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> ONE MONTH, ONE PROTEIN <

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Bio-Art

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Proteins have made it into the world of Art. In 2002, Julian Voss-Andreae[1] – a physicist cum artist – used a Protein Spotlight article as a source of inspiration for one of his sculptures. The protein he chose to sculpt was Kalata B1, a polypeptide with a very special twist in its sequence which forms what is known as the Moebius strip. Kalata was not the first protein Julian undertook to portray, nor would it be the last. Green fluorescent protein (GFP), mating pheromone ER-1, light-harvesting complex and a viral capsomer have also been moulded by the artist's hands, not to mention a homage paid to the man who discovered the alpha helix structure by erecting a huge replica in front of the scientist's boyhood home – now known as the Linus Pauling Center for Science, Peace and Health.

Why would an artist choose to shift proteins into the world of Art? And are biological entities such as proteins transposable into the world of Art? Why not? Over the millennia, artists of all sorts have drawn from animal and plant macroscopic life, and it is no transgression to cross the barrier and move further down the biological scale. Until the microscope made an appearance in the late 1600s, there was no means of skipping powers of 10…unless you had a fertile imagination. And a number of scientists did. Take for instance the 17th century Spermatists who believed that a miniature human – the homunculus – was lodged in the bowels of every spermatozoon, awaiting the ovum and the warmth of a womb to develop. Today we can give our imagination some rest thanks to the development of powerful technologies and means of analysis, which are beginning to offer us a good picture of the minute world which participates in the making of Life.

Julian Voss-Andreae has been hovering between Art and Science since his late teens. Following a master's degree in Physics and graduate research in Quantum Physics in Austria, he left for Oregon, USA, where he attended the Pacific Northwest College of Art. During his graduate research, the group he was working with chose to look into quantum mechanical wave behaviour in large biomolecules. GFP happened to be one of the proteins they chose to consider – and Julian's first acquaintance with proteins. 'Ever since' he writes, 'these incredibly beautiful and fundamentally important structures have captured my imagination.' However, it was only once he had attended a 3D design course and observed the work of a fellow colleague at the College of Art that the idea of using mitred cuts (pieces of material cut at defined angles) to sculpt proteins budded. In the same way that a sequence of amino acids twists and turns to give a protein not only its structure in space but also its function, Julian's mitered cuts can be assembled to give an artistic rendering of the general outline of a given protein. How?

GFP in steel, Julian Voss-Andreae, 2004

Courtesy of the artist

Those who have ever endeavoured to 'build a protein' know – like the author of this paper – that it can be quite a painful exercise. My first and last attempt involved haemoglobin made out of papier-mâché. To make things simple, I decided that each amino acid would be spherical and equal in size. They were distinguished by their colour: alanine was blue, cysteine green and so on. The next step was to assemble them. My intention was to recreate the protein's 3D structure by way of printouts I had made of the protein's sequence as well as its general 3D conformation… Everything went as planned to begin with. The glue's properties proved to be those indicated on the packet and I managed to reproduce the beginning of the structure successfully. Unfortunately, I had underestimated gravitation and it soon became obvious that I could not follow the protein's backbone the way I had intended. I did produce a macromolecule; only it bears little resemblance to haemoglobin.

How does Julian proceed? The sculptor has written a program, 'Mitre', which translates data he extracts from PDB – a databank which stores information on protein 3D structure – into the various mitred cuts he needs. The geometrical nature of such cuts allow for this kind of computational procedure. Using this technique, Julian cuts the various parts he needs out of materials such as steel or wood and then assembles them according to what his software suggests.

Some may wonder where the art is – a question to which Julian retorts that his creativity resides 'in the intuitive decisions he makes as he sculpts'. Indeed, the very nature of his technique or the nature of the material he uses invites the sculptor to part from hard science. Kalata's cyclic conformation, for instance, proved impossible to complete and this drawback prompted Julian to distort the structure's geometry in order to incorporate the Moebius strip topology nevertheless. The nature of a material can also lend its personal touch to a sculpture. As an example, Julian sculpted an alpha helix out of a Douglas fir, where each mitred unit was cut as small as possible. Owing to the taper of the tree, once assembled the resulting structure resembles a human spine with a curve that was inherent to the tree's trunk. Besides tinkering with spatial data, Julian also gives a personal finishing touch to his pieces. In this way, the surface of a bronze virus capsomer was left rough and subsequently corroded with hydrochloric acid to emphasize a virus's morbidity. Julian's methodology began to show its weaknesses though when he decided to attack GFP – the structure collapsed. 'The forces I could not conquer whilst building my protein had shown their face,' he writes. Drawing on this failure, Julian introduced 'chemical bonds' into the sculpture, which he integrated according to their accurate locations.

Recent biotechnologies are certainly a source of creative inspiration and Julian is not the only artist to have been inspired by proteins. Mara G. Haseltine[2], an American sculptor, created the 'Waltz of the polypeptides', an elegant sculpture depicting the birth – as she puts it – of a protein. Hadrien Dussoix[3], a Swiss artist, used parts of the amino-acid sequence of a protein in one of his paintings. And the now famous 'transgenic artist' Eduardo Kac[4] created the fluorescent bunny thanks to the powers of GFP and genetic engineering.

Bringing molecules into the world of Art is far from vain. In the long run, it should help the non-connoisseurs acquire a greater understanding of the luxuriant miniature world that defines Life. And with time, perhaps difficult scientific ethical issues – such as the use of stem cells in research, or genetic engineering – will become more tangible. In the meantime, give it a go and use Julian's DIY manual[5] to build your own protein.

[1] Julian Voss-Andreae's web site: http://www.julianvossandreae.com/

[2] Mara G. Haseltine's web site: http://www.calamara.com/

[3] Painting by Hadrien Dussoix, 2004, gloss paint on acrylic (1.5m x 1m): http://www.expasy.org/images/others/dussoix2.jpg

[4] Eduardo Kac's web site: http://www.ekac.org/

[5] Julian Voss-Andreae's DIY manual: http://www.julianvossandreae.com/Work/DIY/diy.pdf

Cross-references to Swiss-Prot

Green fluorescent protein, *Aequoria victoria* (Jellyfish): P42212
Kalata B1, *Oldenlandia affinis*: P56254

References

1. Voss-Andreae J.
   Protein sculptures
   BFA Thesis, Pacific Northwest College of Art, 2004