1 *Iceberg Field*, artist 3D-printed porcelain, glaze, 2013, H24cm max

The Fourth Way

It is working with clay, but not as we know it. *Jonathan Keep* explains why he has taken up 3D printing with such enthusiasm.

Is it coil built, is it thrown, is it moulded? No, it is 3D printed. What does that mean?

I first had the opportunity to explore digital technology as applied to ceramics in 1999.[1] My ceramic work is characterised by a strong sense of form: 3D modelling software offered possibilities of new and interesting ways to manipulate forms and explore shapes and volumes while virtual reality threw up some fascinating visual and personal dichotomies. There is no gravity in cyberspace and I became aware of how our psychological make-up has an inbuilt capacity to allow for gravity – we have a sense of orientation to forms. Also in the virtual world the scale of the object is related to the screen. You can zoom in and out but this has no meaning in the real world. In reality scale is about the relationship to our own bodies. I began to think of my pots as belonging to one of three scales: handheld, as a cup or jug; lap pots, the sort of size that might rest in your lap; and thirdly floor pots, where the scale relationship is very much your body size confronting the object one to one.

Most revealing about working on screen was the lack of physicality, materiality, the awareness of the stuff that the object was made of. At the time there was great excitement around virtual reality but the experience reinforced for me the beauty to be found in physical contact and in touch, in the solidity of the thing and the viewer's subjective relationship to the object.

What I had found with digital technology was a new set of tools to use in the pottery studio but I needed to find a way to incorporate it into my studio practice. I was hearing about 3D printing but did not want to send digital files off to somebody else to print. I wanted the machine in my studio to stand alongside my pottery wheel.

ANOTHER WAY OF WORKING The best way to think about extrusion 3D printing is as computerised coil building. Clay is extruded from a syringe; the syringe is moved around by electric motors guided by computer software; the clay coming out of the nozzle forms the horizontal cross section of the form layer by layer. When working traditionally you are manipulating the clay in the three axes: up and down, side to side, and back and forth – all by using your hands. Here you are moving the clay in the same three axes but

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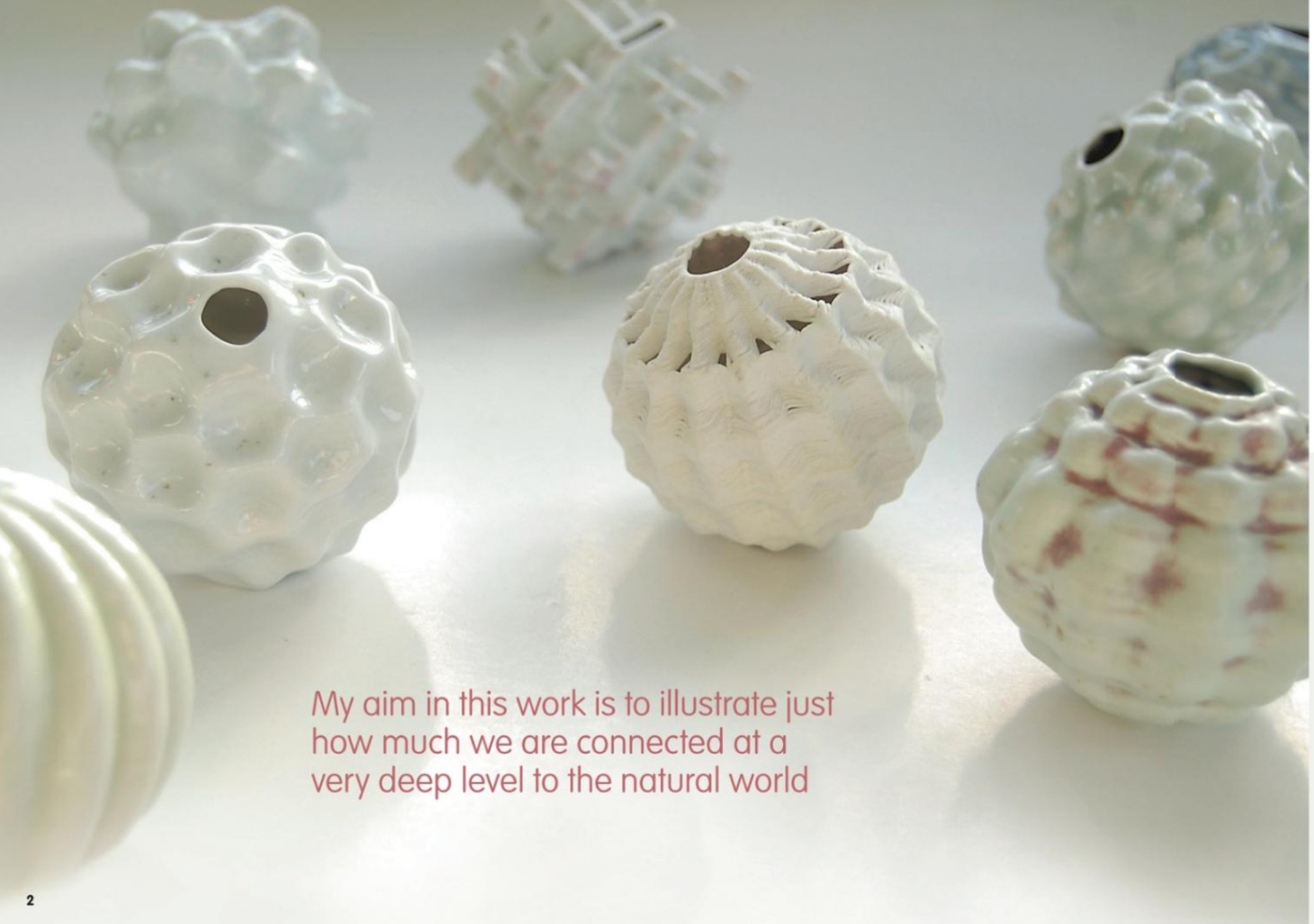

