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Regular Paper

Hidden Patterns

Creating Radial Spreads of Ink in Water

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Abstract : Inks of different types are used together to create a radial spread. Then, having been the cause of the spread, the ink also provides the means of visualizing it. Photographic sequences show the progress of the patterns of the spread as they develop. Images are taken from significant points within the sequences, and, bearing in mind aesthetic considerations, are displayed alone or as part of a group.

Keywords : Art, Radial spread, Ink, Water.

1. Background to Work

I have been working in the area of artistic flow visualization for some time, visualizing turbulence and vortices with ink and taking photographic sequences. Then last year came the idea of building up pictures in water by using different inks in small quantities, and watching the patterns modify (examples at www.chronoscapes.co.uk). It was from this work that the investigation described below developed: unseen by the naked eye, the camera was capturing intriguing small-scale patterns at a point where ink made a sudden spread outward across the water.

To investigate this further I developed, by a process of trial and error, a way of producing the patterns reliably. At that stage I also did some research to find out what caused these 'inksplosions'. Below is a description of the method and some explanations based on the research, followed by a detailed description of some of the patterns.

Finally I include some artistic interpretations of this phenomenon.

2. Method and Explanation

The process makes use of the differing surface tensions of different types of ink. Water, mixed with a small amount of acrylic ink is placed in a bowl, and gold paint with a base of xylol and oil is added with a dropper where it takes up a flat, circular shape on the surface. Its size will vary according to how much it spreads out at this stage: the range is about 1 cm-3 cm in diameter. Then acrylic water-based inks (high surface tension) are added on top of the gold with a dropper, forming domes less than 1cm across. In sufficient quantity the acrylic ink can become too heavy to hold its dome shape, and, after several seconds, gravity overrides high surface tension, causing the 'piled up' ink to drop downwards slightly and burst outwards at a high speed and moving in specific patterns emanating from the stagnation point.

The radial spread happens too fast for the human eye to watch its progress in detail. A tripod-mounted digital camera is placed above the bowl and photographic sequences, with exposures of one per second or more, capture the patterns and their evolution. From the sequences I choose the images of most significance to the development of the pattern; these are then cropped to magnify the main point of interest.

Then, always treating the image as a whole, I heighten colour and contrast to show the patterns to their best effect. Some images are assembled for aesthetic effect (see last section).

3. Patterns

The patterns, whose form to some extent depends on the surrounding gold wall of ink, may originate from a dipole vortex (Fig. 1), and have distinguishing features of axisymmetry and bifurcation (Figs. 1-3). When the ink is moving more slowly after the initial burst, there is more time for the pattern to develop, and ink can both retract from the water or join up with itself; either way forming a network, which continues to become more complex until the ink mixes with the surrounding liquid and the pattern becomes dendritic and falls downward.

