Taitographs

Drawings made by machines

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Abstract

If a machine is instructed to make drawings and the results are viewed in the same way that a person's drawings are read, then speculation about the nature of creativity and art is not only possible but desirable. The decision making process becomes transparent because the maths, mechanics and after treatment are available for scrutiny, unlike the partially subconscious aspects of a person's drawing activity. It is proposed that the ideal way to meet the 'Bridges' aspirations is to follow Harold Cohen's exhortation that the most important task at the end of the 20th C (and beginning of the 21st) is to study how art works. My machines are electro-mechanical devices; from simple instructions they produce rich and complex images. Questions raised by machine drawings will be examined below.

Apposite limericks?

A scientist with maths in her heart
Set a sequence of numbers to start
Imagine her cries
Of joy and surprise
When her work was counted as ART

An artist who thought he could add
Made constructivist work, and was glad
But he sang a sad song
When his maths was proved wrong
Did this mean that his art was too bad?

1. Introduction

1.1. Questions. At a Bridges conference we have a gathering of able minds from science and art. In the past, undue prominence has perhaps been given to the 'nuts and bolts' of the activities and maybe insufficient attention paid to how the results, displayed as evidence of bridge activity, are assessed for provenance and meaning in terms of art objects. Whilst I am aware that "It's art because I say it is" has some currency, this will not do when scientists and artists meet to explore common ground. Given my art education background I feel able to pose what I hope are pertinent questions. If they have some resonance, then surely there is a chance that we might make some intelligent speculations about how art works. When sets of numbers are manipulated, the maths might be elegant algorithms, but how are we to judge whether the results 'add up' in terms of art? The converse is also true when artists flirt with numbers in the hope that the underpinning maths will give their work extra gravitas. We can all be vulnerable in this respect if we wish to attain any standing alongside more conventional areas of science and art. Evidence that we have examined the whole set of issues can only promote our cause and help us to be taken seriously. I am very aware that this point of view might be controversial but perhaps friendly argument and debate are the lifeblood of a good and rewarding conference.

2. Precedents

2.1. Art history. Precedents exist where the choice has been made to veer away from classical drawing and painting, so there is no need to make a special case when using machines to produce art. They are: -

(2.1a) Abstract drawings now have same validity and meaning as figurative work [1]

(2.1b) Mechanical aids, machines, cameras and computers are acceptable means of production. [2+3]

2.2. Variables. There remain only two points to address. As in photography [4] the main variables are WHERE you stand and WHEN you press the shutter; in using drawing machines they are WHAT they do and WHY the results might be regarded as art and their meaning evaluated. I will first deal with the 'WHAT' putting more emphasis on the questions raised by the process. Fine detail about my machines and their workings are given on my website. In examining the 'WHY' I want to use machine drawings to raise questions about our conceptions/misconceptions about art.

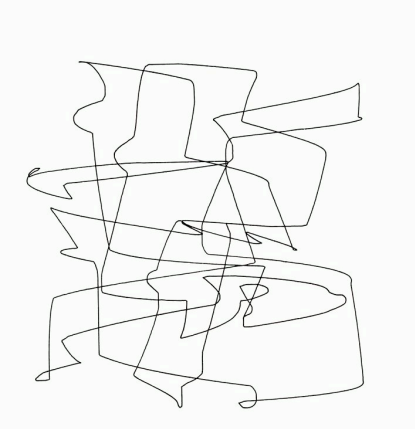
3. The WHAT.

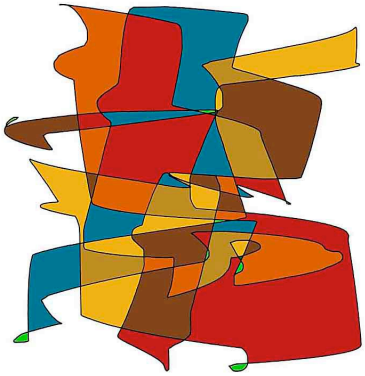
3.1. Method Before describing my machines, I will deal with motivation and process. I prefer to call my activity 'Printmaking' in the broadest sense based on my experience in 'classical' litho, etching and silkscreen work[12]. I am not a mathematician and struggle to deal with some of the maths underpinning my machines. As well as making prints, I am also a photographer and engineer, skills which came together when I used to build cameras. I design, build, and work with drawing machines, who's output I scan into the computer, process in Photoshop and make final prints on an inkjet printer. Photoshop and the inkjet printer have simply taken the place of the litho press; the thinking is the same. The results are 'Taitographs'- hybrids; part drawing, photograph, print and digital image.

