat comically, that in this sense it is a good thing there are many universities in America, and that these sorts of disciplinary debates seem to have parsed themselves out across institutions. Disciplinary, and inter-disciplinary

conflict as a mobilizing force in science would come up again and again in this conference, brought up by artists, scientists, designers and social scientists.

During his talk Zee spoke of visualizing theoretical physics, and how the minds eye was perhaps still one of the best available tools. Catherine Richards asks as to his particular wording of describing this phenomena as "primitive and sophisticated." Zee responded by turning to music, having recently spoken to a concert violinist who visualized music by closing her eyes. Lacking the particular training Zee could not do this, but could compare his own understanding of symmetry and his ability to visualize this phenomena in his mind"s eye. Richards responded by referencing a famous Einstein quote in which he argues that he does not visualize a mathematical formula, but rather a thing or a form. Do new digital visualizations approach this form of representing, are they more similar to psychic processes? Tim Westbury notes that given the Western dominance of the visual, perhaps closing one"s eyes is the pathway for metaphor to enter; both artists and scientists can be assisted in visualizing by shutting out the certainty of the visual material world and entering an internal symbolic state "when the human brain really kicks into action, and allows for metaphor to play out."

Visualization – Virtual and Enhanced Realities and the Human Experience; What is the State of the Current Research? Why Visualize? What Can we Learn from Visualization that We Might not Otherwise Know?
Marc Rioux, NRC
Ravin Balakrishnan
Peter Lunenfeld

Marc Rioux, from the Institute for Information Technology at the NRC, follows a well established tradition for the technical analysis of art objects. Technological advances have long been used in art history to locate pieces within a timeline, judge authenticity, and investigate technique. Rioux"s innovations permit bringing art objects into "virtual space" through advanced digitization techniques; by making these art objects highly calculable in the digital form Rioux"s techniques permits manipulation, analysis, and the creation of historical record and furthering the modern project of the "mechanical reproduction" of art.

Ravin Balakrishnan, Assistant Professor at the Department of Computer Science, University of Toronto, describes his goal as the production of input devices and user interfaces which match the complexity and subtlety of artists" creative tools. He notes that computation, until recently, has privileged the production and manipulation of text and numbers through input devices such as the mouse and keyboard. These devices have allowed for a revolution in deftness for the writer, for the calculator, but have left artists with an impoverished technological grammar. Balakrishnan, and his larger group, have been working to create domain-specific input devices by directing their research at the tools which are already available within design and artistic communities and incorporate these with the "leverage power" of digital computing.
For example, at the most basic practical level, the creation of 3D graphic design models primarily requires curves, in order to create surfaces and then 3D geometric models, but right now we are primarily limited to the use of the keyboard, mouse and sometimes a pen on a digitizing tablet. He offers two examples that he has produced from his work: the physical spline and tape drawing. The spline is a small band which

is sensitive to manipulation, and can be used to quickly create complex curves. Balakrishnan describes the interaction as much more direct and expressive style of interaction, beyond the increased speed at which models can be built the interactive style facilitates real-time design production. Tape drawing is a artistic technique within car design that is the only portion of the design process which has survived unchanged through the digital revolution. Using a roll of hockey-tape, this technique allows the production of large-scale schematics which result in very fluid curves and are highly editable. The user interface for traditional tape-drawing is simple and accessible, with a relatively intuitive use. In creating a digital tape drawing device, many features of traditional tape-drawing had to be preserved for the designers, including the scale of drawing , the "feel" of using their arms, and "sighting down a curve" which involves standing in different positions relative the drawing, in order to produce particular lines of sight. By studying videotapes of auto designers, Balakrishnan was able to extract salient features of the use of tape-drawing and attempt to mimic them with a digital input device. The input device is a controlled mimicking of the by-hand tape-drawing, for example: the IT designers have intentionally dropped the tensile feel of the hand held tape, having decided that the benefits of incorporating this feature into the design did not merit the effort.

