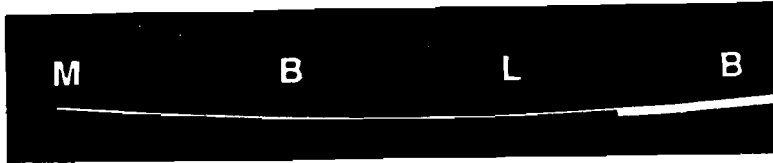


ROMANCING CHAOS



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FIG.1 Fractal landscape of the Magic Dragon.

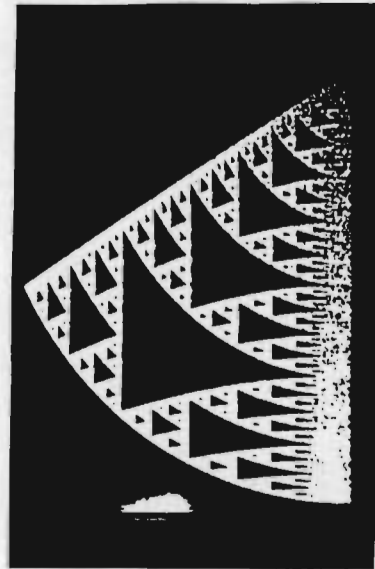


FIG 2. Sierpinski Triangle affine cousin.

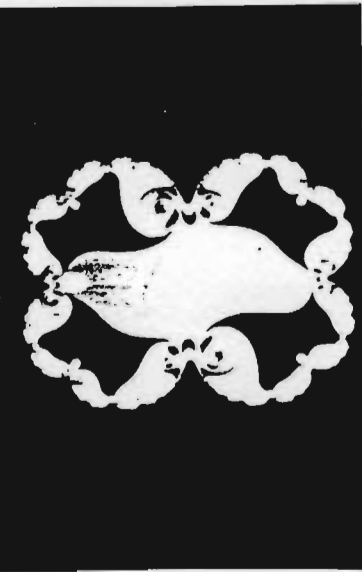


FIG 4. Julia Set Dragon.

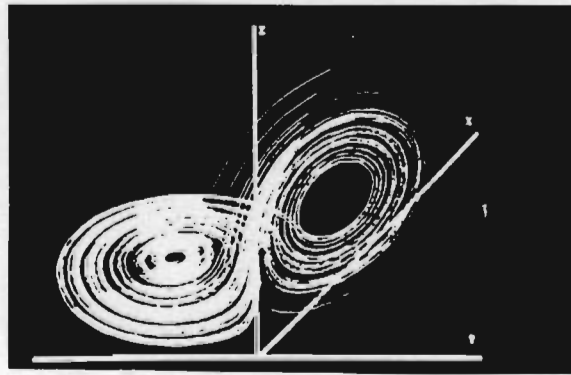


FIG 3. Lorenz Butterfly Attractor. The pathway of Chaos.

FIG 5. Mandelbrot Set Dragon.

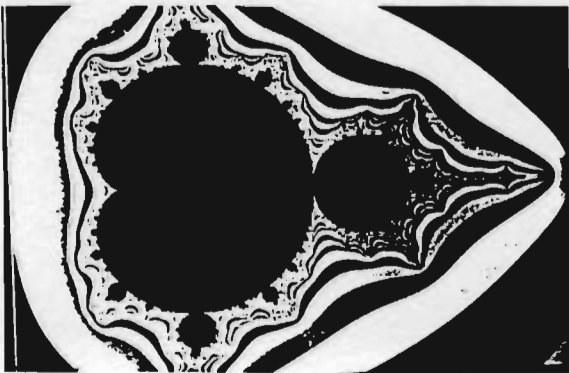
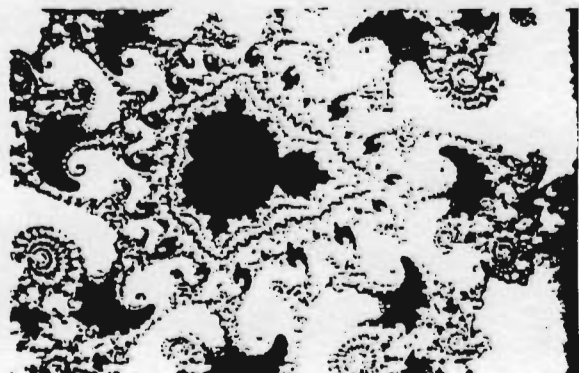


FIG 6. Mandelbrot Set magnified. Illustrating self similar, multiscaling.



