Towards a Poetics of Knowledge

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Abstract
Through electronic imagery, we seem to have been given direct access to scientific research, in a form often set adrift from the usual accompanying texts and explanatory materials. When our perception of scientific ideas is mediated in this way, it can lead to conflicts of context, with bizarre results. The introduction of this material into culture presents us with various challenges. Can we construct cultural readings of scientifically derived imagery that are more than just an enigmatic confrontation with seductive visuals? Can we propose an aesthetic or cultural practice that articulates and is informed by scientific knowledge but can function in a wider cultural context? Such a practice, if it existed, we might call a *poetics of knowledge.*

The most beautiful thing in the universe is the mysterious. It is the source of all true art and science.
Albert Einstein [1]

Science is the only genuine consciousness-enhancing drug.
Arthur C. Clarke [2]

I like Chaos because it validates all the things I saw when I took a lot of acid.
Howie Cook, artist [3]

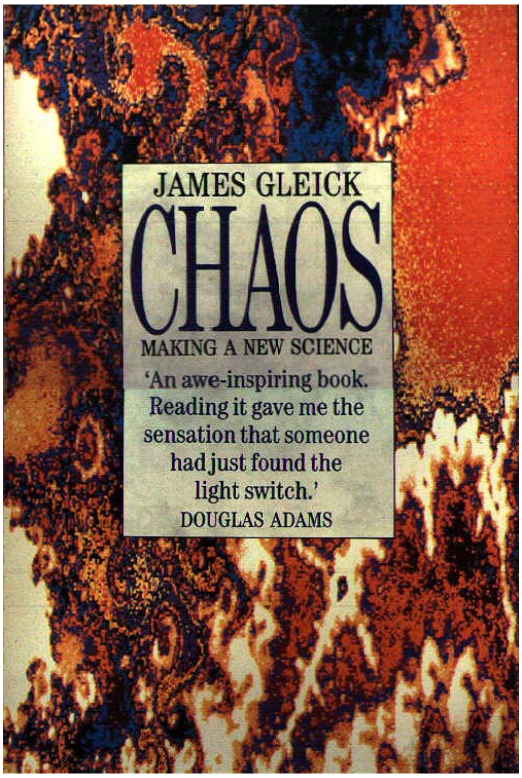

Fig 1. Front cover of James Gleick's 'Chaos' [13].

I hope you won't think it unfair of me to bring all the above quotations together to try to imply a connection between them. Although strictly speaking the authors of the above remarks were referring to different things, the quotations are still very typical of the kind of thing that is frequently reproduced in popular magazines, symposia publicity, and even academic journals. When taken together, they describe quite accurately a new mythology of science that links a transcendent idea of knowledge, the power of the imagination (drug-induced or otherwise), and the mystification of artistic creativity. This mythology has been enabled by recent advances in scientific visualization, which has allowed us to produce new cultural artefacts through the mechanisms of media technology. A recent example of this mythology's effects was the phenomenon known as "chaos culture" (Fig. 1). By around 1987, a number of cultural activities had taken shape around a popularized scientific concept called chaos theory or chaology, ranging from art shows and coffee table books to acid-house videos, T-shirts, and comic books. By about 1990 it had already been superseded by new manifestations of techno-culture, but while it lasted it provided an example of a moment in which a new scientific story found a cultural function due in large part to its easy appropriation by media technology.

Through electronic imagery, we seem to have been given direct access to scientific research, in a form often set adrift from the usual accompanying texts and explanatory materials. When our perception of scientific ideas is mediated in this way, it can lead to conflicts of context, with bizarre results. The introduction of this material into culture presents us with various challenges. Can we construct cultural readings of scientifically derived imagery that are more than just an enigmatic confrontation with seductive visuals? Can we propose an aesthetic or cultural practice

Fig. 2. Left, fractal ‘cloud’ generated from fourier synthesis. Right, cumulus cloud photo.

