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EDITORIAL

In September, 1991, the Geographical Association of Zimbabwe held its biennial conference in Harare. The theme of the conference was *Global Environmental Issues with Special Reference to Zimbabwe* and we take special pleasure in publishing, in this issue of GEM, some of the papers presented at that conference. Unfortunately, several of the papers presented have not yet been submitted for publication but, hopefully, they will be available for the September issue. It seems to have been generally agreed that the conference was a success, with a good attendance of teachers from all over the country. There were interesting poster presentations from Falcon College, the Mashonaland Hunters Association and the Zambezi Society. All in all, a useful few days were spent in Harare by geography teachers. We look forward to this year's workshop, organised by the Bulawayo Branch and to be held at Quiet Waters Conservation Area.

It was with regret that, in 1991, we bade farewell to Dr Richard Whitlow, who has left Zimbabwe to take up an Associate Professor's post at the University of the Witwatersrand. Richard has been a steady contributor to GEM and his papers have always been valuable. However, the good news is that he has left several papers behind for future editions and we publish one of these, on physical geography and the systems approach, in this issue. I am sure that he will be prevailed upon to continue to write for GEM in the future.

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March 1992

INTER-RELATIONSHIPS IN THE GLOBAL ENVIRONMENT

by

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Key-note address delivered at the Geographical Association of Zimbabwe's 1991 Conference on *Global Environmental Issues with Special Reference to Zimbabwe*

It is very recently in the history of humanity that we have begun considering environmental issues on a global scale. This is not only because we have recently realised that humanity is making a significant impact on the global environment, but mainly because it has been very difficult to get the complete subject in view. At the scale of the individual person, the global environment is a very large thing that cannot be fully understood from an Earth-bound perspective. This problem is analogous to that of trying to appreciate and understand the artistry of a large oil painting or tapestry, when standing only a few inches away from it. We no longer have this excuse, however, because modern man is now able to step back and see the full picture. In the present stage of the space-age it is possible to view the entire planet Earth in exquisite detail, like a small organism under a microscope.

The Earth is presently surrounded by numerous orbiting satellites of various kinds, and manned space flights no longer make headline news. This is a unique instant in the history of life on Earth, not just because humanity has reached such a high point in technological development, with all its material benefits, but for more significant reasons. Firstly, it has suddenly happened that living organisms can leave Earth and travel through space in a viable form, like spores through the air. Secondly, astronauts and space technologists have provided humanity with a complete view of Earth as it really is. This view of Earth is remarkable in that it confirms what Earth-bound geographers predicted about the shapes and relative positions of continents, islands, and other surface features. But we now have a new perspective of the Earth, which includes more than just its size, shape and appearance. It is this new perspective that is probably the most significant product of the space-age to date.

The Earth is relatively small on a galactic scale but is visibly very different from all other known planets, and this difference is all owing to a fine layer of life on the surface, thinner than dew on an apple. This layer, the biosphere, is now the subject of growing concern to humanity, which unhappily finds itself to be an integral part of the biosphere. The reason for concern is that humanity has become aware that its own actions have been influencing the biosphere, and the physical environment of the biosphere, in ways that humanity is now beginning to think might be harmful to the healthy and continued existence of humanity itself. Resulting from this concern is a groundswell of environmental consciousness, fuelled by a variable mixture of clear logic, aesthetic appreciation, scientific endeavour, and the preachings of environmental zealots.

The term 'Environmentalist' has become a label for a certain category of people that have an almost religious conviction about the way in which they and all others should behave for the sake of 'The Environment'. The attitudes and actions of many of these people are quite understandable since there is no doubt that humanity has altered the

global environment, and is continuing to do so in ways that are detrimental to humans and other species. I feel that it is important, however, that environmental scientists do not drift into the same category and become priests of the environmental movement. Scientists are not qualified to advocate changes of behaviour or life style to the public although, as ordinary people, they are obviously entitled to their own strong opinions. It is up to the informed individual to decide on his or her own environmental values while it is the responsibility of environmental scientists to inform the global community (to the best of their abilities) of the potential environmental consequences of each available course of action. The above distinction might seem trivial to some, but if the problems of the global environment are to become even half-way solved, the credibility and objectivity of environmental scientists will be crucial.

