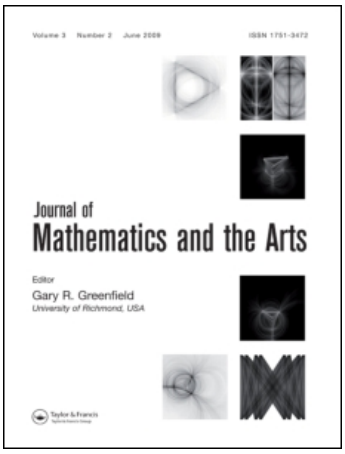

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REPORT

Art by numbers: a collaboration between an Art and Maths Department

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In this report I describe a two-year collaboration between the Art and Mathematics Departments at Paston College, a Sixth Form College in Norfolk, UK. A typical High School in the UK caters for 11–16-year-olds, while a Sixth Form College specializes in educating 16–19-year-olds. A group of art students were commissioned to produce works on mathematical themes, and their ideas were refined in the light of discussion with A Level mathematics students. A Level courses are traditionally the most academic option for 16–19-year-old students in the UK. The report features 13 original artworks produced for this project that are now mounted in the Paston Mathematics Department Foyer. **Those 13 works reproduced here (plus one additional piece) are all copyrighted by their respective student artists, and are reprinted here with their kind permission**.

The reader will be familiar with the 'Two Cultures' thesis put forward by C.P. Snow in his Rede lecture of 1959, where he suggested that there is commonly a divide between the artistic and the scientific ways of looking at life, a divide that affects our intellectual life for the worse [7]. I teach at Paston College in Norfolk, UK, a Sixth Form College formed in 1984, where it could be argued that the Two Cultures idea is visibly lived out. The college is on two sites, formed from the old Boys' Grammar School and the old Girls' Grammar School. With the odd exception, on the first site you will find the Arts and Humanities, whilst on the other Maths, Science and Computing hold sway. There are some brave students who take on a timetable that requires crossing from one site to the other, but for most people, it is quite possible to go a week or two without visiting 'the other side'. There are two staffrooms. The geography of the situation means an unhealthy dislocation between the arts and the sciences arises, at a time when dialogue between the two is perhaps more necessary than ever. Thus the art and maths collaboration project came as a breath of fresh air to the College.

The genesis of Art by Maths began with a chance observation by Sue Tatler, an art teacher at Paston. In the years before I possessed an interactive whiteboard, I used an overhead projector, writing directly onto acetates before the class. I would take pride in these sheets, trying to make them as careful and revealing as possible, using a range of colours and encouraging those taking notes to do the same. Sue caught sight of some of these acetates one day, and was struck by them – she said afterwards, 'as live recordings of your thinking, they seemed to me to be true art'. One of these sheets (on incidence matrices for graphs) was eventually incorporated into student Rachel Bradley's pastiche of Einstein, a piece that was generated by the project (Figure 1).

In 2006, Sue found herself teaching a Business and Technician Education Council (BTEC) Art course. BTEC courses are taken in the UK by 16–19-year-old students wanting a more vocational slant to their studies. The syllabus required the art students to execute a commission for a client, so she invited the maths department to act as the client for a set of mathematical artworks. It is fair to say that initially the Mathematics Department and our students were wary ('Another job!'), but as the project progressed, we caught the vision of Sue and her team, and grew more than willing to supply ideas and criticism. It transpired that many of our mathematicians, myself included, were fascinated by work at the mathematics–art crossing. Equality issues were addressed here too – not only is mathematics sometimes regarded more or less consciously as 'a high-status subject for boffins', but A Level courses are sometimes (falsely) seen as 'more valuable' than

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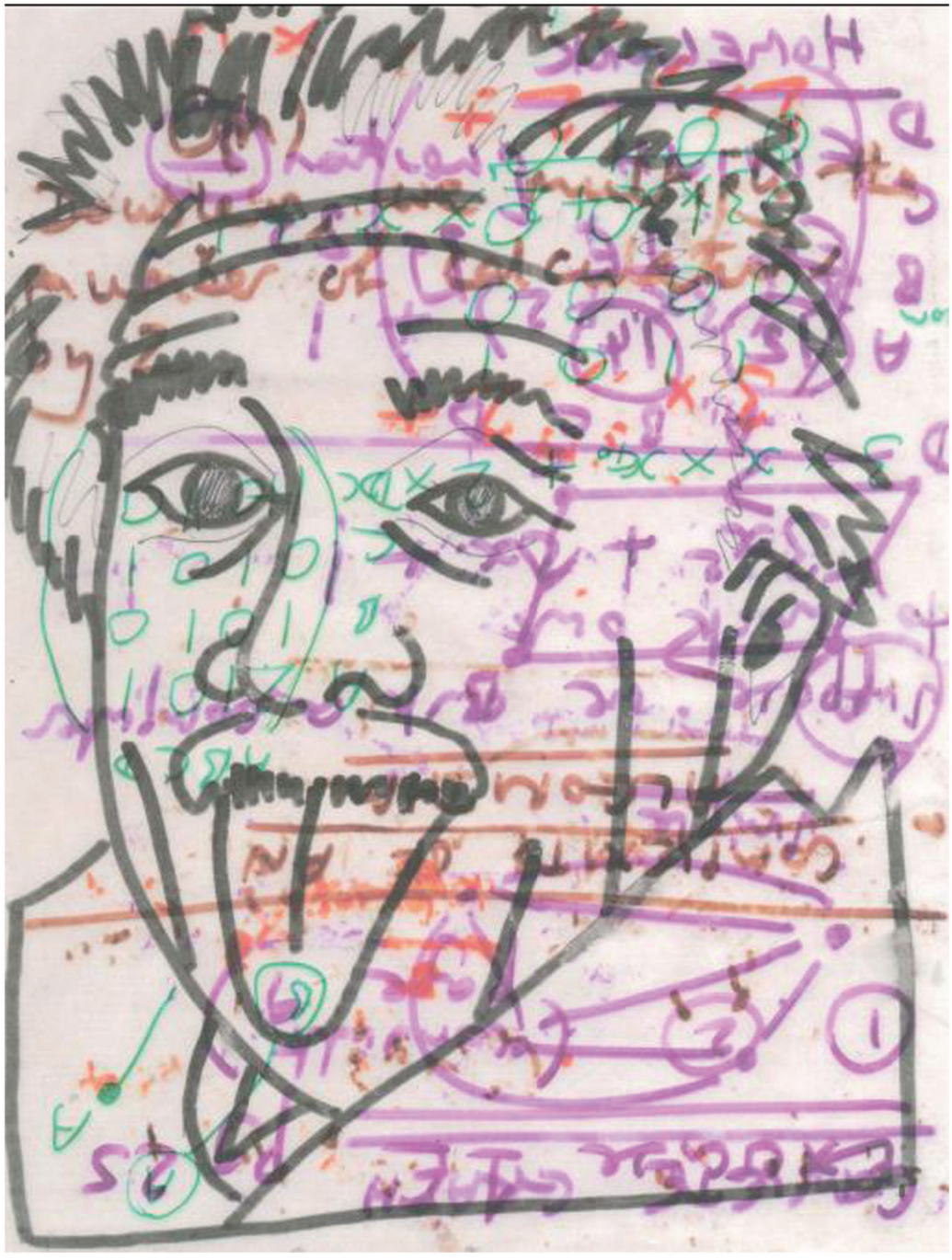

