Vernadsky and Biospheral Ecology*

by

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1. INTRODUCTION: GLOBAL ECOLOGY, THE BIOSPHERE, AND VERNADSKY

For most people, the rise of global ecology (e.g. Bolin, 1979; Budyko, 1980, 1986; Southwick, 1985) — the ecology of the whole of Earth’s Biosphere — dates mainly from the earlier 1970s (Polunin, 1972), as it was at that time of "environmental revolution" that the realization of our complete dependence on our planetary Biospheral environment started to become a widespread in enlightened circles. Such realization of the truth has latterly gathered more and more momentum, but never in sufficient volume or fast enough to satisfy its most dedicated adherents or, we fully believe, the best interests of our world.

During the 1980s, the idea that The Biosphere could be seriously, even drastically, disturbed by a nuclear conflict or mere accident, became a new subject of international concern. Interdisciplinary study by ICSU’s SCOPE **, and others, of the global environmental consequences of nuclear war followed, with much-needed international scientific collaboration. The so-called 'nuclear winter' is a resultant, important argument emphasizing the interconnections of all the parts of The Biosphere. The human demomass thus turned some of its concern from the face of the Earth to the fate of Earth’s Biosphere.

But, as we know, The Biosphere — the initial letters of which we capitalize thus to dignify our only known natural habitat in the cosmos — is also threatened with many other major ecological disasters (Polunin, 1980; 1987a, 1987b; Ramade, 1987), such as that of stratospheric ozone depletion (e.g. Duitsch, 1987; Gribbin, 1988; Rowland, 1988), the increasing concentration of carbon dioxide and other 'greenhouse' gases in the atmosphere (with probable effects on global climate, heightened by deforestation and other devegetation) (e.g. Flohn, 1980), the continued destruction of the world’s tropical forests with extinction of many plant and animal species at an unprecedented rate and concomitant dramatic losses of genetic diversity (e.g. France & Elias, 1977), and yet other looming ecodisasters (Polunin, 1980; Polunin & Burnett, in press).

The Man-made threats to The Biosphere which we share with all living things are very real, though often pitifully little recognized. Yet all nations and peoples are concerned, as we have indeed ‘Only One Earth’ (Ward & Dubos, 1972). Our planet is a very peculiar one, basically because of its unique and hitherto ever-evolving Biosphere; but many points illustrate the fact that this scientific concept of The Biosphere is not yet familiar, unfortunately, to the vast majority of people†.

In the development of this all-important concept and reality of Earth’s Biosphere, the historic figure and work of Vladimir Ivanovich Vernadsky (1863-1945) must take pride of place as the first, far-sighted pioneer. Yet it is a striking and deplorable fact that Western scientific culture,

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We now understand that this, slightly reworked, version of our paper will be published in Russian by the USSR Academy of Sciences but that this publication of the English version following due refereeing will be welcomed by our hosts on that memorable occasion.

** ICSU being the acronym standing for the International Council of Scientific Unions — in several senses the world’s top scientific body — SCOPE is the acronym for its Scientific Committee on Problems of the Environment. — Ed.

† This unhappy and potentially dangerous situation may, however, be changing with such newsworthy ‘scars’ as the aforementioned one to the stratospheric ozone layer (Rowland, 1988) and the announcement since this Kiev Session that the DuPont Company, which is by far the world’s largest producer of chlorofluorocarbons, is starting soon to phase out their production. — Ed.
2. Conceptual and Terminological Confusion

An early point to clarify is the plurality of different meanings that have been associated with the term biosphere in scientific literature. For us The Biosphere is the... integrated living and life-supporting system comprising the peripheral envelope of Planet Earth together with its surrounding atmosphere so far down, and up, as any form of life exists naturally.* This concept, stemming from Vernadsky's work until the 1980s. Thus in a review of the recent English translation of Vernadsky's The Biosphere, the English atmospheric chemist James E. Lovelock declared: 'When Lynn Margulis and I introduced the Gaia hypothesis in 1972, neither of us was aware of Vernadsky's work and none of our much-learned colleagues drew our attention to the lapse. We retraced his steps and it was not until the 1980s that we discovered him [Vernadsky] to be our most illustrious predecessor' (Lovelock, 1986).

