Ecospheres Project

A trans-Atlantic research and media collaboration.

Dr. Martin J. Heath, UK (life & Earth sciences) and Dr. Laurance R. Doyle, USA (astrophysics).

We have specialised in horizon-scanning exercises, identifying and pioneering new avenues for research into habitable planets, which have later developed into major fields in their own right.

Our focus on forests - the next step in the search for life in the universe.

"It could be that the first detection of extra-terrestrial life will be forests."

Statement by Laurance R. Doyle (left) to a congressional hearing at Washington DC, May 9, 2013.

(In centre, Dr. John M. Grunsfeld, veteran astronaut, Associate Administrator, Science Mission Directorate at NASA and right, Dr. James Ulvestad, Director, Division of Astronomical Sciences, National Science Foundation).

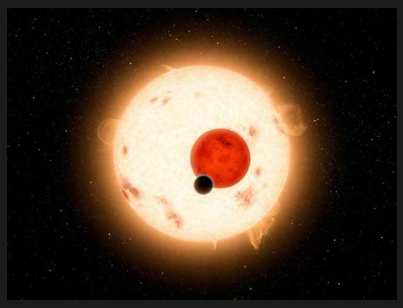
Forest ecosystems cover large areas of the Earth's landmass, sustain the greatest concentrations of biomass and biodiversity on the surface of our planet and play major roles in biogeochemical cycles and in moderating regional climates. They are the environment in which our primate ancestors evolved and developed the hand-eye co-ordination that enabled us to carry out ventures such as the construction of the International Space Station. Forest products, notably wood (a structural material that also floats and burns) and fruits enabled us to create our civilisation and continue to be indispensible today (plantations and orchards are artificial forests). If other civilisation have arisen in our Galaxy, we must ask what has served them in the role of forests and wood. We are not assuming that all life must closely resemble that on Earth, but use the ability of planets to support Earth-type forest ecosystems as a conceptual thermometer to assess habitability and to indicate the kinds of adaptations that would be required in non-Earth-like environments.

Heath, M. J. (1994). Abstracts and presentation. First International Conference on Circumstellar Habitable Zones. NASA Ames Research Center, Moffet Field, California, U.S.A.. Jan. 19 - Jan. 21. Heath, M. J. (1996). The forest-habitability of Earth-like planets. In L. R. Doyle (Ed.). *Circumstellar Habitable Zones. Proceedings of the First International Conference* pp. 445-457. Menlo Park, CA, USA: Travis House Publications.

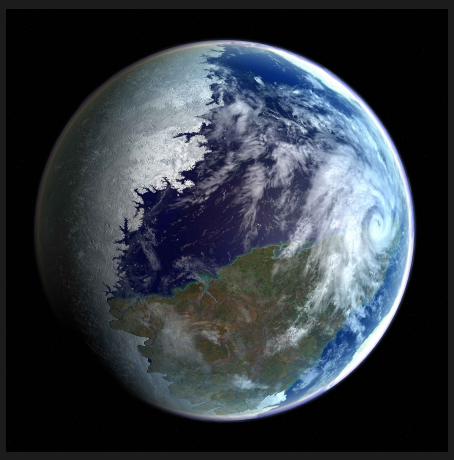
TV projects.

We were consultants and participants on the 2005 two episode Big Wave production *Alien Worlds*, which was based on our published research and we helped to secure funding from National Geographic. *Alien Worlds* won the Royal Television Society (South) award for best factual programme, was the basis of UK Science Museum display, which went on international tour, and was shown in schools to promote interest in science.

Searching for planets of other suns.



