SIMON INGRAM

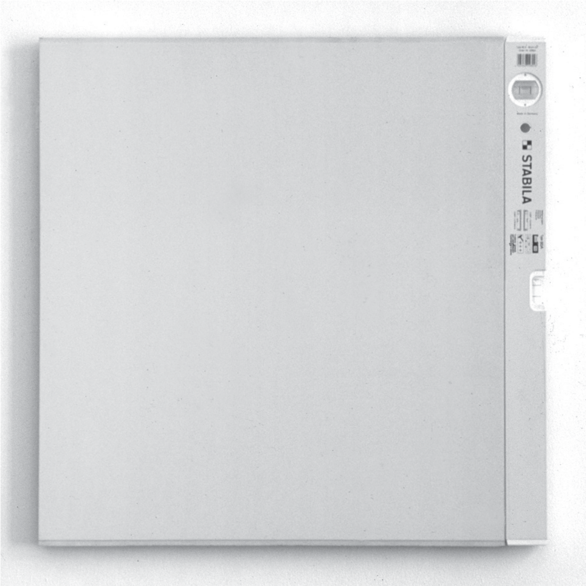
Machinic Practice in Painting

INTRODUCTION

A 'new kind of science' has emerged that enacts the kind of complex patterning found in nature within the computational environment. When specific sets of simple individual rules are run on a grid many times they present a kind of random patterning that might remind one of life. Such dynamic systems are referred to as cellular automata. The level of reflexivity and recursive behaviour that helps generate the conditions for such patterning is reminiscent of some elements in formalist painting over the last 90 or so years. So too are some of the aims of this new kind of science. There is a kind of reverse engineering at work in both cases, an attempt to build machines that are less representations of things in the world than things in their own right.

In order to bring what I have in mind, 'machinic practice in painting' and cellular automata, into some kind of comparison, I shall sketch out the field by providing background and working definitions. I shall then compare and discuss points of similarity between these, and finally, discuss the notion of the computational universe in relation to machinic practice in painting as a kind of reverse engineering.

The remarks here are preliminary, they map out a field of inquiry and relations with which my practice as a painter engages. They owe something significant to ongoing conversations with Allan Smith, who in 2000 (in a way that is quite prescient given the content of this essay) discussed my work in terms of internal logic and self-generation, commenting that "Ingram reveals the procedural code of his paintings like a little motor in a box ..."[1] Though Smith was referring to another body of work, the same comments might easily have been made in relation to *Spirit Level Painting No 1* of 1995, and also to current work that relates specifically to this essay.



Spirit Level Painting No 1, 1995, enamel on plywood with Stabila spirit level, 80 x 80 cm

LOCATING MACHINIC PRACTICE IN PAINTING

What is meant by machinic practice in painting? It is certainly something close to the Russian Formalism of Viktor Shklovsky, who, in *From Theory of Prose: The Novel as Parody* (1925) discussed Laurence Sterne's use of language as a laying bare of the device. 'Lay Bare the Device' is a reasonable slogan for the thing of value I want to sketch out.

To be encumbered with the catalogue of criticisms levelled at formalism – claims that it is evidence of hostility to lived experience, or that such interests reaffirm authority, or that its products are the aesthetic equivalents of 'black tie events' – would, regardless of the intellectual probity of such claims, be to 'bog down' the practice before it was ever sketched out. The category proposed here as *machinic practice in painting* calls out to a formalism but it is precisely 'a sort of formalism,' there being many different kinds. Because there is no one sense of what formalism is, and because an inventory of historical formalist positions would have the usefulness of an academic exercise – 'what formalism is', is not on order here. Still, there are a number of positions, some of which could reasonably be referred to as 'formalist' that I choose to present in order to demonstrate what machinic practice in painting is.

