Stephan Harding, who teaches at Schumacher College, and is currently co-teacher with Professor Brian Goodwin of the new one-year taught MSc in Holistic Science, discusses how a scientific understanding of our planet as a living whole can lead to a deeper relationship with nature.

From Gaia Theory to Deep Ecology

by Stephan Harding, resident ecologist at Schumacher College, an international centre for ecological studies. Trained as a field ecologist, Stephan Harding collaborates with James Lovelock on Gaian computer modelling.

The word ‘ecology’ is used by Western scientists to refer to the branch of biology that examines interactions determining the distribution and abundance of living beings. Ecologists go out in the field to quantify nature, to break it down into numbers which are then placed in computers to tease apart the complex inter-relationships in the living world.

These activities are supported and justified by the concept that our universe is a machine, and therefore ultimately predictable and controllable by man. In one of the most brilliant popular expositions of this type of scientific attitude is 'The Blind Watchmaker', by Richard Dawkins, which describes the blind, unconscious process of natural selection which, we are told, has made all the wonderful creatures, or rather ‘mechanisms’ around us.

But running parallel to this mainstream mechanistic view has been another, increasingly marginalised view, that our universe is an organism, a living being. In this view, the ‘machine’ description of our world is seen as inadequate when applied to living things. It is quite clear that machines don’t arise from eggs or seeds, that they don’t rebuild their own parts right down to the molecular level, nor can they convert fuel into their own substance, as living beings do. The human heart, for instance, acts like a pump, but unlike a man-made machine, it is a pump that grows and repairs itself.

Recently the view of our Earth as a living organism has staged a major revival in the Gaia Theory of atmospheric chemist James Lovelock and evolutionary biologist Lynn Margulis. Put simply, they say that the Earth is alive ~ that a life-like quality emerges from the interactions of living beings with each other and with non-living parts of the planetary system (the rocks, atmosphere and oceans). They say that not only does the Earth support individual living organisms and species, but that sum of all these organisms in the Earth’s environment creates a system that is, in itself, alive. Lovelock and Margulis also made the bold conjecture that this living organism, our Earth, is able to self-regulate essential characteristics of its environment, such as the average temperature, the salinity of the oceans, and the mixture of gases (such as oxygen and carbon dioxide) in the atmosphere.

Scientific orthodoxy has rejected the most radical interpretation of Gaia Theory ~ that it is Gaia herself (the living organism of Earth) that is doing the regulating, for the benefit of life as a whole. This view would seem to imply that Gaia has intent and purpose, while scientists consider the whole system to be blind, unconscious and operated by the random interactions of matter. Lovelock himself was greatly troubled by this criticism, and with his colleague Andrew Watson, developed a mathematical refutation

of it in the form of a computer model called Daisyworld.

Daisyworld is a simplified planet which, like our own, circles around a sun whose output energy is ever-increasing. Scattered on the rich, moist soil of Daisyworld are millions of seeds of the only two species found on the planet ~ black daisies and white daisies.

At first, Daisyworld's sun is so cold that it can't warm up the planet to the point where its soil is hot enough to trigger the germination of daisy seeds. But after some time it becomes hot enough for daisies to germinate in large numbers. Because of their colour, the black daisies are able to absorb the sun's energy more effectively than the white daisies, which reflect heat. The black daisies spread because they are able to produce the largest number of offspring.

In dominating the habitable portion of the planet, the black daisies help to warm the atmosphere, thereby making conditions more suitable for life in general. As the sun heats up further, white daisies begin to do better, since by reflecting heat they are able to avoid overheating. By reflecting the heat away from the planet, the white daisies cool the planetary atmosphere.

Over a long period of time on Daisyworld, the temperature of the planet is automatically regulated by the fluctuations in population of the black and white daisies, competing according to the laws of classical Darwinian natural selection. By this example, Lovelock and Watson hoped to show that Gaian self-regulation can emerge completely automatically from a model planet, without needing to invoke mystical forces or some sort of Gaian consciousness, pre-cognition, or any goal-directed behaviour on the part of the system.

Critics point to the over-simplicity of the Daisyworld model, which they say can't tell us much about the vastly more complex real world. They ask for real-life examples of Gaian self-regulation. To answer these criticisms, it's worth taking a look at the way carbon dioxide concentrations in our atmosphere are regulated, and at the way clouds are formed.

The only natural source of atmospheric carbon dioxide, the notorious greenhouse gas, in any significant quantity, is volcanic activity (both on land and under the sea). The only natural way in which it is taken out of the atmosphere in any significant quantity is through the weathering of certain kinds of rock. Water reacts with the rocks in the presence of carbon dioxide. In the reaction, carbon dioxide is taken out of the atmosphere and locked up with calcium to form calcium carbonate, which is eventually washed into the sea. Life isn't needed for the reaction to happen, but bacteria and plant roots in soils greatly increase the rate of the process by actively pumping carbon dioxide out of the atmosphere and into the soil, where much more of the gas comes into contact with rock and water than would be the case without the intervention of living organisms. Once in the sea, the resulting carbonates are used by various minute marring algae (in particular the Coccolithophores) to make exquisite chalky shells. These rain down to the bottom of the sea when their tiny occupants die,
thereby safely locking away the carbon dioxide as massive deposits of chalk and limestone. The presence of these tiny living creatures means that the chemicals which made up the atmospheric carbon dioxide are 'processed' by a living being and turn back into rock.

