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Dr Mueller writes:

DR KAUFMAN's analysis is naive and ignores information given in several of my publications and papers I have presented at meetings, at some of which I believe he was in the audience. My first report clearly indicates that I was aware of the ambiguity of Pielowski's[2] results which can be interpreted as the prey being conspicuous relative to the flock rather than evidence for selection for oddity. All of my experiments have been designed to segregate the effects of conspicuousness. My ten mice were on pedestals 10 cm square on an arc of a circle 2 m in radius[3]. The hawk was perched at the centre of the circle and 85 cm above the level of the pedestals. The pedestals were affixed to a board 122 × 244 cm, painted the same colour as the pedestals and those constituting the substrate. Measurements for four photographs taken with the camera at the hawk's perch showed that, on the average, the ten mice covered 1.6% of the substrate as viewed by the hawk. The mean distance between mice was 2.9 times their average width. I submit that the mice formed an inconsequential portion of the substrate and that Kaufman's Fig 1 is a simplistic and misleading portrayal of my experimental design.

My most recent presentation[4] shows clearly that hawks select odd mice when confronted with a choice between only two mice, an experimental design which renders Kaufman's criticism completely invalid. Each hawk was presented with a single mouse of a given colour for ten consecutive captures, and then offered a choice between a grey and a white mouse on the eleventh trial. Hawks exhibited a very strong tendency to select the mouse which was odd in terms of the bird's prior experience. Full publication of these, and other, results of my experiments will come in due course.

The differences between my experiments and those cited by Kaufman are many. The lack of obstructions or "cover" for my mice would seem important, as would the fact that I carefully controlled essentially all but the experimental variables. Basically, the argument should be whether the results of carefully controlled laboratory experiments are applicable to nature, and whether experiments and observations under more natural, and variable, conditions can be performed with sufficient accuracy to reveal all of the factors influencing a behaviour.

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New Method for Measuring the Flight Altitude of Birds

WE have measured the flight altitudes of homing pigeons and swifts using a new type of altimeter carried by the birds. The altimeter is based on the fact that the range in air of α-particles from a radioactive substance is inversely proportional to the density of the air and that air density decreases in a regular way with altitude. The altimeter used with the pigeons consists of a lucite tube with outer dimensions of $50 \times 8 \times 5$ mm^3 (Fig. 1). The α-particle source (^{210}Po) is protected by a thin plastic film and inserted through slits in one end of the tube. The detectors are sheets of cellulose acetate plastic placed in the two 45° slits in the other end of the tube, making it possible to measure the maximum range and range distribution of the α-particles. The altimeter weighs about 1.0 g and is open at both ends so that the air may pass through freely without significant heating. Experiments performed by the Aeronautical Research Institute of Sweden have shown that pressures inside and outside the tube are nearly equal, representing an error in altitude of only 10 m (too high). There is no systematic error in the air density determinations. The precision in a determination of the maximum range depends on the source strength and the duration of the flight. The error amounts to about 0.2–0.4 mm, which corresponds to an error of about 100–200 m in flight altitude in the homing pigeon experiments.

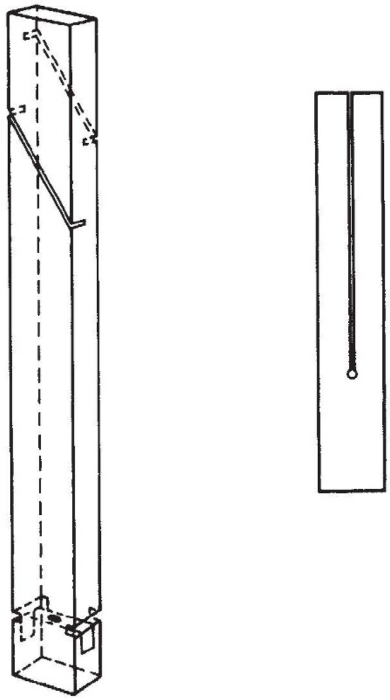

Fig. 1 Schematic drawing of the bird altimeter used in the homing pigeon experiments.

The altimeter is pasted to the bird's back immediately before the bird is released and removed after the flight. Figure 2 shows a record of a pigeon's flight. The density of α-particle marks on the plastic strip is plotted as a function of the distance from the radioactive source. The relation between extrapolated α-particle range and altitude shown in Fig. 2*b* is based on meteorological data for the flight day.

Five experiments with homing pigeons were conducted. Three pigeons were flown repeatedly thus making possible studies on the flying pattern of individuals. Table 1 gives the maximum flight altitudes together with some meteorological data. A comparison of the altitudes shows that different pigeons have different flying habits but every pigeon seems to have a remarkable habitual flying pattern. The data indicate that a mechanism exists which determines each pigeon's flying altitude. There is no indication that