Chemistry in Art

Texts to the Virtual Art Exhibition

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Chemistry in Art
Introduction to the Virtual Art Exhibition

by Tami I. Spector and Joachim Schummer

We are pleased and excited to present the virtual exhibition "Chemistry in Art" which continues and expands HYLE’s aspiration to promote a dialogue among the disciplines by now including the work of practicing visual artists. With this exhibition HYLE’s special issue on "Aesthetics and Visualization in Chemistry" (Nos. 9.1 & 9.2) transcends the usual boundaries of scholarly journals and provides an alternate mode for reflecting on the aesthetics of chemistry that might otherwise be neglected by academicians. It is our hope that the inclusion of artistic works will not only appeal to, and satisfy, the aesthetic impulses of those of us who are already involved in the study of chemistry, but also broaden the conversation to include others who might feel marginalized by scholarly discourse. Toward this end, we present fourteen contemporary visual artists who each reflect on chemistry with a distinct artistic and conceptual perspective.

Since 1986, when the entire Biennale di Venezia was devoted to "Arte e Scienza", the relationship between science and art has been the focus of the art world. Even if one excludes the various popularizations of science and electronic media art projects, which are often also classified under the heading 'art and science', the topic has been the recipient of extraordinary attention from curators, gallery directors, and cultural critics. There are museums, societies, journals, magazines, foundations, and annual awards, and there have been countless conferences, symposia, and exhibitions devoted to the exploration of the relationship between art and science. Examples of recent art exhibitions are Laboratorium, a participatory exhibition that took place throughout the city of Antwerpen, Belgium, in the summer of 1999 and which explored the convergence / divergence of art in science within the framework of the literal and conceptual laboratory (Obrist & Vanderlinden 2001); Weird Science (1999), an exhibition at the Cranbrook Art Museum in Bloomfield Hills, Michigan of four artists' work that adopt "the practices of science" in order to critique "the influence, authority, and effects of the scientific field" (Apel 1999, p. 11); Unnatural Science where artists presented quasi-science at the Massachusetts Museum of Contemporary Art (2000-2001); and, perhaps, most infamously the exhibition Gene(sis) that is currently touring the US (Henry Art Gallery, Seattle, 2002, Berkeley Art Museum, Berkeley, 2003, Frederick Weisman Museum of Art, Minneapolis, 2004), and which created a media sensation with Eduardo Kac’s Green Fluorescent Protein (GFP) bunny, Alba. Internet sites that focus on the relationship of art and science, such as Art and Science Collaborations, Inc. (ASCI), Rhizome, and Leonardo also provide access to information on many other exhibitions. Although these exhibitions are intriguing in their own right, what is most apparent is their overt exclusion of works related to chemistry – save the occasional allusion to alchemy or to what people believe alchemy was (e.g. Schwarz 1986). Indeed, a perusal of current and past exhibitions and texts on art and science makes it apparent that chemistry has been, at best, scantily considered.
The neglect of chemistry by artists, curators, and art critics is quite surprising, because artists, like chemists, have always been personally engaged in combining, transforming, and experimenting with materials. The relation of art to chemistry is, in fact, the most overt among all the scientific disciplines. Indeed, since the late nineteenth century the industrial production of paints and other classical artistic materials has encouraged modern artists to experiment with evermore new and unusual materials. (For an encyclopedic survey see Wagner et al. 2002.) Moreover, as new, process-orientated art genres were established in the second half of the twentieth century, chemical transformations became a central part of modern art. For instance, artists, like Yves Klein and Janis Kounellis, employed fire (the oxidation of combustible materials) either as artistic performances or as means for artistic production. Crossing the boundary between painting and photography, Sigmar Polke and Achim Duchow mixed their own photo emulsions to perform photochemical reactions on canvas and other media. Sometimes, as in César’s *Expansions* of polyurethane, chemical reactions with polymers have been used to control the generation of sculptural forms. Chemical reactions (the qualitative transformation of materials) have been the subject of artistic and philosophical fascination ever since the early days of alchemy – so much that they have become an allegory of radical change and the dynamical essence of nature. Examples of this are the Arte Povera artist Gilberto Zorios, who staged chemical reactions in crucibles to elicit the flavor of the (al)chemical laboratory and evoke obvious allusions to hermetic philosophy; and artists like Joseph Beuys and Dieter Roth, who have deliberately used biochemical processes in their works, like the rotting of edible materials, to illustrate degeneration and decay. In other work related to chemical transformation, electrochemical reactions (the generation of electricity from chemical reactions in galvanic cells or batteries) have become a prominent artistic symbol for the dynamic nature of matter and for energetics in general. In addition, because the chemistry laboratory has been symbolically associated with the image of the scientific laboratory, artists frequently depict fractions of chemical laboratory equipment to allude to science in general or to the miraculous world of radical change. From sixteenth-century depictions of alchemists (Principe & DeWitt 2002) to the *Laboratory Still Lives* of Tony Cragg, who incidentally started as a laboratory technician, the chemical laboratory is a recurrent topic in European iconography. Unlike chemical phenomenology, and as for other physical sciences, chemical theory and models are less present in contemporary art. Examples from chemistry include Kenneth Snelson’s *Portrait of an Atom* and Murray Robertson’s *Visual Representation of the Table of Elements*. More recently, David Goodsell and others have created a highly specialized art form using computer-generated images of actual or invented molecules.

Given the ubiquity of chemistry in art, one may wonder why this aspect of chemistry has been neglected. We assume that the marginalization of chemistry in curatorial art projects follows a broadly established trend in the humanities that favors the cultural examination of physics and biology over chemistry – despite the fact that the societal impact of chemistry arguably surpasses that of any other science. The neglect of chemistry can, in part, be accounted for by a certain culturally rooted 'chemophobia'. Thus, unlike mathematical physics, which has long been aestheticized in a Pythagorean fashion, or biology, with its
inherent link to the aesthetics of the human body and 'nature', everyday associations to chemistry frequently do not reach beyond ideas of toxicity and modern industrialization.

Despite, or perhaps because of the exclusion of chemistry by the art world, there have been numerous efforts by individual chemists and the chemical industry to relate chemistry to art. These include the organization of general art exhibitions by chemical companies, including those at the annual chemical engineering fair ACHEMA in Frankfurt, Germany; educational projects on the chemistry of pigments and other artistic materials, such as the one at the ETH Zürich (Switzerland); lectures on how chemistry helps to analyze and conserve artworks, as found in "Chemie der Kunst" (Berlin, Germany, 2003) as well as the public lectures that chemistry professors advertise as 'art performances'; publications on how the history of chemistry or historical chemists were artistically represented, such as Beretta 2001, Greenberg 2002, Beyer & Behrends 2003; and most notably, collaborations between individual chemists and artists, such as Hoffmann & Torrence 1993.

In contrast to these previous efforts which try to establish indirect or specific links from chemistry to art, "Chemistry in Art" has provided a space for contemporary artist to broadly speak to and reflect on chemistry. Given this, and the neglect of chemistry in previous curatorial projects on art and science, "Chemistry in Art" is the first public exhibition ever to present a variety of artistic perspectives on chemistry. Through this project, we hope to alter and expand the perception of both chemistry and art and inspire a community of artists to include chemistry as a legitimate and important subject of their inquiry. We believe such an exhibition will also begin to break down traditional barriers to the cultural and artistic examination of chemistry and ensure that this influential science is included in future exhibitions on the relationship between art and science.

With "Chemistry in Art" we have also explored new forms of selecting and presenting art. The way we have selected the artistic contributions combines 'double blind peer review', as known from the sciences, with the curatorial and jury models common in the arts. Similar and parallel to our 'Call for Papers', a broadly posted international 'Call for Artworks' invited artists to submit projects related to the general topic of "Aesthetics and Visualization in Chemistry". The many interesting projects we received far exceeded our expectations – expanding and altering our own perceptions of what constitutes art related to chemistry. From among the large pool of submissions, an international jury of artists and scholars from chemistry and art theory made a selection, based solely on criteria of quality and relevance. As in the sciences, our jurors did not know the names or any other details about the artists, nor did they know the choices of their fellow-jurors. Yet, despite their different backgrounds, their selections were surprisingly consistent. And since the jurors, almost in unison, ranked one project extraordinarily highly, we decided to give a special award to the artist, David Clark, from the Nova Scotia College of Art and Design, Canada.

In addition to the juried selection, "Chemistry in Art" also includes a curatorial project jointly directed by art critic David Spalding and Tami Spector. This
curatorial project highlights chemistry-related artworks by renowned artists Susan Robb, Shirley Tse, Cai Guo Qiang, Kim Abeles, and Fred Tomaselli. The images for this portion of the exhibition are accompanied by a dialogue between the curators (see pp. 26-34), which engages larger issues related to the intersections of art and chemistry. We believe that viewing these images in the context of chemistry and in dialogue with each other provides a new critical framework for understanding the work of these exceptional artists.