Peter Lunenfeld, a self-described historically informed cultural critic, points out the particular configuration of the contemporary visual discourse in which the visual is understood as a revealing: transparency, clarity and truth . He contrasts this discourse to historical examples, taken from before a clear division existed between the mystical and the rational or in other words "before physics rejected metaphysics." For example, in the 16th C German alchemist Salomon Trimosin"s book "*Splendor Solis*" which Lunenfeld describes as a "coded guide for the creation of the philosopher"s stone," we see that the book was specifically designed not to reveal its secrets to the alchemically untrained. These visualizations have same goal as those of contemporary science – the transmission of domain-specific knowledges – but for the alchemists these visuals operate under a specific discourse which understands them as operating within a domain-specific knowledge; reading these visuals requires a skill for their decipherment. Contemporary science sees its visuals as transparent, clear and revealing of truth. If a knowledge is understood as required for visuals to reveal themselves at all at all it is understood as publicly available knowledge (following Weber"s notion of "disenchantment" and Popper"s demand that science be open to scrutiny). More often though, visuals are *encoded* as transparent: they rely on visual tropes familiar within popular culture. In this manner the interpretation of the image appears to have been transferred to the individual, and each individual con concur that s/he has done the necessary work to verify the claims of the visual. Lunenfeld is warning us about the "sexiness" of scientific imagery, and its use both within popular culture, policy circles, and even across scientific domains. He asks, "why has draconian pseudo-science always been interested in visual representation." citing phrenology, the baser forms of psychoanalysis and today facial recognition systems deployed in the name of the "war on terrorism". The critics question must be "how can we respect the images own grammar, rather than its glamour?"; to become a "visual intellectual" we must consider how to use visuals for "the good" and avoid the abuse of their rhetorical power.

Data Visualization – What Metaphors and Means do We Use in Visualization?
Sheelagh Carpendale
Amanda McDonald Crowley
Balazs Beothy

During discussion Carpendale was asked to elaborate on her sixteen part typology of visualizations: in short they include the interaction between two typological constructs of four categories each: 1- an axis of the relation of the viewing cue to the data (integrated, augmented, accompanying, perspective) and 2- an axis from biological through to socially acquired cues (preattentive, acquired, formalized, constructed). Each of the categories from one axis can be combined with one of the four from the other axis: thus Carpendale''s complete typology is capable of describing with fine grain distinctions between visualization types.

Amanda McDonald Crowley, curator, presented a comprehensive summary of the art exhibition called "Converge: Where art and Science Meet", shown as part of the 2002 Adelaide Festival in Australia, and self describes the show as both about collaboration and data visualization. Many of projects involved the close collaboration of artists and scientists, often attempting to transcend the art category by pushing understandings within and of science, but also incorporating explicit political themes such a the role of scientific knowledges with Australian indigenous peoples.

Balazs Beothy, C3 Hungary, brought the erudite understanding of a historically and theoretically oriented artist to the conference. His talk included presenting the results of an informal questionnaire, given to artists on the role of the visual. The results of this questionnaire demonstrated the varieties of understanding which exist as to the role, method and goals of visualization within any given artistic community: from strict positivist understandings which exclude the metaphysical, realist beliefs of correspondence, and sceptical questioning of received relationships. From his own work Beothy spoke of his "artistic investigation" of the debates surrounding the famous artefact the "Shroud of Turin" which is the centrepiece of an interdisciplinary debate involving various scientific groups, art historians, historiographers, and theologists. The Shroud has been variously claimed as the burial shroud of Jesus, demonstrating his body print as of the shroud of the last Grandmaster of the Templar Knights Jacques de Mollay (a 1300 year discrepancy!), and at times discredited altogether as a historically insignificant fraud. His own artistic work, historically informed, both contributes to the study of the Shroud and questions the historiographic, scientific and religious contestations which surround the artefact. His deft understandings bring together arcane knowledges, personal relations to the Shroud from his childhood and, the complexities of producing credible knowledge from within the interstices of disciplinary debate.