Figure 1. *Einstein Acetate*, © Rachel Bradley, 2007, photo-montage, 60 cm by 78 cm.

Figure 2. *Torn Textbook*, © Niall Grant, 2008, collage, 33 cm by 50 cm. See insert for colour version of this figure.

BTEC courses. One of the most pleasing things about this collaboration was to watch these prejudices begin to fade away. The commission had to be properly costed, and Sue and I planned for the best of the final pieces to be displayed in our new and empty Maths Department lobby. In the event, 13 of the 28 commissions across the two years were eventually displayed.

The choice of mathematics as a source of inspiration stirred up unhappy memories for some of the art students. In fact, Niall Grant's work took these memories as a starting point; he recalled the celebration that finishing General Certificate of Secondary Education (GCSE) maths exams, which are taken by almost all 16-year-olds in England to conclude their High School careers, had been for him by destroying his old textbook in the process of completing his commissioned piece (Figure 2).

'I wanted to express and communicate visually how I feel about maths', Niall said. 'I looked beforehand at artists like Escher and Rodchenko to help give a sense of direction with my work and so I could bring in other artists' styles. After ripping up my old GCSE maths book, I went out and photographed lots of numbers that I saw, on road signs, buildings, etc., and I then assembled these into an order in which they could be read [as letters].' You can see 'Paston' spelled out across the page here.

School memories also played a part for Matthew Shaw as his piece 'Sun On Head Causes A Headache, Take One Aspirin' shows in Figure 3. It provides a powerful image that intensifies a mnemonic for remembering how to find the sine, cosine and tangent, that is further reinforced by the triangular mountains in the background.

The project received a big lift when a group of Maths A Level students came over to discuss the BTEC students' initial designs (the divide between A Level and BTEC students was another chasm that this project happily addressed). 'All our thoughts to start with were surface thoughts', Sue said, 'But we were really engaged by the maths students visiting and discussing our first designs'. The mathematics students were able to look afresh at a piece and to offer up the

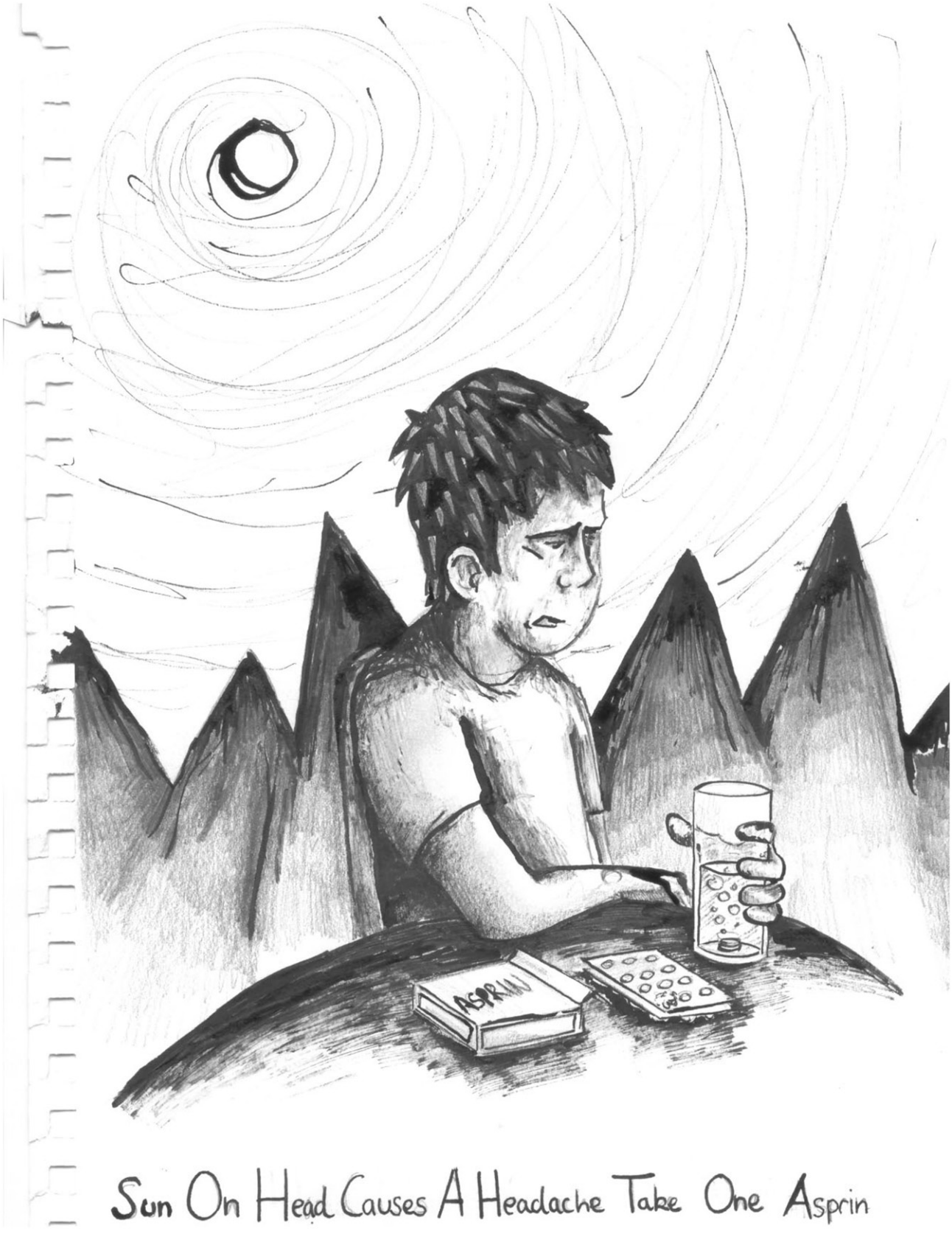

Figure 3. *Take One Aspirin*, © Matthew Shaw, 2008, pen and ink drawing, 33 cm by 50 cm.