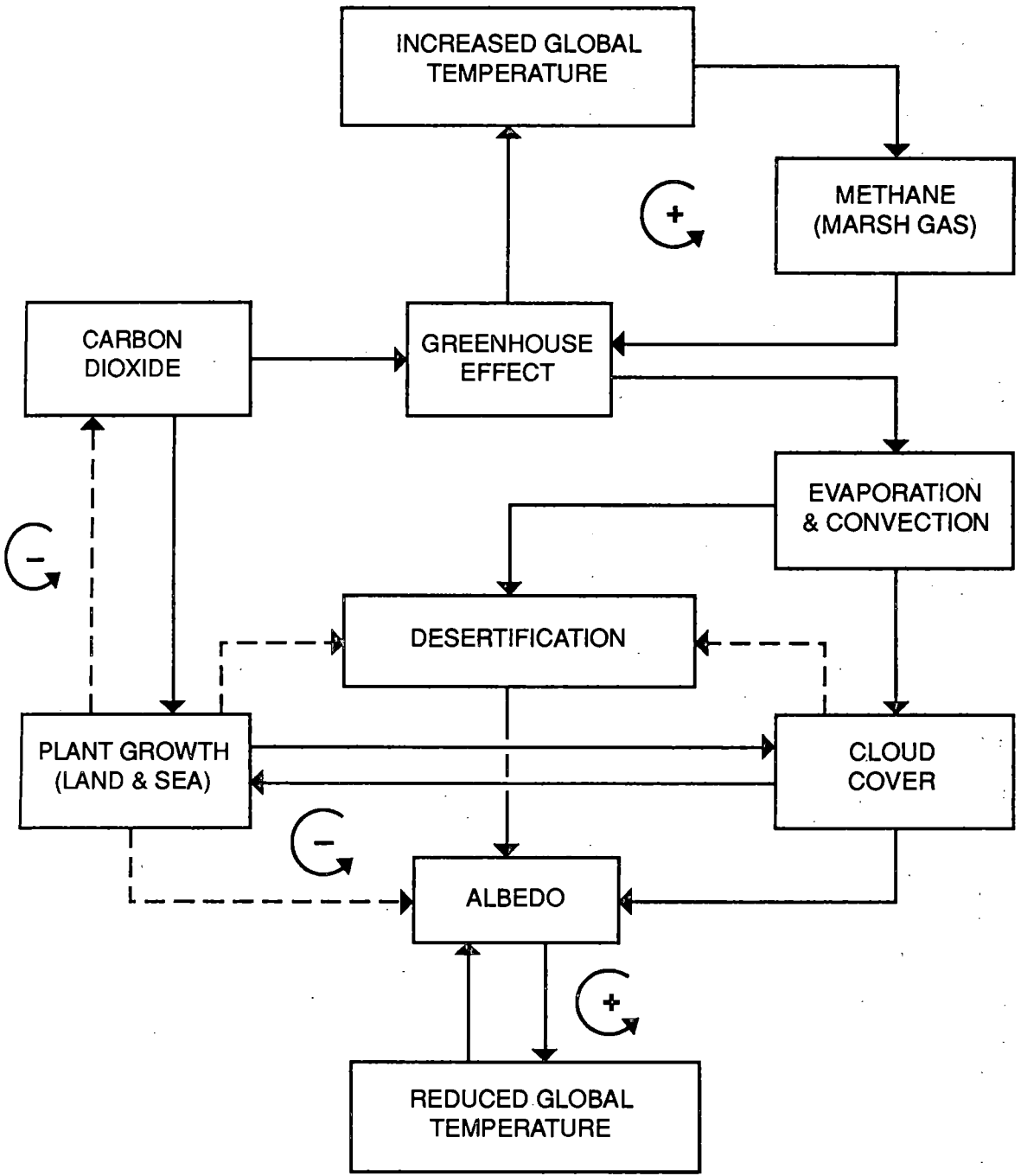
One group of environmental scientists have snatched at the opportunities of the space-age and developed a whole new approach to understanding inter-relationships between life and the physical environment on Earth. This approach is embodied in the 'Gaia hypothesis' (Lovelock, 1979), by which the Earth is viewed as a complete unit of life in itself, given the name 'Gaia' (the Earth Goddess of Greek mythology) for convenience. The hypothesis predicts that Gaia is a complex entity involving Earth's biosphere, atmosphere, oceans and soil. The totality constitutes a cybernetic system that maintains an optimal physical and chemical environment for life. In other words, the physical and chemical condition of the surface of the Earth, of the atmosphere, and of the oceans, is actively made healthy and comfortable **by the presence of life itself**. This is in contrast to the conventional hypothesis that life has adapted to the planetary conditions as they exist and have existed through evolutionary time.

