Not only computing — also art

Fig 2

Fig 1

JOHN LANSDOWN

Nautilus shells are the most striking natural examples of the logarithmic spiral form (Fig 1) which is also discernible in the layout of petals and seed pods of some plants (Fig 2), where it is termed spiral phyllotaxis, and in the shape of some animals' horns. *On Growth and Form* (CUP, £17.50), the seminal work by Wentworth D'Arcy Thompson, first made me aware of the existence of natural logarithmic spirals. The book abounds in fascinating insights into natural form and is an excellent source of ideas for reworking on a computer. The logarithmic spiral form, in particular, has been explored by computer artists such as Ruth Leavitt, William Latham and Robert Dixon, who have all done series of works based on it.

The latest examples to come to my attention are by Australian computer scientist Kevin Suffern, who teaches at the University of Technology in Sydney. I met Kevin at the recent CG International Conference in Leeds. Unlike the work of many of those who gave papers at the conference, Suffern's efforts were rather low-tech: they were prepared on a pen-plotter and an Apple IIe computer but were none the worse for that — as can be judged from the illustrations shown here. Some of his most interesting work comes from mapping simple plane patterns (such as those in Fig 3 and 5) into spiral forms (Figs 4 and 6). Fig 7 shows a variation on this simple mapping idea. The strength of Suffern's mathematical treatment is that it allows rectangular coordinate forms to be transormed into circular or spiral ones. Fig 8 shows a mapping of a more complex set. In this case, a group of four interlocking 11th order dragon curves is the starting point.

You can read about his technique in the Proceedings of the Conference. Suffern's paper is titled 'Logarithmic Spirals and Computer Art'. The book has other excellent papers describing the state of the art in computer graphics.

A technique of computing spiral phyllotaxis is set out in an interesting article called 'Discrete Simulation of Phyllotaxis' by Rivier and others in *Dynamical Systems and Cellular Automata,* J Demongeot, E Goles and H Tchuente (eds), Academic Press, London 1985.