The artworks presented in the juried part of "Chemistry in Art" provide a variety of perspectives on chemistry. Since we asked the artists to speak for themselves by including a brief text in their art projects, we have confined this introduction to general remarks and relations between the different projects. In general, as we can conclude from the large amount of submissions we received, artists deal with chemistry from at least six different perspectives. (1) They deliberately use synthetic / chemical materials which they frequently oppose with 'natural' materials and, thus, work on the aesthetic difference between natural and synthetic. They employ chemical transformations either (2) in an experimental manner to generate novel phenomena, or (3) as part of artistic performances or dynamical artworks that highlight processuality and change. (4) They put symbolically laden parts of chemical laboratory apparatus into new contexts and thereby create and analyze symbolic meaning. (5) By representing either the actors of chemistry or prominent products of chemistry in certain contexts, they reflect the public image and the cultural place of chemists and chemistry in society. (6) Finally, they examine the aesthetic dimension of chemical models and theories and their scientific representations, by means of re-emphasis, re-configuration, re-contextualization, or analogy.

Surprisingly, in the juried part of "Chemistry in Art", three of the artists use the Periodic Table of Chemical Elements as an inspiration for their work to quite different ends. New York artist BLAIR G. BRADSHAW isolates specific elements in his paintings, creating his works out of building blocks of small canvases that mirror the way in which atoms themselves serve as building blocks for our material world – yielding visible and recognizable structures from discreet and indeterminate particles. DAVID CLARK, from Canada, wittily subverts the image of the Periodic Table by using its familiar form, and the atomic symbols that make up the table, to reinvest other visually encoded systems in western culture with new meaning. With craftsman-like artistry, Clark’s Chemical Vision literally translates the imagery of the periodic table into eye-charts and Ouija boards. In contrast to Bradshaw’s and Clark’s more formal use of the atomic symbols and Periodic Table, the installation of German artist ERICH FÜLLGRABE, the Latin Periodic System, seeks a psychological perspective on the Table’s symbolic meaning and explores the analogy between chemistry and linguistics. With works such as Reconstruction of a Representation of a Model of a Description of a Workplace of the Latin Periodic System of the Typographical Elements Füllgrabe not only creates a range of pseudo-scientific labels, instruments, and environments to investigate and deconstruct the relationship between visual systems and conceptual understanding, but also communicates his vision of a formal analogy between scientific and artistic investigation.
Electrochemistry underlies the work of both PAULA L LEVINE from California and BRIGITTE HITSCHLER from Germany. With *Bible Battery*, Levine uses transparent interconnected jars to expose the inner workings of her battery and, metaphorically, the bible. In this piece, sections of the bible submerged in the electrolytic solution literally and symbolically drive its narrative intent. In contrast, Hitschler's *Energy Fields* uses electrochemistry to expose the toxicity under the surface of a soon to be recultivated potash waste site in Hannover, Germany. Like environmental beacons, Hitschler’s field of 400 light emitting diodes poking their heads out of the earth like extra-terrestrial gophers provide an alarmingly beautiful signal for the hidden dangers created as by-products of chemical industry.

Both CHERYL SAFREN from New York and TAMAR SCHORI from Israel create works that expose the aesthetic potential of chemicals as artistic materials. With *Chemistry as Art* Safren uses chemical reactions on metal surfaces to create dynamic abstract images. With these works Safren brings to the fore the chemical materiality of painting and the intimacy of individual artist with their materials. Safren's 'paintings' interact with their viewers through the refractive and reflective nature of the chemicals applied to their surfaces, while Schori’s *e.mia.me* documents the beautiful forms created in response to multi-human interaction with a tank full of slick black-brown ferromagnetic liquid (ferrifluid). Besides revealing the aesthetic nature of the ferrifluid, Schori uses *e.mia.me* to focus on the act of creating participatory and collectively generated art. In this way her work also mirrors and comments on the collaborative (and, at times, playful) nature of research in the chemical sciences.

Finally, CHRISTOPHER PUZIO from California and LANE E. LAST from Tennessee each present works that explore some of the concepts and constructs that underlie modern day chemistry. With *Unit Construction* Puzio has created fifty 'atomic building units' out of steel tubes (which, incidentally, have a remarkable visual similarity to the Dreiding models used by chemists) that he uses as building blocks for his sculptures. Conceptually, Puzio's atomic units are analogues to amino acids, which at the most basic level are molecular units created from the same atomic units (N-terminus, C-terminus, R group). Depending on the order in which they are linked together, amino acids yield an astonishing variety of proteins. In this same way, Puzio's atomic units, which like amino acids are all variations on the same basic form, can lead to an almost infinity of tertiary forms. The vibrantly colored computer graphics of Last's *Imagining the Aesthetic Metaphor* also employ imagery based on the models that chemists use to communicate chemical concepts. Using pseudo-atomic forms these graphical works imitate the style and stretch the limits of the chemist's cartoon-like visualizations. Delving deep into the imagined interior world of atoms, Lane's images make atomic and molecular concepts like electronegativity and valency come alive.

To us what is most remarkable about "Chemistry in Art" is not that the artists use chemistry in clever and engaging ways, but how their work reveals the ways chemistry has seeped into the world outside the laboratory and classroom. Using the icons and materials of chemistry, these artists generate and reflect many of the larger cultural concerns related to this often misunderstood science, whether
environmental or metaphysical. Thus, from the perspective of "Chemistry in Art" the Periodic Table is at once a symbolic system with specific scientific meaning; an almost instantly recognizable cultural icon that encodes the idea of chemistry even to those who have no real understanding of its content; and a template for examining the nature of visual representation. Similarly, the dynamic, interactive nature of ferromagnetic material becomes a means for understanding scientific collaboration. With these and the other works in "Chemistry in Art", the artists in this exhibition have transcended the literal by pushing and prodding chemistry's symbols, materials, and processes to reveal its transformative core.

References


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(last visited 22 July 2003)

Art & Science Collaborations, Inc. (ASCI)
http://www.asci.org/

Chemie und Kunst: Pigmente, EducETH
http://www.educeth.ch/chemie/diverses/pigmente/

Gene(sis): Contemporary Art Explores Human Genomics
http://www.gene-sis.net/
HYLE–International Journal for Philosophy of Chemistry, special issue on "Aesthetics and Visualization in Chemistry", Parts I and II
http://www.hyle.org/journal/issues/9-1/
http://www.hyle.org/journal/issues/9-2/

Leonardo On-Line: the International Society for the Arts, Sciences and Technology
http://mitpress2.mit.edu/e-journals/Leonardo/

Molecular Art | Molecular Science, by David S. Goodsell
http://www.scripps.edu/pub/goodsell/

Rhizome.org: The new media art resource
http://www.rhizome.org/


Vortragsreihe - Chemie der Kunst, by Bundesanstalt für Materialforschung und -prüfung
http://www.bam.de/chemie-der-kunst.htm
Blair G. Bradshaw

Born in 1967
Artist

Contact

315 Bleecker St. #191
New York, NY 10014
U.S.A.
E-mail: bgb@onebox.com
Internet: www.blairbradshaw.com

Exhibitions (selection)

Geraldine Banier, Paris, France, 2003
Tercera, San Francisco, CA, USA, 2003
Zonal, San Francisco, CA, USA, 2002
City Hall, San Francisco, CA, USA, 2002
Temple, Palo Alto, CA, USA, 2002
Globe, San Francisco, CA, USA, 2001
Hang, San Francisco, CA, USA, 2001
Hang, San Francisco, CA, USA, 2000
Zonal, San Francisco, CA, USA, 2000
Montserrat, New York, NY, USA, 2000

An Interpretation of Elements

by Blair G. Bradshaw

When I first started working with the iconography of chemical symbols and models I was primarily attracted to its simple aesthetic. I would use introductory textbooks as reference. I began to research the older forms of the periodic table going back to John Dalton’s graphic symbols for the elements; I would then quote these icons in my paintings. As I learned more about chemistry and the men and woman behind the science my interest grew deeper, going beyond the simple graphic representations. The ability of the periodic table to represent such complicated ideas in such simple form soon became the focus of my attention. There is no simpler vocabulary for such a rich language. I continue to try to explore the complexity and depth of such simple graphic representation by altering and distorting it artistically, giving it a more organic life than cold black and letters and numbers.
David Clark

Born in 1963 in Calgary, Alberta, Canada
Associate Professor in Film at the Nova Scotia College of Art and Design

Contact

Media Arts Division
Nova Scotia College of Art and Design
Halifax, Nova Scotia B3J 3J6
Canada
E-mail: dclark@nscad.ns.ca
Internet: www.aisforapple.net

Exhibitions (selection)

43rd Cracow Film Festival, Krakow, Poland, 2003
European Media Arts Festival, Osnabrück, Germany, 2003
DigitalMedia Gallery, American Museum for the Moving Image, New York, USA, 2003
SXSW 2003 Interactive Web Awards, Austin, Texas, USA, 2003
Transmediale03, Berlin, Germany, 2003
Sundance On-line Film Festival, Park City, Utah, USA, 2003
16th Stuttgarter Filmwinter, Stuttgart, Germany, 2003
Montreal International Festival of New Cinema and New Media, Montreal, Canada, 2002
FILE2002 Festival, Sao Paulo, Brazil, 2002

Awards (selections)

Best in Show, SXSW Interactive Festival, Austin, Texas, USA, 2003
First Prize, FILE2002 Electronic Language International Festival, Sao Paulo, Brazil, 2002
MTT New Media Prize, Nova Scotia Arts Council, Canada, 2001

Bibliographic References (selections)

Core Concepts by Curt Cloniger, Rhizome.org (netartnews), August 6, 2002.
La pomme porte ses fruits by Marie Lechner, Liberation.fr (web magazine), July 12, 2002
Chemical Vision: The science museum of metachemistry

by David Clark

"The law of periodicity first allowed us to perceive undiscovered elements at a distance which formerly was inaccessible to chemical vision."

from Dimitri Mendeleev’s Faraday lecture before the Chemical Society in London twenty years after his discovery of periodic law (1889)

"The limits of my language mean the limits of my world."