1) The first of these positions relates to rudimentary grammar in painting. In an essay on the American Robert Ryman, Anne Rorimer writes of the artist's "life-long inquiry into the notion of painting as a medium and a verb ..."[2] Surely painting is a noun, a thing, something to put on the wall. It's that too. But unlike a lot of painting, Ryman's work manages to show us the ways in which things 'are things'; the ways a thing, in this case a painting, became itself (the 'thing-ed-ness' of a thing). Thus the complexity of variously applied, sometimes thick, other times thin oil colour of Ryman's (almost) wholly white palette demonstrates concrete acts of 'a painting becoming itself'. Fibreglass, or aluminium, or linen, paper or canvas are sometimes left partially revealed in a way that one finds in Matisse; one gets the sense of what 'painted' and 'not painted' amounts to.

Elsewhere, Yves-Alain Bois doesn't hedge on the verb theme; he proposes that Ryman "has attempted to paint that he paints that he paints ..."[3] and, that this excess of self-reference overtakes the tautological condition common in modernism, producing in its turn, something quite other to a tautology. Perhaps he has something more vertiginous in mind than the academic tenor of Joseph Kosuth's *One and Three Chairs*. Ryman's insistent staging of a reflexive act of painting, "I paint that I paint that I paint", hits the noun "painting" in the sweet spot of practice and casts it as a verb with its own sense of agency. As we shall see, this kind of reflexivity is a core operation in the machine systems that I later compare painting with.

2) Another position relates to the question of painting's sentience. An essay by Paul Rodgers entitled "Toward a Theory/Practice of Painting in France", published in *Artforum* (1979, see endnote 4), discusses the work of a (then) contemporary group of abstract painters (Simon Hantai, Daniel Dezeuze, Marc Devade, Claude Viallat, Jean-Pierre Pincemin). The essay deals with the relationship of the French painting to American formalism and the Abstract Expressionism that preceded it in the 40s and 50s. It puts theory and practice in painting into a relationship with Marx's ideas on the synthesis of thought and matter (praxis). It also shows linkages of various members of the group to the theoretical work of the French avant-garde literary journal *Tel Quel* (which from 1960 to 1982 published key writings by major poststructuralist figures: Derrida, Foucault, Barthes and Kristeva).

Central to what I want to discuss in this section is a statement made by Lenin – brought to light in Rodger's essay by Phillippe Sollers, the founder of *Tel Quel* – simply, it is that "matter thinks." A few lines on one can read that it is not the human subject that thinks so much as "his matter of subject."

What is at stake here is a version of materialist philosophy being deployed in a pitched battle against idealism in painting. This idealism is of the kind that tends to separate thought from sensuous human activity, theory from practice, ideas from the domain of matter. In general, thought in the work of these painters occurs at the level of matter, it *is* matter. Thought is substantiated through folds, colour, flow, and occurs in this way and not abstractly. To call the artists' painting 'abstract' is in a sense to mislead, because this work is real or actual in a way that makes representational painting seem unreal.

Rodgers provides an interesting distinction between American formalism and the interests of this group. The French, he claims, seek "to free the American painting it admires from a formalist interpretation ..."[4] He refers to the formalism that turned away from psychic automatism in painting (the surrealist and later abstract expressionist enthusiasm for the unconscious mind as a 'content provider' in painting) and toward an idealist fantasy of painting in terms of its 'purity.'

If formalism contains an idealist prejudice that sees the subjectivity of the painter in painting as just so much tampering with formal properties, or something that considers traces of the painter to represent the failure of an artist to present radical anonymity in their work – then for the French such traces might be said to be component parts of a machine that runs within the socio-economic setting that helped establish it. To offer another differentiation: the French theorists do not construct an argument along lines that were developed in the early 1990s in relation to Abstract Expressionism and the cold war,[5] namely that psychic automatism in painting was a technique of selling a certain kind of capitalist subjectivity to viewers. Instead, the possibility of physic automatism in painting is incorporated within a larger discussion that would refer to a critique of all things humanist, including critique itself.

