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# THE SWEET ONE HUNDRED

## Exploring the Gaia Hypothesis

by

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## 1. INTRODUCTION

### Why I am here

Some months ago, Eddy Goldberg called me and told me about this seminar -a discussion about the Gaia hypothesis. He called me because he knew of the work I had done in Environmental Education, when I was on the staff of the Commission for the Environment; and he wanted to know if I had any ideas on what subjects might be addressed at this seminar, and who might be called upon to present papers.

I was immediately excited by the idea. Although I had only a vague idea of what the Gaia hypothesis was about, I knew that it fell into a broad category of thought about how nature works and how people relate to nature. This is something very dear to my heart because it lies at the heart of the environmental, ecological or conservation debate.

I am drawn into this debate, in the first instance as a botanist: the structure and function of plants, their evolution and geography; nowadays with particular regard to New Zealand plants. However, like many of my colleagues the mere study of plants, for the sake of knowledge, has become insufficient. I am part of a generation that uses knowledge, or science, as a tool for management or social development -not as a method for absolute truth. Science is a language to help people. Hence, my work is directed towards conservation, and in focusing on the needs of conservation I am drawn into a debate on the relationship between people and nature - the facts or impacts of this relationship, the historical factors which influence it, the world views or ethics that underlie it and the means, such as science, with which we understand and use the relationship.

I look around and I am concerned. The relationship is under severe stress. People are stressed, cultures are stressed and nature is stressed. I ask myself what can I do? How can I use my training to help? What ideas can I put forward to others that contribute in a positive and practical way to the issues facing people and nature?

This is why I am here. I believe that the Gaia hypothesis contributes in a positive way to the plight of the Earth and its inhabitants, and I feel privileged to have been forced by Eddy's request to read some literature about it, to think about its validity in scientific and broader cultural terms, and to be able to share these thoughts with you. If I need to seek one word as to why I am here and why I think Gaia is worth talking about, it is education. It is environmental education -Gaia addresses an ethic, contributes understanding and leads to action (Simpson, 1982).

I have been asked to contribute a Western or European perspective on the Gaia hypothesis. I wish to change this: I am not Western nor a European. I am a Pakeha New Zealander. This means that while I might gather ideas and methods and influences from the rest of the world, these are uniquely interpreted according to the particular physical cultural qualities of my home - my place. If there is one overriding thought that underscores the problems of the world it is placelessness, a lack of identity, a lack of understanding of who we are and where we belong, not only of our culture here in New Zealand, but of our species as a whole.

## 2 THE SWEET ONE HUNDRED

I have chosen to call this paper "The Sweet One Hundred so as a final introductory comment I would like to explain its significance. Despite our objective exterior, people are moved by strange forces, numbers among them, and there is no number more significant as a threshold of achievement than one hundred. My "Sweet One Hundred" is a tomato, a variety which I have growing on my land in Takaka and which I heard Alison Holst praising the other day on radio. It's healthy, it's beautiful, it's delicious and it bears lots of small fruit: it's a people's tomato designed to be grown at home and eaten, not as a factory commodity for profit. It's a tribute to the science of plant breeding to have foresaken corporate pressures and produced something of real value for ordinary people.

Its a change that is sympathetic to Gaia. But I have chosen the "Sweet One Hundred for another reason too, for it reminds me of Ken Keyes book "The Hundredth Monkey", a story and line of enquiry that I think is consistent with, and will one day be show to be an integral part of, Gaia theory. The Hundredth Monkey principle is about the spread or tranference of ideas, attitudes or actions without direct contact between the individuals concerned but when a certain threshold of concentration is reached. It is the manifestation of "an idea whose time has come", an expression of Jung's "collective unconscious" or, in particular de Chardin's "noosphere", the envelope of life consciousness around the Earth. It is inconceivable to me that the interconnectedness that is the cornerstone of modem ecological thought and of the Gaia hypothesis does not also involve consciousness.

I will return to the "noosphere" later, but I mention it now because I want you to know where I am coming from. As a scientist I am cautious about accepting metaphysical forces as real. I do not wish to mystify the world as a means of resolving problems. Lovelock says in his latest book (Lovelock 1988) that the destruction of the English countryside can be blamed on the scientists and agronomists. I believe these scientists were operating under a particular world view. I repeat - science is a tool for social development not an unconditional search for truth. I believe that the emergence of the Gaia hypothesis, the Hundredth Monkey principle, Sheldrake's morphic resonance theory (Sheldrake 1981, 1984, 1988) and others indicate a desperate need for new ethics, new understanding and new types of action. If this means broadening the perspective of science, I am all for it.

## 3. THE GAIA HYPOTHESIS

**Definition:** The Gaia hypothesis postulates that the atmosphere, the oceans, the climate and the crust of the Earth are regulated at a state comfortable for life and because of the behaviour of living organisms.