3. Vernadsky and the History of Ecology

Although neglected by many historians of ecology and of science in general, Biosfera (The Biosphere), published by Vernadsky in 1926 in Russia, in 1929 in France (Vernadsky, 1929; cf. Grinevald, 1986), and in 1930 in Germany, is, we believe, a major landmark in our intellectual history and global understanding. In it Vernadsky adopted a new scope of perception, viewing The Earth as a 'living planet' in the solar system, and presenting the concept of The Biosphere as a 'scientific revolution'.

Now we are wondering whether, in the manner of the Wegenerian revolution' proposed in 1968 by the Canadian geophysicist 'Jock' Tuzo Wilson (Wilson, 1968a, 1968b), we should not think very seriously about a 'Vernadskyan revolution' to embrace his vast concept, which could effect...

* See also page 177 of this issue, whereon is recorded the enthusiastic approval of this definition by 'an audience of some 320 (apart from the platform party) including foreign participants of the Vernadsky Commemoration described on pp. 187–9 of this issue. — Ed.

* Subsequently done and carried by acclamation as the first of the Vernadsky Commemoration "Round Table Resolutions" ..., as described on p. 177 of this issue. — Ed.
tively lead to major advances in environmental education and ultimately in world well-being. At least such a Biospheric revolution of thought should constitute an important, special facet of the environmental movement, as we suggested in Leningrad. Our Earth is mobile, dynamic and 'living'; we must understand our global environment as a whole — to improve our capacity to detect and respond to warnings of any major change. This is a new challenge for the international scientific community.

The fact that Vernadsky was the first natural scientist, in the 1920s, to define The Biosphere within a very modern thermodynamic and biogeochemical perspective, despite some mistakes due to the state of science at the time, merits our respectful gratitude, and should be widely acknowledged. In the manner of at least one other vital concept which we are not at present at liberty to divulge, the basic theme was too simple to have attracted attention until Vernadsky advanced it, and even then it was very slow in taking root at all widely.

The links between Vernadsky and modern ecological thought are now at last well inscribed in the history of ecology. His work also had links with other fields, including economics (Vernadsky, 1924, 1925; Grinevald, 1987b; Martinez-Alier, 1987). Nor is it our task to speak about the influence of Vernadsky on Russian ecology and the environmental movement in the Soviet Union. We recall here only the relationship between Vernadsky's biogeochemical concept of The Biosphere and the concept of the 'biocoenose' developed by the Russian plant ecologist Vladimir Nikolaevich Sukachev and his school of thought (Sukachev & Dylis, 1968; Fortescue, 1980).

In the English-speaking countries, G. Evelyn Hutchinson provided the missing link between Vernadsky's work and ecology. At Yale he was a close colleague of the Russian naturalist Alexander Petrunkevitch (a former pupil of Vernadsky) and a friend of the late George Vernadsky, the scientist's historian son. Another supporter of this theme was Raymond L. Lindeman [1916–42], author of the notable article entitled 'The trophic–dynamic aspect of ecology' (1942), who was also an associate of Hutchinson at Yale. In this contribution to ecosystem ecology, written seven years after the British plant ecologist Sir Arthur G. Tansley [1871–1955] had coined the term ecosystem (1935) for his new concept, Lindeman explained his trophic–dynamic viewpoint, emphasizing the energy-flow and nutrients' cycling within a whole ecosystem as being closely allied to Vernadsky's biogeochemical approach already adopted by Hutchinson; and Vernadsky's La Biosphère was included in the literature which Lindeman cited.

In an autobiographical book, G. Evelyn Hutchinson wrote, 'I did my best to help Petrunkevich and George Vernadsky [to] make his V.I. Vernadsky's ideas about the biosphere better known in English-speaking countries' (Hutchinson, 1979 p. 233).