Ludwig Wittgenstein, Tractatus Logico-Philosophicus (1922)

If I am allowed to misunderstand Mendeleev’s remarks, it is possible to imagine that he is suggesting such a thing as chemical vision. What a wonderful idea to think we could touch the world with our eyes, to know the world unencumbered by signs and representations, to know what the world really is; what substance it has, what things really are.

Mendeleev’s great discovery, the periodic table, is a pinnacle of modernism. It sustains the atomist’s hope that signs can be ascribed to all things; and those things, suspended in the proper order of differences and similarities, can be used as the building blocks of our picture of the world. Chemical atomism is perhaps the most pronounced of all the tendencies towards atomism that characterize modernism. But we live in a time after the atom has been split, when our sensorium is being ripped apart by the domination of physical senses and the suppression of the chemical senses. Logic is just another language game; the visual has become the virtual. We are rapidly losing our grasp of the real that has heretofore grounded our existence and knowledge of the world.

Chemical Vision is a large-scale, walk-through interactive installation that has resonances of a science museum. Architecturally, it is derived from the shape of the periodic table, or more specifically the Meyer table that has become synonymous with periodic law < an image which has become a meta-sign of the discipline of chemistry itself. In the installation, the viewer encounters enigmatic displays that reflect on vision, language, and the physical sciences: a Braille visual acuity chart constructed out of the chemical element’s abbreviations, a giant, motorized computer mouse on an Ouija board, also inscribed with the chemical elements. This museum doesn’t explain but shows us the difficulties for art and science in the transition from the modernist world to our own. The mouse is a particular figure here; both the mouse that has lent itself to psychology experiments and the computer mouse that evokes an entire virtual world that is devoid of the chemical senses. What will be the progression of knowledge in this chemical-less dream world? What will become of mice and men?

Chemical Vision was first shown in an exhibition entitled Scienced Fictions curated by Peter Dykhuis at the Art Gallery of Nova Scotia, in Halifax, Canada in 2000. It will be exhibited again in an exhibition entitled Chemical Vision at Museum London in London, Ontario in November of 2003.
Erich Füllgrabe

Born in 1962 in Herne, Germany
Free artist and graphic designer, organizes and teaches art projects with young people

Contact

Goethestr. 57
44623 Herne
Germany
E-mail: null@gmdf.de
Internet: www.laboartorium.de  |  www.gmdf.de

Exhibitions (selection)

Theorien über Nix, Bochum, Germany, 2002
YOU + ME - market (together with Takako Saito and other artists), Düsseldorf, Germany, 2001
2+2, KUBUS, Städtische Galerie Hannover, Germany, 2001
Bewegliche Lettern, Städtische Galerie Remscheid, Germany, 2000
BLACK OUT, Flottmann-Hallen, Herne, Germany, 1999
Collagelaboratorium, Kunst-Wirk-Raum, Gerhard Reinert, Recklinghausen, Germany, 1998
Junger Westen (together with Lotte Füllgrabe-Pütz), Recklinghausen, Germany, 1997
bänder, Galerie Sint Marten, Arnhem, Netherlands, 1997
german contemporary art, Wakefield, England, 1996
grand art exhibition NRW, Düsseldorf, Germany, 1989

Awards (selections)

Special award of the Zimolong-(art)society, Gladbeck, Germany, 1992
Copy-Art-Museum, Mühlheim, Germany, 1988
Art-Award for young artists, Herne, Germany, 1987

Bibliographic References (selections)

Theorien über Nix (Theories about nothing), together with students of the Maria-Sybille-Merian-Gesamtschule, Bochum, 2002
Übergangologie (an introduction to the theory of transition), in: Übergänge (Transitions), Recklinghausen, 1999
Measuring and Comparison

by Erich Füllgrabe

The *Latin periodic system of typographic elements* is part of my general approach in which I try out new definitions of understanding both in art and science by drawing relations between their languages. In so doing, it is not my intention to illustrate scientific knowledge or to replace well-known theories with private explanations, but to understand understanding.

Chemistry is the science of elements and material transmutations. By mixing, assembling, analyzing, and synthesizing, chemists investigate the structures of matter and enlarge both our understanding and the ability to create something new. Provided that art is a way of creating and understanding too - and that artists similarly proceed by mixing, assembling, analyzing, and synthesizing - we may ask similar questions about visibility and existence in both fields. In art, individual experience has to be related to general experience and to be transmuted into visual "images". If art and chemistry are domains of transmutation and of dealing with raw materials, we may address those questions by similar approaches in both fields.

The analogy between chemistry and art does of course not eliminate their differences. However, it might be useful to analyze similarities between the two approaches to understanding. Both chemists and artists must translate their individual experiences and experiments into visual presentations of results that considerably differ from their starting points. Both need to consider that visualizations are never faithful copies of their experiences but at best adequate summaries. In addition, if understanding should reach beyond the individual scientist or artist, both must present their results in a way comprehensible for others and thus place them into a social context. Finally, in both domains visualization is not only a means of illustration but also a creative part of the act of understanding. Such as experiments can test the validity of theories, creating visualization can be used to test the degree of understanding of the corresponding results.

I am convinced that connecting methods from science with procedures from non-scientific domains generates mutually beneficial impulses - not only to find new visualizations but also to reflect on visualization and the relation between knowledge, images, and reality.
Brigitte Hitschler

Born in 1954 in Bochum, Germany
Artist

Contact

Urbanusstraße 13
44892 Bochum
Germany
E-mail: brightschler@t-online.de

Exhibitions (selection)

Lüntec, painting, Technology Center Lünen, Germany, 2001
Energy Field, land art, Hannover, Germany, 1999
Video-installation, Harenberg City-Center, Dortmund/Germany, 1998
Dayflies, text collage, Theatre of Hannover, Hannover, Germany, 1998
Objects, painting & video, Torhaus Rombergpark, Dortmund, Germany, 1998
Grottenolm, video, Marsberger Musiktage, Marsberg, Germany, 1998
The way it begins, video installation, art society, Villa Streccius, Landau, Germany, 1998
not quite the right blue ..., video installation, University of Iowa City, Iowa, USA, 1998
Wir zweifeln jetzt anders, work in public space, text installation (stainless steel),
University of Dortmund, Germany, 1997/98
Energy Field

by Brigitte Hitschler

Four hundred light emitting diodes are glowing red in a marked out field on a potash slagheap in Hannover-Empelde, Germany. Tiny mysterious dots on sixteen poetic square meters. Glimmering lights invoke the slumbering, hidden forces of the hill. The energy, still inside and documented by permanent chemical processes in the material, flown into it as work energy, will be reactivated as "recovery energy" after completed recultivation. They symbolize the past and future energy potential of the place.

Each light emitting diode is placed at the top of two 40 cm long and 2 mm thin brass tubes, which are connected with pieces of magnesium and plates of copper and zinc. The energy for the shining of the diodes is provided by two galvanic cells connected in series which absorb the power generated by the chemical reactions of the salt of the potash mining debris, the metal, and the humidity directly from the hill. Thus, a 4x4 m large surface strewn with tiny light spots is created without supplementary power.

The slagheap of the potash mine in Hannover, which was closed in 1972, is being recultivated. A coating of the entire mountain with rubble and soil is to stop the washing out of the potash and therefore the release of salt into the surrounding rivers. After afforestation a forest biotope will be put up on a long-term basis.