With machine-generated work, the steps in production provide concrete data and insights maybe derived into its workings. Curiosity is my starting point; design problem solving may stimulate intuitive insights. The ability to visualise the outcome of a set of actions is essential. How decision-making takes place, the relationship of calculation, intuition and random effects, the criteria for making choices and the choice of colour are all equally transparent steps. Finally, making wrong decisions and mistakes is an inevitable but ultimately valuable component of a design method. Whilst the above is helpful, what completes the array of data is the effect of the images on the viewer. (By viewer, I mean those with an art background, preferably other practitioners) Having the viewer's reaction [10] completes a feedback loop. At this point all the information is available with which to speculate. This theme is taken further in the 'WHY' section.

3.2. Questions arising. It is part of my strategy to test viewer's reactions frequently and if appropriate to act on them. This has proved very beneficial, but is perhaps more applicable when working with machines than in the case of hand/eye work. Two questions in particular have been raised and are outlined below. with a bearing on both the WHAT and the WHY.

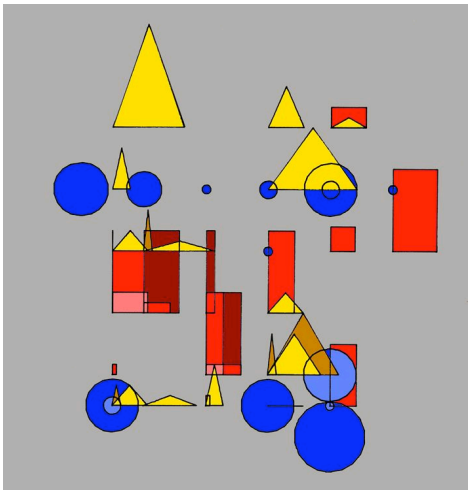
3.3. To Colour or not? It has been suggested that adding colour to the images detracts from the power and impact of the drawings in their 'raw' state. I have some sympathy with and understanding of this view, but my primary concern is that the viewer is first drawn to look at the image. Colour is a powerful expressive tool when used subjectively and a supportive component of the drawing particularly when it is rule based as many constructivist strategies are. **Fig 2.** Colour attracts a wider variety of viewers than would a monochromatic image and once the viewer is captivated, then I hold that the essential qualities of the drawing will insinuate themselves into the viewer's mind, perhaps without them realising it. There is no doubt that the drawing qualities are paramount, but not all viewers bring the same experience to looking at images, **4.4** below. This is also part of communication theory **4.2** below, in that the message of the drawing is received with as little 'noise' as possible and just as important, is more likely to be retained. I am supported in my view by Harold Cohen[5] who also chose to add colour to his computer-generated drawings. See **Figs 1+2**, identical drawings with and without colour.





Figures 1+2 *Green shoots in the desert*

3.4. Digital versus Analogue If the question were that simple then computer programming would be the first choice, but the two are not comparable. Building analogue machines is significantly different from writing a computer programme. With analogue machines, I do not know the exact outcome and I am often surprised by the results, although I treat my work as a design process. This is associated with the expression "Look what **It** has just done!" There is only a vague feeling that a particular avenue will be fruitful. When I write a computer programme I have a more concrete notion of where the process is going. For instance, if I explore sine waves, I need formulas in place, have a clear idea of the end result and limit the range of decision making. Programme writing is exact and unforgiving; it runs or it does not. Admittedly, occasional mistakes may be intriguing, but this seems to be rare. Each method is good and there is a case for using both. **Figure 3** is a computer-generated image which would have been difficult to do by an analogue machine, whilst **Figure 4** is unlikely to have been programmed. Until it was drawn, I did not know the outcome, but a product of intelligent exploration and programming not in any way a 'happy accident'.