Figure 4. *3333*, © Kirsty Howard, 2007, quartet of photographs, 60 cm by 78 cm.

resonances that it summoned from their own subject. In some cases, they felt that the mathematics was peripheral to the drawing – that the 'mathematics' had been crow-barred in. With other works, however, mathematical connections and allusions suggested themselves, ideas by which our less mathematical colleagues were surprised. 'The natural symmetry and beauty in maths had passed most of us by', said Sue. 'We realized that there was a strong and natural affinity between the two areas, and this set us off on new and enthusiastic tracks. It was really motivating to have mathematics students become interested in our ideas'.

Kirsty Howard was keen to place her work (Figure 4) within the history of her subject, art. She cited the Land Art movement [2] as important for her, especially the work of Andy Goldsworthy [1] and Richard Long [4]. This is quite a contrast between the disciplines. How many maths students are keen to refer to particular mathematicians as influences when they, for example, work through the calculus! Kirsty described her piece by saying, 'Three is an artistic and elegant-looking number due to the curves; it is a recognizable number that would not get confused for something else. Three is a prime number and a 'magic' number'. The latter is a reference to the song, 'Three is a magic number' by Schoolhouse Rock [6]. When viewing her piece, the mathematician is left wondering about the properties of the number 3333.

Ty Hood produced a further piece of striking Land Art (Figure 5). 'Not only does this bridge a gap between art and maths', he said, 'But also nature and maths, as the workings of mathematics are a very real part of the natural world'.

Pursuing a different theme, Lewis Guyton (Figure 6) said, 'I started with a normal maths design of a series of squares before deciding to create a crater in the centre to also relate to astrology and infinite space'. Lewis used the notion of 'warping' when we discussed his picture later, and I suggested to the group that there might be some allusion here to Einstein's notion that space is warped in the vicinity of a black hole, say. The group thought this was hilarious, and Lewis felt I was reading things into pictures that really were not there. But I was left wondering, can high-level mathematical ideas ever filter down subliminally into the consciousness of a student? Certainly searching for 'Einstein warped space' on Google produces images close to Lewis's. I felt the same way about Terri Wright's picture (Figure 7). This spoke to me

Figure 5. *Leaf Pi*, © Ty Hood, 2008, photograph, 33 cm by 50 cm.

of a simple curve becoming more complicated, so that it would in the end occupy all the points on the plane similar to the way Peano's space-filling curve [5] does.

In a similarly mathematical way, Ed Bullinger produced a wallpaper pattern (Figure 8), while Sam Curtis chose to think about 'inversion' (Figure 9). This is work created by students who are definitely artists first and mathematicians second, yet they are revealing a natural mathematical instinct as they work within their choices. The artist Sol LeWitt [3] comes to mind in saying this. This is quite unconscious, yet it is surely expressed more often here than was encouraged in any traditional maths education setting. Perhaps by beginning in the mathematics classroom from the idea of creating an artwork, some splendid mathematics could be learnt almost as a by-product.

Matthew Shaw was drawn to architectural structures, especially the angles and shapes that can be seen in scaffolding. As maths teachers, we were left thinking of the ways in which we approach vectors at A Level; how lines in three dimensions can either coincide, or be parallel, or meet, or be skew. Matthew's picture (Figure 10) would be a rather beautiful aid in such discussions. He wanted to include the four basic maths operations somewhere in his work. Figure 11 spells out how he managed this, but he opted for Figure 10 as the subtler final picture.

Michael Lester wittily produced a page of text consisting of repetitions of $a^2 + b^2 = c^2$. 'I laid a black and white image of Pythagoras over the text and darkened the areas that were dark to give an image of him [Figure 12]. I did not want it to be too obvious – maths is all about thinking so I figured that if I made