In 1999, an exhibition project offered artists the opportunity to create works of art between the slagheap and recultivated green area. In context of this project the presented work was created.
Lane E. Last

Born in 1964
Assistant Professor of Art, University of Tennessee at Martin
Editor of New Media Art (www.nmediac.net)

Contact

621 Exchange Street
Union City, TN 38261
U.S.A
E-mail: lanelast@utm.edu
Internet: www.lanelast.com

Recent Exhibitions

Spaces for Experimentation, Museum of Contemporary Art, San Jose, Costa Rica, 2003
[d]vision Festival For Digital Culture, Werkstätten and Kulturhaus, Vienna, Austria, 2003
Icon/X Animation, Remote Lounge, New York, USA, 2003
CyberArts 2002, Prix Ars Electronica, Austrian Broadcasting Corp., Linz, Austria, 2002
5th International Conference on Generative Art, Politecnico di Milano University, Milan, Italy, 2002
International Digital Film Fest, Media Co-op, Memphis, Tennessee, USA, 2002
Deus Ex Machina, On-Line Photography Exhibit 2002, Bradley University, Peoria, Illinois, USA, 2002
Media Art Festival Friesland, St. Jacobparochie, Netherlands, 2001

Awards (selections)

Professional Artist Support Grant, Tennessee Arts Commission, Nashville, Tennessee, USA, 2003
Faculty Development Grant, University of Tennessee, Martin, Tennessee, USA, 2002
Wisconsin Arts Board, Direct Purchase Project, Madison, Wisconsin, USA, 1998
Imagining the Aesthetic Metaphor

by Lane E. Last

Every image can embody a way of seeing and relating to the world. It is nearly always necessary for us to "see" or detect a phenomenon before it can be discovered, studied, and understood. This is a fascinating parallel to some visual arts production, and one not lost on early writers on alchemy.

In many ways the beauty inherent in some types of art is their ability to cling to the imagination of a viewer despite a lack of knowledge of specific information. Whether it is a combination of formal compositional or visual elements, or pure chance is hard to know. What is important is that the recency and attractive visual qualities of such a work can become an opportunity to educate in an informal manner.

As an artist the process of "imagining the aesthetic metaphor" goes far beyond communicating information to a form of persuasion. As the modern world becomes more dependent on the products and processes of the chemical sciences, it is imperative to address the pursuit itself in an interesting and positive framework. "Believing is seeing" is a quite telling notion. This means, however, that the productions of images to support the sciences must be sophisticated, appealing, and not far from mythologizing. It is not said that they should be imaginary. Rather they should challenge the imagination possibly to lead to further knowledge-based inquiry.
Paula L. Levine

Born in 1948 in New Haven, Connecticut
Visual Artist and Assistant Professor of Art at the San Francisco State University

Contact

167 Sussex Street
San Francisco, CA 94131
U.S.A.
E-mail: plevine@sfsu.edu
Internet: http://userwww.sfsu.edu/~plevine/

Exhibitions (selection)

Women of the Book: Jewish Artists, Jewish Themes, traveled to Purdue University Gallery, Minnesota Center for Book Arts, University of Pennsylvania Special Collections Library, & University of Arizona Museum of Art, 2003
Being and Belonging: Reflections on Jewish Spaces, Gottheff Art Gallery, La Jolla, California, USA, 2003
This is not a book, Institute of Contemporary Art, San Jose, California, USA, 2000
10th Annual Jewish Film & Video Festival, Jewish Museum of New York, USA, 2000
PlayBlotto!, Mill Valley Film, Video and New Media Festival, Mill Valley, California, USA, 1999
Facing Fear, Arts San Francisco Arts Commission Gallery, San Francisco, California, USA, 1999
Faces, Dazibao, Center de Photographies Actuelles, Montreal, Quebec, Canada, 1998
Facing Eden: 100 Years of Landscape Art in the Bay Area, DeYoung Art Museum, San Francisco, California, USA, 1995
Death & the Family, Presentation House, North Vancouver, BC, Canada, 1998

Awards (selections)

Videomaker Production Award, Bay Area Video Coalition, San Francisco, California, USA, 2002
Djerassi Resident Artist Program, Woodside, California, USA, 2000
Research and Development Grant, Canada Council for the Arts, Ontario, Canada, 1996

Bibliographic References (selections)

Books that are not books by Jack Fischer, San Jose Mercury News, April, 2001
The Bible Battery

by Paula Levine

Biblical narratives constitute foundations for many cultural, social, and religious beliefs and practices in Judaism. Historically, these narratives have sometimes formed a kind of template through which contemporary historical events were interpreted and understood. While the narratives powerfully bridge time and carry both history and memory, they are, according to Yosef Hayim Yerushalmi in his book *Zakhor: Jewish History and Jewish Memory*, neither fictions nor fact in the modern sense.

The current, ongoing conflicts in the Middle East, particularly in Israel and Palestine, have informed and shaped many of my projects over the past ten years. One of them is a series called "As if the laws are malleable". This series uses bibles as source, subject, and object of investigations and questions of Jewish laws, customs, traditions, conventions, and contemporary politics in Israel. The series can be viewed on line at http://www.as-if-the-laws-were-malleable.net.

Part of the series is the installation "Bible Battery", first exhibited at the San Jose Institute of Contemporary Art in 2001. In this installation, the bible generates a 9 volt current that powers a small LED screen. When a viewer pushes a small button, text on the screen reads: "Move past old narratives."

The "Bible Battery" is the result of a number of confluent threads:

- thoughts about energy as a force that effects change and can transform from one state to another;
- thinking of 'The Word' that has, over time, transformed from one state to another: from an oral tradition to that of a written text;
- thinking about 'narrative' as another kind of force; one that converts or transforms experience into knowledge;
- my own responses to the continuing Israeli / Palestinian conflicts.

The idea was to consider the bible and its narratives as energy that could then be changed from one form to another. I wanted to emulate the shift from oral to written text, but also to have the new form be intangible and immaterial.

Utilizing both older technologies (battery) and newer technologies (LEDs), the piece conveys its message: to move past those narratives that have become dangerously rigid in their interpretations.
Christopher Puzio

Born in 1971 in Paterson, New Jersey

Contact

5218 La Jolla Hermosa Avenue
La Jolla, CA 92037
U.S.A
E-mail: chris@puzio.com
Internet: www.puzio.com

Exhibitions (selection)

Design Show, Detroit Artist Market, Detroit, MI, USA, 2003
Dwellings, IDEA-ARTS gallery, Austin, TX, USA, 2003
Critical Mass, Museum of New Art, Detroit, MI, USA, 2002
Daimler Chrysler recent acquisitions, Daimler Chrysler, Southfield, MI, USA, 2002
Graduate Degree Show, Cranbrook Academy of Art, Bloomfield Hills, MI, USA, 2002
Seats 14: New Functional Seating Design, Detroit Contemporary, Detroit, MI, USA, 2002
Science Fare, Cranbrook Academy of Art, Bloomfield Hills, MI, USA, 2001
In Process: current and ongoing work by cranbrook 3d design department, Cranbrook Academy of Art, Bloomfield Hills, MI, USA, 2001
Cranbrook Connection, D'Arcy Advertising Agency Headquarters - Troy, MI, USA, 2001
Recycle / Reuse, Cranbrook Academy of Art, Bloomfield Hills, MI, USA, 2000

Awards (selections)

Redstone Merit Scholarship, Cranbrook Academy of Art, 2001
Academic Grant, Cranbrook Academy of Art, 2000
Nast Award for design, Boston Architectural Center, 1995
**Warped Structural Loops**

*by Christopher Puzio*

This sculptural investigation was realized in response to some preliminary studies of "protein folding". It is my aim to form a new structural language within the art-practice of sculpture that acknowledges current thought within the fields of mathematics and bio-mechanics as it pertains to our understanding of form.

With this piece, I have developed an assembly that is composed of a family of fifty atomic building units. These units have no specific directional orientation, yet can be assembled by means of a prescriptive sequence into closed loops.

Common to all units are the following characteristics: 12" lengths of tube steel are machined and given a 30-degree bend. Tubes are welded together in pairs at 90 degrees. The relative rotation of the rods prior to being welded is left as an open variable within the fabrication process. These modular pieces comprise the family of fifty atomic units which share many dimensional and directional characteristics, yet no two are the same. (Figure 1)

By selecting a sequence of six units and connecting them at random, one will be able to make the resulting string connect into a closed loop. Each string of six has a unique geometric composition resulting in only one closed loop, whose geometry is specific to that sequence. If the sequence order is changed for any given six units, the resulting loop will have a uniquely original geometry. Since each loop can only close into a singular geometric loop, all rotation is canceled out by the locked geometry. In other words, while the pin connections that join the units on axis allow for rotation, the geometry of the loop becomes rigid and fixed once the loop is closed. (Figure 2) At the next largest scale, these loops can in turn be connected together into six loops of six units. (Figure 3) Resulting structures are indexed, quantified, and reprogrammed to form alternate structural configurations. (Figure 4)

These types of geometric set relationships are more common to the world of biomechanics and chemistry than sculpture or architecture. One of my aims as an artist is to begin to bridge the gap that exists between these worlds of thinking. My compositional approach, borrowed from the world of biomechanics, could be applied to the production of structurally engineered architectural systems through very basic fabrication processes. This would result in a new richly varied structural language.
Cheryl Safren

Born in 1951
Artist and teacher

Contact

57 South Cloverfield Road
Valley Stream, New York 11581
E-mail: tzayaret@optonline.com
Internet: www.safren.com

Exhibitions (selection)

Salon 2003, Williamsburg Art and Historical Center, Brooklyn, NY, USA, 2003
Faber Birren National Color Award Show, Stamford, CT, USA, 2003
City Hall, Balatonfured, Hungary, 2002
Art of Science and Technology, American Association for the Advancement of Science, Washington, DC, USA, 1996

Awards (selections)

William and Freida Kufeld Memorial Award for Excellence in Teaching, 2000
Individual Artist Showcase Competition, Alliance of Queens Artists, 1984

Bibliographic References (selections)

Hungarian Cultural Television interviewed on MTV1, MTV2, July 2002
Nyarts Magazine, CopperWorld, June 2002
Chemistry as Art

by Cheryl Safren

Many artists today address and incorporate a variety of scientific disciplines and technologies. Computer, video, and sound-generated work are prevalent in most major contemporary art museums, and biological themes are ubiquitous. Nevertheless, chemistry, whose many processes can be inherently aesthetic and sensually compelling - often eliciting an "oh wow!" response - is seldom directly considered despite its historic role in art-making.

