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LIMNOLOGY, THE SCIENCE OF LAKES?

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The increasingly closer inter-relationships and inter-actions among the scientific disciplines are the main characteristic of current knowledge and development of natural and societal phenomena. And as important keep piling up, numerous new branches of science are emerging.

Limnology, though no longer a young science since it was founded 100 years ago, falls in line with these trends.

In the beginning, when lakes were the object of study of this discipline, research focused on *morphographic* and *morphogenetic* aspects. Therefore limnology had an obvious geographical character. In time, as the stress was being laid on the volume of water in the lake, on the *water balance*, on *physico-chemical* and *biocoenotic* particularities, also *hydrological and biological* aspects come into the spotlight.

With the upsurge of the biological research of lakes ever more biologist would become attracted to this domain, Limnology become synonymous with the hydrobiology of fresh continental waters. It is not a general view, but it is common among biology specialists (Forel 1901; Gâştescu 1967, 1971, 1972, 1979, 1998; Goldman&Horne 1985; Hutchinson 1957).

On the other hand, geographers, geologists, hydrologists and other researchers whose preoccupations with the study of the Earth are inter-connected, assert that Limnology is the science of lakes (Melvin 1959).

As a result, there is a permanent situation of confusion and disputes because some maintain that *Limnology is the science of lakes in their entierthy that is both geographically and biologically*, while others uphold it to be the science of the life developing in fresh continental waters (rivers, lakes and springs). The first represents the geographical-hydrological research trend.

Confusion in limnological issues does not stop only to delimiting and classifying the branches of science, but spills over to the methodology and content of scientific results as well. Thus, according to the biological outlook, Limnology makes a distinctive approach to rivers which form a *lotic (rheophile*) environment and to lakes which constitute a *lentic* environment. In this way, the *biocoenoses* developing in rivers (rheophile) have altogether different traits that those existing (*limnophile*). These biocenoses are the outcome of different variables of the *hydric regime*, which requires distinguishing the research methodology from the very outset.

In our view (see Gâştescu 1967, 1971, 1972, 1979, 1998), *Limnology should be circumscribed to its initial domain, that is the study of lakes*. And this is not because of a conservative stance, but because of the necessity to set things right in an area of complex, surging research. Complex research is demanded by the need to know and rationally manage water resources which is not are individual endeavour but calls for close collaboration based on a unitary methodology.

Therefore, proceeding from Limnology is the science of lakes, let's see to what extent it inter-connects with other scientific disciplines.

The definition of the lake as object of limnological study, basically of the relatively stagnant water volume within a depression on land that has a certain *trophic potential*, leads one to an association of three components:- *the depression - rather a negative form;- the water – a product of climate par excellence*; - the *biocoenoses – faunistic and floristic associations.*

Taken separately, these three components represent study domains of individual disciplines, namely, *Geomorphology - depression, Hydrology – water, Biogeography and Biology – biocoenoses.*

True enough, the above sciences can make separate approaches to the lake, the results being used to elucidate particular aspects, but fall short of a complex lake analysis as part and parcel of the geographical environment.

As unitary geographical entities, natural and man-made lakes are capable (under the influence of chemical and biological factors) to transform substance and energy. From this viewpoint, *lakes can be considered ecosystems, within which water is in permanent motion and transformation from organic to anorganic and the other-way-round.*

The biotope of the lacustrine ecosystem is the lacustrine depression and the water. They constitute the environment of energy transformation, a process resulting in the formation of *biohydrocoenoses*. *Biotope and biohydrocoenoses together form the lake ecosystem, which is open one.*

This characteristic of the lake ecosystem is revealed by its capacity to permanently receive energy from the outside and release it therein. This energy helps it to develop and pass successively into several stages, each with its own *physiography, physico-chemical particularities and biocoenoses.*

It follows that Limnology is an independent science that studies the lentic continental environment but relies mainly on three disciplines: Geography, Hydrology and Biology, alongside Geology, Chemistry, Physics and others.

The geographical study covers the lacustrine depression, the morphometric elements, silting rate and especially the relationship between the lake as a whole and the physico-geographical factors of its environment. Hydrology deals with the water volume, the hydric balance, the thermal regime, hydrochemical particularities, and water dynamics. Biology (Botanics and Zoology) looks at the flora and fauna, the characteristics of the biocoenoses and their evolution trends.

These aspects are analysed by specialists with the methods specific to each of the respective sciences. Ensuing studies will deal with Physical Limnology (Geography of lakes) and Bilogical Limnology (Biology of lakes).

Making a distinctive approach is required by two considerations: 1) in the present stage, limnology specialists *per se*, trained permanently in the light of the lacustrine ecosystem concept, are missing, what we have are geographers and biologists engaged in lake research; 2) the development of Limnology means also analytical research-work by component parts.

The objective outcome of analytical research is the accumulation of a volume of factual material which enables the study of *limnological typology*, one of the major problems Limnology is posing to-day.

Limnological typology goes beyond the classification of lakes on such criteria as lacustrine cuvette, water, thermal and chemical regime, as well as trophic potential.

For a long time now, Nauman's classification was paramount in Limnology. His Classification had in view trophicity in terms of the main lake categories: *eutrophic, oligothrophic and dystrophic.*

Many biologists adopted the *trophic criterion*. This is indeed a very important indicator of limnological typology. Some lakes are salty and very salty, but they cannot develop floristic and faunistic associations, which mean that their trophic potential is extremely low or missing altogether. Other lakes, in a first phase of existence, have not all the traits of the lentic biotope, nor their relationships with the geographical environment fully shaped out besides their trophic potential is low.

Speaking about Romanian limnological classification in his work *Terra* (1930) the well-known geographer Simion Mehedinţi say's: "*the lake is not only temperature, nor is it only matter oxygen, alone etc., it also has form, depth, colour, physical and biological composition, …..all of which are inter-related. So, in order to get closer to the reality of nature, lakes should be classified not by a single criterion, but by a group of characters, that is*, *by a formula of convergence*".

It goes without saying that the criteria used in defining limnological typology should enable the inclusion and classification of all lakes on Earth, whether in a first or last phase of evolution, whether fresh or salty, situated at the Equator or in the arctic zone (Brezeanu&Gruiţă 2002; Dussart 1966; Gâştescu 1998).

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