These remarks are not intended to recuperate the subjectivity of the painter in painting, so much as to bracket it as a ‘given’ as Marcel Duchamp might have called it, which in this context, is to emphasise it as material. This recalls Duchamp’s comment on the difficulty a painter has in working with anything else than readymades: “you use a tube of paint; you didn’t make it. You bought it and used it as a readymade … no man can ever expect to start from scratch; he must start from ready-made things like even his own mother and father.”[6] In sum, the array of material conditions that comprise the sort of machine that I have in mind here, would include not only the formal elements (paint, canvas, colour) but the painter and viewer’s subjectivity, the wall, and the gallery opening out onto what Devade refers to as painting’s socio-economic determinations:

> the taking into consideration of the work of the unconscious in pictorial practice (in conjunction with history and its formal biomorphic and socio-economic determinations) has the greatest chance of dispelling from its interlocutory discourse a conception of painting as communication (of a sense) which in the final analysis supports order and the law.[7]

CELLULAR AUTOMATA (CA)

John von Neumann is perhaps best known for developing the architecture for a stored program computer, where memory resided in electronic circuits (First Draft of a Report on the EDVAC, 1945). Earlier methods of storing digital memory had depended on punched cards – or a length of tape, as had a highly significant theoretical computer developed by Alan Turing (The Turing Machine, 1937). On the encouragement of his colleague Stanislaw Ulam, and perhaps as an offshoot from the serious business of building an electronic computer, von Neumann developed an abstract model of reproduction in biology by modelling a two-dimensional cellular automata, or a self-replicating (finite state)[8] machine, using pencil and graph paper. Thus it was that the branch of mathematics known as cellular automata, or CA for short, was born.

N Katherine Hayles gives a useful description of the process of a generic CA’s modus operandi:

> Each cellular automata … functions as a simple finite state machine, with its state determined solely by its initial condition (on or off), by rules telling it how to operate, and by the state of its neighbours at each moment … [e.g.] ‘on if two neighbours are on, otherwise off.’ Each cell checks the state of its neighbours and updates its state in accordance with its rules at the same time that the neighbouring cells also update their states.[9]

In 1970, John Conway developed a highly popular CA called *The Game of Life*. Like all two-dimensional cellular automata, this CA runs on a grid according to initial conditions. The rules go something like this:

- All dark squares are alive, all other squares are dead.
- Each cell has eight neighbours.
- A cell will stay alive if it has an optimum number of live neighbours (2 or 3).
- It will die if it becomes lonely (0 or 1) and it will also die if it has too many live neighbours
- If a dead cell has three live neighbours, it will become alive.

The outcome of these rules is a grid-bound killing and birthing field, that demonstrates a degree of visual randomness reminding one of life.

In 1980, Christopher Langton developed another important CA called *Langton's Ant*. An ant starts out on a grid and follows a simpler set of rules:

- If the ant is on a black square it turns right and moves forward one cell.
- If the ant is on a white square it turns left and moves forward one cell.
- When the ant leaves a cell, it inverts the colour of that cell.

After each successive step the ant responds to the state of the grid and changes it according to the rules outlined above. After 10,647 steps the ant starts building what people have come to call 'a highway.' This dramatic deviation from the ant's initial incremental and reasonably localised recompiling of black and white squares, seems almost wilful. Mathematicians find the highway especially puzzling. At a high level (or from an abstract perspective) it doesn't make mathematical sense, it only makes sense when one operates at low level (at the level of practice) by running the programme step by step. With both *The Game of Life* and *Langton's Ant* one gets the impression of watching something living unfold, some form of artificial life. Here is an image of *Langton's Ant* after over ten and a half thousand steps:

It is perhaps useful to think of these two CA as machines that are 'autopoietical' – a neologism which means something like auto-production, or self-making. 'Poiesis' derives from the Greek meaning both 'creation' and 'to make'. The word appeared in the seventies in the context of work by evolutionary biologists Humberto Maturana and Francisco Varela. Simplifying to the extreme, from Maturana and Varela's biological perspective, all living systems are machines engaged in the business of self-making, and as such they're autopoietic. All other machines, generally those that aren't living, produce outcomes quite different from themselves; a tire factory doesn't produce tire factories, it produces tires, etc. CA blur this distinction because while they self-make, they aren't living in the same way that you the reader or I the writer are.