PART 1

THE MAGIC DRAGON

Love is a rest I'm told, so sit back and enjoy a 20 minute rest for this really is a picture show.

I took a rest on a commuter train one Monday morning and dreamed a dream and behold I was walking over a lush Sierpinski Carpet, a wilderness stretched out before me. In the wilderness was a great sea set against Mt. Tagaki on one side and the wild Brownian Mountains on the other with Archimedes Saddle between.

And Euclid walked into my dream measuring the wilderness with a straight line as he had done for 2000 years. As he moved close toward the vague attractor of Kalmigorov I saw the straight line in his left hand and in his right a book, - on the book was written the words "Euclidean Geometry" and on his back was a burden, and in his forehead was the number $x^2 + y^2 = 1$.

I looked and lo beyond Archimedes Saddle a camel like dragon doubled then tripled then quadrupled his humps into chaos, and in its forehead was the eigen value 4.669.

A strange Lorenzian butterfly attractor flitted across my vision as a Sierpinski box swooped low over the Cantor trees, fractal ferns and fibernacci trees.

After this, I looked and lo a Julia Dragon sprang from the deep and behold another like unto the first but with red horns. I stood amazed as dragon after varied dragon stormed across my vision.

Then I felt the Sierpinski Carpet tremble under my feet and the waters parted asunder, and out of the bosom of the sea stood erect a Magic Dragon most terrible and dreadful and exceedingly strong. Its great eye like lightning bolts devoured and scattered the Julia dragons and stamped their residue into Fatau Dust with its feet. The dust clouds drifted up into the heavens as Von Koch snowflakes fell gently down upon the wilderness.

So I saw in my dream that the magic dragon began to multi scale itself, and only after 3 times it had grown to the size of 100 football fields, never the same but self similar. And the Magic Dragon was wrath with Euclid and went to make war with the remnant of his seed.

And I saw that just as Euclid rose to challenge the Magic Dragon, his burden loosed from off his shoulders and fell from off his back and tumbled into the mouth of the Magic Dragon and I saw it no more.

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And the Magic Dragon spake of new fractal geometries and sang fractal songs and played chaos games and in its forehead was an algorithm $Z^2 + C$ and as I began to consider the number, a voice thundered me awake "But what use is it?" It wasn't the train conductor commenting on my train ticket, it was a Mechanical Engineer commuter commenting on chaos. "But what use is it?" is a good question and we will consider it soon but first the algorithm.

$$Z^2 + C$$

where Z is a variable number

C is a constant complex number say $(1+i)$

Starting with say $Z = \emptyset$

the answer is reiterated into the equation see fig (8) for example of multiplying complex number where $\sqrt{-1}$ is (i)

The x and y co-ordinates for the Mandelknot Set Matrix fall between the values -2 , $-1.25i$ and $0.5 + 1.25i$

Each co-ordinate is iterated until either it heads to infinity or stabilizes to less than the Matrix values above. The number of iterations taken to reveal that fact are assigned colour values. The resultant Mandelbrot set has Julia sets and Fatou Dust scattered around its fractal borders.

Embedded in the chaos algorithms are the images. So firstly, we will look at chaos in space and lastly chaos in time.

PART TWO

DESIGNER CHAOS

Back in 1976, Robert May echoed the question "But what use ?" with the comment in "Nature" Vol. 261 June 10, that "Although the exquisite fine structure of the chaotic regime is mathematically fascinating, it is irrelevant for most practical purposes. What seems called for is some effective stochastic description of the deterministic dynamics." Indeed what use is it or what use is Designer Chaos? Well Fractal geometry is the geometry of chaos in space. It is expressed in algorithms, not in the primary shapes of euclidean geometry of lines and circles, all we have to do is extract the image hidden from view in the algorithm. Computers enable the translation of these sets of mathematical procedures into geometric forms in space. Which forms can currently be analysed structurally by Finite Element and Slippery Pole software techniques - and constructed and used as habitable structures. In order to achieve that, let's look at the Designer Chaos of Castle Towers fabric structures. See illustrations (9-13, 16, 17).