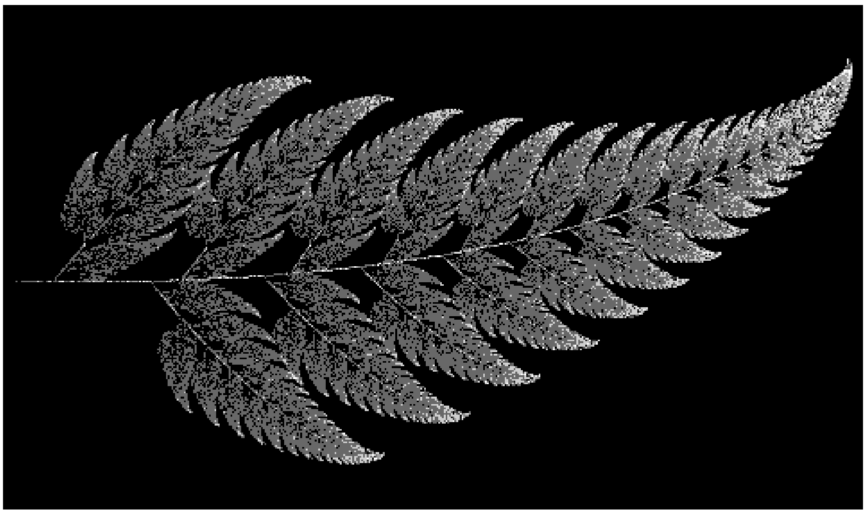

Fig 3. ‘Black Spleenwort Fern’. Generated from fractal iterative functions: Michael Barnsley [8].

that articulates and is informed by scientific knowledge but can function in a wider cultural context? Such a practice, if it existed, we might call a *poetics of knowledge*.

The rise of computer graphics has resulted in the application of many scientific models to image-making. When we now see a computer image, we know that its purpose may be to show the development of new mathematical systems or algorithms to model physical phenomena rather than as merely a demonstration of visual mimicry for its own sake. For this reason we often hear scientists justify their images by appealing to the accuracy of the mathematics behind them as much as to their visual appearance. Alternatively, they may try to find images of natural phenomena that match their computer-generated results (Figs. 2 and 3). At some presentations, for example, a scientist will present a picture of a synthetic cloud and then show a photograph of an unfamiliar view of the sky as if to prove that "real" clouds look even more unlikely than computer-generated ones.

The media theorist Vileem Flusser believed that science and mathematics had advanced to the degree where mere words would no longer adequately convey their concepts. He stated that pictures were now the only way to communicate sophisticated ideas like fractals - these pictures he referred to as "pictures of thinking" rather than "pictures of the world" [4]. Flusser also believed that the best way to regard an image like a fractal image was not as a likeness of the world but as the likeness of an equation. Otherwise, to say that a fractal mountainscape looked like a mountain because of some internal fractal structure of nature would be to credit fractals with an explanatory power they did not possess. Fractals might only coincidentally mimic the appearance of natural phenomena.

Certainly, some thinkers have tried to argue that fractals are structurally related to the visual world, if not the physical world. In a paper by two educators, John Geake and Jim Porter, primary school children were exposed to a set of fractal images to examine the effect such images would have on them [5]. Examples of the children's paintings in an art class were used to show that their work became looser, less structured, and more "natural" after the children were shown images of the Mandelbrot set, the most well-known example of a fractal [6]. It was suggested in the conclusion of the paper that the children could have "unconsciously" recognized aspects of "natural structures" in fractals, making them more sensitive to natural form [7].It is difficult to see what this kind of study is trying to prove, as the most we could expect it to tell us is that fractal imagery appears more irregular than the simple forms children habitually draw. It probably tells us more about our own preconceptions of what "natural form" is supposed to look like than about children's art. It certainly does not mean that looking at fractals can become a short-cut to sharpening your perceptual sensitivity to nature (although it might sharpen your sensitivity to fractals). There are many other ways of seeing nature, from the perspective grids of early Renaissance painting to the classical Arcadias of 17th century landscape. Fractals are a recent addition to this group, but we would not wish to claim a privileged status for them any more than for the other modes of seeing.

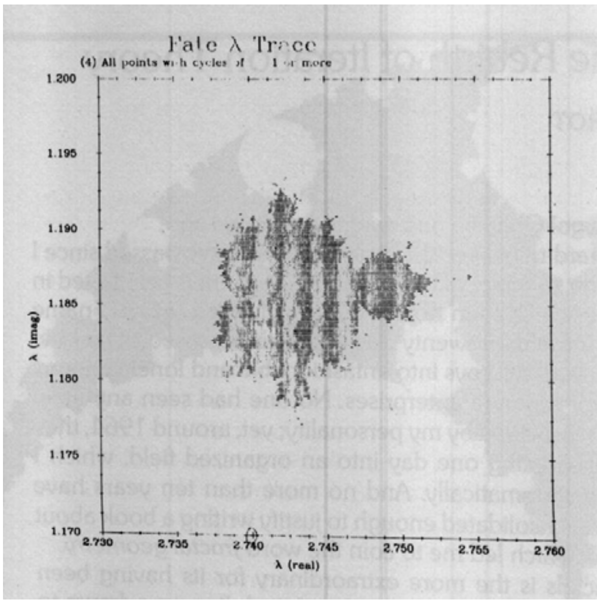

Fig. 4. First image of the Mandelbrot Set, from [10].