This idea of sets of discrete or informationally closed systems responding to their environment according to internal self-organisation, or rules, is central to German systems theorist Niklas Luhmann's notion of 'second order observing.' Luhmann's basic claim is that if an observer is to make observations that in any way 'see' the world – as opposed to imposing an *a priori* observational structure on the world – they must take into account the ways in which they see. This means the observing of observations, taking into account our "latent structures."[10] In Luhmann's schema, traditional positivist scientific method is considered as 'first order,' or 'naïve' observing, and second order observing amounts to the inclusion of observation into the distinction of observing. The kind of science involved with CA is not naïve in this sense and relates strongly to second order observing.

English biologist Jack Cohen usefully describes the relationship of component parts within these sorts of machine systems, and especially the relationship between *Langton's Ant*'s self organisation (rules) and its environment (grid):

> People's first response to a description of complicity is often 'oh, you mean they interact'. No, we don't: we mean much, much more. Things interact when one of them affects the other. Once. Things are complicit when their interactions change them, so that soon they have become different things altogether – and still they continue to interact, and change, and interact again, and change again ... We contend that most natural systems are complicit, and that the natural world – in particular the human brain – cannot be properly understood unless this is borne in mind.[11]

This sense of change brought about by something interacting recursively with its environment could equally be thought of as 'reflexivity', a key concept in cybernetics. These sorts of ideas and contexts, together with the work of von Neumann, Zuse, Conway, Langton and Fredkin might be considered central to the discovery of cellular automata and its significance to discussions on artificial life. But it is Stephen Wolfram who is credited with systematically cataloguing and testing CA, and with releasing the potential – through a mix of intensity, mystery and daring – for CA to become a geek cult or popular techno-science for readers of *Wired* magazine (where I was able to find a good deal of material on Wolfram and CA).

Wolfram's own professional trajectory began within the university and rapidly moved outside of its cosseted confines to set up a company where he developed the software *Mathematica*, which "has been used for everything from designing the flow rate of shampoo to calculating the Nielsen TV rating to designing the cycling arena in the Atlanta Olympics."[12] Aside from such pragmatic uses, *Mathematica* was an indispensable research tool to crunch through millions of different operations relating to Wolfram's CA. The result of this numeric crunching is the remarkable 1200-page, *A New Kind of Science* (2002). It is a vast catalogue of diagrams and source code (instructions) for CA and, as the title suggests, is nothing less than a proposal for a new scientific paradigm.

CA are basically simple programs. However, unlike the application I have chosen to use to write this paper, they perform no other task other than playing themselves out according to internal self-organisation designated by a set of rules. They don't represent, they grow from within, they self-make, they're autopoietic. In simple terms, CA run using rules (software) within the environment of a grid (hardware).

It is specifically the class of systems known as 'elemental CA' that I will focus on here. In Wolfram's schema, there are 255 different elemental CA, each consisting of 8 rules or cases that describe possible states of squares on a grid. I'll call these elemental CAs 'Wolfram CA' to distinguish them from other CA (by Conway or Langton for example). A pre-condition of the running of each rule, is that there should be a black square in the middle cell of the first row of the grid. Here is a description of Wolfram's CA Rule 90: When moving horizontally across a row on a grid, a cell should be black whenever one or the other, but not both, of its neighbours were black on the row above, otherwise it should be white. When this simple rule is run over a number of lines, a 'nested' patterning emerges that reiterates itself over and over, each time multiplying its size in relation to its state.[13]

Unlike *The Game of Life* and *Langton's Ant* which both operate in the more complex two-dimensional space of a grid, a Wolfram CA operates within the much simpler one-dimensional space of a line or row. Whereas other CA can grow in any direction, a Wolfram CA grows in one direction, one line at a time. The development of each row depends on the way the row before developed – remembering the rules are applied according to the state of the previous row. In this way CA exhibit complicity or reflexivity.

Why did Wolfram choose the highly reductive approach of working within the confines of a one- dimensional environment? I believe the answer to be that if conditions were made as simple as possible and if complexity arose out of these conditions, then he would be able to easily observe whether the complexity was merely a design feature of the system or something properly complex.