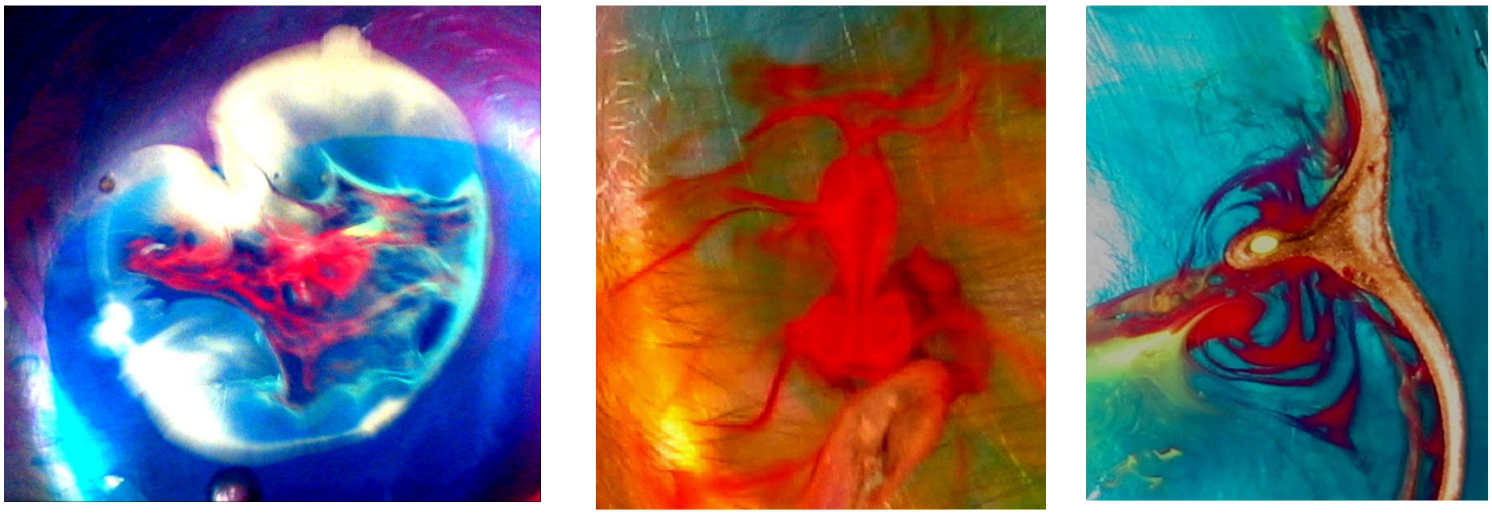


Fig. 1. Beginnings of radial spread. Above left: an example of the initial spread. Ink moves outward at high speed, as indicated by the blurred image. Above middle: a dipole vortex with radial jets. Above right: detail of a spread taken with flash, showing a ‘cage’ forming round the oval stagnation point.

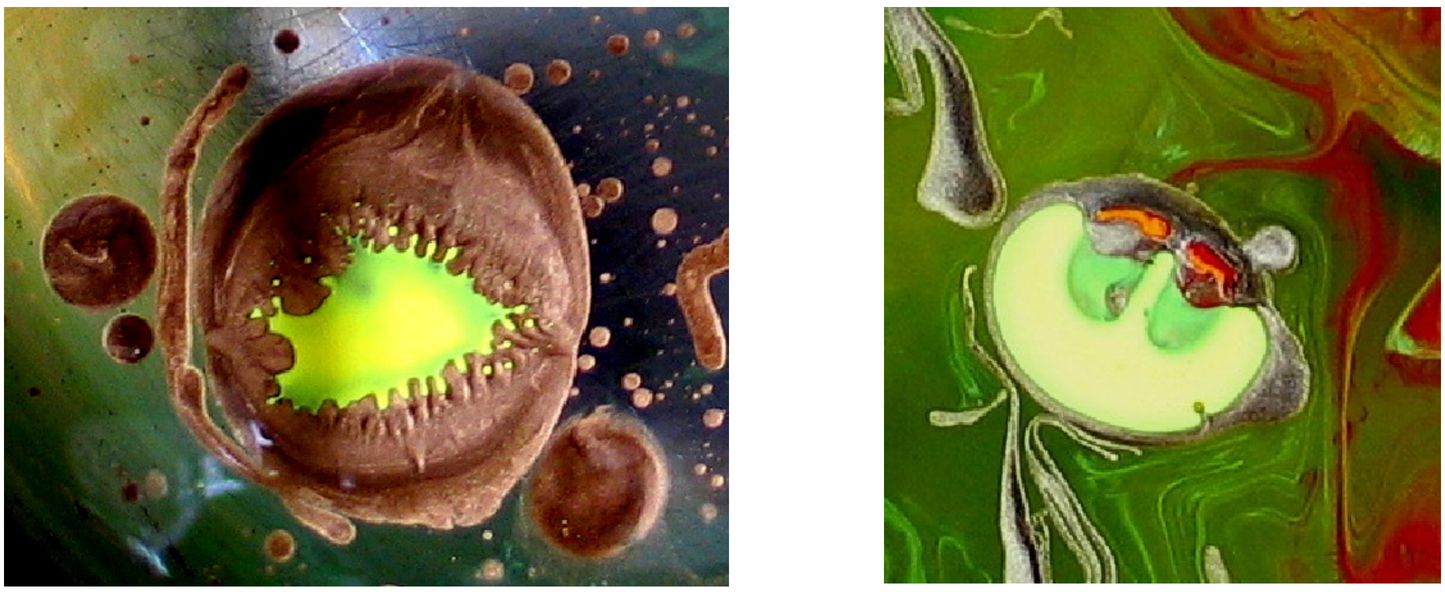


Fig. 2. Two separate examples showing symmetrical patterning from the outset.

4. The Evolution of Patterns after the Initial Burst

The original spread is often a thin film of ink which retracts (Fig. 3) and develops into complex three-dimensional networks. However, sometimes these networks can be evident from the start (Fig. 4, left). Sometimes we see the ink pushing outward rather than retracting (e.g. Fig. 5, left). The way these networks form will depend partly upon what the ink is made of, measured by its Schmidt number, and consequently the way it reacts with water (Prof. H. Stapountzis, verbal communication, 2006).