Catherine Richards asked as to whether in the questionnaires subjects were questioned as to their historical or contemporary influences by other artists, Beothy responded that they were but that the results were not statistically significant since many people used the same references. Perhaps this points to a sampling problem…

Synaesthesia, Sound, Visualization, Multimodality and Human Perception
Luke Jerram
Jack Ox
Catherine Richards

Luke Jerram, an installation artist, described his artistic practice as interested in our physical understanding of space and distance as well as the fact that space is full of invisible forces and energy fields passing through it. The projects he presented included one focusing on the moon and the mathematization and economies of perception. His interest in "that line of communication between the Earth and the Moon. But also between us and the moon, our physical understanding," led Jerram into a tripartite project on the moon: 1) the history of our relationship with the moon, including moon mythologies, folklaw notions of lunacy and madness, 2) a history of our scientific understanding of the moon- which included his research on "The Music of the spheres" – a classical understanding that the celestial spheres produce a form of music which has passed into our preattentive cognition 3) and following these stages then had to work out how he was actually going to physically connect the artwork to the moon. Jerram wanted the artwork to register the presence of the moon "live" in the gallery, having a internet feed of data, in some way was not tangible enough. He ended up collaborating with an Astro-physicist from University of Bristol on how this was going to be possible. In the end he chose a gravity meter to measure the gravitational pull of the moon. The meter is actually registering the Earth Tide- which is where the Earth is caused to bulge like the ocean tides. The ground we stand on now is actually rising and falling about 25 cm ever 6 hours. His second project, called Matrix, attempted to produce after-images, and was partially requisitioned for a mathematics show. This project, called "Everything is Number" manipulates strobe lights in order to produce particular optical effects: "our brain likes to see identical units. Instead of seeing a chair viewers see a grid of defining the dimensions of the installation space."

During discussion Jerram was asked by Sara Diamond to elaborate on his experience of choosing the variety of self-sensing mechanisms, including sensory deprivation mechanisms which enhance or encourage a focus on ones own body. Jerram cites inspiration by scenarios like visiting the dessert, in which "there is nothing to look at" and thus the economy of sensation is re-distributed; he also mentions having "wandered around blindfolded for hours on a mountain," which again refocuses perceptual attention. In short, his interest is in the calibration of the senses.

Jack Ox, visual-musical artist, discussed her production of two visualizations of music. The first involved the 2D representation, and the second was in 3D. The 2D representation involved the representation of pitches and a formalistic phonetic analysis based on how and where vowel sounds were formed in the mouth, these were represented in relation to colour and space. The 3D representation she calls the 21st Century Virtual Color Organ, which is an immerse cave piece. Using a variety of images Ox collected, mostly from natural landscapes and formations, and building metaphorical relations to the particular musical sounds she was interested in representing. These landscape images are digitally edited and collected in an active differentiated montage which responds in tune with the music – each separate image represents a particular "sonic-scape". The colour organ itself stands in a long tradition for the visualization of music (Ox cites the existence of an "ocular harpsichord" in

1775) – the choice of color within both models of representation are partially historically informed, although also includes formalizations taken from various sciences (linguistics and philology, computer, psychology).

Catherine Richards, visual artist and associate professor at the University of Ottawa, began her talk by quoting an aesthetic philosopher: "Music is an analog of emotive life. A presentation symbol of psychic process. What it expresses is not anyone"s emotion but the *idea* of emotion. Every work of art, in whatever medium, is an appearance or a semblance, a merely virtual object." This quote is not only an appropriate expression of many of the opinions expressed at the conference, but also a neat encapsulation of Richard"s work, which attempts to connect science with affect and technologies with subjectification. Richards questions the particular modes by which we represent ourselves within virtual spaces, for example, we know that using certain techniques we can fool our internal sense of body positioning (proprioception), and that that self-representations in VR space could be an excellent medium for this, and yet we still operate in a paradigm of representing our body "realistically", in a discourse of correspondence. She has also attempted an "artistic investigation" of the electromagnetic body. Thinking she could access a scientific model of the electromagnetic body, she quickly discovered that only certain limited portions of the body had been mapped. Her experience mirrors Beothy"s work, where artistic works demonstrate the limitations and contradictions within scientific endeavours. Furthermore her investigations of the heart led her to explore mathematical representations of the heart and found that a sort of "slippery slope" could be depicted in art between physics and emotional states in the heart"s work: the *excitation* of electrons, *attraction/repulsion* etc… Richards also hypothesized and even patented, a future technology which would map and direct our socio-emotional states, "Method and Apparatus for Finding Love", this device would either be programmed by a trusted friend, or the device would build a model based on environment and physiological states, and by communicating with other users of the technology, assist in finding appropriate socio-emotional partners. At least part of Richard"s interest was in expressing the capacities of both science and art to create desire. More broadly this reflects the theme, initially brought up by Zee, that emotion and calculability/intervention are becoming more and more intertwined in the contemporary mind. Richard"s herself also quotes Damasio. She sees his book, a bestseller from a hard science, as a sign that emotions are "becoming real" in Western culture. Because emotions can be described, and once they become describable, codeable, they can become the objects of technology, can then be sold, and once fungible emotions become an object of the market and PR, and thus can be made a necessity to life.

