

YOU NEED TO SEE THIS: PUSHING THE BOUNDARIES OF SCIENTIFIC VISUALIZATION

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In September 2012 a number of leading scientists, designers, artists, animators, and information designers met at the SciViz conference "You need to see this. Pushing the boundaries of scientific visualization" at the Royal Danish Academy of Sciences and Letters in Copenhagen. The ambitious goal of the symposium was to establish best practices for the community to create, perceive and understand scientific visualizations. Speakers explored concepts and processes in data visualization across disciplines, subjects and work experience. It was great fun. More importantly, however, it was immensely rewarding and instructive. The symposium opened up for new and important collaborations, projects and friendships.

Scientific visualizations are essential for the processes involved in generating and presenting scientific data. A glance at the most influential scientific journals and larger newspapers today immediately shows how fundamentally important scientific visualizations are. To address visualization processes in journals and newspapers we were lucky to have Kelly Krause, Creative Director at *Nature*, Nik Spencer, Senior Illustrator also at *Nature*, and Amanda Cox, a graphics editor at *The New York Times*, among the speakers. Amanda Cox told us about some of the (for most part interactive) charts and maps that she has made with colleagues at *The New York Times*, both for the print and web versions of the paper. With a focus on data visualization and a fondness for slightly conceptual pieces, her work with colleagues has won several awards, including top honors at Malofiej, the largest international infographics competition.

Before joining *Nature* Kelly Krause was Art Director for the journal *Science*. Having to work closely with hundreds of high profile scientists in almost every scientific discipline imaginable to create dynamic, memorable covers and graphics for publications in print and online each week, Kelly Krause shared with us her vast experience and introduced the project ENCODE, where interactive graphics is used for navigating in a new publishing platform. As Senior Illustrator, Nik Spencer has produced thousands of graphics during his many years with *Nature*, ranging from infographics, charts and maps, to illustrations, cartoons and logos. He works closely with editors to conceptualize artwork for all sections of the journal. With a background as a freelance artist on local community projects and on private commissions, and a degree in Molecular Biology, Nik told us about the artistic processes he uses when he designs a scientific illustration for the magazine. He also emphasized the use of 3D animation software in producing visuals. Both Kelly and Nik have contributed to this issue of Biozoom on scientific visualization.

Traditionally, art and illustration have played a key role in making scientific graphics. The field of data visualization has grown with computer science, animation and graphic software, advanced art techniques and information design. New technologies give us far more sophisticated tools to handle graphic design and data analysis.

The symposium explored how connections between art, design and science inspire and advance research, innovation and working processes in scientific data visualization and speakers

shared ideas for and processes of their work in visualization across disciplines.

Gaël McGill addressed how visual ideas and intentions are transformed by the use of different tools and technologies. His case was molecular biology and the development of the online portal molecularmovies.org and the Molecular Maya software toolkit. As Digital Media Director for E.O. Wilson's *Life on Earth* next-generation digital biology textbook, Gaël took us behind the scenes and showed us the processes of molecular animation on a larger scale. Gaël McGill's paper included in this issue shows his high dedication of improving communication of science through digital media.

Textile and surface designer Alessia Giardino focused on how to meet the challenges of cross-discipline collaborations and how to gain and apply inspiration through multidisciplinary processes. She told us about her design approach using nanotechnology on concrete. Her understanding for the contemporary social aspects of design, always approached with an experimental and innovative mindset, constantly pushes her to challenge boundaries of established design lines. You can enjoy Alessia's work in this issue of Biozoom. As an artist-in-residence at the Niels Bohr Institute in Copenhagen, artist Mette Høst has collaborated and interacted with science and scientists on a daily basis, investigating what creativity is. She has produced new visual expressions of different scientific subjects and studied how visual working processes can enrich both the practice of science and art.

Another influential example of fusion of art and science was presented by



Figure 1. Nik Spencer and Kelly Krause from Nature, Nature Publishing group, United Kingdom between their talks at the SciViz Symposium.



