3D Printing in Conservation

No matter how meta or theoretical conservation may become at times, ultimately we work on and with things. We care about how they are made, what they are meant to be, how they change, how to fix them if they are damaged. When a new way to make things is developed, it is both relevant and interesting to our profession.

3D printing was born just over thirty years ago. In a progression that echos that of the computer, lab to industry to geeks to early adopters to the consumer market, it is becoming part of our lives and our work.

I started thinking about a 3D printing issue five years ago, knowing that there would be curious minds in the conservation community who would be playing with it and, moreover, that we would soon be having these objects handed to us for display, storage, and treatment.

The articles in this issue describe the analysis of museum objects, the materials of 3D printing, the making of missing parts and replicas, the creation of complex models, and the design and 3D printing of a tool for a specific application. Bookending these are the timeline below and a short glossary of 3D terms. (The tantalizing issues of authenticity and intellectual property rights will have to wait for another time.) The contributions come from Italy, Germany, Britain, Switzerland, Los Angeles, Minneapolis, and Chicago. Some of the information is worth keeping as reference material, and as is the case with all technology, some will soon be out of date. Consider it a snapshot of this moment in our profession.

The History of 3D Printing (an annotated timeline)

1982 - 1986 Charles “Chuck” Hull invents the first form of 3D printing – Stereolithography, a printing process that enables a tangible 3D object to be created from digital data. The technology is used to create a 3D model from a picture and allows users to test a design before investing in a larger manufacturing program. He invents the first working 3D printer. He patents Stereolithography and founds 3D Systems.

1987 Drs. Carl Deckard and Joe Beaman invent Selective Laser Sintering (SLS).

1988 - 1992 Scott and Lisa Crump invent Fused Deposition Modeling (FDM). They patent FDM and found Stratasys.

1995 Researchers at MIT develop ZPrinting.

The concept of 3D printed self-replicating machines is introduced by Klaus Lackner and Christopher Wednt.

2005 Open source collaboration begins. Dr. Adrian Bowyer at University of Bath founds RepRap, an open-source initiative to build a 3D printer that can print most of its own components. The vision of this project is to democratize manufacturing by cheaply distributing RepRap units to individuals everywhere, enabling them to create everyday products on their own.

The early machines were very large, very expensive, and not accessible to the general public / aritsts. Bowyer’s open sourcing for the RepRap (short for replicating rapid prototyper) made the 3D process available for development, at this point for early adopters capable of building their own devices. While some artists may have had access to these early machines, this should be considered an early date for 3D printed art.

2006 The first SLS (selective laser sintering) machine becomes viable. This type of machine uses a laser to fuse materials into 3D products. This breakthrough opens the door to mass customization and on-demand manufacturing of industrial parts.

That same year Objet creates a machine capable of printing in multiple materials, including elastomers and polymers, which allows a single part to be made with a variety of densities and material properties.

2008 RepRap releases the Darwin model, which can print over 50% of the parts needed to build another printer, allowing users who already have one to make more printers for their friends.

Access increases. Interest begins to extend beyond the DIY / maker / hacker communities.

DIY co-creation service launches. Shapeways launches a private beta for a new co-creation service and community allowing artists, architects, and designers to make their 3D designs as physical objects inexpensively.

2009 MakerBot Industries, based in Brooklyn, an open-source hardware company for 3D printers founded by Adam Mayer, Zach Smith, and Bre Pettis, starts selling DIY kits that allow buyers to make their own 3D printers and products.

Thingiverse, a repository of primarily open-source hardware designs for the 3D design community, is founded as a companion website to MakerBot.

Awareness and access increase in US.

2010 NASA begins evaluating Couter Crafting 3D for 3D printing in space.

2011 No more assembly required. Makerbot decides to offer the ability to buy a ready to use 3D printer out of the box.

Users no longer have to build their devices. Printers begin to reach a larger market and prices begin to go down.

Printing Service, i.materialise, starts offering 14K gold and sterling silver as a printable material.

Researchers in UK present the world's first 3D chocolate printer.

Researchers at Cornell University began to build 3D food printer.

2013 First 3D printed gun, 3D prosthetic arm, 3D printed car.

Stratasys releases a printer capable of printing one object in multiple materials and colors, including polymers and elastomers.

Prices continue to go down; the *New York Times* estimates that a machine costing $20,000 in 2011 now costs $1,000.

2014 Expiration of key 3D printing patents.

According to Wikipedia, the 400,000th 'Thing' was uploaded to Thingiverse.

Hasbro toys and 3D systems announced a collaboration to make play printers for children to print Hasbro toys.

And closer to home, as it were ....

Dutch company FormArt develops process for 3D printing of works of art. Color and relief are recorded in one scan, depth of relief is currently limited to 1 cm. "FormArts can hardly be told apart from the original. Data can also be stored. In case of restoration, the specific features of the painting can be restored easier, faster, and cheaper." (FormArt website)

Van Gogh facsimilies created and sold. Fujifilm Europe and the Van Gogh Museum collaborate. "Each canvas is painstakingly examined and compared to the original work by the museum's curators before being admitted as an authentic Van Gogh Museum Edition." (Tribune International website)

Artist grows Van Gogh's ear with DNA and a 3D printer. "Artist Diemut Strebe and a team of scientists have grown a living replica of Vincent Van Gogh's ear out of tissue-engineered cartilage sourced from the great-great-grandson of his brother, Theo. Using a 3D-printer and computer imaging technology, the cells were molded to be identical in shape to Van Gogh's ear, which he self-severed during a psychotic episode in 1888. The ear is being kept alive inside a case of nutrient solution.