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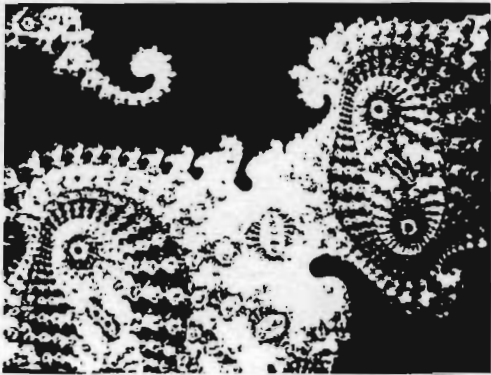


FIG 7. Mandelbrot Set magnified showing multiscaling, self similarity.

FIG 8. Iterative Algorithm.

$$Z^2 + C$$

Z IS A VARIABLE NUMBER
C IS A CONSTANT COMPLEX NUMBER

$$0^2 + 1 + i = 1 + i$$

$$(1 + i)^2 + 1 + i = 1 + 3i$$

$$(1 + 3i)^2 + 1 + i = -7 + 7i$$

$$(-7 + 7i)^2 + 1 + i = 1 - 97i$$

Example calcs.

$$\frac{1+3i}{3i+9i}$$

$$\frac{1+3i}{1+6i-9}$$

$$\frac{1+3i}{-8+6i}$$

$$\frac{1+i}{-7-7i}$$

Mandelbrot Set Matrix coordinates.

-2, -1.25i and 0.5 + 1.25i

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FIG 10. Interior & Castle Towers N.W.

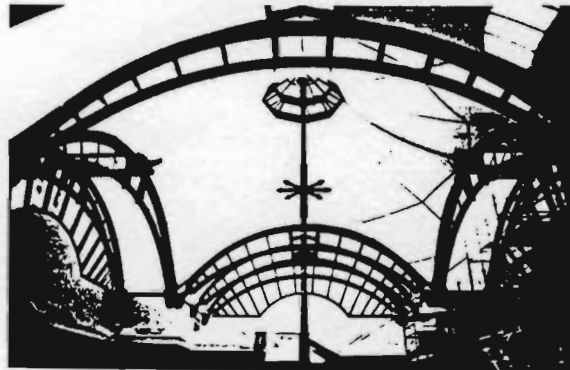
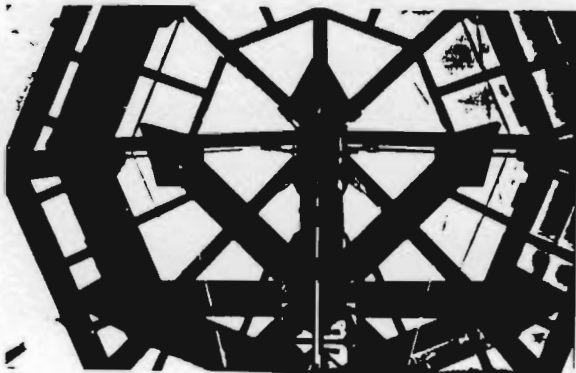


FIG 9. Castle Towers N.W. Mall Interior. Fractal cobweb fabric cut.

FIG 12. Castle Towers L shaped Mall self similar to N.W. Mall.

FIG 11 Mall fractal truss, Mast, skylight.



The design parameters read like a mine field. Firstly or lastly, the Hydraulics Engineer is convinced you are wet behind the ears, which suits the Electrical Engineer who uses your brain as a conductor while the Fabric Engineer tears the fork out of your design and leaves you up a slippery pole with a Computer Engineer. The Fabric Manufacturer woofs you into a corner where the Job Foreman swears and the Project Manager sacks you. The Structural Engineer gives you the indulgent smile reserved for infants while you get six-packed by the Council Building Surveyors and hauled over hot coals by the Fire Control Engineers.