Special Session on Astronomy, Visualization and Art – Quintessence Embodied. Visualization, Physics, Astronomy – Science and Art
Gloria Brown-Simmons
Tim Westbury
Joanne Bristol
Jayanne English

Tim Westbury, in his presentation Imagining Worlds: A Case Study of The Use of Global Image as Metaphor, historically and "artistically" questions the rise of the interchangeability of the terms "world" and "earth" noting that each have different implications. Each deploy a differing symbolic logic, and inspired by author Denis Lee, in which the distinction world/earth corresponds to distinctions of nature/culture or even civilization/barbarism and argues that perhaps these opposing forces may resolve themselves the notion "planet" -- a term which implies both world and earth. In short world stands for an "objective" view which is enabled by contemporary science and technology, we are able to see synoptically, and therefore compose, a whole. Wheras earth remains local, it is the view from the ground, in which wholes are composed not through synoptic viewing from Apollo astronauts" photographs, but from multiple and fragmented experiences. Westbury"s work questions the dual tension present in 1) notions of "world" which stress both its physical unity and the fragmentation of borders and corresponding responsibilities of national citizenship and 2) similarly "world" appears to have no political history, spoken by science as merely *geography*, and denying its *local* geographic production.

Joanne Bristol, a visual artist and professor at the University of Alberta, drawing on the work of Donna Haraway, science historian and social theorist, and particularly "situated knowledges" – the idea that researchers are informed by various factors such as gender, geography, politics and so on. Bristol"s work repeatedly returns to questions of anthropomorphism, and in a creative reversal of Haraway Bristol asks the question: "how can I understand something without projecting and excess amount of my own desire and enculturation onto it." Using A.P. Herbert"s work, British astronomer, who attempted to recover popular interest in astronomy by "re-mapping" the stars using contemporary frames of reference for constellations (Great-Britain, Shakespeare, the Sailor). Bristol takes this attempt as both a "creative fiction" and yet also reminiscent of the naming practices of colonialism. Thus she takes it upon herself to produce feminist cosmologies, to multiply the existence of "explainers" (Caroline Merchant). The result in art, *Space Trash 1999*, is generated from the material and data in the performance of her everyday life e.g. collecting candy foil from Valentine's Day, both her own and her friends in "foil rolling parties." Another example includes a collection of prescription eye classes with text behind them, each text related to astrological statements – this speaks to the left-over feminized space left to the "softer" science of astrology to the harder (male) science astronomy. Bristol"s work brought to the conference an otherwise unrepresented *explicit* reference to the work of feminists in science history, theory, and even practice, and was also the only outright mention of queerness – perhaps this points to the undertheorized nature of these topics within contemporary visualization work, but it certainly points to the importance of reproducing syncretism within interdisciplinary conferences.