Something else sets Wolfram apart from others, and it's an important theme in his book. Rather than start with complex programs seeking to generate complex outcomes, Wolfram in effect turns "the whole idea upside down." He begins with "ordered conditions and looked at which rules spun out greater complexity ..."[14] Wolfram sums this up in the following:

> I did what in a sense is one of the most elementary imaginable computer experiments: I took a sequence of simple programmes and then systematically ran them to see how they behaved. And what I found – to my great surprise – was that despite the simplicity of their rules, the behaviour of the programmes was often far from simple. Indeed, even some of the very simplest programmes that I looked at had a behaviour that was as complex as anything I had ever seen.[15]

Unlike traditional mathematics, a CA runs dynamically as a program. Because a CA is not a static model or equation it is rather more suited – or at least advocates of CA are more confident that it is suited – to explaining the messier elements of existence. It is this sort of confidence that lets Wolfram make comments like:

> This mollusc is essentially running a biological software programme. That program appears to be very complex. But once you understand it, it's actually very simple.[16]

The mollusc carries on its shell a similar pattern to CA rule 30, a rule which was a turning point for Wolfram because it showed a higher degree of emergent phenomena than other CA. At some stage in its development, after having shown a clear sense of order within patterning, rule 30 begins to deviate, and starts 'bugging out,' producing high degrees of complexity:

> As Wolfram studied it, he began to realise that there was something profound about how such complexity would arise from a simple programme and began to wonder about the implications. Eventually, he would conclude that Rule 30 was not an anomaly but a crucial window onto the way the world operated.[17]

SOME COMPARISONS

Now to bring together what has been discussed, in order to get a sense of the machine in painting.

1) First, a comparison of painting as a verb and the reflexivity of CA: Bois proposes the artist "paints that he paints that he paints."[18] If this were the case then this is a situation marked by a high degree of reflexivity, something that underscores discussions on CAs, artificial life etc. Hayles sums up reflexivity as something quite similar to Cohen's discussion on complicity. Reflexivity is "the movement whereby that which has been used to generate a system is made, through a changed perspective, to become part of the system it generates."[19]

Robert Ryman's paintings are of a special kind, often thickly painted, full of the haptic data of paint, with surfaces that are arguably no less complex in their handling of painterly values than one of Willem de Kooning's *Women.* Yet while they share the complete immersion in complex physicality of much post-war American painting, their sentiment is not one of expressionism. This is not simply because of historical locale – that their production falls well outside the period in which Abstract Expressionism was at its height. I believe it is because Ryman's painting is less romantically ebullient (or even agitated) than De Kooning's.

One could argue that this is because Ryman's paintings (unlike De Kooning's) are almost always white or near-white monochromes. However, I would like to suggest something different. The reason feeling in Ryman is not romantic in the sense discussed, is because of the way reflexivity acts on the subjectivity of the artist. To carry basic grammar in relation to painting a little further, where Andrew Forge has written that De Kooning painted in the first person[20] – I would argue that Ryman declares that he paints in the first person, and because this declaration is made "through a changed perspective to become part of the system it generates," a typical Ryman can be said to be painted in the second person.[21] Put differently, the 'action of reflexivity' upon the artist's subjectivity works to translate what readily becomes 'the matter of Ryman,' something bracketed, as material, which coalesces with other component parts to comprise a Ryman painting. This, I believe is the reason why Ryman's work allows painting 'to be itself,' to become an instance of a complex program known as a painting, and at the same time avoids the hyperbole of some applications of Abstract Expressionism.

2) Second, a comparison of painting's matter thinking and the 'intelligence' of CA: To attempt a point by point analysis of a somewhat incongruous pair, namely materialist philosophy in painting and the new science that Wolfram champions, is beyond the scope of this essay. What remains then, as a set of equivalences, is there by way of parallelism.

If painting were engaged with an engineering of sorts, a tactile sort of mechanics operating at the level of givens such as coloured matter bound in a substrate and the application of such to supports undertaken by other material bodies (painter, brush, tape etc.), then to take seriously the implications of 'matter thinking' would be to accept painting's special intelligence. From this perspective, thematics related to Duchamp's quip 'bête comme un peintre' or 'as stupid as a painter,'[22] exhibit an idealist prejudice that thought is something abstract, ungrounded in matter, and consequently that matter is "inorganised"[23] (except perhaps when its Duchampian 'grey matter'). In the context of CA, that 'matter thinks' is another way of saying that 'matter lives,' and the real purpose of this paper is to show that matter is organised, not in the sense of 'tidy and ordered' but that matter is an organism.

