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## Vladimir I. Vernadsky (1863–1945), founder of the biosphere concept

Published online: 25 August 2001  
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### Introduction

The great Russian scientist and philosopher Vladimir Ivanovich Vernadsky (1863–1945) first published his famous book, *The biosphere*, in Russian in 1926. Just in this thin book (only 146 pages) the Earth's biosphere was for the first time shown to be an integral dynamic system controlled by life. As Lynn Margulis and Dorion Sagan wrote, "remarkably, Vernadsky dismantled the rigid boundary between living organisms and a nonliving environment, depicting life globally before a single satellite had returned photographs of Earth from orbit. Indeed, Vernadsky did for space what Darwin had done for time: as Darwin showed all life descended from a remote ancestor, so Vernadsky showed all life inhabited a materially unified place, the biosphere" [13].

In 2001, the 75th anniversary of the first Russian edition of *The biosphere* took place (a list of its later publications in six European languages is given in the paper by M. Piqueras [15]). This celebration was a good occasion to trace whether Vernadsky has been widely recognized as the founder of the "biosphere" concept, which is one of the basic concepts of modern bio- and geosciences.

### Vernadsky's lifetime publications in foreign languages

During Vernadsky's lifetime, about 15% of his works were published in foreign languages. In the 1920s and 1930s, his book, *Essays on geochemistry*, was published in French (1924), German (1930) and Japanese (1933)

and his seminal book, *The biosphere*, in French (1929; see bibliography of Vernadsky's works [12]). In the main European languages, Vernadsky's articles were published first in French (42 articles), then in English (17) and in German (15).

Significantly, Vernadsky's lifetime publications in German and particularly in French were more representative and important than any in English. His basic books on geochemistry and the biosphere concept, along with many major articles on various topics were published in French and German, whereas only brief articles, rather than books, were published in English at that time (for more detail see [10]).

Nevertheless, among these English publications there was an article – "A plea for the establishment of a biogeochemical laboratory" – which was published as early as in 1923 and which coined a new term, "biogeochemistry". Also in English were published two long articles on the biosphere concept, namely, "The fundamental matter–energy difference between the living and inert natural bodies of the biosphere" and "The biosphere and the noosphere" [18], which were published in the USA in 1944–1945 during the last 2 years of Vernadsky's life (for a list of Vernadsky's main English-language publications concerning the biosphere, see [25], p. 159). As was mentioned in an editor's remark to the latter, "the two contributions together present the general intellectual outlook of one of the most remarkable scientific leaders of the present century" ([18], p. 1).

Until the 1960s, V.I. Vernadsky was famous in Russia and abroad as a mineralogist and a geochemist rather than as a founder of the biosphere concept [11]. In fact, at that time his fundamental publications concerning the biosphere remained *vox clamantis in deserto*. The next translation of *The biosphere* into a foreign language published after the French translation (1929) appeared more than 30 years later, in 1960, in Serbo-Croatian; and a German translation of his swan song, the short article "Some words on the noosphere", only appeared in 1972 ([20]).

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### **Vernadsky's followers and propagandists in Western countries, 1940–1980**

From 1940 to 1980, in Western countries there were several followers and propagandists of Vernadsky's biosphere concept. Without doubt, George Evelyn Hutchinson (1903–1991), “the father of ecology”, was the most illustrious of them [5, 7].

G.E. Hutchinson never met V.I. Vernadsky personally, but in the 1940s and until 1971 he worked at Yale University together with V.I. Vernadsky's son George Vernadsky, who was a professor of Slavic languages and an historian. One of V.I. Vernadsky's students, the zoologist Alexander Petrunkevitch, who was the son of one of Vernadsky's nearest friends, Ivan Petrunkevitch, was also at Yale. In the mid-1940s, George Evelyn Hutchinson, George Vernadsky and Alexander Petrunkevitch prepared, for publication in English, two of V.I. Vernadsky's basic articles on the biosphere, mentioned above.

Later Hutchinson remembered: “Vernadsky had a strong influence on some aspects of my research and I did my best to help Petrunkevitch and George Vernadsky make their ideas about the biosphere better known in English-speaking countries” ([9], p. 233). In turn, Vernadsky wrote in a private letter in 1944: “My son's friend, Hutchinson, who has much to do with geochemistry and biogeochemistry and has several followers now, has initiated a new branch in this field” ([21], p. 204). In another letter, Vernadsky elaborated this subject concerning Hutchinson and his followers: “They will outperform us” ([2], p. 67).