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instead of your hands you are using the computer's keyboard or mouse. Excuse the simplistic deconstruction but I am often asked do I not miss the making – no, it is just another way of working. I agree there is a lack of direct touch, and the nature of the digital material is different when making, but you have so many more possible ways to manipulate the shape – and that is what I am really interested in. Although my work is very sculptural, I am drawn to pottery because of the importance of form in the medium. That quality remains central to the pot. The pot or vessel format is the perfect medium for an artist wanting to talk about the relationship between art and nature and material. The poetic resonance of the relationship between the ceramic vessel and the human condition I feel is perfect.

Modelling software makes it easy to generate forms – no mathematical or computing expertise is required – but my personal preference is to use computer code. It has been pointed out that this desire to work with raw data probably represents the craftsman in me wanting to work with and understand the material and techniques at the most basic level. While this might be so, I am also interested in how computer code has been used to mimic nature and nature's codes to offer a greater understanding of natural patterns and processes. Consider for example a fern leaf. No matter how tiny a portion of leaf you take, its shape is exactly the same as the shape of the whole leaf. Clouds show similar fractal properties. Snowflakes show randomness within set rules; so do icebergs – which we shall come to later. Natural codes are everywhere. At first this might appear a very remote or objective way of working but for me it enables the exploration of that fine line between objective and subjective interpretation. Working in computer code I am using, in manmade mathematical notation, a representation of the patterns, structures, rhythms, proportions found in nature to generate my forms. My aim in this work is to illustrate just how much we are connected at a very deep level to the natural world.

'GROW' THE POT Working on the pottery wheel there is something quite magical about the pot emerging from a formless lump of clay as you throw the pot. I could see the potential for the computer to do the same but with much more complex forms, to sort of 'grow' the pot in the computer. Growth has become an important thread in my work, referring to personal artistic and creative growth, growth in nature, and the ability to generate or grow three-dimensional form with computer code.

I tend to work in series based around an idea or creating morphologies of related works. I am interested in the sense of time that this offers between elements, a sort of animation captured over time. Referencing growth patterns and mimicking evolutionary

2 *Seeds*, artist 3D-printed porcelain, glaze, 2012, Ø7cm average **3** Jonathan Keep in the studio, 2013 (Photo: Jonathan Dayman) **4** *Iceberg* in the process of being printed, porcelain, 2013

