

A NEW INTERPRETATION OF THE OLFACTORY HYPOTHESIS

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Introduction

This note is about the homing capability of carrier pigeons.

The Olfactory Hypothesis

This was brought into being as a result of experiments by Professor Papi and colleagues in 1971. (Papi F, Fiore L, Fiashi V, and Benvenuti S "The influence of olfactory nerve section on the homing ability of carrier pigeons" *Monit Zool Ital* Vol 5 pp 265-267.)

The essence of the matter is that if the nerves going to the pigeon's nose are cut then the birds' homing ability is lost.

One is led to think along the lines that the pigeons follow a scent trail or are referring to some unseen semi-permanent distribution of gases in the atmosphere, and these concepts seem to fail when subjected to analysis. ("Avian Navigation: Pigeon Homing as a Paradigm" Hans G Wallraff Springer 2005 ISBN 3-540-22385-1 See especially Chapter 7)

I have thought of another way of interpreting the data that have been heretofore accrued.

Navigational Co-ordinates

I will explain in the next paragraphs that I think it is possible that the birds can obtain a reading of whether they are East or West of the home loft by scenting the air.

The birds must then obtain a second co-ordinate to determine whether they are north or south of the home loft. I suggest that birds cannot do this by olfactory means and I suggest that they use a geophysical indication as the second co-ordinate, perhaps the magnetic dip angle or one of the components of the earth's magnetic field.

In this note, I am only concerned with the E-W navigational cues.

The Scenting Bird near to a Home Loft

A bird will scent the air throughout the day. Early in the morning, when the air is cold, there will be a relatively low concentration of scent molecules in the air. As time progresses these scent molecules will increase in concentration passing through a maximum somewhere around noon and will thereafter fall off in concentration.

The exact types of molecule will not matter save to say that they are materials transpired from plants, perhaps terpenes and the like. What is important is that there are some molecules of some type and that there more of them in bright sunlight.

The bird will be able to register that there is a position of maximum concentration.

I propose that the bird registers the "maximum position" on a time axis and that while it remains near its home loft, it will expect this time of maximum to appear at 24 hour intervals.

The Scenting Bird moved to a New Loft

Suppose the bird were translated 111 km (one degree of longitude) to the East in the middle of the night. Then at its new loft, on the next day, it will see the scent maximum occurring four minutes (one degree of time, so to say) before the time expected were it to be still in its home loft, the sun rising earlier as you go Eastwards.

It is a small step to say then that **so long as** the bird can measure time to within a minute or two in 24 hours, then it can get an indication of its position relative to the home loft simply by sampling the air.

It does not matter that the molecules it is smelling are different to the molecules it was smelling at the home loft. All that matters is that they are molecules from vegetation that will go through a maximum concentration when the sun is hottest.

Time Sense in Pigeons

I am quite aware that the idea that a bird can measure time to within a minute or two in twenty four hours does not meet with excessive approbation by biologists. I have already tried this idea out for long distance migrations as described in <http://www.3aaa3.com> .

Against this I lay the whole human experience of accurate navigation. There is always a time measurement involved, and I maintain that is pure and simple folly to ignore the idea that birds and other navigating animals can count time.

In this note, **it is assumed**, evidence or not, that pigeons can measure time.

Consequences of this Interpretation

The points enumerated below require that the bird is released far enough from the home loft that it cannot see familiar landmarks near to the home loft. Although birds probably process visual information very differently from humans beings, it seems unwise to allow birds the chance of homing by visual cues if you are investigating some other navigational method. There has recently been a forum discussion about this matter at the Animal Navigation Group (ANG) of the Royal Institute of Navigation. <http://www.rin.org.uk> Click the SIGS tab to find the ANG.