The synthesis of human activity and thought is something Marx referred to as praxis, a paradigm shift in the development of thought. Marx wrote in the *Theses On Feuerbach*: "The philosophers have only interpreted the world, in various ways; the point is to change it."[24] In the spirit of praxis, Russian artists Strzmenski and Kobro had proposed in the 1930s that painting was something "built in accordance with its own principles, [that] stands up beside other worldly organisms as a parallel entity, as a real being, for everything has its own laws of construction of its organism."[25] This was some forty years before biologists Maturana and Varela had coined the term auto-poiesis, or self-making. The question could be asked, in what ways did painting in the modern period influence the work that fed into CA?

Self-making painting, painting that thinks or lives, draws up alongside a similar view held by Wolfram that verges on the fantastic. Wolfram's core project is perhaps to show that matter, the stuff of the universe, in all its complexity, is organised according to simple computational rules, just like CA. This is the notion that the complexity of the entire universe, from molluscs to humans to the formation of galaxies flow from a program running according to simple rules that are yet to be established. Wolfram calls this the principle of computational equivalence:

> The principle of Computational Equivalence asserts that almost any system whose behaviour is not obviously simple will tend to be exactly equivalent in its computational sophistication. So this means that there is in the end no difference between the level of computational sophistication that is achieved by humans and by all sorts of other systems in nature and elsewhere. For my discoveries imply that whether the underlying system is a human brain, a turbulent fluid, or a cellular automaton, the behaviour it exhibits will correspond to a computation of equivalent sophistication.[26]

Stephen Levy has referred to Wolfram as the self-styled Newton of our times.[27] However much C20 relativism is implied within the reflexivity of CA, and however much the hardness of their determinism is softened by this (the equivalent of the uncertainty principle) – an unabashed determinism underscores proposals such as the theory of computational equivalence. It should be said that any tendency to universalise rings out like alien speech in the context of 'critical theory,' which tends to trade interest in universals for inquiries into the local – something Lyotard puts well when discussing universalism as a kind of transcendental or meta-narrative, with "postmodernism [being] an incredulity to metanarratives."[28] So what about Wolfram's metanarratives, are they sustainable outside of a science environment?

In the context of critical theory, Wolfram's determinism might engender a series of incredulous *frissons*, and, at the level of metaphor this is one reason why he's so interesting. From one perspective, his ideas are an assault on humanist values, on what it is to 'be a human' –

traces of which may remain in the literature that surrounded postmodernist discourse (which the theory of computational equivalence might be said to tease out). Perhaps this is the problem that Lyotard both raises and enacts when he makes the following remark: "the trivial cybernetic version of information theory misses something of the decisive importance, to which I have already called attention: the agonistic aspect of society."[29] Elsewhere, the cybernetics of Niklas Luhmann has been discussed in terms of producing a moral supercooling, a chilling effect in sensitive readers, and also as being a cold shower – something good to "get the blood circulating again."[30] Wolfram's universalism may be good for circulation in a similar way, or perhaps something to shake one out of a postmodern proclivity to think always in terms of the local – from another perspective, Wolfram's big idea is a kind of computational animism:

> So while science has often made it seem that we as humans are somehow insignificant compared to the universe, the Principle of Computational Equivalence now shows that in a certain sense we are at the same level as it is. For the principle implies that what goes on inside us can ultimately achieve just the same level of computational sophistication as our whole universe.[31]

