Life's hidden depths

The Deep Hot Biosphere

By Thomas Gold, Springer-Verlag, New York 1998
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In November of last year, Copernicus Books (Springer-Verlag) published The Deep Hot Biosphere by Thomas Gold. Many readers of Gaia Circular will recall Gold's provocative 1992 paper of the same title. This book now represents the culmination of two decades of Gold's work, which began with his deep-Earth gas theory.

Because of very recent discoveries of bacterial life at depth within the Earth's crust, and owing to the blossoming of interest in archaebacteria that thrive in conditions of severe heat, 'deep biosphere' is now a familiar term. Only in Gold's formulation, however, is this new biosphere something other than a downward extension of the surface biosphere. Indeed, only in Gold's formulation is this companion biosphere put forward as the antecedent to Gaia.

Gold's theory hangs entirely on his grounding view that hydrocarbons are not 'biology reworked by geology, but geology reworked by biology'. As with the hydrocarbons detected on the surfaces of comets and in the atmospheres of the outer planets, hydrocarbons within Earth are held by Gold to be primordial. They originate from reservoirs in the outer mantle where complex molecules are held stable by enormous pressures. Samples of crude oil drawn from all reaches and depths of the globe contain indisputable biological molecules, not because petroleum is derived from the buried remains of surface life, but because petroleum makes excellent food.

I had the privilege of working behind the scenes with Gold in the organisation and writing of this book. It was a struggle to decide which linear sequence of arguments would work best, given the torrent of counterclaims that his theory always provokes. At the outset he deals with the oxygen question, positing two likely sources of loosely bonded oxygen atoms by which denizens of the deep can metabolise petroleum. He next identifies the five underlying assumptions upon which his theory is based. Firstly, hydrocarbons are primordial. Secondly, the Earth was subjected to only a partial melt. Thirdly, hydrocarbons are stable at great depth. Fourthly, rock at depth contains pores and finally, hydrocarbons are still upwelling.

He goes on to provide empirical evidence in favour of this 'abiogenic' view of petroleum formation. For Earth system scientists, the section 'Clues in the Carbonate Record' may present the most important argument of the entire book. Gold's aim is to show how the widely recognised 'carbon isotope anomaly' is not an anomaly at all within the purview of his deep-Earth gas theory.

As James Lovelock discovered when he offered up his Gaia hypothesis, there is substantial resistance among scientists to seriously consider any proposal, no matter how soundly set forth, that upsets the framework within which they currently work. Gold entices his colleagues to open their minds by showing how his deep-Earth gas theory and, to a lesser extent, deep hot biosphere theory can solve long-standing puzzles in a variety of Earth sciences. He offers a new mechanism for diamond formation, a new explanation for concentrated metals deposits, a contrary view of earthquake causation, and even a startling proposal for the deposition of coal.

Throughout the book, Gold urges us to shed our deeply rooted 'surface chauvinism'. When that mental shift is made, one can then see why NASA's excellent new research program on 'Life in Extreme Environments" has, in Gold's view, been given an unfortunate name. 'It is we who live in the extreme environment', Gold maintains. The surface of any planet is a tough place to inhabit. And so Gold reiterates the prediction he made in 1992, that ten planetary bodies in our own solar system offer subsurface conditions suitable for life

I wish Gold had been willing to offer more than just a brief section of thoughts comparing and contrasting the deep and surface biospheres. But one person can only do so much. Overall, he provides a wealth of research ideas for others to follow up, should they be so inspired. In this way, The Deep Hot Biosphere strikes me as very much in the mould of Lovelock's Gaia: A New Look at Life on Earth. Change 'on' to 'within' and that is precisely what Thomas Gold has given us

Whether Thomas Gold proves to be right or wrong (I suspect it will be decades before judgement can be cast responsibly) the book surely will be acclaimed as an astonishing accomplishment of a wide-ranging, brilliant, and seasoned scientific mind

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