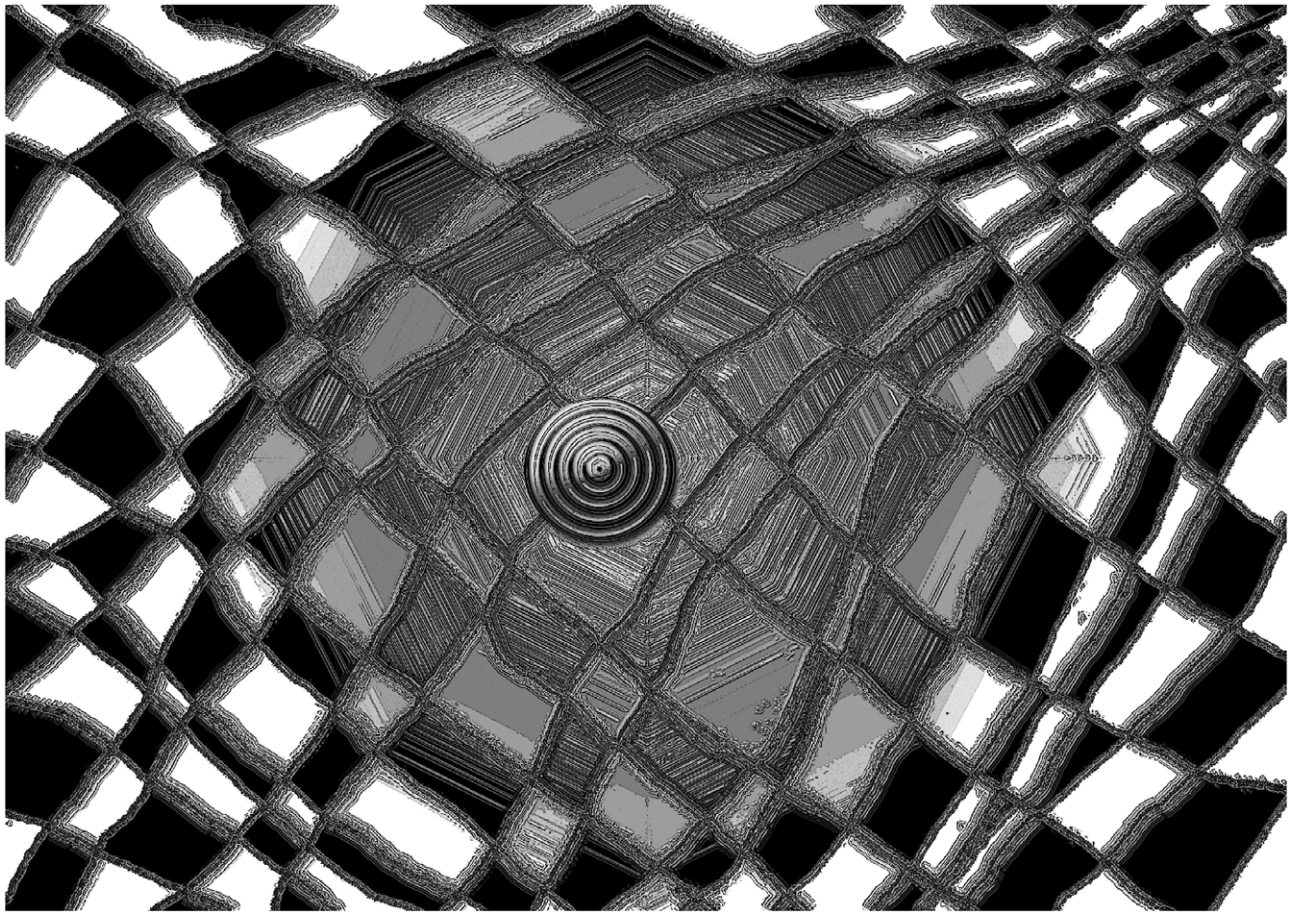

Figure 6. *Grid Crater*, © Lewis Guyton, 2007, computer graphic, 33 cm by 50 cm.

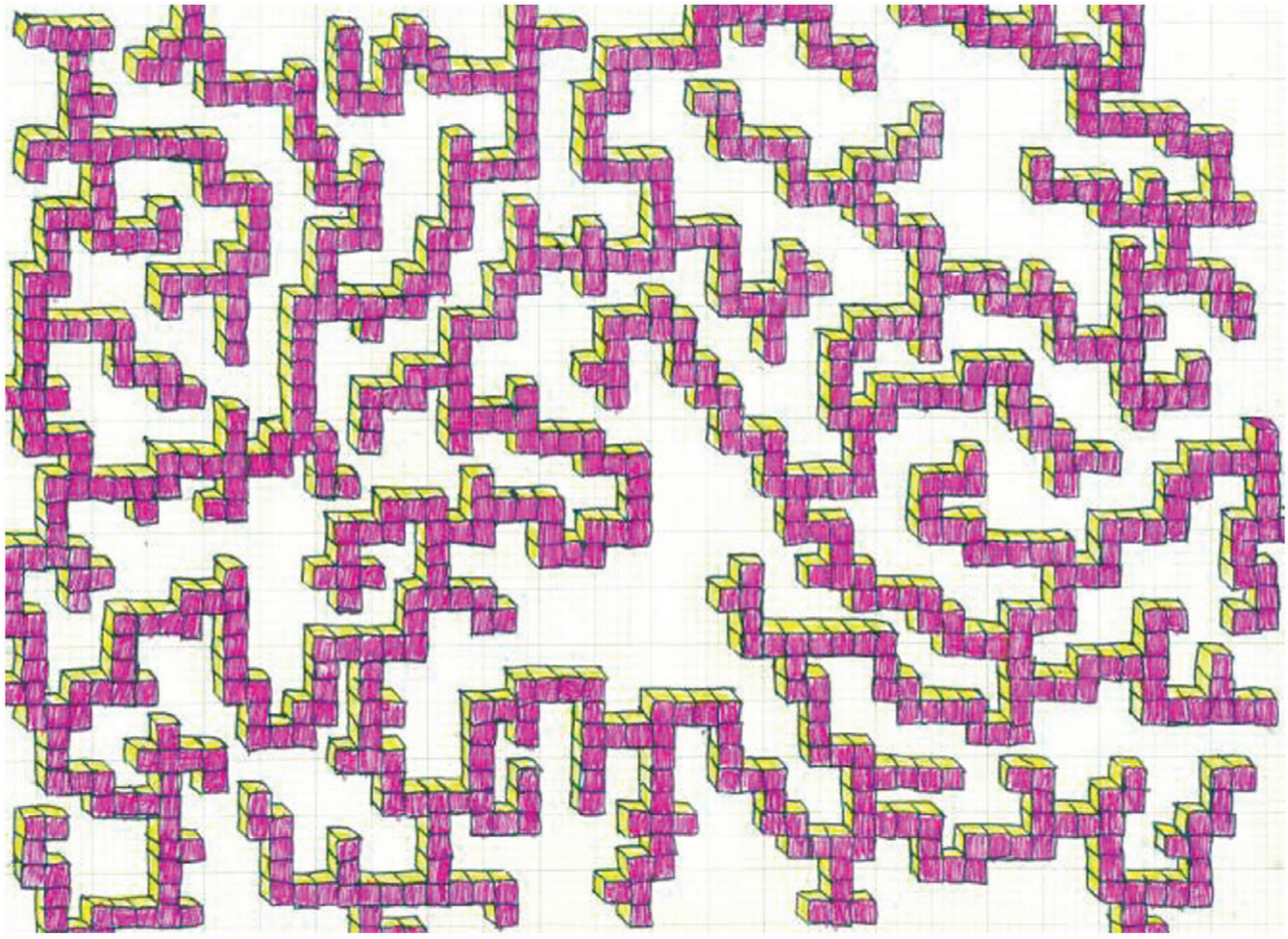

Figure 7. *Purple Curve*, © Terri Wright, 2007, drawing, 33 cm by 50 cm. See insert for colour version of this figure.