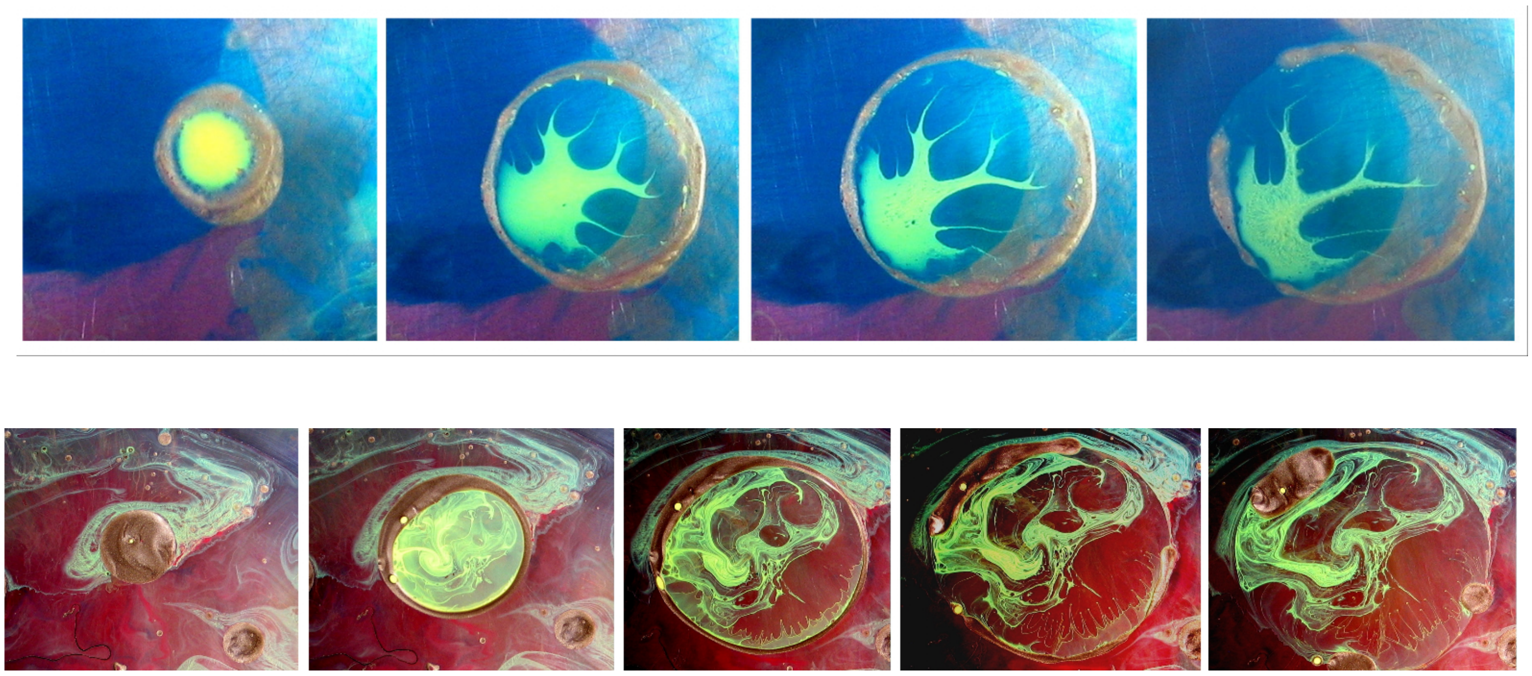


Fig. 3. Two sequences. Top row: evolution of a symmetrical bifurcatory pattern, showing self-similarity. Bottom row: yellow ink, at first submerged, floods out towards the gold wall edges, taking up the dipole vortex pattern (2^{nd} frame), then it retracts, probably because of its surface tension, leaving clear areas (3^{rd} frame). Intervals between each frame range from 4 to 7 seconds.

