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ECOTECHNOLOGY, ECOTECHNICS OR ECOLOGICAL BIOTECHNOLOGY

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Since the 1972 UN Conference in Stockholm, as a result of the ever growing demands of human society, ecology has witnessed a rapid development - from a theoretical science to one with profound practical implications which has received the generic name of Applied Ecology. Within it, during the last 2 decades, ecotechnologies have made great progresses, i.e. the activities of managing or restoring the ecosystems affected by various human impacts. These ecotechnologies, incorrectly called ecological biotechnologies, were grouped by the author into ecotechnics, a distinct branch of applied ecology. In the present paper these notions are clearly defined and the domains in which ecotechnologies have been developed so far are specified.

During the last century ecology progressed extremely rapidly, from a branch of the biological sciences it became an interdisciplinary science with deep implications not only in the field of biology but also in various branches of the sciences of nature, of the technical sciences or the socio-economic ones (Figure 1) (5, 6, 11).

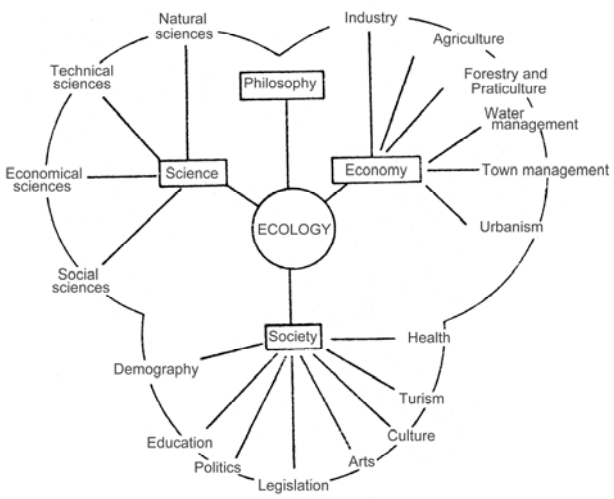

Fig. 1. The relations of ecology with the main fields of human activities

The issue of ecology has permanently widened alongside with mankind's awareness of the limited character of the resources, the emergence of the concept of sustainable development, the process of economic globalization, the expansion of human impacts at the regional and planetary level. As a result, from a predominantly theoretical science, ecology has had to change and become closely involved with the most varied human activities (5, 10).

From among the ecologists, a pleiad of specialists emerged, who understood that it was necessary to broaden the ecological concepts, to more closely unite the immediate needs or the long-term ones with the needs of the people. This is how the concept of applied ecology emerged, which in its turn differentiated into numerous sub-branches, such as agroecology, forest ecology, aquaculture ecology, human ecology, the ecology of the territory, the ecology of diseases and pests, etc. (Fig. 2) (6, 7, 11).

At present ecology has solutions and is able to offer them on a multitude of human activities, such as:

- the optimization of the management of natural and improved land (how much to obtain, when and in what way, how to cultivate the agricultural land, how to restore the quality of soils, how to introduce new varieties of wild plants or of genetically modified ones and under what circumstanc
- the prevention and struggle against humidity in excess, the saltiness of the land, putting an end to land-sliding, the securing of a vegetal carpet adequate for the various regions from the climatic, pedologic and hydrologic points of view;
- the optimization of the activities in agriculture, forestry and zootechny, the extension and diversification of aquaculture, the acquiring of products with higher nutritive contents and at the same time devoid of pollutants or of synthetic compounds or of nutrients in excess, the struggle against diseases, pests, immigrant and anthropophile organisms having negative impacts on man and domestic animals;
- the use of naturist methods in the prevention and treatment of diseases, the extension of balneotherapy, of the natural methods of prevention and control of people's health;
- the intensification of the range of activities related to environmental protection (the preservation of nature, pollution prevention and control, the development of ecological restoration and recovery, etc.).

In all the cases, applied technology;

- raises awareness on a situation, a case, a phenomenon or an issue,
- shapes the process,

- offers interdisciplinary solutions
- contributes to their achievement,
- finds out the effects of the steps taken and offers corrective measures, and
- allows the monitoring of the process for various durations of time.