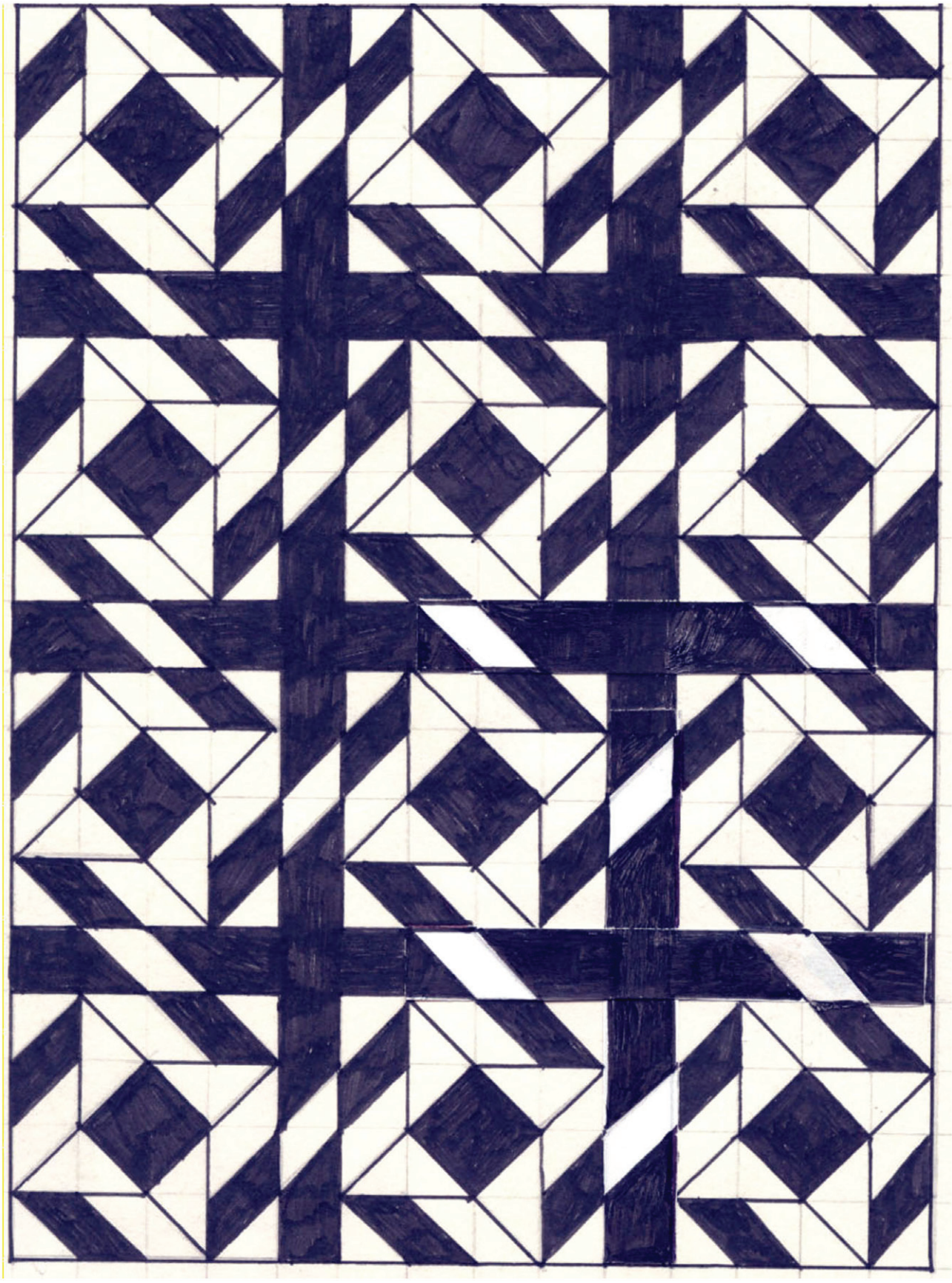

Figure 8. *Wallpaper Pattern*, © Ed Bullinger, 2007, pen and ink drawing, 33 cm by 50 cm.

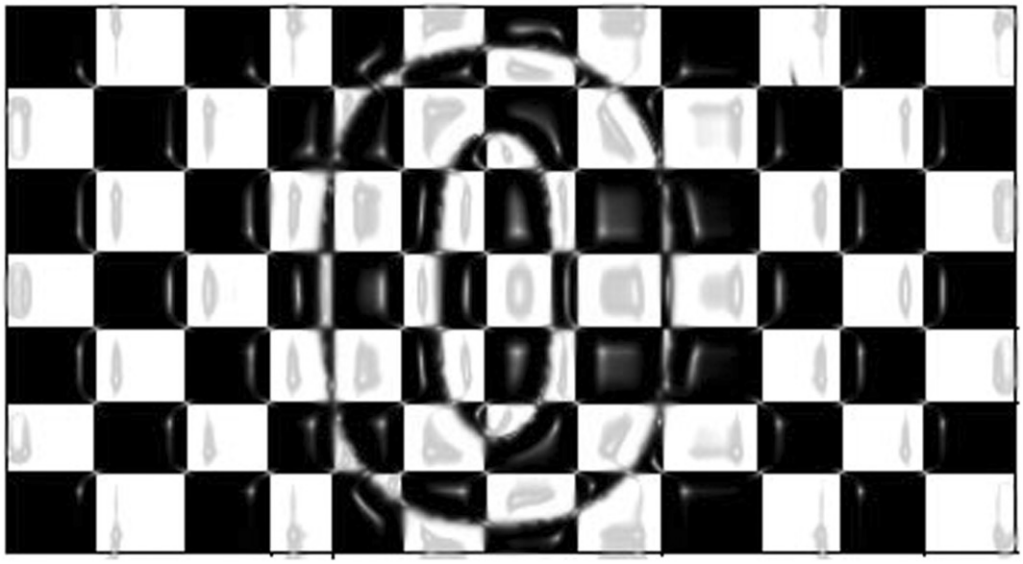

Figure 9. *Transparent Zero*, © Sam Curtis, 2008, computer graphic, 33 cm by 50 cm.