Meanwhile, the Steel Fabricators weld you up in King Arthur's Armour when what you drew up was a tie pin. The Mechanical Engineers let off a lot of hot air over the Sun Diagrams whose butterfly effect threatens the Dewpoint calcs. All the while the leasees want more front than Myers and the Bean Counters (read owners, financiers, accountants) keep you guessing how many beans really are in their bag. You sigh at the onset of chaos (period doubling of the Schematic Estimate) by the Quantity Surveyor, meanwhile the Real Surveyor plots the relative levels on every grid except the grid you need urgently. Of course, the Erector's crane and not the dogman install the trusses and gantries back to front and the cleaners complain of the vertigo inducing spaces.

The Insurers laugh all the way to the bank while the fractal noise of the structural event is music to the Acoustic Engineers ears. So you see Designer Chaos is really doing what comes naturally - like cleaning behind your ears.

There is a little bit left for the Designer such as self similarity, multi scaling (see Figs. 13, 14), and the subjective feeling of how densely a fractal occupies space, i.e. its fractal dimension and Slartibartfasts 'kinkly bits' around the edges of fiords, like a bit of lace in the right place, and the small matter of Form follows Function. But, of course it doesn't - even though preached by Euclid's disciples. Form follows chaos which we now focus on.

PART THREE

CHAOS RODEO

Ideas that challenge our personal belief structure of the world are viewed as threatening intruders to be repulsed with evangelical zeal by physical, mental and spiritual coercion.

"For never looms a story of more woe than the clash of Chaos Science with the Status Quo" (with apologies to Juliet and Romeo).

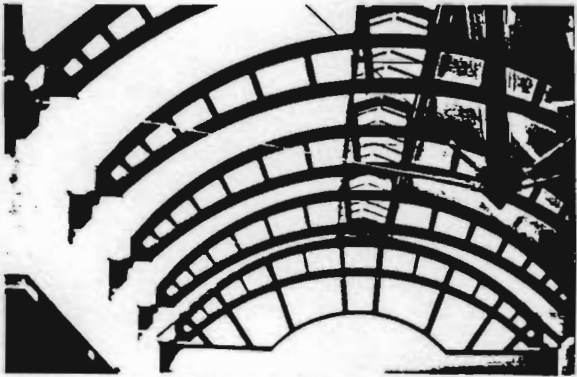


FIG 13. Castle Towers L shaped Mall
Compare proportional strut spacing
with fig 14.

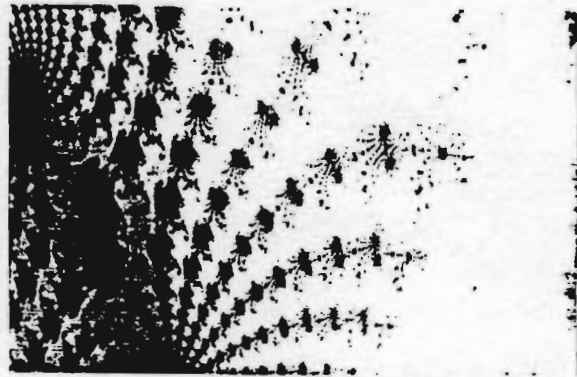


FIG 14. Mandelbrot Set magnification
illustrating self similarity, multiscaling.



FIG 15. Milton Keynes Exterior England.
Shopping Centre. Linear forms.



FIG 16. Castle Towers Exterior Sydney.
Shopping Centre non-linear forms.
compare with fig 15.

FIG 17. Castle Towers Interior.
W. Mall non-linear.
Compare with fig 18.



FIG 18. Milton Keynes Interior. England
Shopping Centre, linear interior identical
throughout centre.



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Grecian architecture has kept Designers on the straight and narrow for 2000 years. Western Architecture is today menopausal, it is deplete of physical, mental and creative powers - it desperately needs the natural hormonal therapy of fractal geometry to enrich it where Form follows Chaos as illustrated in the contrasting Figs. (15, 16 & 17, 18).

Imprisoned designers are still belting out form follows function while the tools of chaos lie idle. Fractal geometry awaits the hand, mind and heart of the free and the brave - the Gaudies, the Goughs. Open ended Fractal Architecture is setting in motion dynamic attractors for people of today in space and time.

