Miracle of the bird brain

Today's pigeons are often raced over distances of 500 miles or more. They can home over the sea, even flying at night or in fog. Despite a century of effort, no scientific

When I was a young child, on Saturday mornings in the spring and summer my father took me to see a great liberation of pigeons. At the local railway station, racing birds from all over Britain were waiting in wicker baskets, arrayed in stacks. When the appointed time came, the porters opened the flaps, and out burst hundreds of pigeons, batch after batch, in a great commotion of wind and feathers. They flew up in the sky, circled around and set off towards their faraway homes.

Years later, in the early 1970s, when I was a Research Fellow at Clare College, Cambridge, my interest in pigeon homing reawoke, and I asked my colleagues in zoology how the pigeons did it. I soon found no one really knew, an impression confirmed by reading the specialised papers and reviews in scientific literature.

Every reasonable hypothesis had been tried and seen to have failed. I then saw that this intriguing mystery concerned not only homing, but also migration. How do English swallows migrate in the autumn to South Africa and then in spring return to England even to the building where they nested the year before? Again, no one knew.

Homing pigeons have been used for carrying messages for thousands of years. In the Bible, we read that a pigeon homed to Noah's Ark with an olive leaf in its beak, showing Noah that the Flood was abating. Today, there are more than five million pigeon enthusiasts who routinely race birds over distances of 500 miles or more.

Pigeons are by no means alone in their homing abilities. Countless anecdotes tell of domesticated animals, even cows, coming home after being left many miles away. The commonest concern dogs and cats. For example, a collie called Bobby lost in Indiana, turned up at home in Oregon, more than 2,000 miles away, the following year.

But the distance records are held by birds. Adelie penguins, Leach's petrels, Manx shearwaters, Laysan albatrosses, storks, terns, swallows and starlings have all been known to home from more than 1,000 miles away. For example, when two Laysan albatrosses were taken from Midway Island in the Central Pacific and released 3,200 miles away on the west coast of America, in Washington state, one returned in ten days, the other in 12 days.

Clearly, these remarkable homing abilities are closely related to migrations from one home to another. In many cases such as that of British swallows, migration is a double homing system. They migrate in the autumn to their winter home in eastern parts of South Africa (where it is spring) and return to Britain in the Northern spring.

More amazing still is the instinctive ability of young birds to home to their ancestral winter quarters for the first time without the need to be guided by birds that have done it before. For instance, European cuckoos, raised by birds of other species, do not know their parents. In any case, the parent cuckoos leave in July or August for southern Africa, about a month before the new generation is ready to go. In due course the young cuckoos congregate and migrate in flocks to their African home to join their elders.

How do migrating animals know where to go? In the case of migrant birds, the most popular hypothesis is that they orientate by the stars, and perhaps are also exquisitely sensitive to the Earth's magnetic field. They are also supposed to have an inborn program, complete with star map and maybe also a magnetic map. In the scientific literature this is called an "inherited spatio temporal vector-navigation program".

But little is really understood. This impressive sounding technical term merely restates the problem, rather then solving it.

Numerous experiments on homing have already been carried out with pigeons. Nevertheless, after nearly a century of dedicated but frustrating research, no one knows how pigeons home and all attempts to explain their navigational ability in terms of known senses and physical forces have so far proved unsuccessful.

Charles Darwin proposed a hypothesis of pigeon homing by a kind of "dead reckoning", registering all the twists and turns of the outward journey, even when enclosed in a box. J. J. Murphy proposed a mechanical analogy in terms of a ball hanging from the roof of a railway carriage, reacting to shocks given to it by changes in the carriage's direction and velocity.

But in 1893 S. Exner showed that pigeons could still home perfectly well after being transported to the release site under heavy anaesthetic. More recent experiments with other species, such as herring gulls, have confirmed Exner's findings. Nor does taking the pigeons to the point of release by complex and devious routes make them lose their way. They can even home after being transported in a large, light-proof rotating drum.

In any case, if the birds were to sense and integrate all the twists and turns of the journey, the appropriate organ would be the semi-circular canals in the middle ear, which detect accelerations and rotations. The total destruction of this organ stops birds flying properly, but in experiments involving the surgical cutting of the horizontal canals, the pigeons still homed normally after being taken more than 200 miles away.

It is sometimes suggested that homing depends on familiar landmarks. This is probably the case when the pigeons are released a few miles from the loft, and also when they home repeatedly over the same terrain. But pigeons can home from completely unfa-