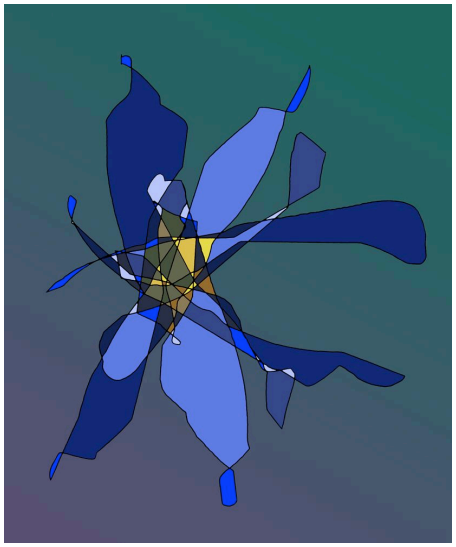


Figure 3 - *Homage to Kandinsky*

Figure 4 - *Rotor 6*

3.5. Electro-mechanical devices Most of my machine images are of this type. There are two. The first set has the 'programming' integral (by this I mean adjustment of the settings - see below) and the images are

changed by means of the relationship of linkages, drive wheels and ratios. Both are wholly deterministic and have no random element in their sequencing. Figure 5 shows the Linkogram and figure 6 the Sinewave machine.

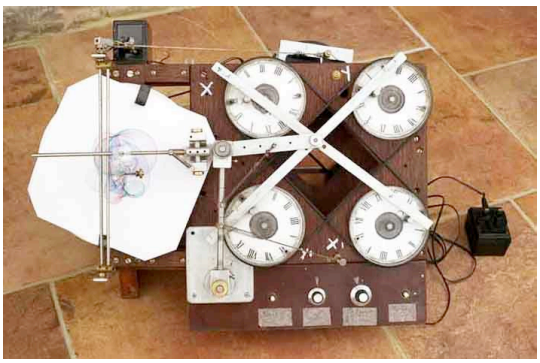


Figure 5 - *Linkogram machine*

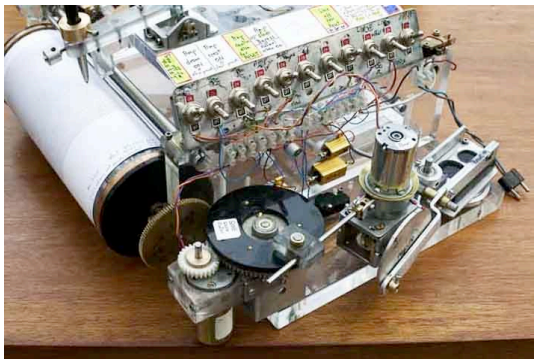


Figure 6 - *Sinewave machine*

3.6. Set 1 - Deterministic machines. The Linkogram is 'programmed' by the setting position of the clock face wheels together with the ratios of the X wheel set (top left and bottom right) to the Y set (top right and bottom left) and to the turntable speed. A typical setting might be X=2, Y=3, Turntable =2. The start position of the pen also alters the character of the drawing. Lifting and lowering the pen in synchronisation with the Y set of wheels afford further variety. **See figures 8 and 9.** The organic growth of the lines is controlled by the very slight variation of the wheels' speeds i.e. the X and Y sets differ by approximately 1:1.05 whilst the X:Y speed difference is 1:1.03. This means that the positions of the clock settings varies as the machine draws and causes the line growth to continue at around x 1 to x 1.5 line widths on each revolution. The settings are sufficiently accurate to allow almost identical repeats. A light pen is available which enables the drawing to be made on photographic paper (see I below right).