As to French-speaking countries, an active follower and propagandist of Vernadsky's biosphere concept, in the 1960s and 1970s, was the Belgian ecologist Pierre Duvigneaud, who together with M. Tanghe published an important book, *Ecosystemes et biosphere* [4]. It is pertinent to note that the native language of Duvigneaud was French, a language in which a lot of Vernadsky's works concerning the biosphere were published.

In 1971, UNESCO organized a long-standing international program “Man and the biosphere”. Vernadsky's ideas are embedded in this program and his basic works were quoted in some of the program documents.

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### **The invisible Vernadskian revolution in the 1980s and 1990s**

It was not only until the second half of the 1980s that the popularity of Vernadsky's biosphere concept spread all over the world. The Swiss historian of science, Jacques Grinevald, has called this process “the invisible Vernadskian revolution” [8]. A possible reason for this phenomenon might be that, in 1988, Vernadsky's 125th

anniversary was widely celebrated in the former USSR and other Eastern European countries. On that occasion, many publications about Vernadsky's biosphere concept appeared not only in Russian but also in English, German, French and Spanish [10]. Also during that period, Jacques Grinevald, working in Geneva, Switzerland, published his first work on the history of the concept of biosphere [7]. Grinevald, who is a French speaker, had the same advantage over English speakers as Duvigneaud had. As to the USA, the first abridged version of *The biosphere* by Vernadsky was published there in 1986. In 1990, K.E. Bailes published a book on Vernadsky that became well known [3].

The interest in Vernadsky's scientific heritage is increasing all over the world. During the 1990s, *The biosphere* was published in the West four times, namely in Italian (1993), French (1997), Spanish (1997) and English (1998; the first complete annotated edition in English) [15, 25]. Another great book by Vernadsky, concerning a holistic philosophical approach to the biosphere, *Scientific thought as a planetary phenomenon*, was republished in Italian [22], German [23] and English [24]. In addition, *The biosphere and noosphere reader*, with a foreword by Mikhail Gorbachev [16], was published recently. It contains many of Vernadsky's writings and other information concerning his biosphere concept. A major contribution that credits Vernadsky for making biosphere theory was covered in the world's first encyclopedia of the biosphere, published recently in Catalan in Barcelona, Spain [1].

From this discussion, it may appear that Vernadsky's biosphere concept has become well known all over the world during the last few years. Unfortunately, there is also a fly in the ointment. According to the *Science citation index* for 1998 [17], there were only 19 citations of Vernadsky all over the world that year. So, it emerges that, even during the past few years, Vernadsky is quoted only rarely (except in Russia and other CIS countries), whereas Charles Darwin had 446 quotations during the same period.

Consequently, in spite of numerous modern publications of Vernadsky's works concerning the biosphere, his work still remains inadequately known to Western scientists. For example, during a discussion in the 2nd Chapman Conference on the Gaia hypothesis in Valencia (19–23 June, 2000), a graphic phrase “life as a geological force” was quoted as an innovation by Westbroek [26]. But it was not P. Westbroek, but V.I. Vernadsky who wrote the following as early as the beginning of the 1940s: “Living matter is the most powerful geological force, growing with time” ([19], p. 127). At this conference, C.M. Fiorilla had an original poster entitled “Is granite a Gaian rock?” [6], but she did not quote Vernadsky's famous statement that “the granitic envelope of the Earth is the area of former biospheres” ([18], p. 7).

So, even anonymously, Vernadsky remains, as Fred Pearce wrote [14], “green from the grave” until now.

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## Conclusions

Although, essentially some of Vernadsky's major books on the biosphere concept, such as *Essays on geochemistry*, *The biosphere* and *Scientific thought as a planetary phenomenon*, and a great deal of his important articles on this topic have already been published in the main European languages, Vernadsky is still not as well enough known as he should be in the West. To put the contemporary situation concerning Vernadsky's popularity on a world-wide scale in a graphic phrase, one can say that the dinner table has already been laid, but the guests are arriving late. So, let us learn, discuss and quote Vernadsky's great scientific heritage.

**Acknowledgements** The author wishes to thank Dr. George Levit (Carl von Ossietzky University of Oldenburg, Germany) for providing him with helpful information on the numbers of Vernadsky's and Darwin's citations in 1998 and Mrs. Tatiana Reus (VSEGEI, St. Petersburg, Russia) for her thoughtful correction of the English text of the article.

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