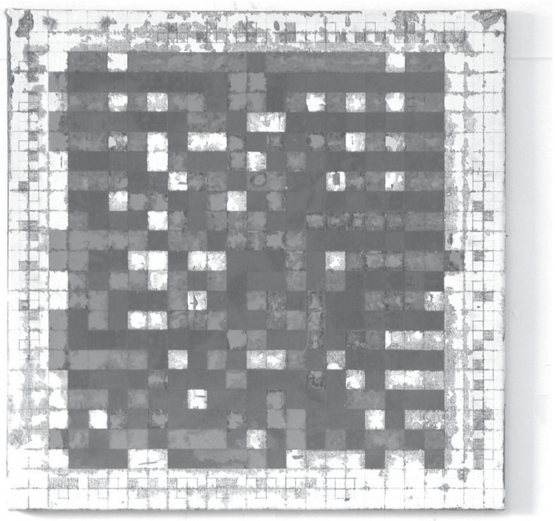
CONCLUSION: (YOU ARE) THE UNIVERSE OR PAINTING AND REVERSE ENGINEERING

> Now the physicist himself, who describes all this, is, in his own account, himself constructed of it. He is, in short, made up of a conglomeration of the very particulars he describes, no more, no more, no less, bound together and by obeying such general laws as he himself has managed to find and record. [32]
> (Thus writes George Spencer-Brown in his *Laws of Form,* 1969.)

The history of mechanical assemblages, of gears and pulleys harvesting nature's energy to irrigate crops or grind wheat; of fascinatingly curious C17 versions of robots known as automata; of the rather more serious notion of the clockwork universe and attempts to understand nature through deterministic mathematical models – are all candidates for precursing the theme of a computational universe discussed (among others) by Ulam, Fredkin and Wolfram. It's also an idea that Douglas Adams' *The Hitchhiker's Guide to the Galaxy* spoofs when it is revealed to the reader that the earth is actually a giant computer charged with the responsibility of finding the answer to life, the universe and everything. Discussing the idea of a cosmic computer, Brian Hayes wonders forward to the outcome of this work:

> All those events that seem so random and pointless will be explained when the cosmic computer prints out the final answer. (Either that, or the computer crashed ages ago, and we've been waiting all this time for someone to reboot us.)[33]

Until we know for sure, Wolfram might well argue, we have cellular automata (he is sincere when he remarks that our whole universe may be governed by a single underlying simple program).[34]



Automata Painting No 1, 2004, acrylic on linen, 50 x 50 cm

To conclude, the technical term 'reverse engineering,' is a method of recreating system components in software where the source code, or 'behind the scenes' instructions for that software, are absent, out of date, or not commensurate with those components. The tools used in this context are known as disassemblers and decompilers. Machinic practice in painting is the running of a machine in reverse. Its techniques are those of disassembly and decompiling of unconscious and materialogical characteristics attracted by patterning and the sum of painting's 'givens' (a sum that grows) – in the midst of all this, painting's component parts engage in acts of autopoiesis and the sensuous human activity of painting.

1 Allan Smith, " Informational Space", *Like Art Magazine*, No. 11, Autumn 2000.
2 Anne Rorimer, "Robert Ryman", http://www.diacenter.org/exhibs_b/ryman/essay.html
3 Yve-Alain-Bois, "Ryman's Tact ", in *Painting as Model* (Cambridge, Mass: MIT press, 1990), 224.
4 Paul Rodgers, "Towards a Practice of Painting in France", *Artforum*, April 1979, 54.
5 Serge Guilbaut, and Benjamin H. D. Buchloh in *Reconstructing Modernism: Art in New York, Paris, and Montreal, 1945-1964* (Cambridge, Mass: MIT Press, 1990).
6 Katherine Kuh, *The Artist's Voice: Talks with Seventeen Artists* (New York: Harper and Row, 1962) 90.
7 Paul Rodgers, "Towards a Practice of Painting in France", *Artforum*, April 1979, 61.
8 Definition of a finite state machine: "An abstract machine consisting of a set of states (including the initial state), a set of input events, a set of output events, and a state transition function. The function takes the current state and an input event and returns the new set of output events and the next state. Some states may be designated as 'terminal states'. The state machine can also be viewed as a function which maps an ordered sequence of input events into a corresponding sequence of (sets of) output events." http://wombat.doc.ic.ac.uk/foldoc/foldoc.cgi?Finite+State+Machine
9 N Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*, (Chicago: University of Chicago Press, 1999), 240.
10 Niklas Luhmann, "The Modernity of Science", in "Special Issue on Niklas Luhmann", *New German Critique*, 61, Winter 1994, 28.
11 Jack Cohen, *Figments of Reality: The Evolution of the Curious Mind* (New York: Cambridge University Press, 1997), 64.
12 Michael S Malone, "God, Stephen Wolfram and Everything Else", *Forbes Magazine*, http://wwww.forbes.com/asap/2000/1127.162_print.html