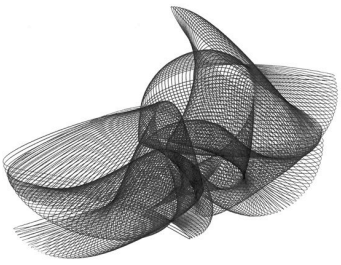


Figure *7 – Linkogram*

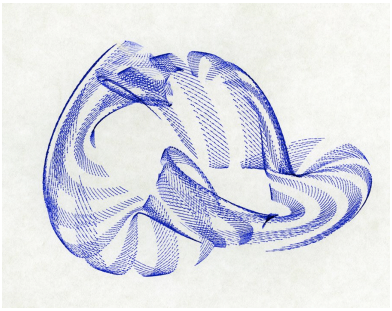


Figure 8 - *Blue line wih pen lift*

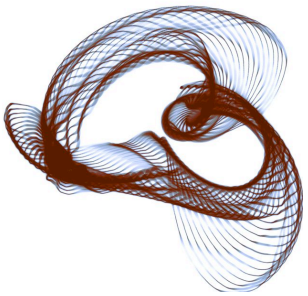


Figure 9 - *'P'- light pen*

3.7. Linkogram. Figure 7 is a simple linkogram image allowed to run for an extended time, **Figure 8** had the pen lifted and lowered and **Figure 9** had the light pen lifted in and out of focus, where a light pen 'wrote' onto photographic paper.

3.8. The Sinewave machine. Figure 6 is 'programmed' via switches to control the line spacing and the wave growth speed. The number of waves is governed by the gearing to the main sinewave gearbox shown on the bottom of the picture. Altering these gears can change the number of waves. **See Figure 10.**

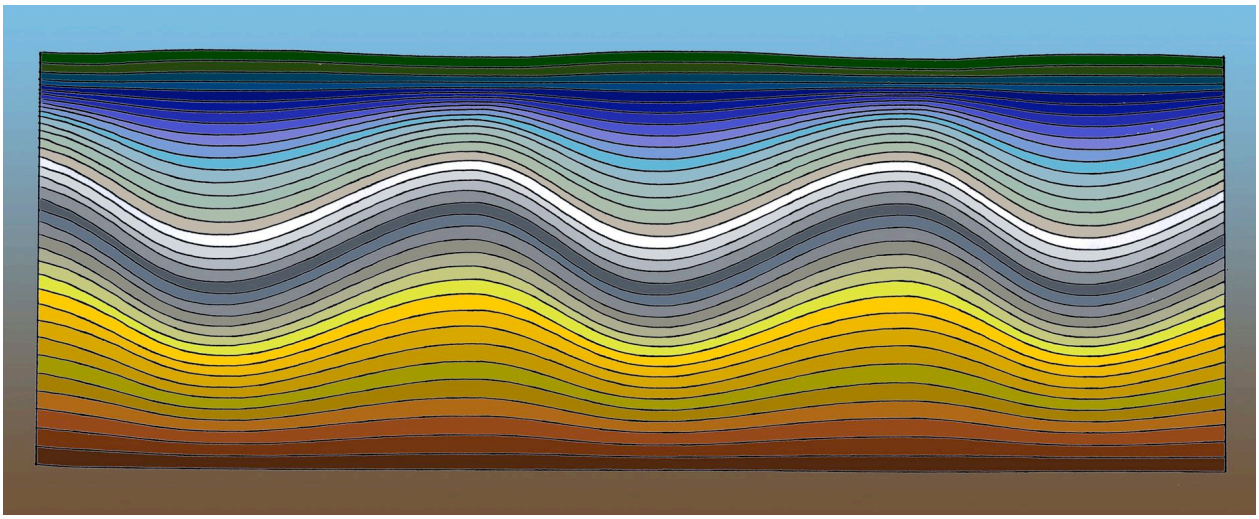


Figure 10 - *Seascape*

3.9. Set two – Programmed machines The second set of machines relies on the input from sequential time programmers to execute the drawing. There are two such sequential programmers at present; each has a quasi-random element built in and can be used to control a number of machines. By quasi-random I mean that sets of switches are driven by gears whose numbers of teeth are slightly different and take time before they repeat. Added to this the sequential timers and reversing switches may be applied to each of four different motors; the practical outcome is a large number of permutations.

