

OXYGENOLOGY AS A NEW DISCIPLINE IN THE ENVIRONMENTAL SCIENCES
(a proposal for discussion)

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Oxygenology can be defined in the most general terms as the scientific discipline dealing with oxygen and phenomena connected with the existence and the role of oxygen in nature on Earth. It is a branch of environmental sciences comprising problems of generation, absorption, transport, storage, turnover, functions and measurement of oxygen in the environment. The origin of the name of this new discipline is analogous to that of hydrology.

The necessity for identifying oxygenology as a separate branch of science is justified not only by unique role of oxygen as the most abundant component of the lithosphere and an exceptional component, on the cosmic scale, of the atmosphere of our planet, but also by the need for a holistic approach to the oxygen related problems faced in aquatic, wetland and dryland ecosystems because of their common nature and structure.

Oxygen is an environmental component which plays an essential role in the life of all macroorganisms, in the survival, vitality, and composition of many populations of microorganisms and the type of their metabolism, as well as in the biochemical and chemical processes occurring in the biotopes *i.e.* in the abiotic part of the ecosystems.

In the proposed discipline which is limited only to Earth's oxygenology (*i.e.*, without extraterrestrial oxygenology related to other planets), the following branches can be distinguished in contemporary oxygenology (that is, excluding paleooxygenology concerning the previous geological periods in the history of Earth):

1. Oxygenology of the atmosphere comprising problems of oxygen production, distribution, turnover, absorption in the atmosphere as well as formation, distribution and reactivity of ozone in the troposphere and stratosphere, *etc.* In atmospheric oxygenology such research areas as *e.g.* tropospheric oxygenology and stratospheric oxygenology can be distinguished.
2. Aquatic oxygenology or hydrooxygenology can be defined as the oxygenology of the hydrosphere. It deals with problems of oxygen formation, absorption, storage, transport, distribution and transformations in aquatic media. Within hydrooxygenology, the following subbranches can be distinguished:
 - ocean oxygenology,
 - lake oxygenology (limnooxygenology),
 - river oxygenology.

3. Oxygenology of the lithosphere comprises processes of absorption, distribution, supply, transport and the role of oxygen within the lithosphere especially in its most active part which is the pedosphere. Here some special research fields can be defined for example:

- oxygenology of natural wetlands,
- oxygenology of natural drylands,
- oxygenology of anthropogenic systems (agroecosystems, landfills, recultivated areas, waste water treatment plants, storages of agricultural materials...).

4. Oxygenology of biota or biooxygenology can be defined as the oxygenology of living organisms. It is focused on the effect of availability of oxygen in the environment on living organisms as well as on the studies of absorption, roles and transport of oxygen within organisms themselves. Within biooxygenology, the following branches can be distinguished:

- zoological oxygenology (zoo-oxygenology),
- phyto-oxygenology (oxygenology of plants),
- microbial oxygenology.

It should be stressed that the number of publications devoted to oxygenologic problems is steadily increasing. As an example in soil oxygenology the textbook „Soil Aeration and its Role for Plants” makes reference to more than 820 publications [1]. The publication of Sojka and Busscher, [3], presenting the dynamics of the increase in the number of publications devoted to soil oxygen studies (in our terms to soil oxygenology), gives the total number of papers for the period of 1950-1985 as 1300 which tends to increase dynamically (1955-65: - 170 papers, 1965-75: - 310 papers, 1975-85: - 790 papers). A similar situation exists in the field of oxygenological studies in aquatic ecosystems. The existence of symposia organized or coorganized by the International Society of Anaerobiosis [2,4] and many papers related to oxygenological issues in international meeting devoted to soil science, horticulture, agrophysics, *etc.* confirm this.

Oxygenology is a science related to already well-defined disciplines such as: hydrology (oceanology, limnology, potamology),

geology, soil science, chemistry, physics, physicochemistry and biology (physiology, zoology, botany, microbiology, *etc.*)

As a consequence of recognizing oxygenology as a separate branch of science, the following advantages are expected:

- acceleration of progress in research in fields dealing with similar problems in different types of ecosystems and their elements;
- unification and standardization of notions and terminology which has been facing some difficulties. For example, notions such as soil aeration, soil ventilation, oxygenation, oxic and anoxic processes, aerobiosis and anaerobiosis which are often discussed *e.g.* in the above quoted book of Gliński and Stępniewski [1], can be redefined more precisely. It should be also stressed that the terms aerobiosis, anaerobiosis, anaerobes, anaerobic *etc.* are rooted in the period of time before oxygen had been discovered by Priestley and Sheele (in 1772), and the terms oxibiosis, oxic organisms, *etc.* better reflect the essential role of oxygen.

There are many measurement methods already available for the study of oxygenology. These include:

- gas diffusion coefficient in soil,
- soil respiration rate,
- root respiration rate,
- field respiration and gas exchange,
- redox potential and redox processes (reduction of nitrates, sulphates, hydrogen fermentation, methane fermentation, methane oxidation),
- soil redox resistance,
- gas exchange through plant tissues,
- gas production and absorption in soil,
- gas production and absorption in hydrosphere,
- oxygen turnover in the biosphere (O_3 , O_2 , isotopic exchange),
- nitrogen turnover in biosphere (N_2O),
- carbon turnover in the biosphere (CO_2 absorption and production),
- H_2S formation and evolution,
- sulphur turnover (SO_2 , H_2S),
- PH_3 evolution.

Some sampling techniques had been developed and are being developed especially to study oxygenological problems *e.g.*: sampling of the atmosphere, of waters and of soil as well as measurements *in situ* in these media.

It can be concluded that oxygen - related studies in the environment present a vast and rapidly - growing research area characterized by:

- a) proper research subject,
- b) specific methodology,
- c) specific theories and hypotheses,
- d) possibility of further development, and
- e) a substantial amount of accumulated knowledge which is increasing.

All of this leads to the conclusion that oxygenology should be identified as a separate discipline within the environmental sciences.

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