Paints, pastels and other rendering media are chemical formulations that have been traditionally employed by artists. As an artist, I have been one of the many grateful users of paints, dyes, binders, and various mediums that have been developed and perfected by chemists. Since this journal is read by many chemists, I would like to acknowledge the vast and historical body of artwork made possible through chemistry. Chemists have created media of every conceivable hue and viscosity and made these materials more light fast, quicker drying, more permanent, and less toxic.

However, chemistry's contribution to image making extends beyond paint media. The images shown here were rendered without the use of any paint. Instead, dynamic chemical reactions on sheet metal form the basis of my process. Changing color through reaction, crystallization, fusing, and solidification are a few of the ways chemistry informs this work.

Light's movement on the metal, as well as the viewer's motion, are the kinesthetic forces that alter our perception. When lit obliquely, the color appears saturated, majestic, and even reverential.

In addition to chemical manipulation, I sometimes form glass or plastic on the surface of the metal to suggest the genesis or formation of different types of matter. While the subject of creation plays a role, it is the chemical interactions that give full expression to the images. Chemistry is sometimes the subject of my work, often its inspiration, and always the method or means of its creation.

Chemical reactions are highly charged visual stimuli that have influenced my work for years. If you feed the keywords "chemistry + art" into any search engine, you will be supplied with examples of illustrations and animations explaining various chemical processes. I am truly impressed by some of this work. However, my art is not created to explain chemistry, but to harness chemistry to create art. My works are not simulations or illustrations of processes but, rather, art produced by these processes. Not art about chemistry, but art by chemistry. It is my hope that these visuals will promote an awareness of the beauty that chemistry can create.
Tamar Schori

Born in 1965
New Media Artist

Contact

9 Hadaga St.
Tel-Aviv, Jaffa
Israel
E-mail: ts@tamar-schori.net
Internet: http://www.tamar-schori.net

Exhibitions (selection)

*click on*, Impakt Online, Beadgee, net.art project commissioned by Impakt.nl [http://www.impakt.nl], 2003
*Vitalia*, generated images, Gut aufgelegt, Griffelkunst, Kunsthau, Hamburg, Germany, 2001; Art Forum Berlin, Berlin, Germany, 2001
*Vitalia*, interactive installation, Fotohof Gallery, Austria, 1999; Art Statements, Art/30/Basel, Switzerland, 1999; CYNET Art 00, Germany, 2000
*The delight of deception*, computer enhanced installation, Art Focus, International Biennale, Israel, 1997
*The chant of the Dying flash*, computer enhanced installation, Neue Galerie Museum, Shteriches herbst festival, Austria, 1996; Nikolaj Center, Denmark, 1996; Waino Alto Museum, Finland, 1997
**e.mia.me' - Matter Breaks Free**

*Smart materials in the service of physical interaction*

*by Tamar Schori*

Ferrofluid, a magnetic fluid, is the principle actor in e.mia.me'. Ferrofluid is part liquid, part solid. When put in presence of a magnetic field it expresses flexibility and reversibility. It is made out of tiny particles that respond to external magnetic, gravitational and surface tension forces.

E.mia.me' includes an elevated round stage that serves as a physical interface. Sixteen visitors may use pairs of pedals to manipulate a video projection. The group invokes a magnetic field that animates a magnetic fluid in a hidden aquarium. The images are streamed from the aquarium to the center of the stage. Parts of the stage may vibrate following users' choices. These vibrations will stop only through a group effort.

Users experience direct control over the video projection at their footstep. The reversibility of the Ferrofluid in the presence of a magnetic field is therefore used as the driving force of this interactive installation.

The interactive model in e.mia.me' encourages a group behavior. When the stage vibrates the group will have to generate a mutual will in order to avoid or pursue the vibrations.

The tiny particles of the magnetic fluid respond unanimously to an external force. When a group is formed through trial and error a time may come when the group itself will act in a similar way.

The ability of a medium to receive input, change its shape according to the input and return to its original state when the input seizes, is generally attributed to digital products and outcomes. Here, the Ferrofluid reversibility enables the assimilation of digital flexibility in a physical substance. (In daily conditions) e.mia.me' uses the Ferrofluid's qualities as part liquid, part solid, to visualize process, data transmission and control. As the material visually breaks from the restraining boundaries of gravity it expresses the beauty inherited in interaction and flux.

The images created in e.mia.me' document users' choices and behavior. The generated dynamic and shapes are intrinsically beautiful. This beauty lures the audience into participation as they gain control over the mechanism and develop a hive mind that guide them through a recursive process that enhance both the material and the group.

The artist acknowledges the support of Ferrotec.
Chemistry in Art

The Curatorial Project

www.hyle.org/art/cia/
Curatorial Project

Between Chemistry and Art

Curators Tami Spector and David Spalding in Dialogue

Tami Spector: I would like to begin by discussing why you and I chose the artists that we did. Unlike the artists who submitted projects for the refereed part of the Chemistry in Art exhibition, who presumably intended to explicitly reference chemistry in their work, this part of Chemistry in Art is really based on our own conceptions of art and chemistry. I am curious about what types of things you were thinking about when you first tried to come up with artists that fit the theme. In other words, what did chemistry in this context mean to you?

David Spalding: When we first began discussing the possibility of identifying artists whose work relates to chemistry, I was immediately interested in artworks that stretched curatorial parameters and defied expectations. I had not given much thought to chemistry, but had recently been writing about art and the human genome project. During my research, I was struck by the way that the ethical dilemmas that science generates can be both neutralized and amplified by artists.

One of my first impulses was to consider artists that address the phenomenological aspects of chemistry, like Cai Guo Qiang's explosions, or the drug trips evoked by Fred Tomaselli's pill paintings. From the outset, we both agreed that it was important to select artists who present work from a range of cultural vantages. Clearly, representations of chemistry and chemical processes, of the conceptual concerns evoked by chemistry, of the promises and dangers of chemistry – all these things would be imagined and imaged differently in a variety of cultural contexts. I was also thinking about this during the preliminary selections.

Many of the artists came to mind while I was reading one of the introductory chemistry texts that you lent me. Looking at the pictures and reading about what chemists actually do in laboratories made me think more about the material aspects of chemistry. It was then that Shirley Tse's work came to mind – the way she transforms polymers and synthetic packaging materials raises so many interesting conceptual questions. The materials that she uses are clearly chemical, but her work is also linked to chemistry because it embodies the notion of transformation.

Initially, I wanted to see what would happen if we brought together artists whose work is not usually associated with chemistry or science. By conceptually reframing the work and putting it in dialogue with other unlikely candidates, could we broaden the way these artists are understood? I did not want to see sculptures of giant beakers. I was interested in works that are more ambivalent. Ideally, I wanted to challenge the ways that art and chemistry have typically been linked, asking viewers to make connections that are not always obvious. This would not only transform the chosen artworks; it might change the way we imagine the conceptual, ethical, and material dimensions of chemistry.
TS: I must admit that when we first started I had some initial reluctance about many of the artists that you suggested. On the surface, they seemed to mostly speak to the negative aspects of chemistry in society, or at least to the more industrially driven domains of chemistry. I suspected that many chemists might also have a similar knee-jerk response to the artists that we decided to include, which made me a bit hesitant. It is not that I thought that we should not include anything on this aspect of chemistry; rather I did not want it to be the only focus. From this perspective, I viewed Fred Tomaselli’s work as a response to the pharmaceutical industry and drug addiction, Kim Abeles’ to industrial pollution, Cai Guo Qiang’s to weaponry, and Shirley Tse’s to the impact of plastics on the environment. My initial hope was that the artists we included would not necessarily glorify chemistry, but perhaps get inside the metaphorical aspects of chemistry – the transformation, synthesis, and production of products – and perhaps the symbolic language and the experimental vocabulary and apparatus of chemistry. Also, I wanted to clearly distinguish chemistry from biology, which is often mixed up with chemistry by non-chemists.