Jayanne English, professor in the Department of Physics and Astronomy at the University of Manitoba in Winnipeg, sits neatly between the sciences and the arts. With both an official training in the visual arts and in the astronomical sciences she is one of the rare participants at the conference fully versed in the esoteric languages each camp. Bold colour images from telescopes act as extraordinary ambassadors for astronomers because they pique the public"s curiosity. But are they snapshots documenting physical reality? Or are we looking at artistic spacescapes created by digitally manipulating astronomy images? This lecture provided a tour of how original black and white data from the Hubble Space Telescope, for example, are converted into the colour images gracing magazines. English describes how each image is a battlefield where the attempt by scientists to represent their discoveries all but drowns out the voice of visual literacy. Yet sometimes in this battle, between the cultures of science and visual art, both sides win. The images which English assists in constructing must negotiate between remaining "believable" as an existing reality and yet also be faithful to the scientific knowledge which they attempting to represent – thus there is tension between realistic representation and realistic knowledge.

How Can Models Provide New Forms of Knowledge? Modeling Life – From the Real to Nature. Modeling Abstractions, Learning From Form and Non-Representational Images.
Mario Costa Sousa
Christian Jacob
Ingrid Mary Percy

Christian Jacob, Department of Computer Science at the University of Calgary and now heading the Evolutionary and Swarm Design group in the Artificial Intelligence Lab. Under the paradigm of "evolutionary software" his main principle is that randomly generated programs, using a base of "building block" program characteristics, would be run. Programs would then selected using fitness criteria for a given environment, these programs would be "mutated" or "recombined" using various operations, in order to produce a second generation. This second generation, in turn goes through the same process: it is run, selected, mutated and then run again…Jacob displayed examples of virtual ants, which in simple environments composed of walls and food, would have selection principles applied in order to produce the most efficient food-eating ant. His following two examples show the power of this form of evolutionary perspective using the notion of "bushiness" and the more general notion of "swarms." Under the assumption that "bushiness" is a difficult property to explicitly define, this is a reality in computer generation, evolutionary processes can be used to produce a random series of automated drawing programs; the program which produces the ultimate "bushiness" can be analyzed in order to extract the programming steps to produce this result. Somewhat similarly "swarms" – or swarm intelligence systems – are many individual agents, with individualized properties, which are placed in interaction. Thus swarm systems can demonstrate the emergent properties of complex systems, and then certain evolutionary fitness criteria can be imposed in order to test for new results. His two examples in this case are simulation of protein interaction and traffic/highway/streetlight interactions. In the case of traffic/highway/streetlight interactions one example of fitness criteria can be minimizing waiting time for cars at a given intersection.

During discussion Jacob was asked as to the particular benefits for domain scientists i.e. how is his visualization work linked to scientific practice outside computer science. Noting the particular difficulty of finding computer scientists who are deeply versed in any particular domain science, say biology, or vice-versa a domain scientists comfortable with code level programming, Jacob argues that there must be close interaction between these two parties. A given interface/simulation can often be adapted to a particular domain"s interests if careful work is invested by both parties in "tweaking" the software, and thus embedding the relevant domain knowledge in the simulation.

Zee asked whether evolutionary algorithms have been used in order to solve the contemporary and very complex problems of protein folding: citing the pharmaceutical"s current interest in the field, and the particularly baffling problems being encountered with protein misfolding. Jacob responded that there indeed have been attempts to apply these techniques to protein folding, but have thus far failed miserably. He believes that this might be due to excessively simplistic models, leaving out relevant variables, and that most approaches have not been "agent based" – that is, simulations where characteristics are assigned to particular agents (here amino-acids), then allowed to interact emergently/evolutionarily. This may be a future task of his research.

Ingrid Mary Percy, visual artist and teacher in the Department of Visual Arts at the University of Victoria, describes her artistic work as primarily abstract and focussing on systems and patterns. Much the work displayed in this presentation could fall under the rubric "minimalist pop-art" using the mass produced objects of the everyday in innovative non-representational forms. Mirroring some of Bristol"s ideas to escape excessive anthropomorphism Percy describes her recent phase of interest as not representing the world as she sees it, but rather painting which could teach her something of the world. Recently, she has been making large format digital prints and video installations based on symmetrical molecular structures. She describes her most recent project, *ATOMIKA: snowflakes/laceflowers*, as "a painting that thinks it"s a video installation". This 17-minute video projection/installation consists of a series of approximately 70, highly saturated, abstract radial images dissolving one into the next. The images are derived from actual models of molecular structures that she constructs using the children"s toy Lite Brite, digitally photographs, then manipulates in Photoshop. These images refer as much to North American popular culture (specifically music and raves) as they do to recurring patterns in Nature (snowflakes, beehives, and cell structures) and high modernist abstract painting. Another example involved using standardized woodcuts and mouldings, found at any Home Depot, and systematically cutting and juxtaposing them together to observe the emergent process of blending these sorts of standard mass-products in a standard but invented method of her own.