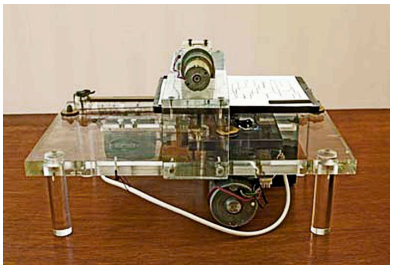


Figure 11 - *NSEW*

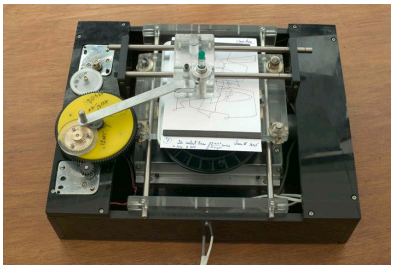


Figure 12 - *NSEWsp*

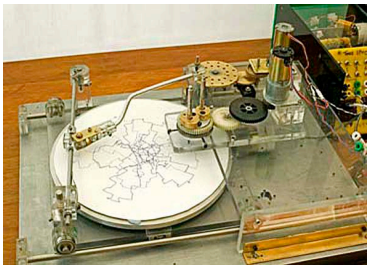


Figure 13 - *Turntable*

3.10. NSEW - In this machine **Figure 11** , simple X and Y axis movements are driven by d.c. motors; voltage variation gives different speeds. Underneath there is a reversing relay box to automatically reverse the direction at each end of the travel. This is in addition to any reversing done by the programmer and is solely to prevent overrun. This simple range of right angle movements in North, South, East, West directions (hence the NSEW name) is able to offer a wider range of drawings than might be expected.

3.11. NSEWsp - Figure 12 shows a more complex version of the above, having a sun and planet gear system on each axis, with two motors to each, and offers greater richness and variety. This set up can produce lines which are not confined to right angles as in the first NSEW machine. With my elementary maths, I calculate that the theoretical extent of possible images from the NSEWsp model is in the order of 37 million.

3.12. Turntable - The third machine in **Figure 13** is a turntable unit coupled with a rotating pen and a simple harmonic linkage. It has three separate motors and the combinations available to either programmer are large. The sequential programmer can just be seen at the top right of the picture.

4. The WHY

4.1. The Influences. When dealing with the WHY, I want to start by recognising the influences which have a bearing on my work. At art college and afterwards, I immersed myself in the range of work listed below. In cases, such as Cezanne, this had a direct bearing on my still life photography. Others were indirect and include Maholy Nagy, Man Ray, Paul Klee, Kandinsky, Mondrian, Cezanne, Matisse, Kenneth Martin, Brigit Riley, Vassarely, Tanguely, Harold Cohen, Constructivism, Kinetic art, Cybernetics, and Artificial Intelligence. The influences did not lead to machine building but developed alongside it. It was never my intention to 'mimic' the constructivist pictures and if there are obvious parallels then these are done as 'homage' to the painters and are an attempt to understand their preoccupations more fully [6,7+8] If similarities do exist then this has no relevance to the standing of my drawings; they derive nothing from any likeness. I am only interested in the significance of what machines can do. If one movement in art were to be selected as pivotal, it would be the Bauhaus and in particular the philosophy of Moholy Nagy, Man Ray, Klee and Kandinsky. If I have to classify my work, then it paddles in a backwater of constructivism with a bit of cybernetics thrown in for good measure!

4.2. Design process [9] **and Communication theory**
In trying to learn more, we need a framework in which to place data referred to above in motivation and method. The Bauhaus teaching set the path, in particular Moholy Nagy's telephone pictures. This was further encouraged by the Harold Cohen's statement quoted in the Abstract. Design process may help and two questions may be borrowed from it: By what criteria are alternative solutions rank ordered? How do we evaluate the results?

4.3. The Philosophy
In conventional art practice, the underpinning philosophy is very complex and outside the remit of this paper. Our prime concern is how is meaning derived from marks on paper. Using machines to make drawings simplifies things. Clear instructions must be given and 'allowable decisions' chosen. The process then becomes 'outside our minds' and evaluation can happen 'as if the images were not ours.' The response "I would not have thought of doing that" *(had I been drawing in the conventional way)* becomes significant. The nuts and bolts are accessible, the viewers' reaction generates feedback and the process is complete.