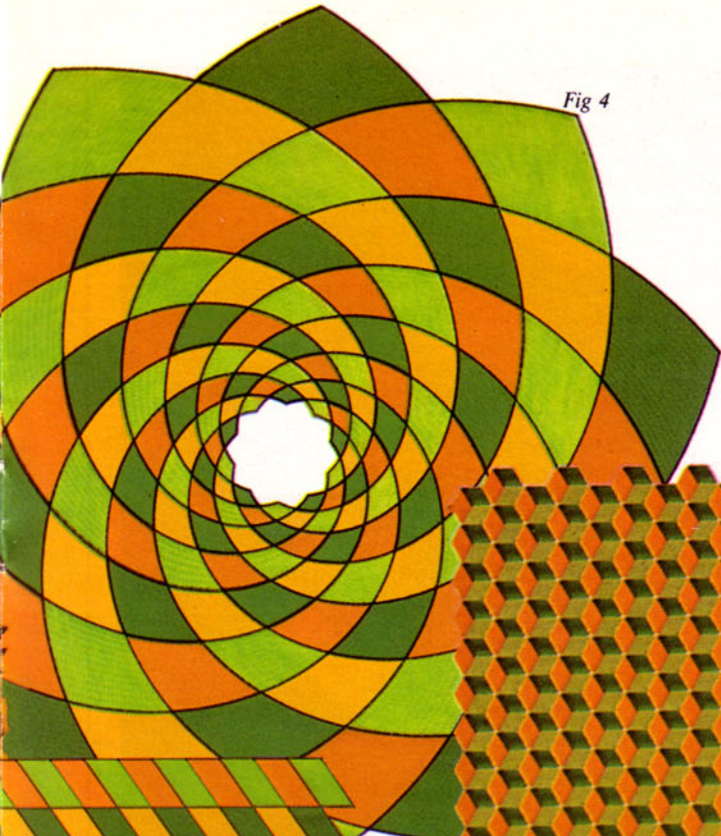

Fig 4

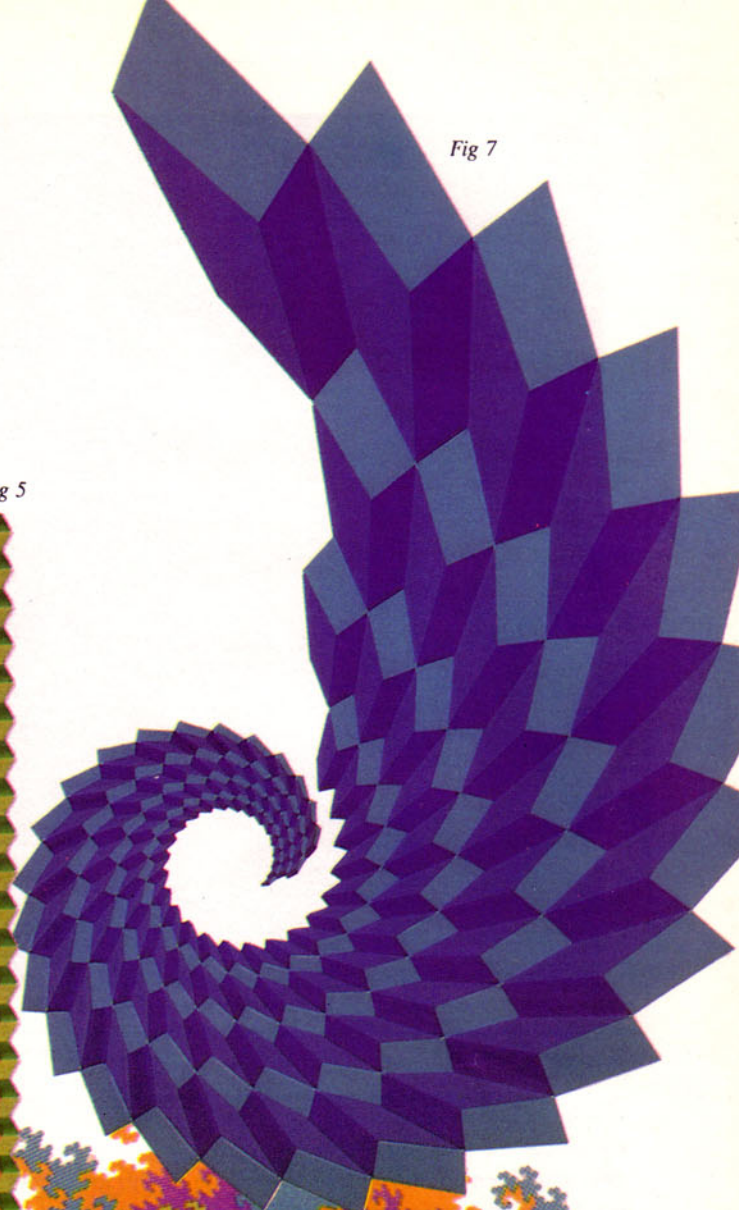

Fig 7

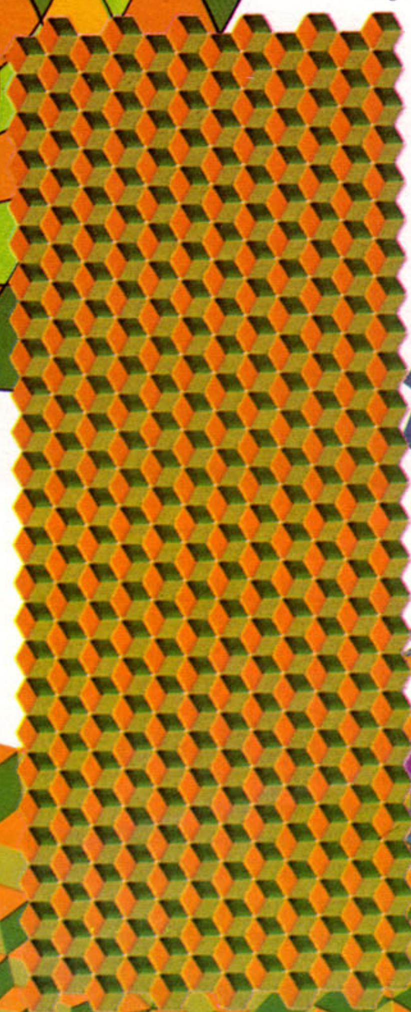

Fig 5

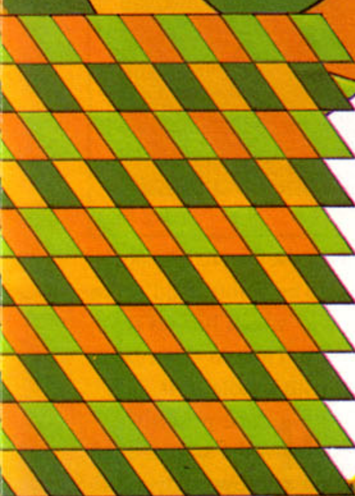

Fig 3

Fig 8

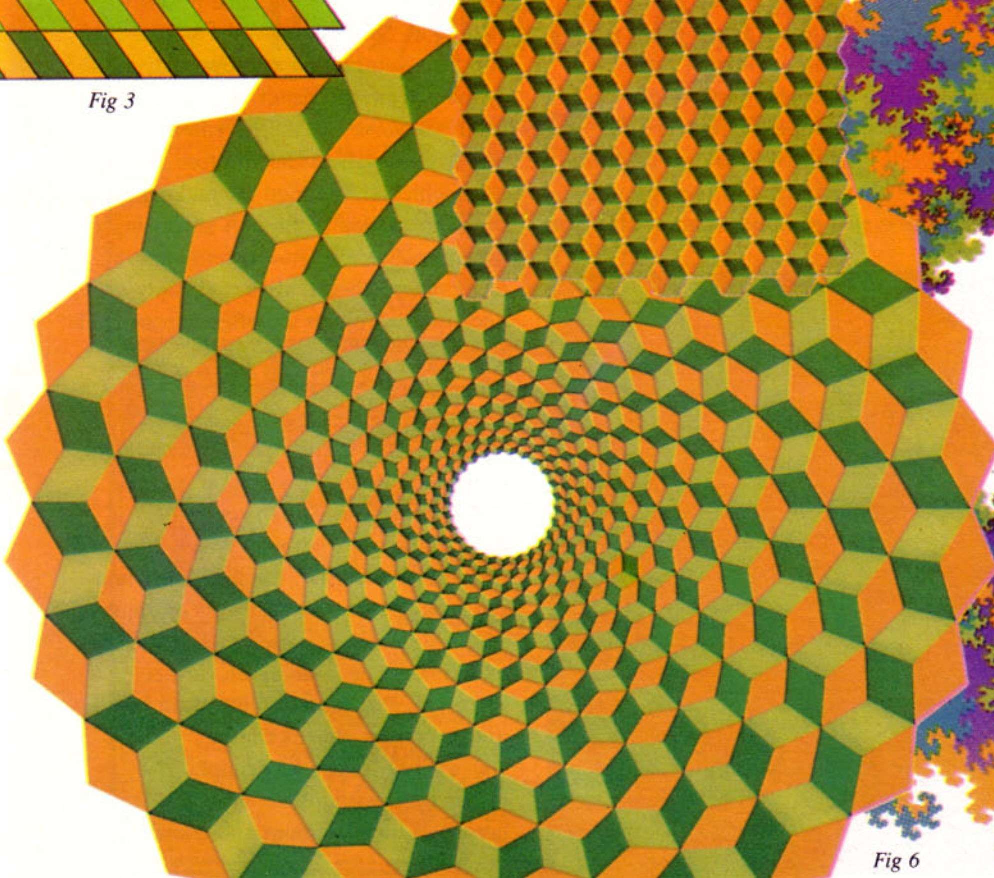

Fig 6

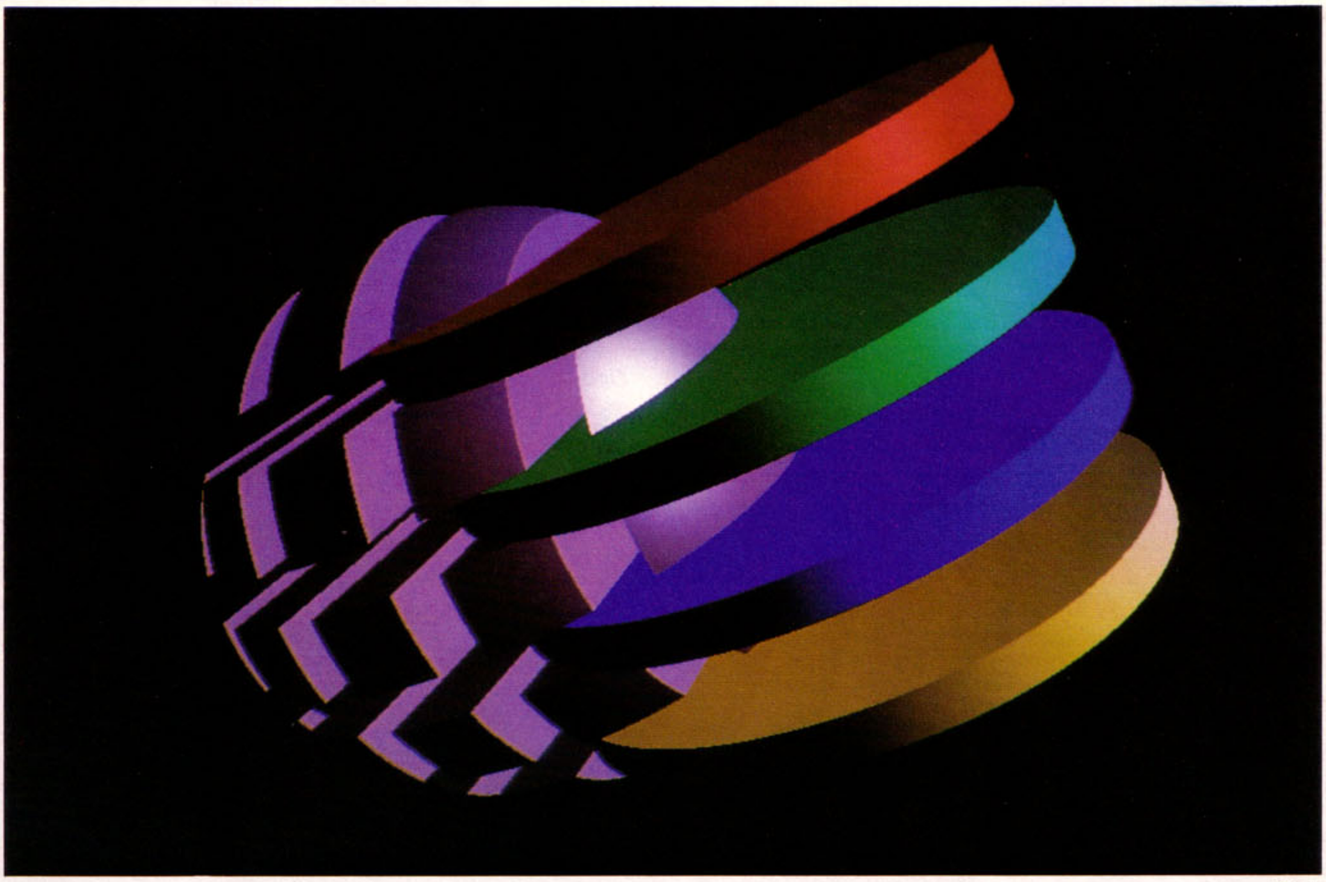

Fig 9

Solid modelling

When I was making computer graphics sequences for film and TV much of my time was taken up, not with programming the animated movement, but with describing the shapes of objects to the computer. It was not an easy process and usually entailed measuring a real object or a drawing of it with a micrometer or ruler and