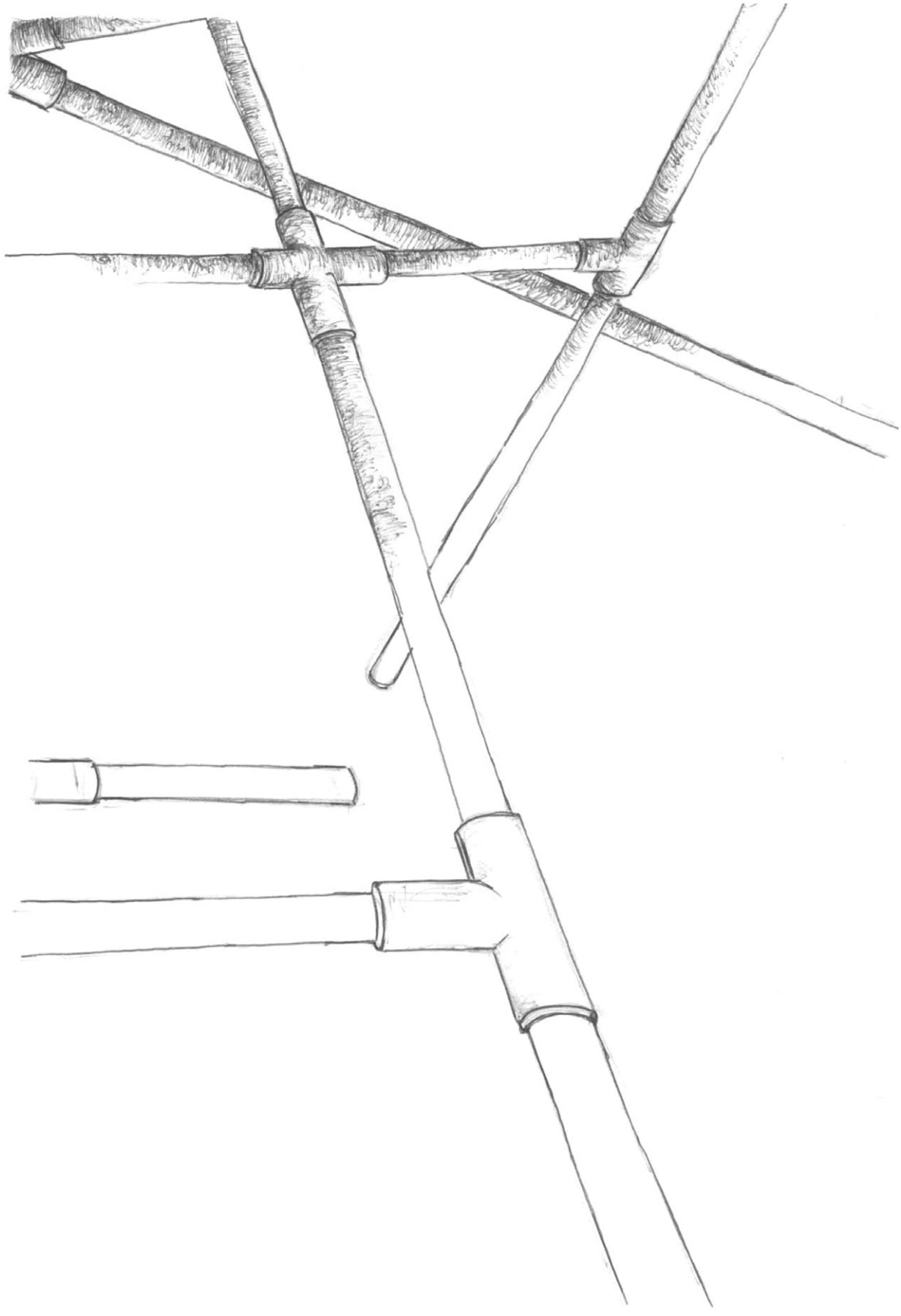

Figure 10. *Scaffolding*, © Matthew Shaw, 2008, pencil drawing, 33 cm by 50 cm.

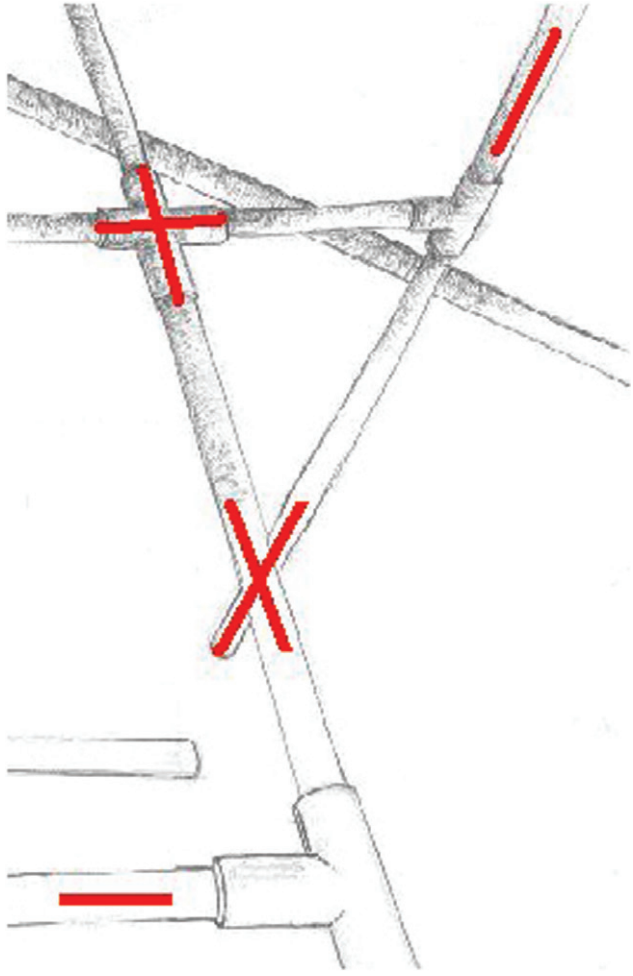

Figure 11. *Pipes*, © Matthew Shaw, 2008, pen and ink drawing, 33 cm by 50 cm.