4.4. The Beholders Share [10]
Gombrich stresses the vital role played by the viewer's experiences in governing their evaluation. From this I developed, in my design teaching, a way of differentiating between a **design object** and an **art object**. If a design object is evaluated by a number of viewers, they all respond to it in a similar way, i.e. a chair will not be mistaken for a table. Their previous experiences are unlikely to condition their responses to any great extent; they all get the same message. When an art object is evaluated, their response to it is likely to be different in each person because they have brought to it a wholly different background experiences. The message received is almost certain to be individual. I propose that this is a workable benchmark for identifying whether or not an artwork 'adds up'.

4.5. The Turing test [11]
Recentl machines have complicated linkages and programmers containing quasi-random elements. **See figures 12+13.** Earlier images had deterministic characteristics and might not have 'added up to art' ref. **4.4** above. Now, the complexity and richness of images shown in **Figures 4, 14 and 15** take on ambiguous qualities; they ceased to shout "machine image". Many viewers have felt that they exhibit characteristics more akin to hand-drawn abstract paintings. Given that a concensus exists, then a Turing type test can now be proposed. Can the viewer tell the difference between an image made by hand and one done by machine? If they create the same viewer response then perhaps no difference exists! From this, can we begin to speculate how art works? Recent work, using light pens fed into a digital camera, suggests more potential as the images look wholly photographic.