The most popular images of fractals look nothing like any recognizable object, natural or otherwise, and it is this otherworldly quality that gives them so much of their appeal (Fig. 4). That is not to say, however, that an intense study of fractals will not change the way you see the objects around you, but it may not be purely because of what they look like. In his book *Fractals Everywhere*, Michael Barnsley describes how his research into fractal image generation has changed his perception of nature until he cannot help but see clouds, rivers, and trees in terms of iterative systems (Fig. 5) [8]. This kind of experience that of tuning your perception to a certain way of thinking until you achieve a kind of algorithmic vision is not difficult to appreciate and provides a good example of how Flusser's "pictures of thinking" can become a means of thinking and perceiving in itself. In this case, we see that it is not the appearance of fractals that is exclusively important; rather, their expression of a theoretical model of nature is what lodges in our mind and influences our vision.

To return to the problem that Flusser sets us of trying to uncover something like the meaning of a fractal equation, we find that any study of fractals must expand to include other epistemological and cultural issues. The appeal of fractals has less to do with single-minded dedication to the equations of pure mathematics than with the grand scientific aim of mastering our natural environment through the exercise of causally controlled instrumentation. Therefore we need to extend Flusser's strategy to ask not just about the algorithm itself but about the purposes behind the wider scientific program. And in the case of electronic imagery like fractals, we are compelled to include cultural influences such as those that appeared in the public debate over the meaning of chaos theory in the late 1980s, linking it with arguments ranging from free will to fascism. Through electronic imagery, scientific graphics became recontextualized and injected directly into the cultural sphere through the media network. When people relied upon these pictures to "show" what the science of chaos meant, the results were very unscientific.

The most successful attempt by scientists working with fractals and chaos theory to give their work wide appeal was the series of exhibitions and books produced in the mid-1980s by a group of German mathematicians, principally Heinz-Otto Peitgen and Peter Richter. Their exhibition "Frontiers of Chaos" [9] and book The Beauty of Fractals [10] were daring ventures by scientists to juggle the immediate seductiveness of fractal imagery with their importance as scientific artifacts. Indeed, in their book they state that at first they thought that
the attractiveness of their pictures would be enough to satisfy their audience without the need for any further explanation. There have been other groups of scientists (and sometimes artists as

well) who have sought to present work derived from scientific visualization experiments in a cultural context, mostly by restricting the images to an aesthetic appreciation until they become a kind of mathematical ornament. It sometimes seems as though a scientific graphic can acquire a cultural status simply by cutting off its scientific function. Typical is the group called (art)$_n$ based at the Illinois Institute of Technology, who state in their copious publicity that their aim is to "communicate their love of the often complex mathematical beauty of nature" [11]. This tendency to conflate notions of mathematics, beauty, and nature results in a conflict of context in which the work seems to be trying to say that science can prove that nature is beautiful.

Several scientists testify to the importance of imagery in publicizing their work in fractals and chaos theory. Benoit Mandelbrot himself explains that his work was based on the First World War research of mathematicians Gaston Julia and Pierre Fatou (of which Julia was fortunately also his tutor), but that their work was ignored until he found a way to display it graphically and make it understandable [12]. What Mandelbrot does not emphasize, however, is that the acceptance of fractal geometry also depended on things like its relevance to chaos theory, which lent it an explanatory role and thus drew attention to it throughout the 1970s. So on the one hand fractals had to wait until they were linked with some wider body of knowledge, but on the other the use of imagery was also very influential. If we consider the pioneering work of Edward Lorenz on chaotic systems in the early 1960s, we realize that even his very practical research into fluid dynamics had to wait many years before its full implications were appreciated [13]. How would the situation have been changed if Lorenz had had access to the latest computer imaging technology? How would his work have been received if he had been able to make colorful pictures of strange attractors in time for the hippie revolution?

It seems clear, then, that for scientific concepts to become mobilized they must typically be aided by both the diffusion of image-making technology and their wider resonances in everyday life. For chaos theory, its cultural impact came primarily through its ability to unify notions of determinism and freedom in one scientific mythology. And, crucially, these features could be expressed through imagery. It is this status as objects of knowledge that gives chaos-derived images their full cultural meaning and which gave rise to chaos culture. Unless Fatou and Julia's work had found this wider application and relevance, fractals would have remained just an aesthetic curiosity.