Percy"s talk inspired Tony Zee in order to make a comment about physicist Eugene Wigner, regarding the notion of order out of disorder. Wigner had placed numbers in a grid, a matrix, and discovered certain unpredictable properties would emerge from these matrices. He commented that this spoke to the "unreasonable effectiveness of mathematics in physics." Percy"s work on emergent systems and structures inspired Zee to remember this.

Bioinformatics, Medical Imaging. The Body and Visualization Research.
Kim Sawchuck
Tamara Munzner
Steven Oscherwitz

Kim Sawchuck is an Associate Professor in the Department of Communication Studies at Concordia University. She began by discussing advertising which appropriated bioscientific iconography, such as Canadian Dairy Board"s "milk builds strong bones" which uses X-ray images. As in Lunenfeld contemporary visual paradigm, here the image of an X-ray, a now easily accessible image to the public, seems to speak for itself, no explanatory caption is necessary. She calls this use of biology in a public space for private purposes "biotourism" -- the transformation of bodies into landscapes, the recreation as bioscapes for imagined travel, the establishment of regimes of truth and knowledge by rendering visible the invisible. The use of these images in public forums cannot be easily dismissed as the popular vulgarizations of lab-work, for these displays are often the product of collaborative efforts between scientists and producers. Today, collaboration with and media production is seminal to science, as public funding becomes scarce, and corporate-PR itself becomes fungible on the market. Sawchuk constructs a typology of biotourism, which includes 1) the macro/microcosm relation, particularly the scaling of bodies; 2) space and the construction of the body, particularly its rendering into geographic-type features; 3) the sorts of movements either created or reproduced: is it is a tour, a walk, a machine to be observed?; 4) the production of sensibility in body renderings, including luminosity. This talk focused on the first, the scaling of bodies: the culture of display in childrens' museums and theme parks. Here anatomy is made interesting by scaling up, often to the grotesque. She notes that this scaling up of bodies, their making visible the invisible, and reversal of inside and outside, has limitations imposed by the particular logic of symmetry, proportionality and realist representation. These displays end up curtailing, rather than expanding, imaginary possibilities. "It is not that they are not realistic enough, but rather that they are not virtual enough." Sawchuck sees a "fiction of literalness" which hides the mode of production of these displays (how is the data generated? how is it transformed into the visual?), in short the unquestioned *product* of science is privileged over its *process*. It is a form of reductionism not of causal relations, the traditional grail of science, but rather a reductionism of methodology.

Tamarah Munzner, assistant professor of computer science at the University of British Columbia in Vancouver, presented a series of visualization projects which are intended to be task specific. That is to say, that rather than producing visualization technologies which are meant for general purpose visualization of data, a common trend in data visualization, Munzner"s work is specific to the particular requirements. Her examples include a representation device for websites, the WWW is represented in terms, appropriately, a web like structure rather than the pages themselves, and thus many pages and their links can be synoptically viewed. The program includes has clever filters to hierarchically order links and thus remove the clutter of less relevant links while browsing at this macro level. Perhaps her most impressive work is in the visualization of huge datasets – she points out that the modern "killer app" will be in

handling the massive amount of data being produced by contemporary science and technology. Using large phylogenetic trees as an example, Munzner demonstrates the strength of her visual interface devices which permit the user to keep track of the work they are doing by use of carefully chosen distortion (those which do not alter salient relationships but which permit convenient magnifications); make visible logical connections within a dataset, which might involve undue effort in large scale datasets; comparison of differences by allowing synoptic viewing, which, again, can be difficult when datasets are large and differences small or subtle. Finally, Munzner finished by playing an excerpt from a digital video which drew a great response from the crowd: *Outside In*. This video is a very successful attempt to popularize the age old mathematical question of how to turn a sphere inside out – the video"s producers had to negotiate between mathematical detail and comprehensibility, all while not compromising the realism of the phenomena.