Over the past decade the Gaia hypothesis has developed and gained recognition among environmental scientists (see Myers, 1985), mainly as a useful model against which observed global patterns and processes may be compared to stimulate further research.

Evidence for the Gaia hypothesis is most convincingly found in the behaviour of the atmosphere, which is more similar to a biologically derived layer around an organism, like the fur of a cat, than a purely physical layer like a synthetic blanket. Fossil evidence shows that the average climate of the Earth has been almost constant since the origins of life, 3.5 billion years ago, despite significant fluctuations in solar radiation and changes to the Earth's surface. Also, the chemical composition of the atmosphere is not in chemical equilibrium, but is somehow maintained in a steady state. This means that if the atmosphere could all be captured in a glass tube and separated from the biosphere, it would change radically from its present state as it settles into equilibrium through the reduction and oxidation of its component gases. Finally, according to the fossil record, the climatic and chemical properties of the Earth have been **continuously** optimal for life from the time that the biosphere originated. The probability of this being a chance combination of randomly interacting physical processes is equivalent to the probability of a blind-folded commuter surviving a high-speed drive through rush-hour traffic.

It would appear that Earth/Gaia has various homeostatic properties, and a good example is the regulation of average global temperature through the opposing actions of the greenhouse and albedo effects (Figure 1). The greenhouse effect presently appears to be responsible for global warming, and is created by a mixture of atmospheric gases, mostly carbon dioxide and methane. These allow incoming solar radiation to pass through the atmosphere and warm up the surface of the Earth, but tend to inhibit outgoing radiation from Earth to space. The albedo (or 'whiteness') effect is created by the reflective features of the Earth such as clouds, snow, ice, and desert sands. The Earth's albedo

Figure 1: A simplified model of the feedback linkages that control the average global temperature. Solid arrows denote positive effects, dashed arrows denote negative effects, and circular arrows identify positive (+) and negative (-) feedback loops.



reflects solar radiation back into space, and thus tends to allow global cooling through a net increase in outward radiation.

Given enough time, and without interference from man, a rise in carbon dioxide in the atmosphere would be countered by increased plant growth, mainly in tropical forests and in oceanic algal blooms. Also, the increased global temperatures that would result from the greenhouse effect would promote evaporation (creating some desertification) and convection currents, leading to increased cloud cover, and consequently increased albedo. This albedo would then be countered in turn by the increased plant growth (stimulated by carbon dioxide and rainfall from the clouds), which tends to darken the continents and oceans. Plants are thus key components of two negative feed-back loops that on the one hand reduce the greenhouse effect through their actions as a carbon dioxide sink, and on the other hand reduce the albedo effect by darkening the Earth's surface.

The question arises, given such convincing evidence for the cybernetic system of self-regulation embodied in the Gaia hypothesis, whether our concerns about the global environment are unfounded. They probably are unfounded if we are purely concerned with the survival of the biosphere in any form, regardless of whether it includes humans or not. The total eradication from Earth of life in all its forms will probably require more than the actions of mere humans, and, since the evolution of humans is a relatively recent event in the history of life on Earth, we know that the biosphere can get along fine (and probably better) without us. We must, however, be concerned if we wish to maintain a planet that is comfortable for continued human life. The growth of the human population, when considered at geological or evolutionary time scales, is equivalent to an outbreak of cancer. Moreover, the rate at which deforestation, greenhouse gas emission, and ozone-layer depletion is taking place is incompatible with the rate at which the cybernetic system of Gaia can respond. This raises concerns about the potential for two alternative scenarios, which are presently purely hypothetical, but are worrying in that they entail rapid and uncontrolled heating or cooling of the Earth to disastrous extremes. In the one scenario high carbon dioxide emissions and deforestation create a greenhouse effect that raises temperatures at high latitudes, so that bogs in the tundra regions warm up and release vast quantities of methane through accelerated anaerobic decomposition of accumulated organic matter. The methane reinforces the greenhouse effect and so a positive feed-back loop (Figure 1) is established, driving global temperatures increasingly higher. The alternative scenario is that even if carbon dioxide emissions are controlled but deforestation and desertification are not, the albedo effect will lower global temperatures so that ice caps expand and snowfields cover wider areas and take longer to melt. This could trigger another positive feed-back loop that makes the surface of the Earth increasingly reflective and winters increasingly colder.