In her book *Simians, Cyborgs and Women*, Donna Haraway constructs an argument in favour of cultural theorists becoming scientifically literate to the extent that they can challenge scientific research on the basis of its scientific credibility as well as its political or social implications [14]. Her aim is to reconcile scientific practice as a political and social activity without sacrificing scientific values. In her research into primatology Haraway gives many examples of how the study of apes and monkeys as models of human nature has been improved through the influence of the feminist movement in conjunction with changes in laboratory practice, "It is now no longer acceptably scientific to argue about animal models for a human way of life without considering female and infant activity as well" [15]. The question she poses is this - "...feminism, like science, is a myth, a contest for public knowledge. Can feminists and scientists contest together for stories about primates, without reducing both political and scientific meanings to babble?" [16]. Her answer is best expressed in the concept of "situated knowledges" [17], that is, when a theory's political and social framework are clearly apparent so that its historical background and current applicability can be critiqued. Using this method of actively engaging scientific discourse we can adopt a position which is not just attacking the social results of scientific practice from the outside, but where we are all much more involved in constructing a scientific objectivity from a standpoint of knowledge and mutual respect. As a trained biologist, Haraway again and again stresses the importance of science as a potentially liberatory human activity - scientific stories can be weapons for social transformation and scientific stories can also be fun.

But as we try to get together with our new scientific partners to create stories for the way we wish to live today, on what level is this dialogue to take place? What is not covered in Haraway's work is the impact of media technology in channelling scientific artefacts directly to the public in the form of electronic imagery. When graphics are used to publicise research in this way, how does this complicate the process of telling and critiquing scientific stories? The perception by the scientific community of their role in these cultural activities also determines the outcome of these opportunities. If we compare what is happening now to cases in the history of modern science when new research has informed cultural debate we can get a better idea of what the culturally active aspects of scientific work are and how the mechanism of their agency has changed.

For example, in the sixteenth century the pioneer anatomist Vesalius had to enlist the help of the painter Titian in order to accurately depict the structure of the bodies he was dissecting. The drawings that resulted not only proved invaluable reference material for surgeons but also gave the world a new image of the human body as a structure of mechanical parts performing technical functions like clockwork. Similarly at the turn of the century Edward Muybridge devised a technical system of photography to produce sequences of images showing animals and humans in states of motion. These images became a focus for the notion of the human body as a dynamic system rather than a static structure, a constantly changing biological process that had much in common with the functioning of other animals.

Fig 5. Flocking scene from: Craig Reynolds, "Flocks, Herds and Schools. A Distributed Behavioural Model" [18].

Fig. 6 “Stanley and Stella”, Symbolics Corp, 1987.

Today there are many new ways for modelling human and natural systems that are often visualised used electronic imaging techniques. But scientists often seem to have problems finding a contemporary cultural form for these new scientific concepts. One recent example was the application of artificial intelligence techniques to the animation of animals that move in large groups like flocks of birds and schools of fish. In 1987 Craig Reynolds of the Symbolics company wrote a system for modelling this behaviour and in his research paper presentation included animation of simple objects like triangles that appeared to swoop and congregate just like birds (Fig. 5) [18]. By treating animals as information processing systems Reynolds was able to show how a few simple rules of interaction could give rise to a wide range of apparent behaviour and questioned our definition of intelligence as a complex phenomena and how it can be reproduced and evaluated. However, the most common form in which Reynolds work is now seen is a promotional video produced by Symbolics called *Stanley and Stella* about a cartoon fish and a bird that fall in love, completely obscuring the wide ranging issues raised by his research animation (Fig. 6).

Sometimes it seems as though scientists do not have the confidence that artists do in order to express their concerns lucidly without subordination to very genre orientated cultural forms. So when a computer graphics research team come to apply the results of their work to some tangible cultural product the most obvious and inappropriate forms are chosen, almost having the effect of emphasising the distance that exists in our society between different areas of human creativity instead of building a dialogue between them. Sometimes we need more technology and less art. Sometimes the use of a ready made artistic genre can stifle the non-artistic references that can cross epistemological disciplines and instead results in a closing down of meaning. Instead, the promiscuity of media might open up channels so that ideas mingle freely like a poetry of knowledge and release their potential to restructure our perception of the world. What is at stake here is the development of the skill of reading scientific imagery that can do full justice to their textual richness.

Peitgen and Richter's book stresses that the phenomenological study of iterated functions can provide the student with an intuitive grasp of their unexpected dynamical properties, in short that mathematical graphics engender a different understanding than that suggested by scientific notation alone. We are talking here about images stimulating a shift in perception, like the jarring effect of an epistemological montage technique operating through visual dynamics. They become a focus for conceptualisation, as a medium for thinking. Their visual enjoyment becomes a strange attractor that perturbs the symbolic order of the aesthetic plane. The scientific image can 'objectify' knowledge into visible form, but at the same time 'situating' it through the forms of subjectivity necessary for its reading.

References and Notes

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Illustrations

1. "Global Chaos". Hex, poster, 1993 (courtesy of Robert Pepperell).
2. Fractal Cloud and Cloud photograph
3. Black Spleenwort fern.
4. Mandelbrot set.
5. Craig Reynolds Flocking
6. Stanley and Stella