then laboriously translating the measurements obtained into coordinates for typing into the machine. We had one or two labour-saving programs which speeded up some of the work but, in general, it was a tedious business which was easy to get wrong. Nowadays, the job of describing the forms of many objects is facilitated by the use of *solid modelling programs.* These usually allow users to build up a complex form by assembling together more simple elements such as cubes, cylinders and spheres — collectively known as *primitives.* A characteristic of the assembly process is that primitives can not only be added together as if they were physical entities, but can also be 'subtracted' from one another in a way which has no real physical counterpart. Thus to describe a rectangular block with a hole in it, it is possible to start with a cube primitive, change its dimensions to the size needed and then subtract an appropriately-sized cylinder from the result. The computer itself will work out the coordinates involved as well as the surfaces descriptions which are needed for making a properly shaded picture. A surprisingly large number of man-made objects are amenable to this treatment (mainly because the objects are often constructed in a physically analogous way). The process is now so well understood that Master's students regularly write systems and programs in their project work. One of my Middlesex Polytechnic students, Peter Stensel, is in the process of completing a system with which it is possible to describe, render, shade and put surface texture on all sorts of objects. The system is being used as a testbed for experiments he is doing on surface texturing. Figs 9 and 10 illustrate how quite complex shapes can be constructed from a few simple instructions without the need for laborious measurement and coordinate description.

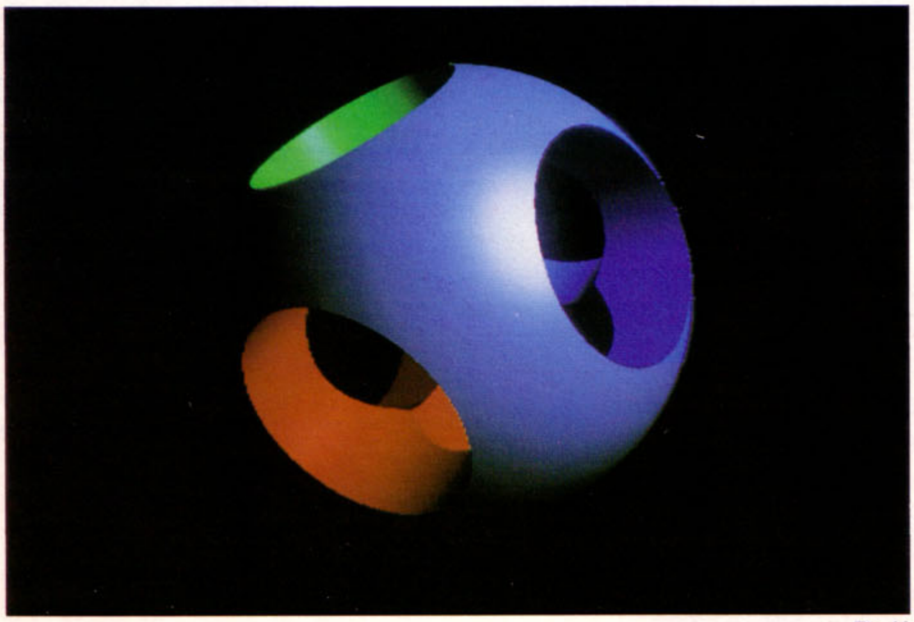

Fig 10