Looking deeper, however, I realized that the artists that we were thinking of including do address what I initially had in mind, but they also reflect the larger tensions that are embedded within the chemistry community. There is an inherent tension in chemistry between the doing of chemistry and its applications – in the way the products of chemistry can at once be scientifically and/or aesthetically compelling and fraught with societal implications. I believe that many chemists conceptually separate the chemistry they do from its potential applications, whether the chemistry they are doing is socially benign or not. On a day-to-day level chemists tend to steep themselves in the intricacies of their work, whether it be developing plastics with new material properties, new pharmaceuticals for AIDS, new explosives, or something potentially quite boring, like developing a new soap, without much thought about the ultimate application of the materials. I am not saying that chemistry as a discipline and culture is neutral to its place and impact on society. But in the day-to-day world of chemistry, it is the chemistry that captures a chemist’s imagination and that there is often an inherent tension between the allure of the work that they are doing and its ultimate outcome.

With this in mind I realized that the artists we selected for this exhibition are representative of the intersection of chemistry and art because they explicitly mirror these tensions in their work. What I mean is that the works like Abeles’ *Presidential Commemorative Smog Plates* (1992) or Tse’s *Diaspora? Touristry?* (1999) both carry with them the intricacies of art and chemistry and serve as social commentaries on chemistry. For me this perspective provides a groundwork for understanding these artists in relation to chemistry, and also, as you suggest, in relation to one another. Your comments also make me realize how overly sensitive I am to negative associations with chemistry – so that, where for you Tomaselli’s and Cai’s work has to do with the phenomenology of chemistry, I immediately leapt to nastier interpretations of their work.
DS: When we began selecting artists, it never occurred to me to impose a viewpoint that would glorify or demonize chemistry. Chemistry seems so immediate and diverse in its incarnations that it would be impossible to reduce its multiple meanings in this way. That is part of what made this project so interesting. Since chemicals are literally everywhere, which aspects should we choose to isolate and highlight? As you have said, chemistry does give form to a number of provocative tensions. Is it a helpful science, or a dangerous one? Of course, it is both. Some artworks embody these tensions by delaying their resolution, while others are quicker to take sides. Shirley Tse’s work certainly embraces this kind of multiplicity. Her sculptural installation Shelf Life (2002) uses various kinds of polymers – from Styrofoam to “memory foam” – to confront viewers with a constellation of associations. Climbing the steps cut into the side of the enormous structure, one enters a hybrid space: part amusement park ride, part spa, and part futuristic medical center. The title suggests packaging and its ability to extend expiration dates, but sitting inside a flesh-colored tub makes one wonder what (or who) is being packaged. One of the things the installation implies is that it is our conceptual categories that are culturally given, enveloping us in a strangely hermetic embrace. The more we stay open to the multiple meanings suggested by Shelf Life (2002), the closer we get to chemistry as a way of thinking. This is not to say that chemistry is a screen that is ready for any and all of our projections. But Tse’s work begins to create a series of heterogeneous associations that can exist simultaneously. For this reason, her work best addresses the way I imagine chemistry.

TS: Can you say more about this? What is it that you mean by chemistry as a way of thinking?

DS: Though I have a very limited understanding of chemistry, I want to venture that transformation – changes in the molecular structure of matter, for example – is central to many of chemistry’s applications and incarnations. Seen in this way, chemistry itself, with its myriad productive and non-productive applications, becomes analogous to its central tenant of transformation. This interests me because it creates a set of parallel structures whose alignment rests on the idea of multiplicity – simultaneous possibilities that do not void each other. For this reason, chemistry is illustrative of certain models of thinking. Rather than reductive, oppositional, or binary logic, which can consolidate meanings through the minimization of internal differences within each conceptual category (i.e., “natural” and “artificial”), chemistry’s focus on and embodiment of multiplicity and transformation suggests other, more inclusive and complex ways of organizing information. It is surprising that chemistry can take us outside the bounds of more traditional notions of scientific reason, offering up a model that might accommodates that flux of our lived experiences. I wonder if your experience as a chemist resonates with this investment in transformation and multiplicity.

TS: One way to think about this is that for any chemical product there are multiple approaches to its synthesis or, from a reverse perspective, chemical entities hold in them multiple transformative possibilities, multiple means to an end, and multiple ends.
On the level of practice this means that a number of chemists might work toward the exact same ends using different synthetic processes and different starting materials. As a result it is the choices made by both chemists and chemicals that inform and define our understanding of the final product and not just the product itself. I think this is probably true for art also, but in art the process may or may not be relevant to the artistic product, while in chemistry the synthetic process takes precedent in many ways over the end product and the process is always explicitly revealed. I think this is somewhat different from what you are suggesting about Tse's work, where it is the end product of the artistic process, the piece of art that embodies its multiplicity. I suppose that this is also true for chemical products but for me what defines chemistry's complexity and irreducibility is how process, transformation, and product are inextricably linked to each other.

Because of its transformative nature, much of chemistry also opens itself up to the unexpected and serendipity. A chemist might plan and perform a particular transformation but in actuality a different process occurs as revealed by the end product. In that way chemistry seems parallel to the artistic process, where there is often a disjunction between an artist’s conception and the art she produces. Among the artists that we are featuring here, I think Cai Guo Qiang’s work is most readily understood in this regard because of its performative nature (i.e., its focus on process) and in its unpredictable, yet circumscribed, outcome.

DS: I wonder how much of Cai’s work with fireworks and gunpowder is unpredictable. Many of his performances appear so well planned, particularly those involving fireworks. Transient Rainbow (2002) was commissioned by Cai and the Museum of Modern Art in New York to celebrate the opening in its temporary location in Queens. Grucci, a family owned pyrotechnic company based in New York, was actually responsible for the execution of the project. If you look at the preliminary study, it is clear that very little was left to chance. Remember that the event took place on June 29, 2002, when New Yorkers were still recovering from the events of September 11. Explosions in the night sky – however beautiful – could alarm the public. My sense is that the project was very exacting and controlled. It is interesting to think of fireworks as staged chemical reactions that have to maintain a careful balance between safety and spectacle.

TS: I agree in some ways with what you are saying, but at the same time I think that there is an inherent unpredictability in this work, since it relies on the chemistry working properly each time. If I were Cai, I would not be worried about the uncontrollability of the work but about whether it would be a dud – in chemistry parlance, whether it would be “crap-out”. Maybe a better way of expressing it is that it is not completely reproducible.

In order to shift things slightly I will refocus our conversation onto Fred Tomaselli’s work. I think it is important that viewers know that he is using pharmaceuticals in his work – that he is actually applying pills, cannabis leaves, etc. to the canvases. When you look at reproductions of his work, that is not necessarily apparent. Bambogenesis (1992) uses hemp leaves, saccharin, and other assorted pills, while the “lines” in 13,000 (1991) are made of aspirin tablets. At first glance, people might not realize this, so viewers need to look closely at the images, particularly in a screen-based exhibition. More
importantly, I think the fact that Tomaselli uses real drugs in his work is ripe for interpretation in the context of chemistry.

The production of pharmaceuticals and the ways in which pharmaceuticals interact with the human body and mind are huge parts of chemistry. From an overly reductive perspective, drugs are chemicals that are synthesized or isolated by chemists and that people ingest to induce a biochemical reaction(s) that yield a physiological effect. By using the pills as materials for his paintings, Tomaselli literalizes this connection between pharmaceuticals and physiology and, more specifically, gets at the aesthetic qualities of drug induced biochemical states like hallucination. As exemplified by *Bambogenesis* (1992), his images are often reminiscent of the work of 1960’s psychedelic poster artists; but unlike these artists, he appears to approach his work with an ample dose of self-consciousness. Looking over Tomaselli’s output over the years, it seems clear that he likes to play with genre, but at the same time his work seems very obsessive. In that way it reflects our cultural obsession with drugs, both legal (proscribed and over the counter) and illicit. The work also mirrors how drugs cause obsession through addiction.

**DS:** Like the psychedelic posters and Op art that he is referencing, Tomaselli’s work relies on repetition and patterning. The interlocking, concentric circles of tablets in *Bambogenesis* (1992) suggest stellar constellations, fiery starbursts radiating with rings of light. The work also evokes the kind of geometric abstraction found in Islamic art and architecture. Like drugs, the decorative designs found in mosques can be understood as helping the devout to transcend the everyday.

In short, I am wondering if these circular patterns – which recur in so many images or patterns that are meant to take us beyond the senses – are related to the electrochemical nature of vision, the chemical processes that enable sight. While maintaining the important distinction between chemistry and biology, I think that the chemistry of vision might open up another, less obvious reading about Tomaselli’s obsessive arrangements of pills. How does focusing on the chemistry of vision move us away from the objects of sight, retraining our focus on the spectacular process of seeing?

**TS:** Visualizing the invisible is very much a part of what chemistry is about – where spectral data and the visible manifestations of chemical reactions, such as color changes, light emissions, or smoke, encode what is happening on an atomic or molecular level. For example, a color change can tell us that something is being reduced or oxidized – that an electron is being moved around from one atom / molecule to another. For chemists, there is a constant interpretation of the atomic scale phenomena based on macroscale properties. These interpretations are then transcribed into symbolic forms, such as written chemical structures and molecular models. In this way the question of "seeing" is opened up even further. What is seeing? Is it the direct observation of an object or phenomenon or is it an interpretative and contextual act that becomes transcribed by the scientist or artist? For me, Cai Guo Qiang’s work clearly makes this connection between chemistry and art, since he uses the spectacular nature of chemical explosions and fireworks to create a visually spectacular (chemical) image. In a way, he reverses the practices of chemistry – using
chemistry to create visual effects, while chemists use the visual effects of reactions to create chemistry.