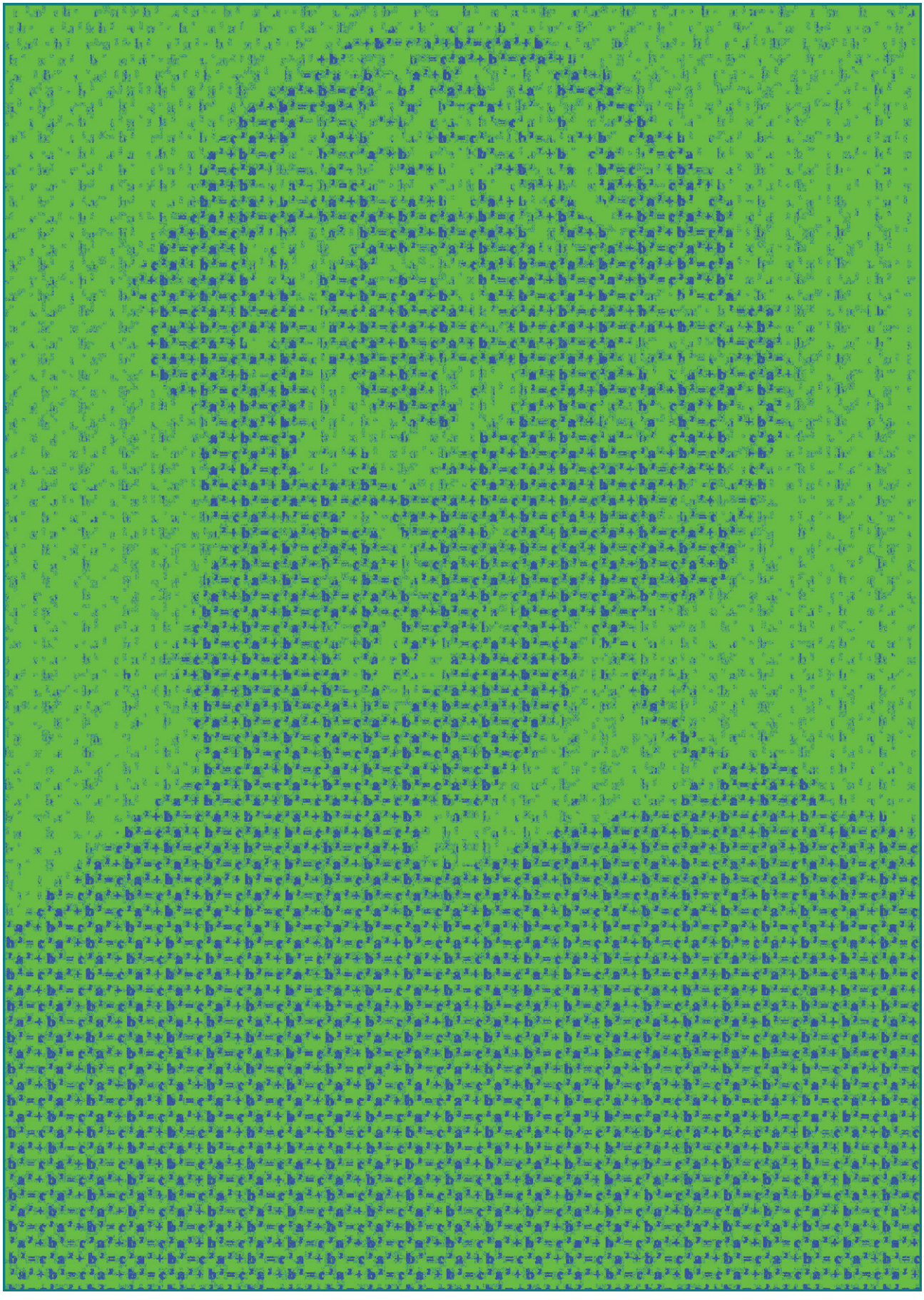

Figure 12. *Green Pythagoras*, © Michael Lester, 2008, computer graphic, 33 cm by 50 cm. See insert for colour version of this figure.