A man of unusual foresight, Hutchinson was also instrumental in the publication in America of two of Vernadsky's works, George Vernadsky being the translator. The first work was under the editorship of Hutchinson himself and was published in 1944 in the Transactions of the Connecticut Academy of Arts and Sciences (Vernadsky, 1944); the second, more diffuse, entitled 'The Biosphere and the Noosphere', was published in American Scientist in January 1945 with the following footnote: 'The sad news of Academician Vernadsky's death on January 6, 1945, has reached us in going to press.' In a foreword the Editor (Hutchinson?) wrote this laudatory tribute: 'The two contributions together present the general intellectual outlook of one of the most remarkable scientific leaders of the present century' (Vernadsky, 1945a). In addition, Hutchinson published several studies of biogeochemistry, which he treated as a new science (Vernadsky, 1945b) created by Vernadsky (Hutchinson, 1943), while at the 1948 AAAS symposium on 'The World's Natural Resources', he provided a wide intellectual framework for an 'anthropogeochemistry of cultural life' under the significant title 'On Living In The Biosphere' (Hutchinson, 1948).

4. Importance of the Concept of Biosphere

There can be no question of the vital and vast significance of the concept of Biosphere in our modern world, even as its actuality provides almost all the components of the life-support of Man and Nature. Yet, looking back historically, it seems extraordinary indeed that nobody appears to have had, or anyway developed and published, these ideas until they were so clearly enunciated by Vladimir Ivanovich Vernadsky less than 70 years ago. And now The Biosphere is emerging as a vital overall reality that we need to maintain intact and cherish perhaps even more ardent than any particular part or factor of our planet's terrestrial or aquatic surface.

To be sure, the approximate limits (Vernadsky, 1929) to which life extends naturally up in the atmosphere as spores and yeasts etc. (e.g. Polunin et al., 1947; Polunin, 1951) and down in the lithosphere as chemosynthetic Bacteria (e.g. Winogradsky, 1949; Margulis & Sagan, 1987), have only become known relatively recently, and, from their very nature, must remain imprecise. So must the dependent limits of our Biosphere, though it has long been known that they include the deepest depths of the oceans and ocean troughs. There has also been the unfortunate confusion of other interpretations to which we have already referred. But such questions are largely academic, and do not detract from the vast importance of the concept of the great thinker.

Suffice it to say here that, after The Universe, The Biosphere is in several respects probably the greatest reality with which we, as humans, have to deal; and yet we are threatening it in many ways, of which most stem basically from our increasingly too-great numbers and profligacy. We should also beware that, from some of the changes wrought by humans, the dangers lie in their subtlety, so that they are liable to be overlooked until the period is too late for remedy, whereas others appear drastically, even sud-
denly, after reaching a threshold or being triggered unexpectedly.

5. Necessity of Safeguarding The Biosphere
In view of what we have just been digesting, it is clearly one of the greatest imperatives of our time, and indeed of all time, to safeguard The Biosphere and maintain its integrity in every possible way. Concerning this we recently held a conference entitled ‘Maintenance of The Biosphere’ (Polunin, 1987b; Polunin & Burnett, in prep.), which was followed by a tour around the world talking about our choice of 20 ways in which it seems ‘Our World [is] Menaced’ and, with it, The Biosphere (Polunin, 1987c).

Fortunately there are, nowadays, increasing numbers of enlightened people and even governments who understand the situation and realize its potentially extreme gravity. This, albeit belated, realization has been helped by the information ‘media’ making much of nuclear possibilities and, latterly, of various threats to the stratospheric ozone shield, to the world’s climates through the so-called ‘greenhouse effect’, and to what remain of the world’s great forests.

Fortunately, too, much is now starting to be done to counter these and others of the more obvious threats to The Biosphere’s integrity — we can only hope in time, and press for it to be prosecuted with sufficient dedication and speed. But then there are the less obvious dangers, such as increasing desertification, and doubtless others that have yet to emerge. For instance who, only a few years ago, would have thought that the stratospheric ozone shield could be seriously threatened with depletion; and yet it is one of the conditions without which life could scarcely have developed on Earth, at least as we know it, and without which its equitable maintenance would be problematical at best. Yet human overpopulation remains the greatest basic threat.