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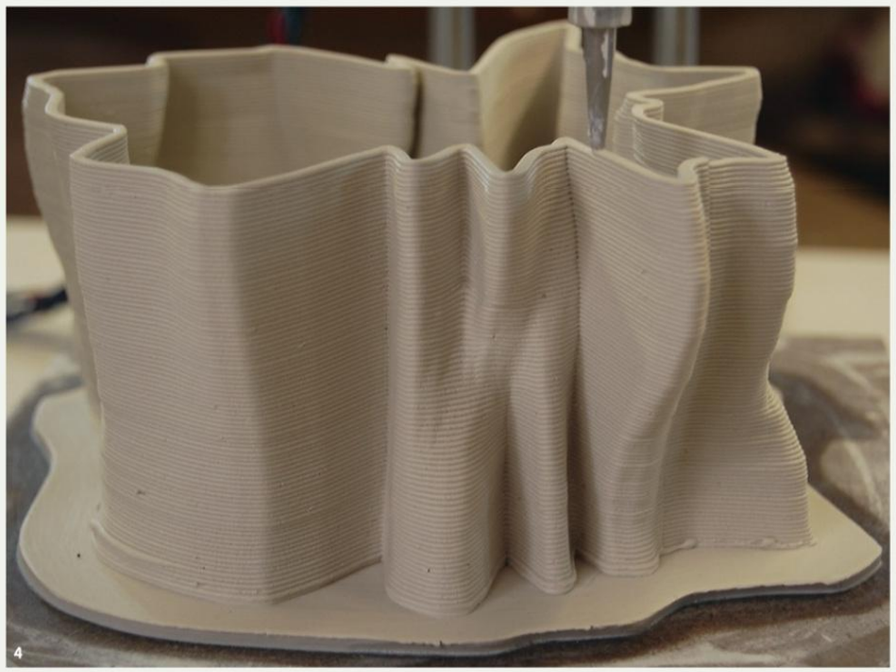

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5 *Petrified tree – over grown*, artist 3D-printed stoneware, glaze, 2013, H22cm **6** *Sound Surface – Benjamin Britten, 4 Sea Interludes*, artist 3D-printed porcelain, glaze, 2012, H23cm average

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Growth has become an important thread in my work

processes in code I can gradually alter parameters and numerical values to create groupings of vessels, each slightly different, in one way or another, from its predecessor. What is important for me is to blend process, content, and form. I see no point in just replicating in printing what could be done with other techniques. Works such as the *Iceberg* series are about the beauty to be found in apparently random natural form. The algorithm used to generate these forms has an inbuilt randomness set within natural parameters, as with the formation of real bergs. The 3D printing technique offers a timeless sense of layering while the porcelain echoes the translucency of ice. It is the way of working, of generating forms through computer processing – forms that one would otherwise probably not visualise or comprehend – that becomes significant for me.

RETHINKING OUR MAKING Designers, artists, and makers are going to need to rethink their objects taking into account the strengths of this technology. Those strengths include the ability to customise or iterate, to make developing variations, and to work through ideas quickly. For good or bad, certain traditional techniques will need to be reassessed, to consider where 3D printing is going to sit in relation to labour-intensive hand skills. I always make this point: that, difficult as all the 3D print technology and technical development is, it is even harder to do something sensible and meaningful with it.

Clay has no intrinsic form of its own. It requires some kind of manipulation to make it into more than a lump of stuff. In broad terms I have always previously thought of three approaches to working in clay. There is handbuilding, which includes coiling. There is throwing on the potter's wheel, a more mechanical process where the forms are strongly influenced by the nature of the revolving machine. The third process is moulding in all its many forms. Now we have 3D printing. It is not moulding as there are no moulds to be made. There are elements of throwing but the process hugely extends the limitations of the revolving pot. I have referred to my printing process as a sort of mechanical coiling but I don't think you can call it handbuilding! I am suggesting 3D printing in clay, and however it develops, will become recognised as a fourth way of transforming formless clay into desirable ceramic shapes and forms. CR

Note 1 CR193 Jan/Feb 2002, 'The Language of Pots', pp30-33
Forthcoming exhibitions *Nature Features*, Ann Linnemann Studio Gallery, Copenhagen, Denmark, until 25 October 2014; *Formed*, Djanogly Art Gallery, Nottingham, 22 November 2014-22 February 2015

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Jonathan Keep is an artist potter who lives and works near the Suffolk coast. He designed and built his own 3D ceramic printer, and has published the build online as an open source community development project along with operating videos and parts list: www.keep-art.co.uk/Self_build.html