An additional concern is that some of Gaia's corrective measures, even if they do kick in, in time, might not be pleasant for a great many people. Global temperatures that maintain a constant average but oscillate between wide extremes might be worse than a gradual change in the average. Finally, given the importance of plant life and its supporting pollinators, decomposers, seed dispersers and so on, the rapid and uncontrolled destruction of biodiversity that is presently underway is equivalent to dismantling the life-support system of a space-ship and throwing the parts away. Gaia's organs are being vandalised.

Nevertheless, the projections of doom and gloom should not obscure the fact that humanity is different from a cancerous growth because humanity has the power of self-regulation. If the self-regulating ability of humanity does kick in, it will be recognised in the form of population control, sustainable development, protection and rehabilitation of

biodiversity, and global cooperation in environmental conservation. Happily for us nervous passengers on this 'space-ship Earth', there are good indications that the self-regulating abilities of humanity are beginning to twitch into life, and it is a waiting game to see how fast and effective these abilities are. Perhaps we should not even wish humanity to act with such haste, since recent debates among experts on the global environment have concluded that the presently optimal strategy for the greenhouse problem might be to do nothing more than improve the quantity and quality of available information on the problem through research (Ausubel, 1991). The rationale is that human responses to the greenhouse problem will have to entail such a huge economic commitment that it might be dangerous to lock into the best available option at present (e.g. replacing all coal-driven thermal power stations with nuclear reactors) at such a large investment that it precludes the ability to adopt better options that may arise through technological advances in the near future. Finally, recent advances in commercial satellite communication systems have created a 'global village' in which information flow is extremely fast and efficient. This situation is favourable for the promotion of a global understanding of environmental problems and, coupled with a relaxation of tensions between the super-powers, international cooperation in problem solving.

Not losing sight of the Zimbabwean focus of this conference, I would like to conclude with a brief review of the options available to Zimbabweans who would like to give Gaia a hand. Unfortunately, due to the small size of Zimbabwe when measured both geographically and economically, there is actually very little that we Zimbabweans can do on our own to influence the environment on a global scale, although I believe there are two ways of confronting the problem. Firstly, Zimbabweans would be well advised to improve their understanding of the global environment, especially with respect to predictions on climatic change. The importance of agriculture to the Zimbabwean economy makes it essential that local agricultural research is adequately maintained and contingency plans are continually revised to ensure that farmers adapt to climatic change with new crop varieties and appropriate agronomic methods. Secondly, Zimbabwe can join and encourage other developing countries in voicing a united appeal to the developed countries that they adopt a more responsible attitude toward the global consequences of industrialisation. The 'Earth Summit', which is the UN Conference on the Environment and Development in Rio de Janeiro in June 1992, and to which Zimbabwe is sending a delegation, will be the ideal forum for this purpose.

Despite the fact that Zimbabweans will just have to learn to live with changes to the global environment, there is much that can be done to address the looming environmental problems within Zimbabwe itself. These problems are almost all related to rapid population growth, and can only be tackled with programmes and policies aimed at population control, conservation education, and sustainable development.

Sustainable development is development to the state of sustainability, by which the needs of the present are met without compromising the ability of future generations to meet their own needs. In developing countries, the goal of attaining sustainability by the early part of next century will only be reached if at least a 3% growth in per capita income can be maintained (MacNeill, 1989), together with socio-political stability and technological innovation, mainly in the context of improved use of renewable resources. The requirements for economic growth and socio-political stability are paramount because poor people that are hungry and ravaged by civil unrest are the last people that can be expected to make meaningful provisions for future generations. Lastly, but most importantly, national environmental and economic planning has to cover realistic time-scales; not just the working life-times of the incumbent decision-makers. All this really requires is some foresight and responsibility, which should be nothing new. Indeed, the guiding ethic of

sustainable development was elegantly expressed in the latter part of the last century by an unnamed American Indian, when trying to reason with a US government official who was eager to tame the American West. 'The land belongs to a great number of people', he said, 'many are dead, some are living, and many are yet to be born'.

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