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How quantum is bird migration: A review.

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Quantum biology, despite scepticism regarding the application of quantum physics to the warm, wet and messy environments of biological systems, is by now a well-established field of research. Two of the predominant topics of this research are photosynthesis and avian magnetoreception. However, while there has been some conclusive experimental evidence that photosynthesis employs quantum effects it is still debatable that birds use quantum mechanics to navigate. This presentation will explore the extent to which avian magnetoreception might be considered a quantum phenomenon. It has been hypothesised that birds employ a radical pair mechanism to negotiate the earth's magnetic field. The hypothesis is supported by the fact that the avian compass is a light dependent, inclination compass. It has been shown that it is structurally possible for a molecule in the eye of the bird to be measurably effected by the weak geomagnetic field. Progress has also been made into the details of the mechanism by identifying a possible molecule, cryptochrome, in which the effect occurs. Cryptochromes in fruit-flies have been demonstrated to mediate magnetic responses. Four different types of cryptochrome have also been confirmed in the eyes of migratory birds while cryptochromes from migratory garden warblers form radicals with millisecond lifetimes under the influence of the blue spectral range. Recent experiments have also demonstrated that the avian compass is disrupted by low intensity anthropogenic electromagnetic radiation across a broad range of radio frequencies. Current theoretical approaches suggest that this could be explained by a quantum needle effect which would further confirm that avian magnetoreception belongs in the category of quantum biology.

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