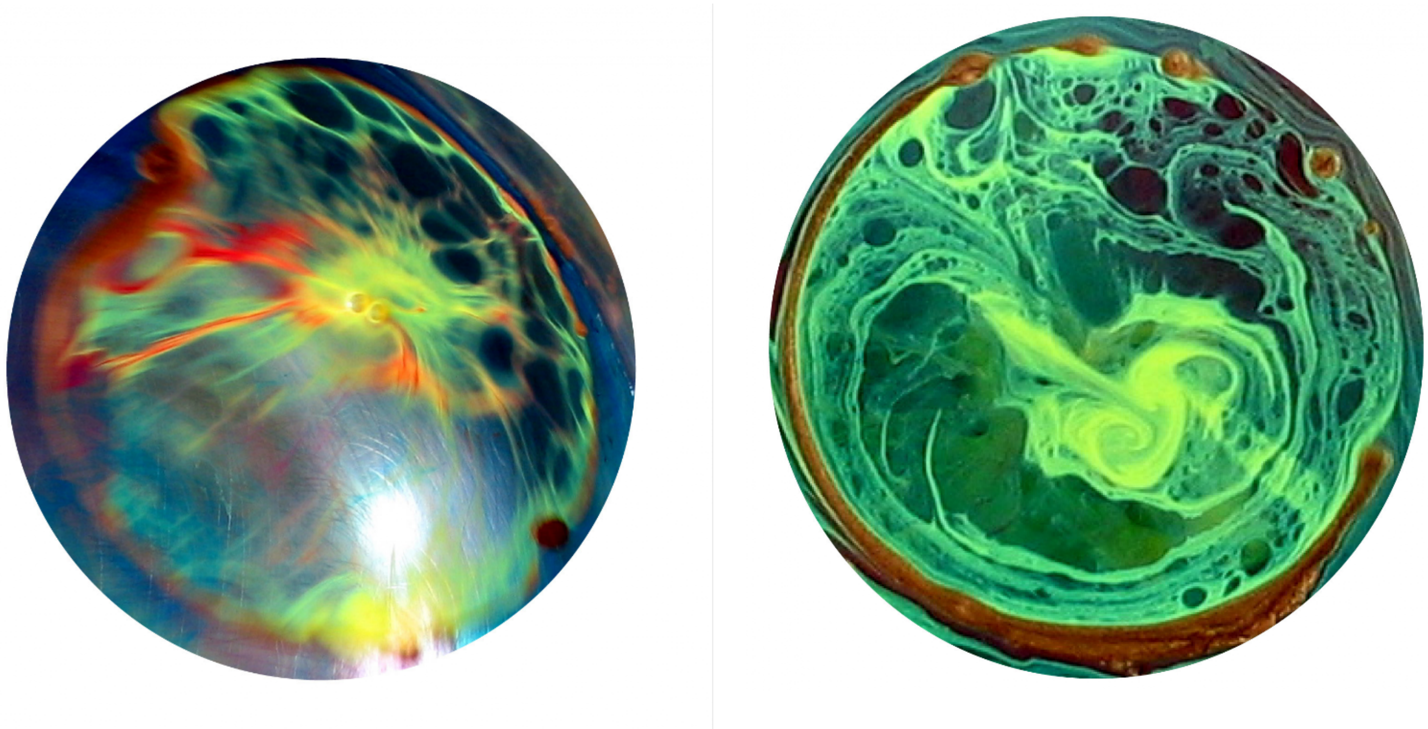


Fig. 4. Two separate examples. Left, a network pattern is evident at this very early stage of the radial spread where the ink is still moving very quickly. The stagnation point is marked by the red jet emanating from the bubble near the centre of the image. Right, some axisymmetrical patterning is evident as well as the well-formed vortex.

5. Later Stages in the Patterns

Patterns continue to evolve and become more complex for several seconds before they start to deteriorate by mixing and falling. Bubbles, which sometimes form at the stagnation point of initial spread, can provide a useful source of visualization because ink streams out from them, forming individual channels that can be easily tracked (Fig. 5, left).