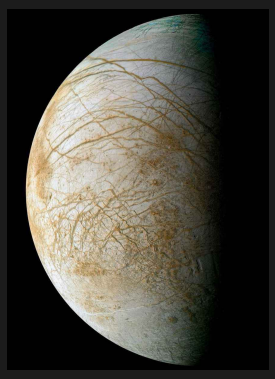
Dr. Laurance R. Doyle of the SETI Institute (USA) played a key role in the first planet search using the transit method. He has also been a participating scientist on NASA's Kepler mission and led the team which, in 2011, discovered Kepler-16b, the first planet confirmed to be orbiting around two Suns. We announced this as the historic first Kepler object to be of potential interest to astrobiologists (previous planets being too hot). The planet itself was a gas giant, but could plausibly have moons able to support life, perhaps microbial-grade life in subsurface habitats. Doyle, L.R. *et al.* (2011). *Science* 333: 1602-1606. Heath, M. J. & Doyle, L. R. (2011). Kepler 16: A system of potential interest to astrobiologists. *arxiv.org/pdf/1111.0002*.



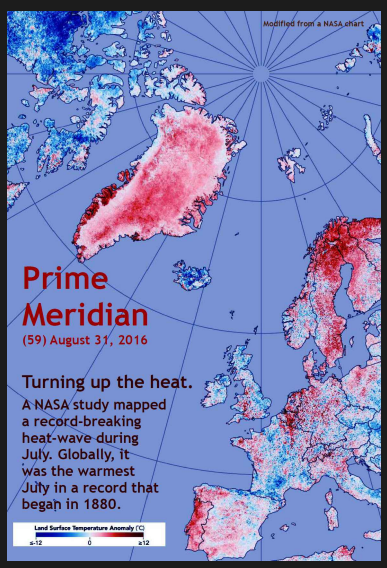
Habitable planets of red dwarf stars.

Despite comprising over 75% of the stars in our Galaxy, red dwarfs had been dismissed as parent suns for habitable worlds. Working with climatologists Manoj Joshi and Bob Haberle, we re-assessed the possibility that planets in tidal lock around red dwarfs might support complex life. Previous work appeared to have over-emphasised the dangers of extreme climate, stellar flares and reduced Photosynthetically Active Radiation in red dwarf sunlight. Today, this is a well-trodden field. A NASA-sponsored workshop was staged by the SETI Institute in 2005. Other workers investigated the ability of Coronal Mass Ejections to strip planetary atmospheres and issues of planet formation and availability of water on terrestrial-type planets in the red dwarf Habitable Zone and we are looking at the implications for the equivalent of forest ecosystems. Heath, M. J., Doyle, L. R., Joshi, M. M. and R. Haberle, R. (1999). Habitability of Planets Around M-Dwarf Stars. *Origins of Life* **29**: 405-424.

Snatching a free gift from an alien ocean.



Jupiter's moon Europa possesses an ocean beneath an icy crust (its thickness is the subject of a major controversy). Our presentation to the Europa Ocean Conference (1996) suggested that if, as is possible in some models, bodies of water can reach the surface, we should expect plumes of water vapour to escape, potentially carrying micro-organisms and their biochemical signatures. These, we argued, might be sampled by a space craft in low orbit. This was an in-principle concept not then supported by new observations or models of plume mechanisms and it was received with scepticism. Recently, a couple of teams have claimed potential observations of plumes from Europa and the possibility of plume sampling has been discussed at a 2015 NASA workshop. Heath, M. J. and Doyle, L. R. (1996). Accessability of Europan Organisms. Presentation to *Europa Ocean Conference, Nov. 12-14, 1996, San Juan Capistrano Research Institute, San Juan Capistrano, California, U.S.A.*.



Prime Meridian - promoting Earth stewardship.

Our newsletter reflects the way in which ecosystems are nested within a hierarchy of physical environments. It has its roots in the parochial as it follows the cycle of the seasons in the woods, fields and hedgerows of SE England, through which runs the longitude 0° Meridian. It looks at global issues and highlights the vital contribution made by scientific research in safeguarding human communities around the world in the face of climate change. It looks at our planet in its astronomical setting and communicates our perspective on the search for other habitable worlds.

http://www.ecospheresproject.org

Images from NASA, NOAA, Big Wave & M. J. Heath.