I also think that Kim Abeles' work addresses this very well. Her work literally makes the invisible visible by capturing the stealth particulates that swim along in what seems like innocuous air. Air is interesting that way – how we can only see it indirectly through the wind, the residues it leaves behind, or chemical analysis. It is a good analogy for the interpretive nature of seeing.

**DS:** I am drawn to the way that Abeles' Presidential Commemorative *Smog Plates* (1992) use chemical processes to initiate dialogues about chemical air pollution. There is tremendous humor in the series, but it also invites serious contemplation. As she explains:

"*Presidential Commemorative Smog Plates are portraits of U.S. Presidents from McKinley to Bush created from particulate matter in the polluted air. The cut stencils on dinner plates were placed on my rooftop for varying lengths of time depending on the extent of their violation or apathy toward the distressed environment. Upon removal of the stencil, the Presidents' visages in smog are revealed, accompanied by their historical quotes about the environment and business.*"

The aesthetic created by the smog is wonderfully icky, more grimy than ghostly. There is pleasure in seeing certain Presidents rendered in the pollution that they helped to facilitate. Yet, if one considers the series as a whole, the plates become less about pointing fingers and more about visualizing a continuum of environmental neglect.

That is not to say that chemistry is inherently dangerous. In fact, just as certain synthetic chemicals may adversely affect the environment, the environment is also filled with many naturally occurring chemical substances that we find useful. This is often used as an argument for preservation (i.e., the rainforests may contain undiscovered medicines that will save lives). Are not many of the psychotropic pharmaceuticals prescribed today derived from natural sources?

**TS:** Yes. The isolation and synthesis of natural products is a major aspect of the pharmaceutical chemistry of psychotropic drugs, and many other drugs, too. For me what is most interesting about this is the tension between natural and artificial that the chemistry of these drugs exemplifies and how these tensions are mirrored in the art included here. Is a chemical that is synthesized in the lab as an exact replica of a chemical that exists in nature natural or artificial? Is it ethically / culturally better or worse than its natural analogue? Is the rainbow of Cai Guo Qiang's *Transient Rainbow* (2002) natural or artificial? And what about Susan Robb's *Macro-fauxology series* (2000)? Are her photographs original works of art or imitation of scientific artifacts? These issues are also addressed by Tomaselli’s work since he uses the synthetic products of chemistry to create synthetic images of natural phenomena, like his work entitled Bambogensis (1992), which, as you mentioned to me, appears to be a visual and verbal play on the meteorological phenomena called bombogenesis. At the same time he seems to be asking what is natural about the nature of seeing, since his work
appears to be the result of ingesting psychoactive chemicals that generate their own synthetic visual perspective.

**DS:** I think the strict opposition between the natural and the artificial – an historical product of forces that preceded the 18th century – begins to require reconfiguration at the points where art and chemistry intersect. Since science is often accused of being instrumental in facilitating the split between the natural and the artificial, I would like to suggest that through chemistry they can begin to reconcile in surprising ways, as indicated by Cai’s *Rainbow* (2002) and Robb’s experiments. In fact, many artists have worked to reveal the "natural" as historically and culturally contingent, raising questions about science and identity.

**TS:** Yes. The question of the split between the artificial and the natural is nicely addressed by chemistry since, unlike physics and biology, it is very much a science of the synthetic. Much of the identity of chemistry as a discipline is related to the generation of materials that have not existed before and have no natural equivalent, rather than to understanding what exists in the natural world \* what chemists like to call "novel" molecules, compounds, or materials. To me, all of these issues of natural / synthetic / imitation / novel also relate to issues of originality, which is another point of connection between chemistry and the art included in this part of the Chemistry in Art exhibition. Tomaselli’s work *13,000* (1991) speaks well to this since it appears to be a play on minimalism – a non-representational, easily imitated style of art that has evoked debates about originality in art – yet it is made of aspirin tablets. Indeed, it is not the image or the aspirin that are original in this piece but the reinterpretation of minimalist art through the recontextualization of common aspirin that makes this piece new and compelling.

**DS:** Robb’s *Macro-fauxology* (2000) series also addresses the aesthetics of chemistry, suggesting that the ways in which chemistry is visualized are culturally coded. The photographs in her series (and their petri dish frames) are both works of art and imitations of scientific documentation. Art often approximates or even replicates other cultural practices; it distinguishes itself by reflecting critically on the disciplines and languages from which it borrows.

When I spoke with Robb, she joked about creating images that looked contemporary, rather than something that appeared too dated, too "Science 2000" or "Science 1999". When she showed part of the series at the University of Seattle, the artist was approached by a biochemist who presumed that Robb's photographs documented typical biochemical experiments, when they are really close-ups of things like Tic-Tacs and Play-Doh. Robb is very interested in the fact that, as she put it, "science has a style". She wonders about what motivates changes in the way science and chemistry is imaged in textbooks and science journals. We can all imagine a 1950s, cold-war stylization of atomic science that appears paternalistic and authoritative. At the same time, atomic science also entered the popular imagination through design sensibilities, with images of whirling electrons informing everything from textiles to furniture design. (See, for instance, the movie *clip A is for Atom* (1953), by Sutherland Productions). Certainly, emerging imaging technologies transform the ways that chemistry is made visible. But what about the cultural forces? What has made chemistry look
the way it does in our current moment? I would love to hear your thoughts on this.

**TS:** The most overt way that chemistry has recently entered the culture in the US is through pharmaceutical and cosmetics advertising. Since 1997, when the Food and Drug Administration (FDA) approved commercials for pharmaceuticals, there has been a drastic shift in the use of molecular forms and chemical or chemical-sounding words in popular US media. It is now common to hear and see words like "retinol A", "alpha-hydroxy acid", "Ephedrine®", and "anti-oxidant" rather than words like "superelasticdoubleplastic", which were quite popular in the fifties and sixties. Commercials now use real (or quite realistic) chemical terminology. In terms of non-linguistic forms, the images of atoms from the fifties that you mention have also morphed into molecular forms that are, or resemble, the actual types of molecular forms that chemists use to communicate within the scientific community. So they are less iconic and scientifically more accurate.

I think this ubiquitous use of chemical symbols and vocabulary in popular media naturalizes and neutralizes chemistry in the cultural discourse. By using the words and images of chemistry, these commercials have the patina of scientific authenticity but are emptied of their scientific content. Thinking about this makes me wonder what it means when chemical nomenclature is applied to objects outside of the realm of actual science. In particular, Robb appears to be exploring these ideas in her work by the way she titles her pieces. Her use of titles also reveals how chemical nomenclature within the chemistry (science) community is integral to the scientific aesthetic that it communicates.

It seems to me that Robb's work is more dependent on its titles to communicate its chemical "content" than the other artists we are discussing. What do you think?

**DS:** Perhaps because I first saw Robb's series in a show about the human genome project, I did not find it necessary to reference the photographs' titles in order to link them to chemistry. Instead, it was an understanding of Robb's process that changed the way I saw the photos. She stages actual chemistry experiments in her studio, using household materials rather than chemicals; she photographs the results with a macro lens. Of course, the experiments are modified as needed. Perhaps it is because I am not a chemist, but names like *Quadrihatrimineglucose* (2000) – Robb's photo that poetically visualizes the molecules in phenylethylamine, the chemical that produces the feeling of love – are not so informative for me. Robb's titles speak to an audience that recognizes the language of chemistry. But with its strangely electric colors and gooey sensibility, the series would evoke chemistry and biochemistry even if it were untitled.

I am curious, too, about the title of Tomaselli's, *Bambogenesis* (1992). It sounds like bombogensis, a meteorological phenomenon in which sudden cyclones "bomb" the earth, suggesting a tempestuous association between psychotropic drugs and the spontaneous, destructive forces of the natural world. But again, the title is quite opaque: how many viewers will know what it means?

**TS:** I do not think that the precise meanings of their titles are so important to Robb and Tomaselli, as long as the titles have scientific or chemical sounds. To
the best of my knowledge, *Quadrihatrimineglucose* (2000) is not an actual chemical compound nor is *Bambogenesis* (1992) an actual scientific phenomenon – so their precise scientific meanings are unintelligible even to a scientist. Like the pharmaceutical companies that name their drugs like Viagra® and Nexium®, Robb and Tomaselli’s are using neologisms that have the air of science in order to purposely elicit certain associations from their audiences.

**DS:** We often hear about science influencing art, but rarely about how art has influenced science. Has putting together this exhibition and thinking about the artwork changed the ways you understand chemistry? How?