Figure 2. David Goodsell, The Scripps Research Institute, La Jolla, California on the podium at Medical Museion.



Figure 3. Poul Nissen, Aarhus University, Denmark lectures at the SciViz symposium venue: Royal Academy of Science and Letters.

David Goodsell, a molecular biologist and artist, with his talk at the Medical Museion. David is trained as a crystallographer. His research covers computational chemistry and biomolecular computer graphics. He combines his extraordinary talent in painting with his professional interest in molecules in unique watercolours of complex cell environments. David's molecular watercolours are meticulously prepared to be scientifically correct with regards to scale and design. He uses a combination of computer graphics and hand-drawn ink and watercolour illustrations to fuse art and science. Many of David's illustrations are made in collaboration with the Protein Data Bank and are used as both research and educational resources. You will see an example of David's work on the cover of this issue of Biozoom. He is also contributing to this issue.

Colin Ware took a more theoretical approach. Most people in data visualization make use of Colin's book *Visual Thinking for Design* when taking about the psychology of how we think using graphic displays as tools. Colin combines interests in both basic and applied research and he has degrees in both computer science and in the psychology of perception. He told us about visual thinking processes for interactive data analysis. To further explore how informative visual encodings of data coupled with the researchers' knowledge of the subject under investigation is a potent combination for discovery. Bang Wong introduced to his research focusing on the analytical challenges posed by the unprecedented scale, resolution, and variety of data in biomedical research. With a combination of degrees in immunology and medical illustration he sha-

red with us processes behind visualizing genomes and considerations inspired by his monthly column on data visualization for *Nature Methods*.

Søren Brunak, a physical and biological scientist working in bioinformatics, Ebbe Sloth Andersen, a scientist working with biomolecular design and RNA/DNA origami, and Poul Nissen, a professor in molecular biology using X-ray crystallography to study processes of the biomembrane that relate to transport in and out of the cell, all gave us a view of how a scientist works with processes of art and design. Ebbe's group has pioneered the design of three-dimensional DNA origami structures, where a long DNA strand is folded into a designed nano-scale shape by several hundred DNA helper strands. In the complex design process of DNA origami the group develops principles for biomolecular design and devices for practical applications such as multiplex biosensors for small molecule detection. Ebbe is also a cartoonist and uses his gift to communicate science to the public, for education, and within science. Poul's group has shown how the calcium pump works through transitions between well-defined states in the membrane representing "snapshots" of a molecular movie of conformational changes of a molecular pump. Poul also contributed to this issue.

On the second day we had a tech demo showing how novel technology can bring scientific visualizations beyond the confinements of personal computers and hereby embrace science as a collaborative activity. The tech demo was done in collaboration between the Interdisciplinary Nanoscience Center, The Centre for Advanced Visualisation

and Interaction (Aarhus University), The Alexandra Institute, and the Department of Computer Science.

During the course of the two days we had many examples of the fruitful interactions and constant breach of the barriers between art and science. Artists are using current scientific knowledge as a creative repository, but also providing inspiration to see and understand things differently. Scientists are relying on design principles combining key elements of their research with visual imagery. Bringing these two groups together brought about a wonderfully inspiring meeting. We are happy to present some of the thoughts and ideas that were exchanged on that occasion in this issue of *Biozoom*.

The meeting was organized by associate professor Rikke Schmidt Kjærgaard, iNANO and AIAS, Aarhus University, director Thomas Söderqvist, Medical Museion, University of Copenhagen, and creative director Bang Wong, the Broad Institute of MIT & Harvard. The organizing committee would like to thank professor and chairman Flemming Besenbacher and professor and dean Niels Chr. Nielsen for their academic advice.

We would also like to thank the administrators and the president of The Royal Danish Academy of Sciences and Letters in Copenhagen. A special thanks to our sponsors the Carlsberg Foundation, Medical Museion, and Aarhus University (Visualization Lab, AU IDEAS). Without them this important meeting would not have been possible.

For more information on the meeting see <http://projects.au.dk/sciviz/>