- A bird unable to freely inspire the air surrounding its home loft will not be able to locate the time of maximum. So if a bird is locked in a closed loft so that the wind can't blow through will simply smell the inside of the loft. Such a bird will not be able to home.
- A bird that is continually fed with some artificially imposed strong odour might not be able to determine the maximum concentration of natural chemicals in its surroundings and so not be able to home.
- A bird whose home loft is in the middle of some sort of featureless wasteland such as a desert, might not be able to find enough sun-dependent air borne chemicals to determine a noon.
- *I am not sure what would be the case if the home loft was on a ship, at sea 50 km or more from the shore; or if the home loft was on land and the release point was on the 50 km offshore ship. Does the sea smell ?*
- A bird being able to breathe and scent normally, however it is moved from home loft to release point, will not be able to home until it has passed through a scent maximum near noon. So if the bird was moved from the home loft in the early morning and released well before noon, then the bird would either not be able to home at all, or it would wait until noon had passed before taking up a final homing flight. Birds forced to fly before noon would probably fly off in unexpected directions.
- If a bird has been moved to a release point, and has been allowed to breathe the air and pass through a scent maximum near noon, then subsequent inactivation of the nose will not prevent the bird from homing as it will already know its longitude relative to the home loft.

- Birds will only cross large bodies of water if there is a strong indication for them to fly north or south. It is explained in the next section *Homeward Direction and Progression* that a bird does not continually know its East-West position and it will be reluctant to enter what, to it, is probably, a featureless environment. I can understand how a pigeon might fly across the English Channel, or might cross the Straits of Gibraltar, but I have more difficulty in imagining a pigeon flying from Mallorca to Sardinia.
- The birds will not necessarily fly directly home by the shortest route. See *Homeward Direction and Progression below*

Homeward Direction and Progression

Even if the bird has determined how far East or West of the home loft it is, and it knows whether it is North or South of the home loft by some other (perhaps geophysical) means, this is far from being sufficient (as I see it) for the bird to determine and fly along a shortest distance line to get to the home loft. I would expect to see the bird flying some other route. Once the bird starts flying home, it may be able to monitor its North South progress by looking at a magnetic quantity, but it cannot continually monitor its East West position, because this is determined only at noon. Birds may overfly or fly nearby but past, and then have to wait for the following noon to re-set their relative longitude.

Nearing the Home Loft

Although I imagine that birds will normally use visual clues once they get near enough to their home loft, experiments in which birds cannot see because they have been fitted with frosted contact lenses show that they can still get quite close to the loft. (K. Schmidt-Koenig and H.J. Schlichte, Proc. Nat. Acad. Sci. USA Vol 69 (9) pp2446-2447 1972).

I think the birds will recognise a characteristic scent pattern near their home loft, because there is a semi-permanent odour cloud hanging over any particular geographical location.

I have already suggested that birds detect molecules that are transpired from plants. These molecules will have a limited life and are then deactivated, probably by reaction with oxygen under sunlight. The molecules are probably mostly terpenes, and that they emitted from the plants as a hydrosol.

Imagine a field of maize on a sunny day. Water and active chemicals are known to be pouring out of the plants. For example, caterpillars eating maize can cause the plant to emit pheromones which attract wasps that will kill the caterpillar. If the molecules have a short life, then effectively there will be a relatively small cloud of maize chemicals above and around the maize field. The maize chemical cloud is semi-permanent because there is a dynamic source – the growing maize plants. It is semi-localised because although the wind might blow the cloud into an elongated downwind sausage shape, the tail will be continually weakened in concentration because of both physical dilution and because the molecules are being destroyed by sunlight. One assumes that a wheat field will not have the same chemical efflux as a maize field; different crops will have their own characteristic scent cloud hanging over it.

So, the home loft will have a characteristic scent geometry around it which the bird will recognise. So long as the bird can home close enough, then it could, I suggest, make the final approach using its previously garnered scent-based local knowledge.

Conclusion

If one is willing to accept the idea that a bird can measure time to within a minute or two in twenty four hours, then the Olfactory Hypothesis could afford a way for a bird to determine its East-West position with respect to the home loft.