Coccolithophores also play a part in the formation of clouds. When they die, they emit a sulphurous gas called dimethyl sulphide (DMS), which floats up into the air above the ocean surface, producing minute acid droplets. These droplets act as particles on which water vapour can condense, to make clouds. In Gaia terms, the Coccolithophores are therefore a crucial part of a living process which helps cool the

whole planet ~ the clouds reflect the sun's energy away. (Just as the sun's energy is reflected away by the white daisies on Daisyworld.) They are also of vital importance to the survival of trees on the land, as the clouds carry water and sulphur from the sea to the land, where it is dropped as rain. This is what Gaia Theory calls a regulatory feedback loop. The Coccolithophores are one stage of a sequence of events which together act as a Gaian temperature regulator.

These examples demonstrate that living beings have a major part to play in shaping the environment, through the creation and absorption of carbon dioxide and oxygen, and the recycling of nutrients such as sulphur. But these are only two examples. All around us, plants and animals are creating, absorbing, emitting and recycling the essential components of our lives: water, nutrients and gases in Earth's system in a complex and creative process. In this vision of Gaia, it is difficult to accept the traditional ecologist's compartmentalisation of species and chemical interactions. Rather, we must see the Earth as an organic whole, with properties that are observable on the vast scale of the atmosphere and the oceans. This has important implications for the way science is conducted and taught.

To understand Gaia, we must let go of the mechanistic, compartmentalising conditioning imposed on us since childhood by our society. From an early age nearly all Westerners (and especially young scientists) are exposed to the concept that life has come about due to the operation of blind, meaningless laws of physics and chemistry, and that selfishness underpins the behaviour and evolution of all plants and animals. A child's mind becomes totally ensnared by this style of intellectuality, so that the intuitive, inspirational qualities of the mind are totally ignored. The mind's intuitive ability to see each part of nature as a sub-whole within the greater wholes is destroyed by this sort of education. The result is a totally dry, merely intellectual ecology, not a genuine perception of the dynamic power, creativity and integration of nature.

A Gaian approach opens new doors of perception and opens up our vision of the inter-dependence of all things within the natural world. There is a symphonic quality to this interconnectedness, a quality which communicates an unspeakable magnificence. When you stand on a sea-cliff in winter, watching masses of grey cloud rolling in from the Atlantic, a Gaian view helps you understand the cloud in its global context. It has formed due to massive climatic forces and has manifested within a small part of the whole ~ the part you happen to be standing in. The water in the cloud is circling through the water cycle, from rain to river to sea to Coccolithophore to cloud again. As you experience this dynamic, ever-shifting reality, you may suddenly find yourself in a state of meditation, a state in which you lose your sense of separate identity, and become totally engrossed in the life process being contemplated. The contemplated and the contemplator become one.

From this oneness there arises a deep appreciation of the reality of inter-dependence, and from this comes the urge to be involved in opposing all sorts of ecological abuses. Here arises the feeling that what is happening in evolution has great value and a meaning impossible to articulate or to detect via reductionist scientific methodology. This highly developed sensitivity, this experience of radical interconnectedness, is the hallmark of supporters of the Deep Ecology movement, and is the basis for the elaboration of any ecological philosophy, such as the pioneering work of the Norwegian philosopher, Arne Naess, who first coined the term 'deep ecology'.

No student of ecology is ever introduced to this new mode of mental discipline ~ in our schools and colleges. There is no culture of experiencing oneness with the natural world. All one does on an ecology field trip is to collect and measure. Deep contemplation of nature is considered to be at worst a waste of

time, at best something to do during one's spare time.

It can be argued that truly great scientists had this connection, this sense of the greater whole of which they were a part. Without educating this sensitivity, we churn out scientists without philosophy, who are merely interested in their subject, but not thoroughly awed by it. We churn out clever careerists, whose only concern is to make the grade, be the first to publish, be the first to be head of a department, or to split the atom.

It is this kind of training which leads to the mentality responsible for the massive social and environmental mistakes of Western-style development. Trained to shut down our perception of the world so that we see it as a mere machine, we are perfectly free to improve the clockwork for our own ends. We are perfectly free to build huge dams which flood vast areas, perfectly free to log established forests, perfectly free to sanction economic growth at all costs, or to alter the genetic make-up of any organism for our own ends.

Gaian perception helps to remedy this great mental and spiritual plague, a malaise which has arisen in the West and which is now claiming millions of victims, human and non-human, throughout the world. Gaian perception connects us with the seamless nature of existence, and opens up a new approach to scientific research based on scientific institutions arising from scientists' personal, deeply subjective ecological experience. When the young scientist in training has sat on a mountain top, and has completed her first major assignment to 'think like a mountain', that is, to dwell and deeply identify with a mountain, mechanistic thinking will never take root in her mind. When she eventually goes out to practise her science in the world, she will be fully aware that every interconnected aspect of it has its own intrinsic value, irrespective of its usefulness to the economic activities of human beings.

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