Steven Oscherwitz, an artist and lay historian of science, began by conflating Renaissance paradigms of bodily visual representation and contemporary visualization of cancer cells. His goal is to bring closer to integration our own experiences and especially artistic practice, with contemporary natural knowledges including the nature of microscopic space. Oscherwitz takes us through four historical forms, or modes, of visualizing the body and its portions: the first he calls classical (Euclidian, Platonic) where representations are mathematized to instil an sense of measure; the second he calls Cartesian, and believes that these forms are more capable of portraying change and dynamism; the third is flow mechanic or architectonic which are capable of portraying a more refined sense of motion and change; the final form he calls "cancer" which is chaotic or at least appear to us as such, perhaps simply remaining beyond science"s attempt to order them. Perhaps artistic involvement in these visualizing practice will help produce a sort of ordering of these representations which currently defy intervention. Each of these four modes of representation remain active within the current paradigm of micro-biological visualization.

During the discussion period Kim Sawchuk was asked to elaborate on the relationship between giganticism and the grotesque: are these two coextensive in biotourism? She responded that there is a need to elaborate the notion of the grotesque, since there are forms she has observe in which in magnification there is a also a sanitization (say, in scaling up the body removing the anus) but also in other occasions using magnification to "gross out" the subject – which is not altogether the same as the grotesque, but is a use of the abject in order to engage participants.

Catherine Richards pointed to the European history of brutalizing the body, practices such as "drawing and quartering" (the dismemberment of the body by attaching limbs to horses), and noted that perhaps we have our own form of brutalism: giganticized bodies which we slide down, can bang up against etc., as if the body maintained an unreal robustness.

Tony Zee proposed a thought experiment in which rather than considering the scaling of biological creatures, one would consider the kinds of changes necessary to the laws of physics to make scaling of living creatures possible. Sawchuck responded that the concerns of biologists and physicists might diverge at this point, since biology considers scaling an interesting question in itself, but also that these interests might be

conversing at the line between microbiology and biophysics as these camps consider the question "what are the physical limitations of scaling living creatures."

Learning From Realism – Learning From Abstraction – The Tools of Art
Victoria Interrante
Dan Torop
Chris Cran
Laura DeDecker

Dan Torop, photographer and more recently digital visual artist, began with a "romantic and meaningful" photograph of chickens by the ocean. He followed with images of swans by the ocean, and then related to us how in time he came to realize that the ocean could be photographs without swans and chickens. This realization soon became obsession as he returned time and again to photograph the ocean; but the approaching summer, and oncoming tourist and beach glut would soon push his photographic efforts aside. And in this manner Torop came to the decision to built a digital ocean simulator. The ocean simulation, programmed in C and assembly, and was controllable (wind, rain, stars) with a game pad and covered 1000 sq. ft. of ocean. The sublime, or nature as a repository of truth, has always been important for both scientists and artists, and Dan asks the rhetorical question, what would happen if a sufficiently realistic reproduction of the ocean was produced, could the sublime be found in representation?

Chris Cran, a painter left untouched by continuous declarations of painting"s death. His presentation meanders like a well composed train of thought. He argues that the mirror, or reflection in nature, is the most likely model for painting, but puts this notion aside in favour of considering painting as the most uniquely human version of the mirror. Cran cites the influence of Gerhard Richter, which, in his early work, started as a copying of everything from popular media, "when I say everything I mean it in that liberated 60"s sense that you could make art out of anything, and that anything could be art, in that and in the spirit of the times, the less it looked like art the better." Cran also cites David Hockney, "the one thing missing in a photograph is time," and quoting Hockney "photography is OK if you don"t mind seeing what a Cyclops sees for a fraction of a second" and attempted to reinstate time by organizing them, registering and assembling images in interesting formats. Asking himself the question, what constitutes good and bad painting, he came up with the answer that good painting had to at least have the capacity to hold the viewer"s attention. How is this done? By the formation of "space" which holds the gaze effortlessly: the classical conventions of composition, colour, scale all effect this garnering of attention. His own work is informed by these classical techniques, including classical conventions, psychological and optical tropes in order to create space and alert the spectator to the viewing process.