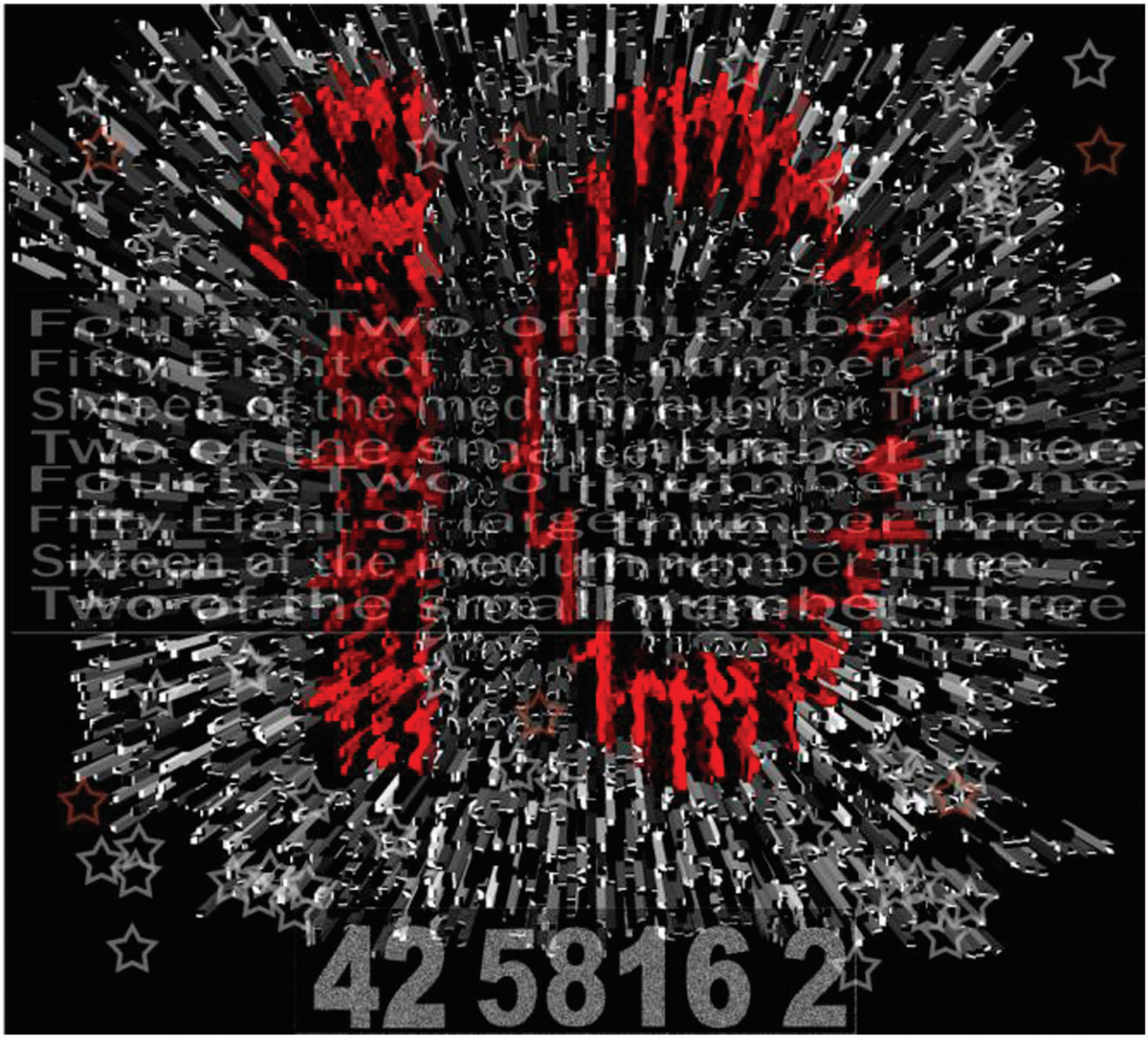

Figure 13. *10*, © Daniel Guest, 2007, computer graphic, 60 cm by 78 cm.

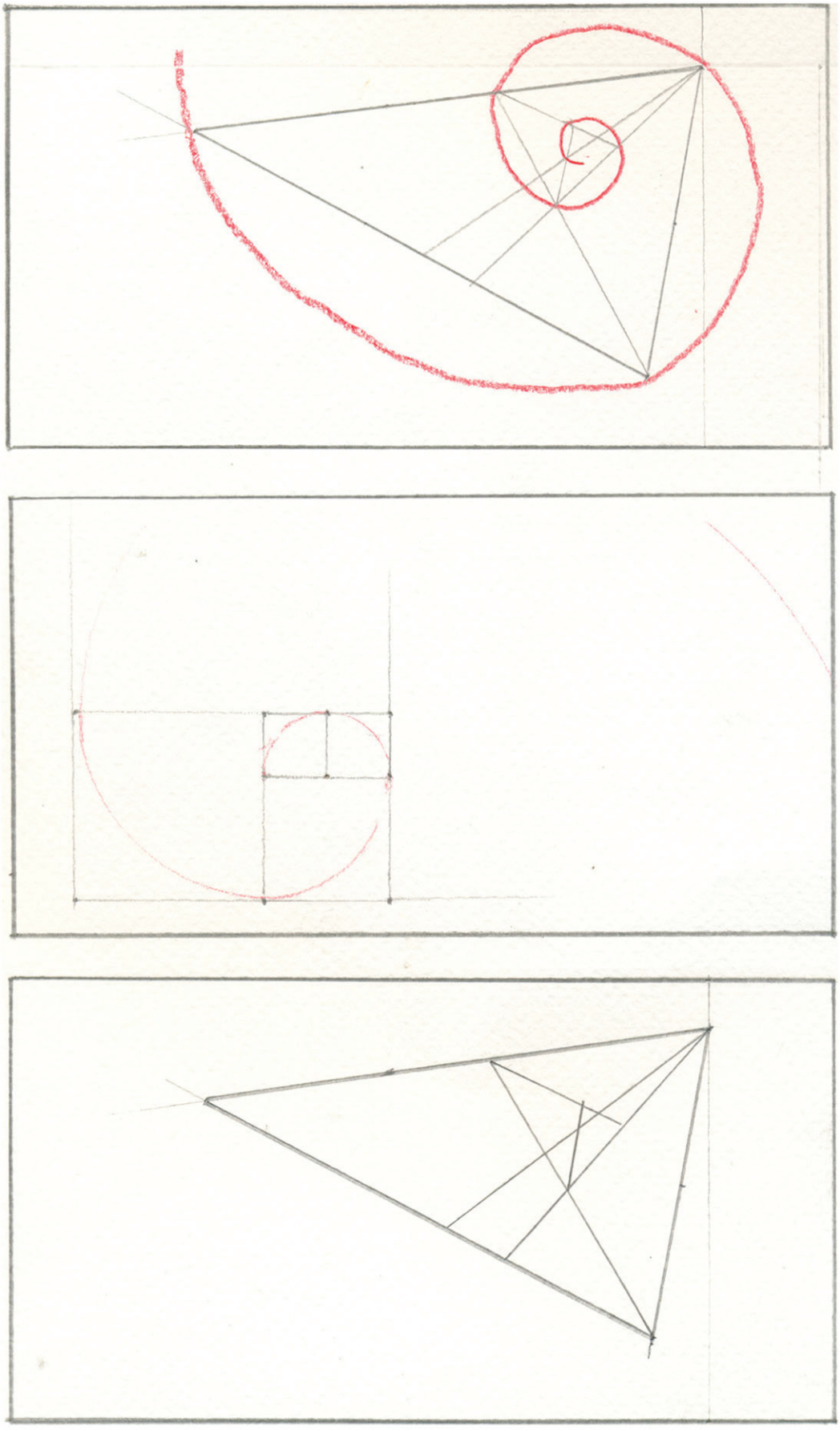

Figure 14. *Development of a Triangle*, © Matthew Woodrow, 2007, pencil drawing, 60 cm by 78 cm.

the image quite subtle, you would need to work a little harder to see the image.'

Daniel Guest's and Matt Woodrow's contrasting pictures (Figures 13 and 14) show an exploded '10' and 'Development of a Triangle', whose carefully constructed spirals one might easily imagine could have come straight from a notebook by Archimedes.

Thanks to their participation in the Art by Maths project, the BTEC students had the experience of successfully working for an appreciative client. The Maths Department has a lobby with 13 unique artworks adorning its walls, a gallery that makes us proud and which enhances the life of every maths student who works with us. All of us have been winners in this endeavour – our maths students have had the chance to emphasize and reflect upon the beauty of their subject, and art students have benefited from adding more profoundly mathematical ideas to their designs. But above all, it has brought our two sites together in dialogue, and the result has been a greater respect for each other and our ways of looking at the world.

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