13 Due to copyright restriction, relevant graphical images are unable to be shown, however they can be viewed at the following address: http://mathworld.wolfram.com/Rule90.html

14 Michael S Malone, “God, Stephen Wolfram and Everything Else” http://wwww.forbes.com/asap/2000/1127.162_print.html

15 Stephen Wolfram, *A New Kind of Science* (Champaign, IL, Wolfram Media, 2002), 2.

16 Michael S Malone, “God, Stephen Wolfram and Everything Else”, http://wwww.forbes.com/asap/2000/1127.162_print.html

17 Steven Levy, “The Man Who Cracked the Code to Everything”, *Wired*, http://www.wired.com/wired/archive/10.06/wolfram.html

18 Yve-Alain-Bois, “Ryman’s Tact”, in *Painting as Model* (Cambridge, Mass: MIT, 1990), 224.

19 N Katherine Hayles, *Posthuman,* 8.

20 Andrew Forge, in *Studio International*, 1968, Vol. 176, No. 906, 246.

21 For a discussion on painting in the second person, see: Thierry de Duve, *Look, 100 Years of Contemporary Art* (Ghent-Amsterdam: Ludion, 2001), 119 - 167

22 Richard K. Merritt, “Intentions: Logical and Subversive, The Art of Marcel Duchamp, Concept Visualization, and Immersive Experience”, in “Tout Fait, The Marcel Duchamp Studies Online,” April 2002, http://www.toutfait.com/issues/volume2/issue_5/articles/merritt/merritt1.html

23 Paul Rodgers, “Towards a Practice of Painting in France”, *Artforum*, April 1979, 57.

24 Karl Marx, “Thesis on Feuerbach”, http://www.marxists.org/archive/marx/works/1845/theses/theses.htm

25 Yve-Alain-Bois, “In Search of Motivation”, in *Painting as Model* (Cambridge, Mass: MIT, 1990) 136.

26 Stephen Wolfram, *A New Kind of Science* (Champaign, IL, Wolfram Media, 2002), 844.

27 Steven Levy, “The Man Who Cracked the Code to Everything”, *Wired* http://www.wired.com/wired/archive/10.06/wolfram.html

28 Jean-Francois Lyotard, “Introduction”, in *The Postmodern Condition: A Report on Knowledge* (Manchester, Manchester University Press, 1994), xxiv.

29 Ibid., 16.

30 William Rasch and Eva M. Knodt, “Systems Theory and the Systems of Theory”, in “Special Issue on Niklas Luhmann,” in *New German Critique*, 61, Winter 1994 (New York, Ithaca: Cornell University,), 7.

31 Stephen Wolfram, *A New Kind of Science* (Champaign, IL: Wolfram Media, 2002), 845.

32 George Spencer Brown, quoted in William Rasch and Eva Knodt’s “Systems Theory and the Systems of Theory”, in “Special Issue on Niklas Luhmann”, in *New German Critique*, No 61, Winter 1994 (New York, Ithaca: Cornell University,), 68.

33 Brian Hayes, “Computational Creationism”, *American Scientist*, 87 (5), September-October 1999, 393.

34 Stephen Wolfram, “Quick takes on some ideas and discoveries in a new kind of science” http://www.wolframscience.com/reference/quick_takes.pdf

With thanks to Allan Smith and Wystan Curnow

Simon Ingram is primarily an artist who paints. He exhibits frequently in New Zealand and Australia and writes occasionally. In 2004 he is releasing a publication which documents his work, some of which can also be seen in an upcoming issue of *Landfall*. Ingram is a doctoral candidate at Auckland University’s Elam School of Fine Arts and also teaches in the painting department of Auckland University of Technology.