

## SNOWBALL EARTH : LES KNIGHT – Report by Ian Royston

Dr. Les Knight, a geologist whose career has spanned work in the coal industry, exploration for gas in coal measures and mudstones, and research with Nirex on long-term nuclear waste disposal, delivered a talk on the concept of "Snowball Earth" and the deep history of climate change.

He opened by situating his subject within geological time — a scale so vast it dwarfs the span of recorded human history. We currently live, he noted, in an unusually cold period relative to most of Earth's past: permanent polar ice caps are the exception rather than the norm over geological timescales, and our current cold phase has persisted for roughly 26 million years. Our everyday understanding of climate change is constrained by recorded temperature data, the oldest reliable series of which — the Central England Temperature record — dates only to 1659. That record reveals temperatures averaging around 9°C before 1900, with slow warming to mid-century and then more rapid increase, driven by industrialisation and transport.

Dr. Knight challenged the premise underlying the widely cited 1.5°C warming target, pointing out that "pre-industrial" baselines are typically set during the Little Ice Age (roughly 1400–1890), a period of exceptional cold. Average temperatures were likely higher — by perhaps a degree — during classical antiquity, suggesting the choice of baseline is not neutral. Climate proxies such as tree rings, oxygen isotope ratios, and Antarctic ice cores (which extend back up to 800,000 years) allow scientists to reconstruct temperatures well beyond instrumental records.

Ice ages — in the conventional sense — have repeatedly covered the UK, at times reaching as far south as the Thames Valley, driven by Milankovitch Cycles: the interplay of Earth's orbital eccentricity, axial tilt, and precession relative to the Sun. Ice ages are typically followed by rapid warming periods, and we are currently in such an interglacial, which began approximately 11,000–20,000 years ago. The mechanisms behind why temperatures drop from warm maxima into ice ages are less well understood, although volcanic activity, radioactive heat from rocks, and the albedo effect — where ice-covered surfaces reflect solar energy, driving further cooling — all play roles.

The talk also surveyed the history of glacial theory, noting that geological evidence for past ice ages conflicted with religious chronologies well into the nineteenth century. Louis Agassiz, who formally presented his glaciation theory in 1837 and published it in 1840, was the pivotal figure in establishing the science. Evidence such as erratic boulders — notably Shap granite boulder found in Deepdale near Barnard Castle, transported from Cumbria — and polar wandering in magnetic particles provided compelling proof of continental drift and past glaciation at latitudes now in the tropics.

The talk concluded with the pre-Cambrian "Snowball Earth" events: the Sturtian and Marinoan glaciations (roughly 720–635 million years ago), evidenced in Scotland's Dalradian belt. A completely ice-covered Earth was likely not the full picture; a "slushball" model — with liquid water and rocky margins persisting — better explains how life survived. Stromatolites provide evidence of life enduring even through these most extreme climatic episodes.