British Pugwash Discussion Meeting

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Generating clean energy from sunlight and maintaining biodiversity

Professor Peter Weightman

The growth of the human population of the earth and the consequent demand for energy has led to an increase in CO_2 in the atmosphere and a loss of biodiversity that is likely to lead to a "sixth extinction". Both of these developments must be countered, or their consequences mitigated, if the human population is to continue to grow and current lifestyles are to be maintained or improved.

Professor Weightman argued that not only are these two problems linked by human population growth, but that they pose challenges, some of the solutions to which require similar advances in scientific research.

The challenges include the need to improve our existing understanding of the basic physics of chemical and biological processes, and develop new experimental techniques to study them. It is particularly important to study dynamic processes out of equilibrium and to understand the possible role of nanoparticles and nanostructures in capturing the energy in sunlight. "At a theoretical level, scientists need to develop their understanding of how complex systems operate in nature, and of non-equilibrium thermodynamics. These are probably the most difficult problems we face."

Sunlight is one of the few sources of clean energy with the potential to satisfy our needs. Professor Weightman reviewed what needs to be done to realize the potential of several forms of energy generated from sunlight in order to meet future needs for clean energy and maintain biodiversity. He looks to enhanced understanding of natural systems to provide critical insights and tools to address the problems thrown up by efforts to make solar energy a practical and affordable alternative.

Solar power is do-able, but requires more efficient solar cells. He suggested that the development of reproducible nanoparticles would be an effective way to raise cell efficiency At present both photovoltaics and artificial photosynthesis are in the early stages of development but both have, in Professor Weightman's view, great potential. He outlined the potential for third-generation photovoltaics and techniques developed in artificial photosynthesis which could, it is thought, allow photovoltaic cells to repair themselves, as occurs in plants in nature.

The challenges to this solar pathway are still very great but if met, would, Weighman argues, both advance scientific theory and support biodiversity. He argued:

"If we want to understand how biological systems are organised and how we may maintain biodiversity, we have to have a theory of the flow of free energy through this open system. We have to learn how to control the dynamics and the non-equilibrium thermodynamics, which are the same intellectual problems we need to solve to make the solar cells and the artificial photosynthetic systems. Intellectually the problem is the same but what we apply it to is different, so if you make progress in one, you can apply it to the other."