Chaos in time - if fractal geometry is nature in space then Fractal Noise, is nature's musical time machine and its fractal attractors their pathway. Fractal noise is the unpredictable change of a quantity varying over time, e.g. in Fig. (19), the top phrase of music is 'white' noise - totally random - the middle phase $1/f$ noise is closest to actual music (and most pleasing) and the bottom phase is 'brown' noise - too correlated.

If you have an innate sense of timing, chaos may come easy to you. If fractal geometry is a forgery of nature in space then fractal music is an imitation of the characteristic way our world changes over time. The smallest fractal music phase reflects the whole - there is something interesting on all time scales, it is infinite - even as Bach attempted with music scores played forward, backward, inverted and with continuous phases reflecting the whole piece.

Even so, man made structures are quantities randomly changing over time - singing at the top of their voices but we are not listening to their fractal melodies. Speech too is fractal.

Now we have briefly canvassed chaos in space, chaos in time, but what of chaos in both space and time?

The philosophy of Reductionism espoused by Euclidean and Newtonian scientists and engineers led us into believing that if you could find the ultimate building blocks of the universe and their ultimate rules, then you could predict eternity. Such hopes could only end in frustration because life is greater than the sum of its parts, the material universe is greater than the sum of its parts. Consciousness is greater than the sum of its parts and we are all now experiencing that the whole of the Federal Budget is a greater depressant than the bean counting sums of its State parts. So too is a hologram greater than the sum of its parts in space and time.

Many people have attempted to create computer holograms using linear equations unsuccessfully and you may be disappointed I cannot give you the iterative algorithm for a holographic interference pattern so you can run away and play with it.

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White Noise,

1/f Noise,

Brown Noise.

FIG 19. Fractal Music.



FIG 20. Ray Martin in a holographic forest

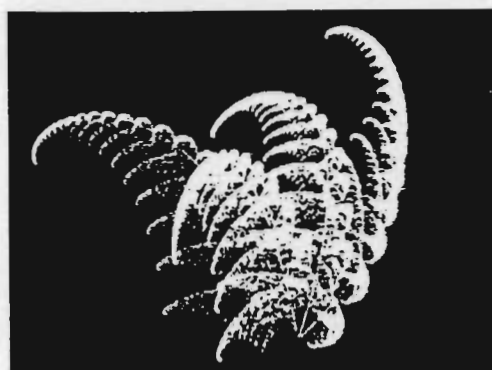


FIG 21. Computer fractal forgery of ferns

But if one of you were to ferret out the algorithm in which it is buried, the media would beat a euclidean line to your door. Best of luck. You will need it to trace a laser cosine² wave in a chaotic interference mode. In addition, there are 2 million addressable points for a Ruby Laser in one square millimetre. Therefore, it would require 100 computer screens of 2 million pixels each, to capture a hologram 10 millimetres square. Further, each one of the 100 screens would display (as is the nature of holograms), the whole image as viewed from each particular location. Remember however that just a 3 times magnification of the Mandelbrot set can be 100 football fields in scale, therein is the simple key to multi scaling holography - well within the ability of today's hardware and technology.

How would you like to play a fractal melody on a keyboard which clones fabric structures before your eyes in holographic 3 dimensions - even to have spoken a fractal word and a fabric structure was! Who is going to be first? Slartebastfast or you?

What are we going to do when a client comes with a design brief which is a single line of complex numbers? What we may need to copyright in the future is a fractal melody, a 1/f noise, an algorithm wherein is embedded a hologram of our membrane structure creation.

If in this paper, I have prostituted precise scientific usage of mathematical terms - this is after all an 'out of whack' Romance with Chaos. I make no apology except perhaps to Francis Thompson "if this be error and upon me proved. I never writ nor no man ever loved."

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Slides

a. The Computer Division of MBLB provided access for the fractal geometry slides on a silicon Graphics - Unix system

b. Castle Towers slides were contributed by Sydney student, Pia Katsoolis.

c. John Marshall of the Computer Section of Queensland University of Technology assisted with the computer fractal forgery slides.

d. Holographic slides taken from a Ray Martin interview on the 'Today Show' with Paula Dawson.

e. Total list of colour slides scheduled for presentation No. 82, No. 21 illustrated in paper.

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