(My emphasis)

(Lovelock 1979).

James Lovelock formulated this hypothesis while working for the United States Space Programme, faced with the question of how to test for the presence of life on Mars. He asked himself the question "How do I recognise the presence of life on Earth?", and to find the answer, focused on the Earth's atmosphere. He was intrigued to find that the composition of the atmosphere could not possibly exist as it is without ongoing rejuvenation which stabilizes the levels of carbon dioxide, oxygen, nitrogen and other gases. By comparing Earth with Mars and Venus, and applying the laws of thermodynamics the Earth was seen to be aging in a unique way - it was not running out of energy, it was not overheating and it was not drying out. While changes have occured as a result of aging or collision with meteors, Earth has maintained or quickly regained its stability. This self-regulation, maintains, is through automatic positive feedback changes, goal-directed towards the optimum conditions for life, although not sentient.

The most obvious manifestation of this change lies in the fossil record. As outlined in his book "The Ages of Gaia" Lovelock (1988) brings together evidence from a variety of disciplines to provide an overview of the history of Earth. Very briefly, he identifies the following ages:

1 Origin of the Earth from a super-nova which created our solar system about 4.8 billion years ago.
2 The Archean Age from 4.5 to 2.5 billion years ago during which (at about 3.6 billion years ago) life evolved in the form of anaerobic photosynthetic bacteria. The chief impact of this age was the reduction of atmospheric carbon dioxide resulting in cooling of Earth, and the generation of oxygen.
3 The Proterozoic Age from 2.5 to 0.57 billion years ago in which aerobic plants and animals evolved including the evolution of cells which enabled the growth of complex organisms.
4 The Cambrian Age from 0.57 billion years to the present time, characterised by the presence of large and complex animals and plants both aquatic and terrestrial; for instance, trees.

There is nothing in this broad sequence that contradicts accepted understanding. Perhaps the most astounding fact, based on fossil evidence and radio-isotope dating is how soon after Earth's origin, life evolved. Lovelock maintains that Gaia was born as soon as physical conditions enabled life to evolve and to establish widely in the oceans and freshwater environments.

It is on the impact that life had on the physical Earth itself where the Gaia hypothesis breaks new ground. I cannot deal with this in detail but some salient points are as follows:

1. Photosynthetic bacteria consumed carbon dioxide reducing the greenhouse effect and enabling cooling. Cooler conditions, the photosynthetic production of water and reduced ultraviolet radiation following the formation of oxygen and ozone all contributed to protect the oceans from evaporation.

2. The precipitation of Calcium carbonate was facilitated by living organisms so that massive sedimentation occurred (eg. to form the oldest fossils -stromatolites). This is considered to be important in generating movement of the Earth's crust along continental margins and establishing plate tectonics - subduction and mountain building. I find this one of the most exciting aspects of the Gaia hypothesis.

3. As the sun's heat increases with its age, the earth is kept cool by reducing the greenhouse gas carbon dioxide through photosynthesis. As the carbon dioxide concentration diminishes new C4 plants have evolved to operate at a lower carbon dioxide threshold.

4. A vital ingredient for life on land, sulphur, is carried from the sea in sulfide, derived from algae. Sulphur, as sulphuric acid, is a major component of the nuclei involved in the condensation of water vapour to form cloud which not only diminishes solar heat but also produces rain. Life in the sea influences life in the forest.

These are examples of planetary cycles that identifies in support of the Gaia hypothesis. They result in some general principles. For instance:

1. The Darwinian concept of adaptation, while generally supported, is incomplete because both species and environment are tightly coupled as a single indivisible process. Lovelock calls this process "geophysiology".

2. Such coupling facilitates more rapid recovery after perturbation and there is enhanced ability to regulate when there is a high level of species and environmental diversity.

3. Because life and environment together regulate for comfortable conditions there are long periods of stability punctuated by periods of rapid change rather than a progression of change.

4. Lovelock's use of the term "geophysiology" focuses attention on process, interconnectedness and the whole in much the same way that medical physiology does. Hence, he recognises the discipline of "planetary medicine" which is clearly appropriate in considering the global impact of humanity on Earth.

5. The interconnectedness also means that there is no strict division between life and non-life, but rather a continuum. This concept leads us to one of the most fundamental principles of all - that Gaia is a living system made up of all the living things and their environment.

6. Finally, the life-environmental coupling identifies the existence of constraints or bounds that establish the limits of life. While there are optimum or preferred states, life can exist in more extreme conditions through particular sets of feedback mechanisms operating within a narrow range. It is understanding of these limits that Raymond talks of emerging when people live in an area for a long period of time and develop a sense of place (Dasmann 1976). Lack of this understanding can lead to ecological disasters.

## 4. The Significance of Gaia Principals

What can we take from the Gaia hypothesis and the principles flowing from it to help understand the Earth and our relationship to it?

