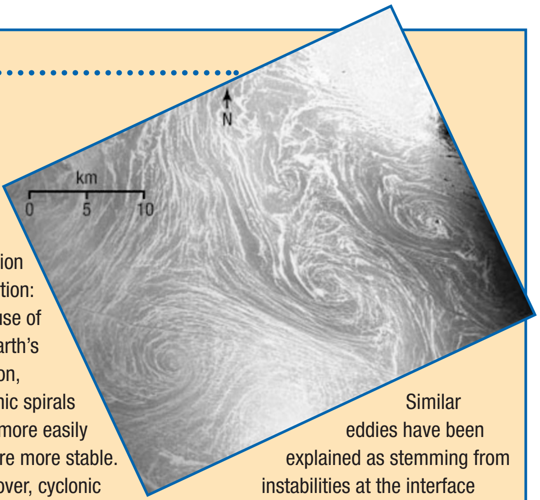
Oceanography

Given a twirl



NASA

Only with the advent of space oceanography have spiral structures in the sea become recognized phenomena. They have proved rewarding, if difficult, subjects for research.

Walter Munk and colleagues have analysed 400 photographs from space that show these attractive patterns on the ocean surface (*Proc. R. Soc. Lond. A* **456,** 1217–1280; 2000). They restricted their investigation to small spirals, 10–25 km in diameter, that last for only about a day, excluding features such as the rings in the Gulf Stream that can be up to 300 km across and last for years.

It turns out that most spirals rotate in the same direction as storm cyclones: anticlockwise and clockwise in the Northern and Southern Hemispheres, respectively. Munk *et al.* find that all potential mechanisms favour the same direction of motion: because of the Earth's rotation, cyclonic spirals form more easily and are more stable. Moreover, cyclonic rotation is more likely to be visible, because streaks on the sea surface that can be twisted into spirals are more likely to occur where cyclones are created.

For much the same reasons, the Mediterranean in autumn is particularly rich in visible spirals: the seasonal, strong winds, followed by calm conditions, are ideal generators of streaks. The picture here shows an example of fully developed spirals off Crete in October 1984.

Similar eddies have been explained as stemming from instabilities at the interface between two water masses of different densities. But that cannot apply to many of the images studied by Munk *et al.* Rather, they think that the driving force is often turbulence generated at the boundary of two water masses moving relative to each other.

As the authors remark, however, there is certainly more than one way to make an ocean spiral. Which may explain why they are such common features of the seascape. **Heike Langenberg**

technology should soon be applied to the main vector of human malaria, *Anopheles gambiae*. This is the principal vector of malaria in sub-Saharan Africa, where more than 90% of all malaria cases — and an estimated one million deaths each year — occur.

Not all forms of a mosquito vector species can transmit malaria parasites; those that cannot are called refractory strains. Advances in understanding the molecular basis of the mechanisms involved will provide molecules that can be introduced into a receptive strain to make it refractory. Furthermore, advances in understanding insect immune systems are providing potential target genes that can be transformed into a mosquito strain to prevent the development and transmission of malaria parasites. Researchers can also borrow molecules of immunity, such as antibodies, from vertebrate systems — through a variety of molecular methods, the binding domains of antibodies that recognize malaria parasites can be cloned as small pieces of DNA and then incorporated into the mosquito genome.

Although it is likely that a refractory mosquito strain will be created before too long, the question of how it would be introduced into the wild remains. It is unlikely that enough mosquitoes could be mass-reared to allow a simple replacement of the wild population, even assuming that the engineered strain had an equal chance of surviving under natural conditions. But perhaps the ability of transposable elements to spread through natural populations could be used as a driving force to spread the refractory strain[5]. Research into cytoplasmic incompatibility phenomena, such as that caused by the symbiotic bacterium *Wolbachia*, may provide another possible driving force[6]. Cytoplasmic incompatibility causes sterility under certain mating conditions, aiding the transmission and spread of the bacteria.

The consequences and risks associated with the field release of a transgenic mosquito will require careful assessment before the approach could become a reality. Whatever the final outcome, however, the successful transformation of a mosquito vector of human malaria is a notable advance in our ability to combat this devastating disease. ■

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Daedalus

Solid explosion

Fire-retardant paint is a cunning product. When strongly heated, it swells up into a frothy char which seals gaps and insulates its substrate from the heat. Daedalus is now taking the idea to extremes. He is devising a polymeric composition loaded with separate tiny particles of a mild explosive, of the type used in automotive air-bags. When detonated, it will expand suddenly and violently into a solid resembling foamed polystyrene.

The chemistry of this novel product is quite challenging. Each particle of explosive must expand into a gas bubble, transiently melting and deforming the polymeric solid around it. The heated viscous thixotropic polymer must be tenacious enough not to fragment under this sudden shock, although it will be hot and soft at the moment of explosion, and will inflate in a pneumatic manner. It will incorporate an added monomer which rapidly sets in the heat, absorbing heat by its reaction and reinforcing the final expanded solid. The mild explosive must be sensitive enough for one particle to set off others nearby, but not enough to make the composition too dangerous to handle. It will be tricky to develop, but the final product, DREADCO's 'Solid Charge', will have many uses.

For a start, it will wonderfully extend the air-bag form of impact protection. Painted on the sharp edges of a vehicle inside and out, and set off by cunning sensors, it could cushion impacts to passengers inside and pedestrians outside. In block form, Solid Charge could offer other forms of safety. While most explosives blow things open, it could blow things shut. It could block pipes, tunnels or entrances against leaks or spreading fire. It will pose no fire or smoke hazards itself, as it seals in its own fumes — useful in mining as well as domestic protection. It might even defeat burglars, by sealing their way in or out, or suddenly filling an opened safe or closet with a protective polymeric mass encapsulating the contents.

Exploded inside in a tough folded plastic envelope of adequate volume, Solid Charge will extend air-bag technology in another way. It will expand to take the shape of the inflated envelope. It will suddenly create an 'instantaneous object' of defined shape. Daedalus likes the idea of a self-inflating instantaneous rubber dinghy for marine emergencies. Once inflated it could not spring a leak, and would ride solidly, without the queasy flexibility of conventional rubber craft. **David Jones**