**TS:** By engaging in the Chemistry in Art exhibit, I feel like I have been able to tap into an understanding of the conceptual expansiveness of chemistry in a way that I never have before, which has been quite compelling, even exhilarating, on a personal level. Often, when I mention my own work on aesthetics and chemistry to people, the response that I immediately elicit involves vague notions about the beauty of mathematics and physics – the elegant proof, etc., rather than any particular associations with chemistry itself. This has always struck me as odd, since chemistry is such a visual, tactile, and odiferous science, but I have never quite been able to get a handle on the specifics of its unique relationship to art beyond the obviousness of its materiality. As you could probably tell from my initial responses in our conversation, I had an ideal of using the underlying tenets of chemistry as a metaphorical springboard into the arts; but in actuality I was caught up in a reading of the artwork as a somewhat reductive social commentary on chemistry. For me, your opening comments on how chemistry could inform our understanding of the art were particularly illuminating. Working on this exhibit has pushed me to be more aware and precise about how chemistry distinguishes itself as a science – that is, what makes it conceptually distinct from other sciences. In fact, I feel like the intersection of our conversation with the art itself has taught me a lot about the philosophical richness of chemistry and heightened my own intellectual connection to it as a discipline.
Biographies

David Spalding

... is a San Francisco-based art critic. His writing appears regularly in national and international publications, including Flash Art, Artweek, Art Papers, and ART Asia Pacific. Currently at work on a book-length study that locates the ghosts of the past in the art of the present, Spalding teaches contemporary art and critical theory at Mills College and the California College of Arts and Crafts.

Contact: d_spalding@hotmail.com

Tami I. Spector

... is a professor of organic chemistry at the University of San Francisco. Her work on aesthetics and chemistry has included reading at the Huntington Library in San Marino, California, appointment as the University of San Francisco National Endowment for the Humanities (NEH) Chair, and serving as co-editor of HYLE's special issues on "Aesthetics and Visualization in Chemistry". Her published work in this area has focused on the scientific aesthetics of HIV protease and the aesthetic response to John Dalton’s atomic representations.

Contact: spector@usfca.edu

Kim Abeles

Often focusing on environmental concerns, Kim Abeles' artworks and installations have been exhibited in venues throughout the Americas and Europe. The artist represented the United States in Fotografie Biennale Rotterdam (1992) and Cultural Centre of Berchem, Antwerp (1993). From 1993 to 1997, Abeles was the subject of a traveling mid-career survey entitled Kim Abeles: Encyclopedia Persona, A Fifteen-Year Survey, initiated and sponsored by the Fellows of Contemporary Art and organized by the Santa Monica Museum of Art. Her recent solo exhibition, Frankenstein's Hearts, was on view at Intersection for the Arts in San Francisco in late 2001. Abeles lives and works in Los Angeles.

Cai Guo Qiang

Since the late-1980s, Cai Guo Qiang has achieved international acclaim for a hybrid artistic practice that comprises installations, gunpowder paintings, pyrotechnic performances, and other site-specific interventions. In 1999, the artist received the prestigious International Award at the 48th Venice Biennale. Recent solo shows include Cai Guo Qiang at the Shanghai Art Museum (2002); An Arbitrary History, Musée d'art contemporain Lyon (2002); Project for Projects at the Fondation Cartier pour l’art contemporain, Paris (2000); and I am the Y2K Bug, Kunsthalle Wien, Vienna (1999). His projects have also been included in many international art exhibitions, including the 1st Guangzhou Triennial (2002); the 1999 Asian-Pacific Triennial, Brisbane, Australia; and the 1998 Taipei Biennial. Born in Quanzhou City, China, Cai was based in Tokyo from 1985 until 1996. He now lives and works in New York.

Internet: http://www.caiguoqiang.com
Susan Robb

Susan Robb uses sculpture and photography to address recent developments in biotechnology and genetic engineering. Conceiving of artists as investigators, Robb sets up laboratory conditions in order to conduct research at the intersections between the personal, the fictive, and the scientific. Robb's Macro-Fauxology series was included in Genesis: Contemporary Art Explores the Human Genome a traveling exhibition opened at the Henry Art Gallery, Seattle in 2002. Her work has also been featured in solo and group exhibitions at venues such as Negative Space at Consolidated Works, Seattle (2001); The Pound Gallery, Seattle (1999 and 2002); and Contemporary Northwestern Women Photographers at the Fry Art Museum in Seattle (2002). In 2003, Robb was the artist-in-residence at the Atlantic Center for the Arts, Florida. The artist lives and works in Seattle.

Internet:  http://www.poundgallery.com/members.html#robb

Fred Tomaselli

For over a decade, Fred Tomaselli’s mixed-media paintings have referenced drug and psychedelic subcultures, addressing America's utopian fantasies and dark obsessions. In recent years, he has had solo exhibitions at the Contemporary Arts Center in Cincinnati, Ohio (1997); the Yerba Buena Gardens Center for the Arts, San Francisco, California (1996); the Jack Tilton Gallery, New York (1997 and 1995); the Christopher Grimes Gallery, Santa Monica, California (1995); and Galerie Anne Devillepoix, Paris (1994). His work has been shown in many group exhibitions including A Passion for Pictures at the Whitney Museum of American Art, New York (1997); Multiple Identity: Selections from the Whitney Museum of American Art at the Alexandros Soutzos Museum in Athens (1996), which traveled to Barcelona and Bonn; Painting Outside of Painting: The 44th Biennial Exhibition of Contemporary American Painting at the Corcoran Gallery of Art, Washington D.C. (1995); and Jet Lag at the Galerie Martina Detterer in Frankfurt, Germany (1994). In 2002, the Palm Beach Institute for Contemporary Art presented Tomaselli’s first solo Museum show, Fred Tomaselli: Ten-Year Survey, which traveled to SITE Santa Fe, New Mexico in 2002.

Internet:  http://www.jamescohan.com/artists/fredtomaselli/index.html

Shirley Tse

Shirley Tse is an artist who works primarily with plastics. Her photographs, sculptures and installations have been featured in many group and solo exhibitions around the world, including 010101: Art in Technological Times at the San Francisco Museum of Modern Art (2001); the 2002 Sydney Biennale; and the 2002 Biennial Ceará América in Sao Paulo, Brazil. In the fall of 2002, Tse was the artist-in-residence at San Francisco’s Capp Street Project, where she created the installation Shelf-Life. Born in Hong Kong, the artist lives and works in Los Angeles. She is represented by Shoshana Wayne Gallery in Santa Monica, California, and Murray Guy in New York.

Internet:  http://www.murrayguy.com/current/
Contributors

General Editors
Joachim Schummer (editor@hyle.org) & Tami I. Spector (spector@usfca.edu)

Graphic and Design
ArtCommunicationProjects, Hamburg, Germany

CD-ROM Reproduction
MARCON-Media, Hamburg, Germany

Production
HYLE Publications, Karlsruhe, Germany (publications@hyle.org)

Artists
Blair G. Bradshaw, New York, NY, USA (bgb@onebox.com)
David Clark, Halifax, Nova Scotia, Canada (dclark@nscad.ns.ca)
Erich Füllgrabe, Herne, Germany (null@gmdf.de)
Brigitte Hitschler, Bochum, Germany (brighitschler@t-online.de)
Lane E. Last, Union City, TN, USA (lanelast@utm.edu)
Paula L. Levine, San Francisco, CA, USA (plevine@sfsu.edu)
Christopher Puzio, La Jolla, CA, USA (chris@puzio.com)
Cheryl Safren, Valley Stream, NY, USA (tzayaret@optonline.com)
Tamar Schori, Tel-Aviv, Israel (ts@tamar-schori.net)

Jurors
Barbara H. Berrie, Senior Conservation Scientist, National Gallery of Art, Washington DC, USA (b-berrie@nga.gov)
Pierre Laszlo, Scientist-Writer & Professor Emeritus of Chemistry, Universities of Paris & Liége, France & Belgium (pierre@pierrelaszlo.net)
Ulrich Mattes, Artist & Lecturer at the Academy of Electronic Print Media, Hamburg, Germany (info@ulrich-mattes.de)
David Spalding, Art Critic & Lecturer of Art Theory, California College for Arts and Crafts, San Francisco, CA, USA (d_spalding@hotmail.com)

Tami I. Spector, Professor of Chemistry, University of San Francisco, CA, USA (spector@usfca.edu)

Patricia Waller, Artist & Lecturer of Sculpture, Pforzheim University of Applied Sciences, Germany (art@patriciawaller.de)

Curatorial Project

Artists & Galeries

Kim Abeles, Los Angeles, CA, USA

Cai Guo Qiang, New York, NY, USA

Susan Robb, Seattle, WA, USA

Fred Tomaselli; James Cohan Gallery, New York, NY, USA

Shirley Tse, Los Angeles, CA, USA; Shoshana Wayne Gallery, Santa Monica, and Murray Guy, New York, USA

Curators

Tami I. Spector, Professor of Chemistry, University of San Francisco, CA, USA (spector@usfca.edu)

David Spalding, Art Critic & Lecturer of Art Theory, California College for Arts and Crafts, San Francisco, CA, USA (d_spalding@hotmail.com)
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