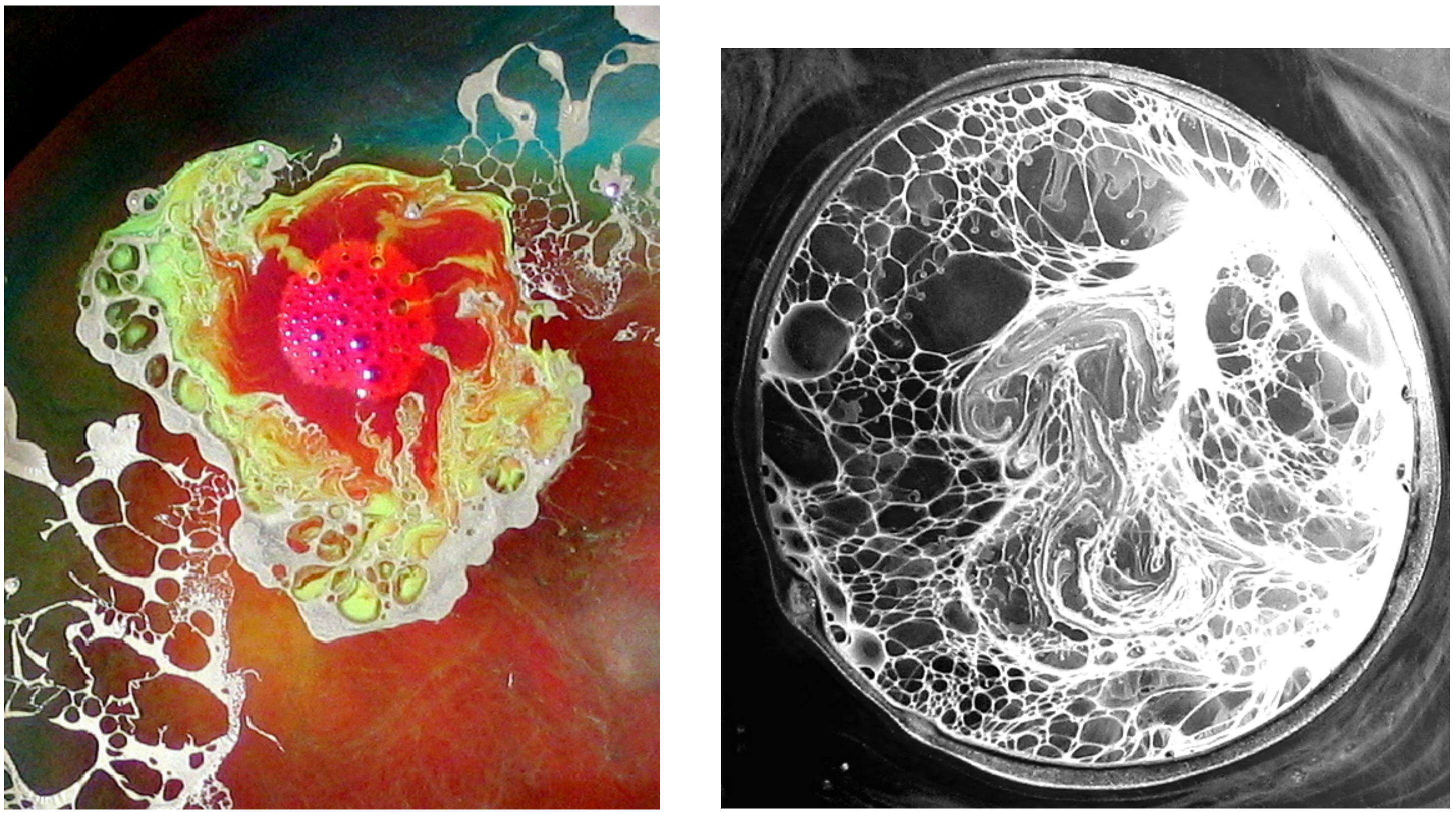


Fig. 5. Later stages. Images are taken from the later moments of their respective sequences and show highly complex patterning. Left: Bubbles mark the stagnation point, with a lower yellow layer of ink flowing upwards and out through the bubbles and continuing in zigzag pathways. The surrounding gold ink takes up patterns that are sometimes self-similar. Right: This pattern, also showing self-similarity, is rendered in black and white to highlight the hexagonal shapes found mainly to the left of the image. Polyhedral shapes have been found in soap bubble patterns (Ball, 1999), and the shapes in the example shown here are of a similar construction.

Fig. 6. Some developing vortices. The radial spread on the left has its original vortices as well as a well-developed network, whose 3-dimensional aspect is apparent. The other two images also have bubbles marking the stagnation point.

6. Artistic Interpretations

Images that include aspects of art and science are particularly rewarding to generate, and provide rich ground for speculation and discussion (Hertzberg and Sweetman, 2005). Phenomena that are observed during the scientific process can be evaluated for their aesthetic qualities, and artists may make use of these phenomena as part of their explorations. For example, the phenomenon of vortices in water flow was approached from the artistic side in Jomon pottery, and the same phenomenon has been analyzed in terms of twin and Kármán vortices (Nakayama et al., 2004).

My view is that nature is the best artist, and I aim for a partnership with nature so as to highlight or expose what is already there. I make certain choices about the colour and type of ink, then nature takes over as the radial spreads form themselves. Then, with the photographs, I make further choices as to how the images are presented.

Perhaps the images may be used to highlight aesthetic ideas. For example, their presentation in a sequence emphasizes the evolution and transformation of the shapes made by the radial spreads, which viewers may interpret in their own way. Or perhaps parallels may be drawn between radial spreads and large-scale phenomena (Fig. 7).

Fig. 7. **Pangea**, after the supercontinent.

The blue images, above, are taken from a point well on in the sequence, and show the radial spread generating a swirling motion. As it began to rotate, the mass began to separate up and drift apart, as we see from the sequence around the main image, and this dissipation formed a parallel with the 'real-life' event of continental drift. There are areas in the gold ink to the right of the main image which may possibly be self-similar (Dr. D. Graham, personal communication).

Parallels can also be drawn between radial spreads and organic forms – the spreads can be seen as visual metaphors for birth, life and death; bursting out suddenly and unexpectedly, growing in complexity, and finally re-integrating with their surroundings. Within Fig. 8 below three stages in the 'life-cycle' of a spread are seen simultaneously; the red circles of ink are spreads about to burst; to their left is a spread actually occurring, and there are other spreads which have almost finished. Again, in common with life-forms, each spread has its own unique set of features within the broad characteristics outlined above.