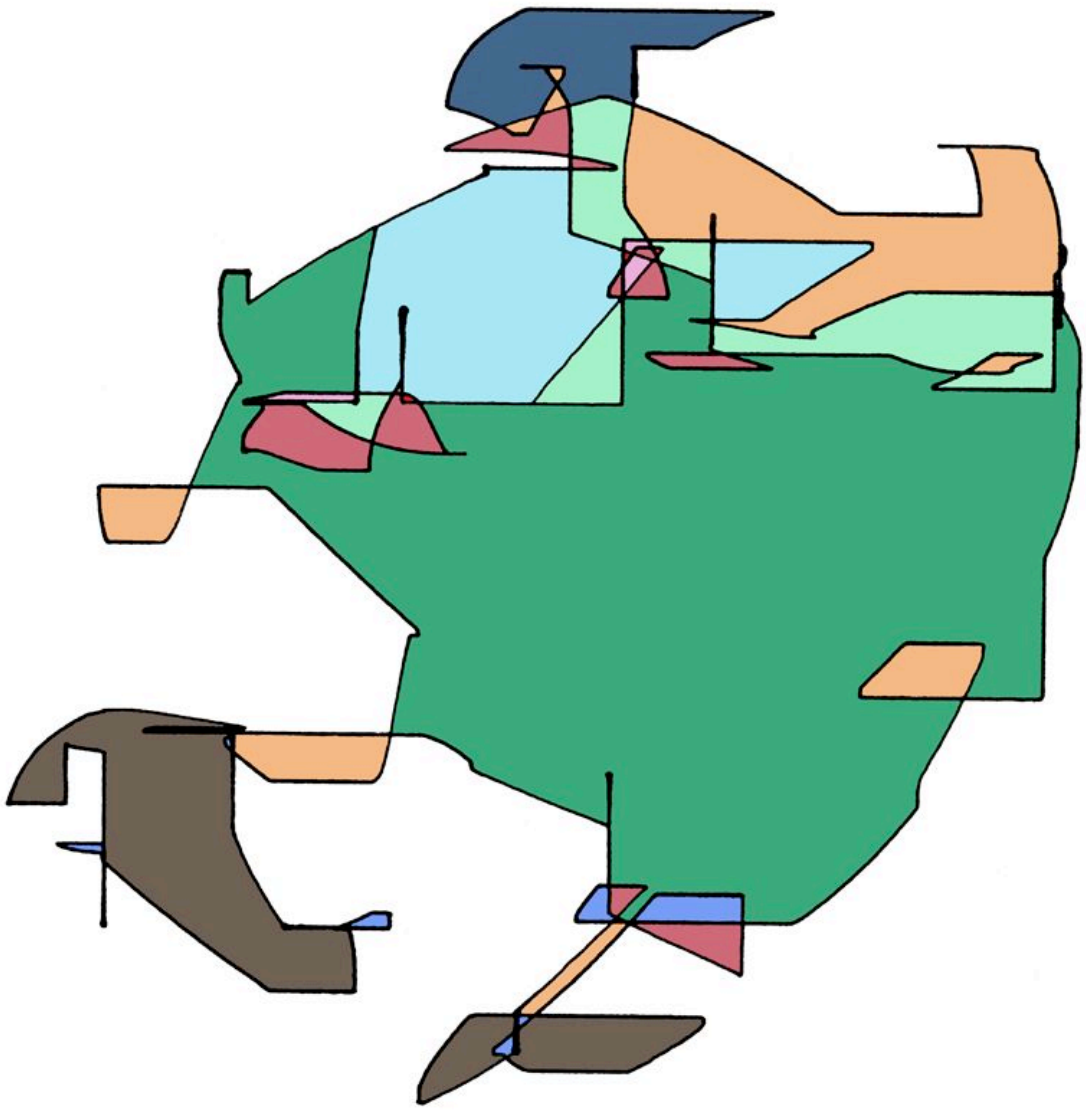


Figure 14 - *Dancer*

5. Conclusion

5.1. Sharing questions. In showing machine drawings I have put intriguing questions. I accept that it is impossible to rule out subjectivity in picture-making activity; our subconscious minds always insinuate themselves into every corner. However, speculation that the machine drawing activity might unravel some threads of the creative act, has motivated and enriched my printmaking. With luck, something useful might have been transmitted and even received. In the final instance, I hope that my images will be more eloquent than I have been.

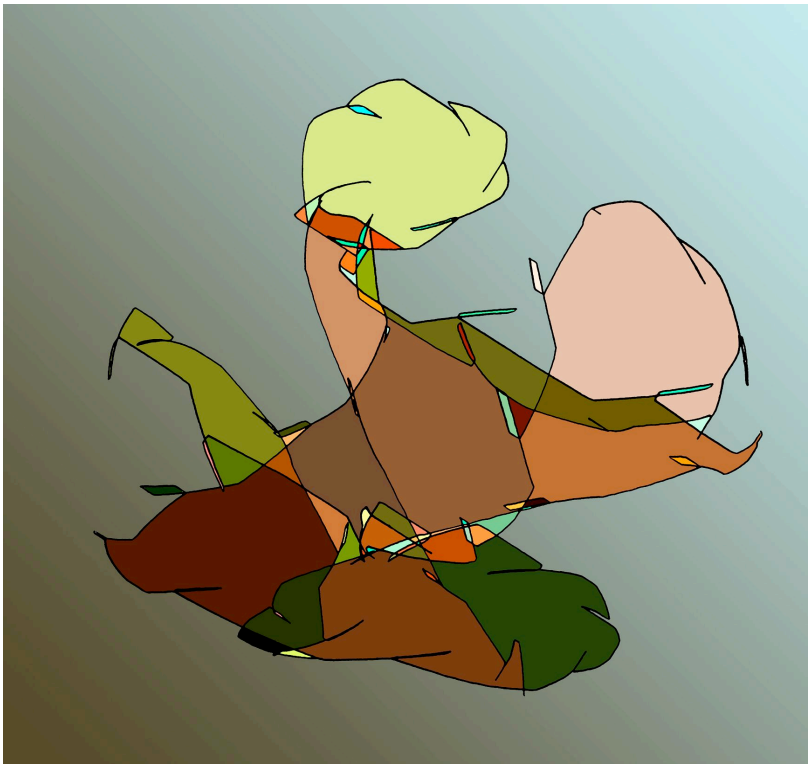


Figure 15 – *Figures*

6. References

[1] Royal Academy of Arts London Bauhaus - German Exhibition - Catalogue 1968
[2] Tate Gallery - Tinguley Exhibition catalogue - 1982
[3] Malina F - Kinetic Art Theory and Practice - Dover Publications New York 1973
[4] David Hurn/Bill Jay 'On being a photographer'- 3rd ed.- Lenswork USA 2001
[5] Tate Gallery - Harold Cohen - 1983
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[9] Sebastian Lera - Synopses of some recent studies of design process and behaviour- RCA 1983.
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[12] Jack Tait - Beyond Photography - Focal Press - 1977
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