Laura DeDecker:

The juxtaposition of colour and the relationships entailed by such colour combinations became a central interest to me as a painter. My belief that interpretations of the aesthetic decision-making process will yield new visualization

techniques prompted me to develop software to simulate aspects of my studio environment, track the creative process and analyse the outcomes. My program, *Inoculation*, acquires data by querying user on his or her aesthetic taste in relation to colour during a two-phase process. *Phase 1* requires the user to select a colour from the arrays of colours displayed between two static computer-generated random colours. In *Phase 2* the colour combination from the previous stage is transferred into a target configuration whereby the user adjusts the radii of the two inner circles to select the proportions of the colours that make up the combination. Various attributes belonging to colour, trial records and record-sets are calculated for analyses. The translation of aesthetic data into forms such as coloured images, three-dimensional graphs or numerical relationships enables me to apprehend the media in new ways while also informing the development of the tools. My work uses language, information, technology, creative process and scientific method as both media and tools.

In discussion de Decker was asked how the computer and her programs could assist in her colour work rather than using "a more natural setting." In response she cited her influence by artists such as Albers who often had his students cut up pieces of coloured paper previous to using particular paints; thus providing a quick and clean manner of observing colour. She believes it is important to optimize the time spent observing before engaging in practice.

Noting a particular mode in the ocean program, titled "scary mode" in which effects of the program are magnified beyond any imaginable realist action of the ocean, Torop was asked whether simulation and the screen are relevant or possible locations for the sublime. His response was in the immanence of the sublime, that it can be found anywhere, such as in the art-slides we had been viewing during this session. "We are all used to going to dark rooms, and watching spectacular light effects on a screen." Finally, he cites the work of contemporary DJ"s as masters of producing subtle and detailed technological effects.

DeDecker was questioned as to the specificity of her program for exploring colour relationships: is it possible that her program is more generally a mechanism for the comparison of phenomena, be it colour, or perhaps more relevant to Percy"s work the semi-automated comparison of forms. "Is your program not a method for mapping intuitive decision making?" DeDecker responded that although her own work was focused on colour, it is true that the larger form of the program could facilitate this intuitive decision making, which in many senses is copasetic with her own definition of art practice.

Data Visualization – Information Architectures and Visualization -- Methods and Metaphors
Luigi Benedecenti
Brad Paley
Code Zebra – Sara Diamond, Richard Lachman, Kevin Liang, Annie Tat

Sarah Diamond and her colleagues presented on "Code Zebra" or CZOS. Code Zebra an advanced web based visualization tool that enables conversations between different individuals and groups on the Internet. It employs animal print metaphors – a reference to the technological jungle in which human survival is increasingly reliant on communication skills. Its pattern recognition function is a new way to visualize the herds that naturally converge around any prey or subject. Its role-play and aesthetic approach is meant to encourage cross-disciplinary dialogue and play within a highly functional authoring environment. CZOS helps user/players to link ideas, see and create relationships, and consider the emotional qualities of a discussion. The software provides a series of provocative language toys and games that can shift the dynamics of a conversation. It also creates affinities between underlying concepts that are not visible to the user. The organic pattern device uses reaction/diffusion patterns clonal mosaics. CZOS groups participants according to topic interests, conversational styles and affinities. Individual users grow their own patterns (moniker).

During discussion questions were raised as to weather Code Zebra could be construed as a form of social control, since it can be programmed to detect and either encourage or discourage anti-social behaviour, silences, aggression and so on. Diamond responded that this is a common concern, to which the short answer is yes: clearly a code of social behaviour can be embedded within the implementation of Code Zebra. This said, the program is quite flexible, and different kinds of communities could adapt the program to match their own ethical system: thus the social control aspects of the program are not inherent in the programming, but rather a decision product of the moderator or even of the subject community itself.