Figures 8 and 9 also illustrate how the 'fourth dimension', time, may find its full expression. Relatively static and dynamic areas of ink movement are juxtaposed; each thereby highlighted by virtue of contrast. We associate blurring with speed, as in Fig. 8, with its 'time-lapse' area on the left. The nature of the lines can indicate speed of travel: straight lines of ink may indicate a sudden, fast outward movement as opposed to the slow curves of older spreads.

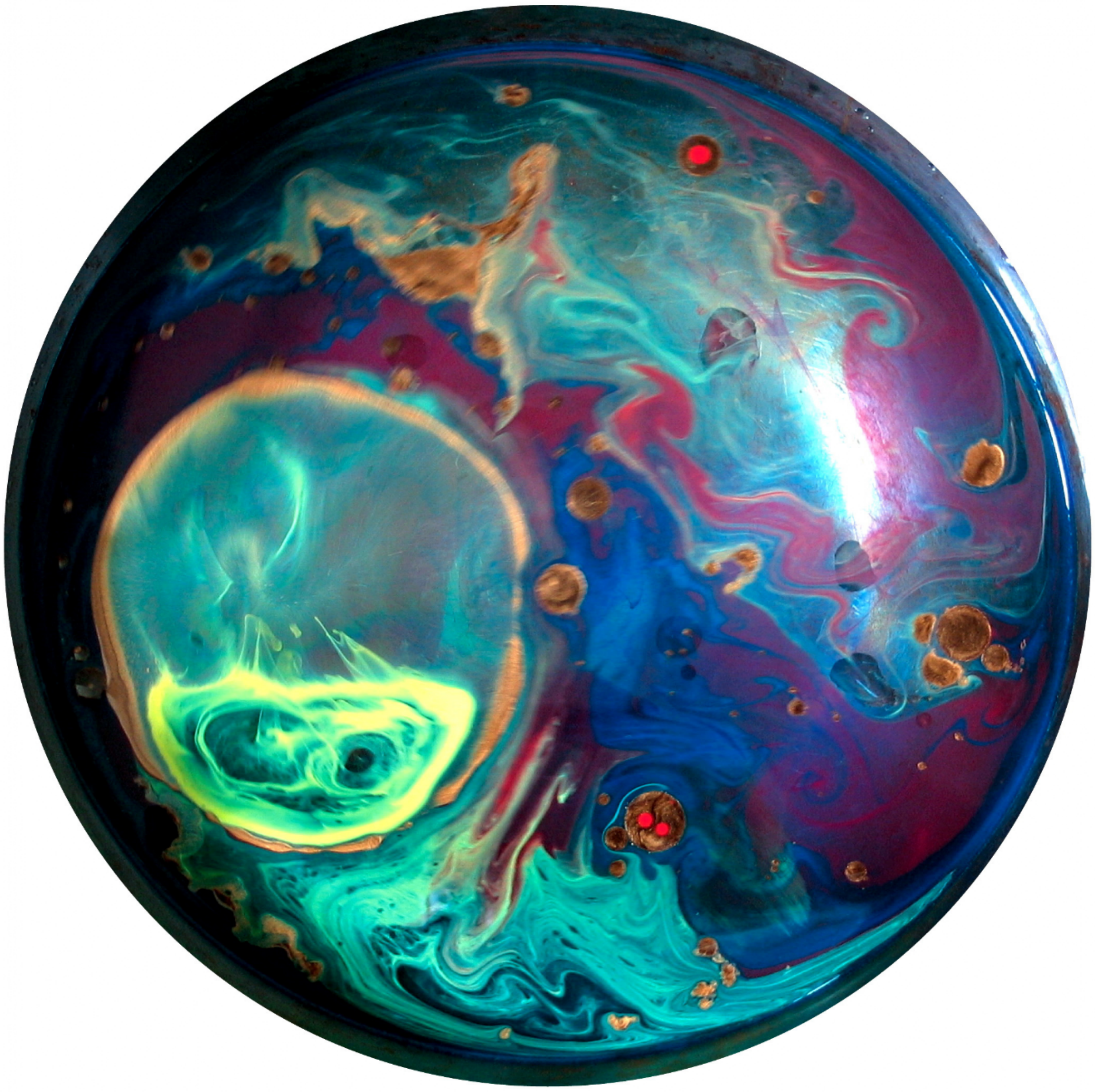
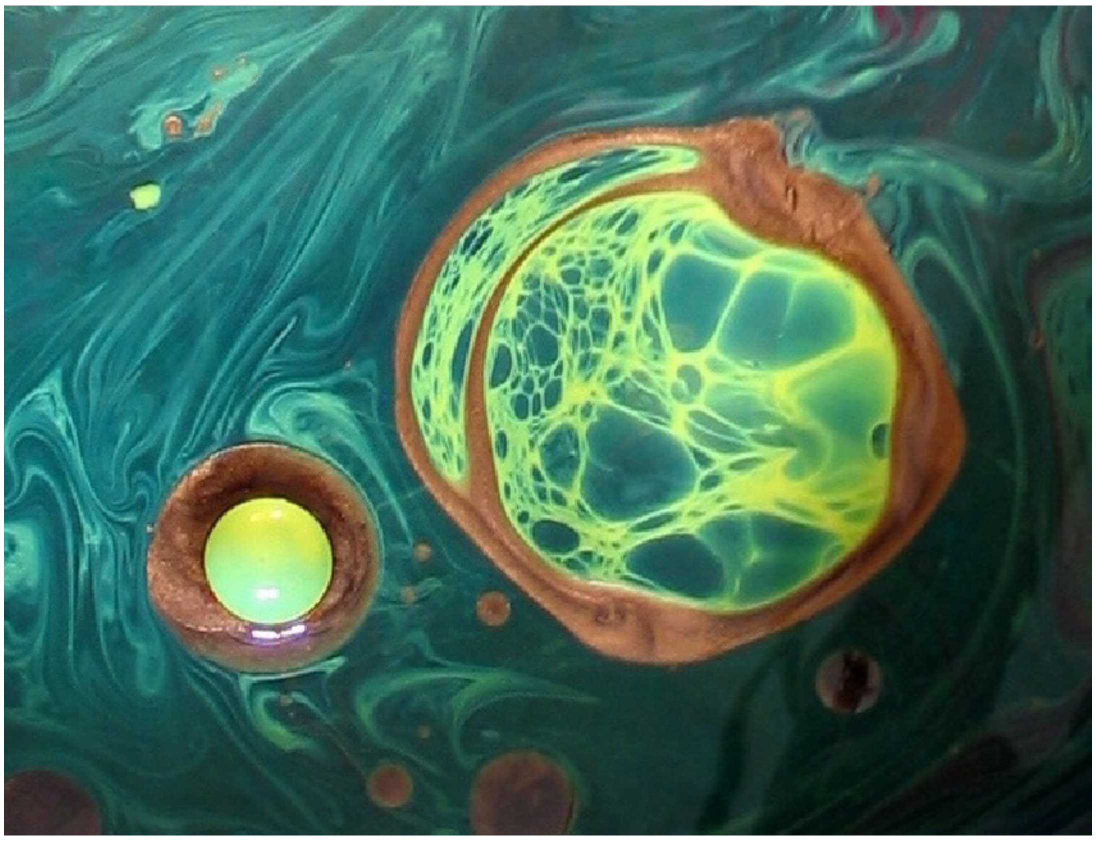