1. It is a further step in the evolution of ecology. As outlined by di Castri (1981) ecology has undergone a number of changes since identified as a science last century. Ecology began as the study of single organisms, or species, in relation to their environment. It progressed this century to the study of communities and food chains. In the 1940's the concept of ecosystems was introduced, followed by awareness of interconnections between ecosystems to form the biosphere. The latest phase was recognition of the human dimension in the functioning of ecosystems.

   The Gaia hypothesis takes a further step by describing life and the planet as a singly entity, essentially living through the automatic regulation that takes place in order to optimise conditions for life.

2. The Gaia hypothesis is an explicit statement about interconnectedness. Not only is life and the physical environment functionally linked, but all the "spheres" form a continuum. This makes humankind an integral part of the earth. Our impacts are not inherently different from any other and will be responded to by Gaia like any other. The hypothesis helps us to understand that all our activities take place within nature, that we are not extraterrestrial aliens, and that Earth is our home.

3. This is particularly important with regard to resource use. The underlying purpose of the hypothesis is to establish a planetary perspective on the potential hazards of the current degree and kind of resource use: extinction of species, pollution of water and air, burning of fossil fuel, removal of forests. These phenomena are placing stress on the stability of the ecological system in which we evolved. The ozone layer and global warming are current issues of international concern. Drought, soil erosion and starvation are constant reminders of resource loss. Isolation in cities is destroying our ability to understand the origins of food and shelter.

   The Gaia hypothesis is a planetary expression of sustainability, a concept now at the forefront of international and national debate. The United Nations has agreed in its 42nd General Assembly that nations, governments, organisations and all enterprises should have sustainable development as a central guiding principle.

4. Such steps are needed because most people lack an ethical or spiritual dimension that identifies them with other living things and the environment at large. Science itself has fostered a separatist ethic by discouraging awareness of connections between disciplines and encouraging concepts of growth and superiority over nature. The English language attests to a competitive relationship rather than one based on mutual benefit.

5. Lastly, in relation to the need for a new world view, the Gaia hypothesis lays a foundation for changed approaches to understanding ourselves and nature. Gaia is a powerful stimulus for science to investigate ecological connections such as the

noosphere, and the recently discovered W-waves in plants (Wagner 1988). The science of sustainability demands appropriate technology, ecocentric rather than egocentric methods of farming and fishing. The politics of scarcity has barely touched the western world as yet, and we have a long, long way to go before the harmony we aspire to can be attained.

Gaia offers us a clue.

## 5. CONCLUSION

I would like to conclude by asking how the Gaia hypothesis relates to New Zealand and New Zealanders. We are obviously part of the whole, but there are particular aspects of unique importance. Our proximity to the hole in the ozone layer makes planetary geophysiology specially important to each of us. New Zealand has a unique set of physical and biological characteristics which seem to exaggerate human impacts. Extinction of species is exceptionally high as a result of their sensitivity to animals, including people, and the loss of habitat. Forest removal has vastly increased the already high natural rate of erosion in our hills and mountains, as the recent cyclone Bola demonstrates. In resource use we have tended to ignore the need for sustainability.

Yet, the people of New Zealand are strongly motivated to conserve, in recognition of the uniqueness of our resources, our dependence on them and our isolation from outside problems. Maori have a conservation ethic at the heart of their world view, and many pakeha have developed a strong sense of place after only a few generations in residence. The sweet one hundred is bearing fruit but only a few of them are ripe.

I will conclude as I began: the Gaia hypothesis offers educational insight. It provides a foundation for a new ethic on the relationship between people and nature, it provides objective understanding of ecological connections and human impacts, and it provides stimulus and direction for actions -for research, for technology, for sustainability, for personal development.

As Lovelock concludes, living with Gaia is a personal responsibility for ensuring a healthy planet for future generations.

## 6. REFERENCES


Raymond 1976: Biogeographical provinces. *The CoEvolution Quarterly, Fall 1976:* 32-37.

di Castri, Francesco 1981: Ecology - the genesis of a science of man and nature. *Unesco Courier April 1981:* 6-11.

Lovelock, James 1979: Gaia. A new look at life on Earth. Oxford University Press, xi + 157 pp.

- - - - - - - 1988: The Ages of Gaia, Oxford University Press, xx + 252 pp.

Sheldrake, Rupert 1981: A new science of life. London Granada, 236 pp.

- - - - - - - 1984: Form and origin. *Resurgence 103:* 6-10.

- - - - - - - 1988: The Presence of the Past. Collins, pp 391.

Simpson, Philip 1982: Environmental Education: A philosophy for a dynamic land. *The Landscape, April, 1982:* 11-15

Wagner, Orvin. 1988: W-waves, News Item, "Morning Report", February 9, 1988.