6. Towards Recognition of The Biosphere and Her Problems
Nearly a decade ago there came to us, from Canada, Dr John R. Vallentyne with the idea of an International Year of The Biosphere, which in time developed into The World Campaign for The Biosphere (Anon., 1982; Pauling et al., 1982; Polunin, 1982, 1984). In its quiet way this has been, and continues to be, quite widely supported — not least by issuance of special ‘Save Our Biosphere’ stickers and sports-shirts from India, and by various publications and demonstrations there and elsewhere. Meanwhile, as ‘Johnny Biosphere’, Vallentyne continues to speak before enthusiastic audiences practically world-wide — commonly with a symbolic globe on his back (Vallentyne, 1984), whence emanate telling ‘Biospheral’ noises. He now reckons that he must have been seen in the flesh or on television, or anyway heard on the radio, by a considerable proportion of the people now living on Earth, and meaningfully, stems from the writings of V.I. Vernadsky in the 1920s but has only emerged and become widely accepted in the latest decades. Yet it is quite one of the largest and most important entities with which humans have to deal, being, moreover, the only natural habitat and life-support of Man and Nature and, as such, needful of safeguarding and healthful maintenance.

Another threat which an international group of us founded some years ago is the World Council For The Biosphere (WCB), which has recently been expanded with the adoption of its own Constitution though remaining under the general aegis of the Foundation for Environmental Conservation. Its main objectives are to (A) alert decision-makers to potential threats to the integrity of The Biosphere especially from human activity, and, whenever and wherever possible, recommend measures to counter those threats; (B) advise on ways to improve the sustainability of desirable economic systems while maintaining the integrity of the ecological systems that form the main bases of continuing human activity and productivity; (C) foster ecologically sensitive thinking and action, bearing in mind the holistic nature of The Biosphere, in which each and every part should contribute to its overall functioning; (D) investigate the limits and validity of key assumptions underlying predictions especially regarding the integrity of The Biosphere; (E) warn against specific dangers to The Biosphere, including major pollutions, breakdown or malfunctioning of Man-made devices, and misguided practices; (F) promote the World Campaign for The Biosphere as a global, primarily educational effort to increase public awareness and understanding of The Biosphere and our utter dependence on it, and (G) advise the International Society For Environmental Education (ISEE) and its national and other affiliates on leading concepts and critical issues to be considered in their development of educational materials and programmes for decision-makers, the young, and the general citizenry, throughout the world.

To conclude we’ll merely mention one more item to come, provided only that we can find the necessary finance — a Fourth (and for its organizer final, at least as regards primary responsibility) International Conference on Environmental Future, this time on the theme of Threats to The Biosphere and Imperative Countermeasures. Such a conference should form a useful part of the above-suggested Biospheral revolution of thought inspired by Vernadsky. May we add one simple belief: what we should really look to — worship if you will — is not some hypothetical deity but life itself. As suggested on page 177 of this issue, such an objective could give to the [International] Vernadsky Foundation a highly positive thrust.*

**Summary**

The concept of The Biosphere as the integrated living and life-supporting system comprising the peripheral envelope of planet Earth together with its surrounding atmosphere so far down, and up, as any form of life exists naturally, stems from the writings of V.I. Vernadsky in the 1920s but has only emerged and become widely accepted in the latest decades. Yet it is quite one of the largest and most important entities with which humans have to deal, being, moreover, the only natural habitat and life-support of Mankind and Nature and, as such, needful of safeguarding and healthful maintenance.

No other meaning than the above should be attached to the term Biosphere, the importance of which concept and actuality being such that it should be far more widely known than is currently the case — to which end a small conference was held in 1987 and a larger one is contemplated in 1990 on the theme of Threats to The Biosphere and Imperative Countermeasures.

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* This Foundation was established on the final day of the Vernadsky Commemoration as indicated elsewhere in this issue (Polunin, 1988a, 1988b).
Other activities on behalf of The Biosphere include the ‘Johnny Biosphere’ media campaign of Dr John R. Vallentyne, those of The World Campaign for The Biosphere and its sponsoring World Council For The Biosphere, and the newly-established [International] Vernadsky Foundation which it is hoped will have, as one of its main objectives, the fostering of due reverence for life in its full Biospheral context.

REFERENCES


POLUNIN, Nicholas (1988b). Jubilee events dedicated to Academician V.I. Vernadsky’s 125th Birthday anniversary, including


TEILHARD DE CHARDIN, P. — see CHARDIN, P. Teilhard de


WINOGRADSKY, Sergei Nikolaevich — see WINOGRADSKY, S.