Fig. 8. **Fast, slow chromaflow**, Many stages can be seen at once in the 'life-cycle' of the radial spread, and there is a marked contrast between the dynamic, blurred, fast-moving spread on the left with the relatively static areas surrounding it.



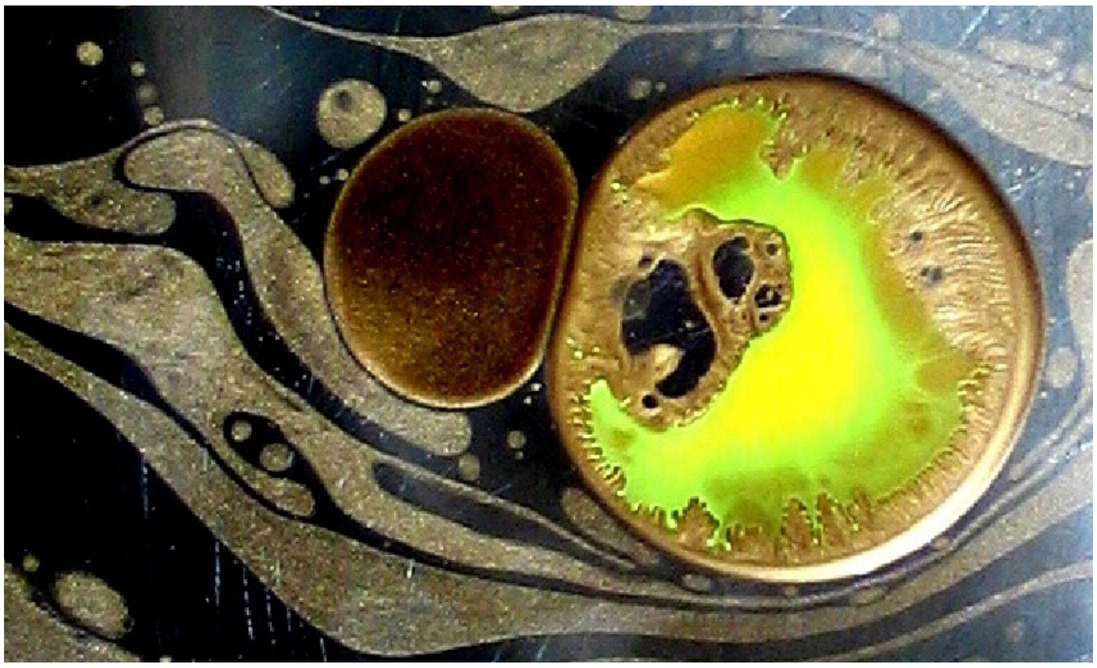


Fig. 9. more static/dynamic juxtapositions. Upper picture: the domed blob contrasts with the dynamic spread below. Lower picture: the yellow area is ringed with splash marks as it makes its way outward.

The examples above show how relatively static and dynamic areas of ink provide aesthetic contrasts of line and form within an image. Just as contrasts are of aesthetic importance in an image, so are unifying features, to confer upon the image a sense of wholeness. Artistic devices for achieving unification can include self-similarity and symmetry; both of which are 'natural' attributes of radial spreads, as seen from the examples given above. Furthermore, symmetrical forms may provide visual resting points within relatively complex areas. In 'Ovalevolve', Fig. 10, below, the eye may move around the complex gold areas and pink vortices to arrive at the relatively straightforward symmetry of the yellow spread.

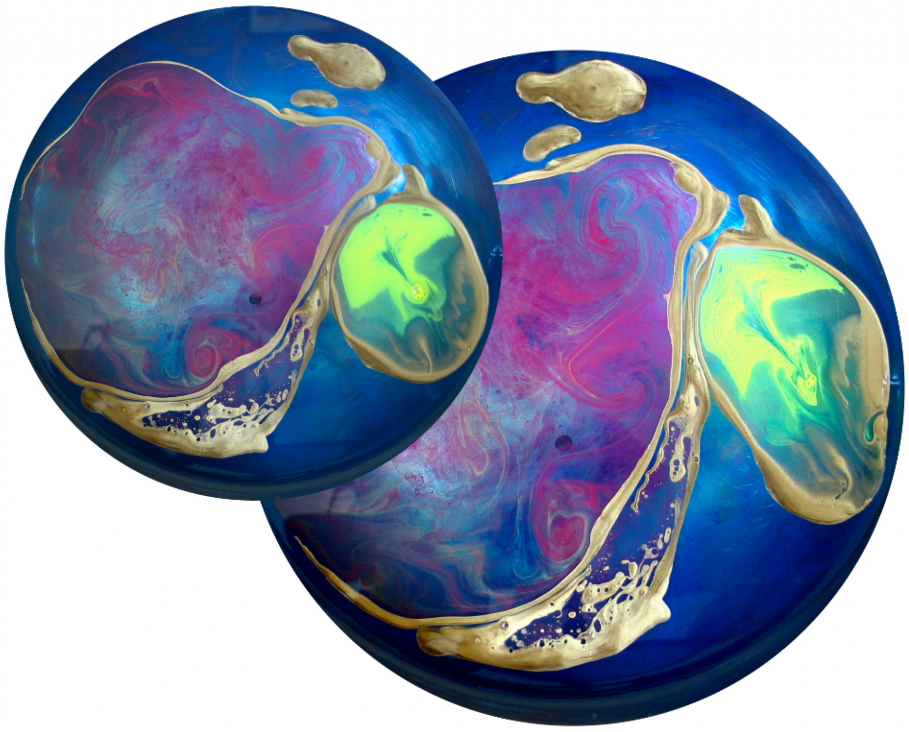


Fig. 10. **Ovalevolve**, Two images taken from a sequence; the pink area at the left being the final stages of a radial spread; at the same time a new yellow spread at the right is evolving.

7. Concluding Remarks

There are many aspects of radial spreads which invite further investigation. Changing variables such a surface tension values and viscosities of inks will affect the types of spread produced. Some spreads cause a rotation to occur (as in Fig. 7, 'Pangea') which affects the final image. It will also be interesting to investigate patterns for evidence of self-similarity. Finally, exploring aspects of time in radial spread images is a particularly exciting and potentially rewarding prospect.

Acknowledgments

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Author Profile

Pery Burge: She trained as an artist in London and Cambridge, has been working professionally since the early 1990s, and since then, has been using ink on paper to create abstract landscapes without a brush. A few years ago she started working with ink in water, initially visualizing turbulence and rotation, and more recently making paintings on water and exploring the phenomenon of radial spread. She is an associate member of the National Society of Painters, Sculptors and Printmakers, and has displayed her work in solo and open exhibitions throughout the UK.