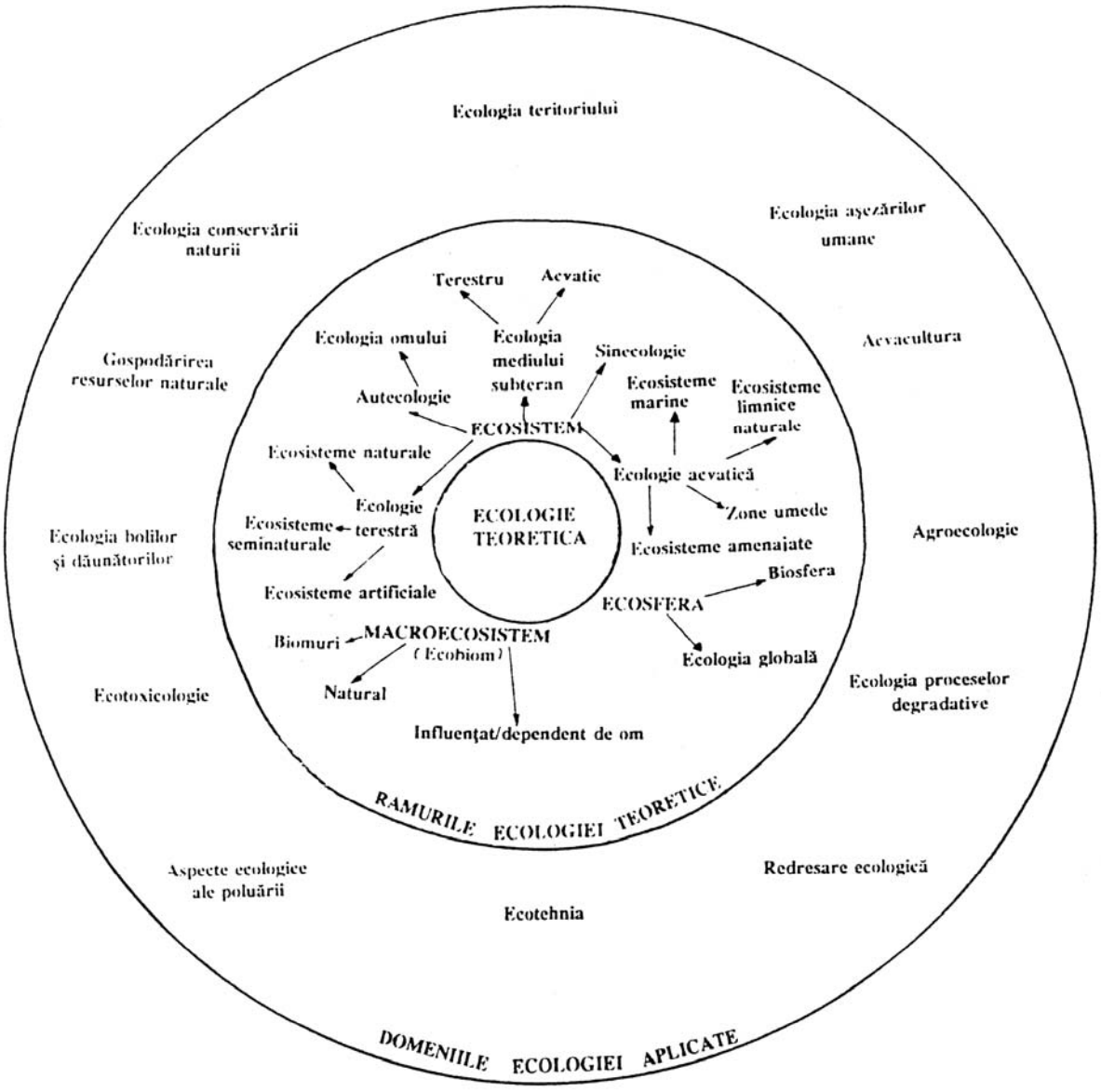

Fig. 2. The subdivisions of ecology seen as an interdisciplinary science

Mankind, consciously or not, has affected, modified or destroyed various life environments, has determined a decrease of the natural renewable resources; this fact has led to the emergence of a current of opinion which considers that since man has destroyed, he must also restore (7, 8, 9, 11).

The activities of redressing and restoring the environment are analyzed in close relationship with the engineering activities, which use various technological means. These activities have been given the generic name of ecotechnologies (9, 12, 13).

Since ecotechnologies are extremely diverse, they may be grouped into a special field which has been called Ecotechnics ever since 1998 (7). It comprises all the technical activities based on the ecological concepts of restoring the balance in ecosystems or groups of ecosystems and which are solved by technical means. Ecotechnics is based on the knowledge of the principles underlying the natural ecological systems and it transfers this knowledge to manage them, so that the cost and damage to the environment should be minimal. The starting point in ecotechnics is that man and nature's interests cannot be dissociated, since man is a part of nature and he cannot develop in the future without taking care of the surroundings, in all their complexity. Therefore, the more man shall take care and manage the environment, the better he shall ensure the sustainable development of human society for a long term. For these reasons, the measures to be taken should rely directly on the thorough ecological knowledge of the situation, both at a certain moment and in prospect. Ecotechnics achieves a common purpose of human society and of the natural environment, that of reaching a common benefit for both. Seen from this point of view,

ecotechnics represents a fundamental element of the modern concept of sustainable development (4).

Ecotechnics deals with a broad range of extremely complex activities aiming at the optimization of the relationship between man and the environment and the restoration of those which were wrongly performed. Finding a solution to the ecotechnics issues is extremely complex and subtle and the effects will become visible after a long time. The cost of the ecotechnics activities includes both the numerous preliminary studies, the ecotechnological activity properly and its follow up and correction over a longer period of time (7).

All technologies involve competent quantifications and estimations. Since they operate with extremely sensitive and complex open systems, the ecotechnical technologies require quantifications of the relations and reactions of their extremely demanding components. That is why it is imperiously necessary to shape the processes, this being the only way to ensuring the holistic vision which is so necessary in order to choose the optimal solutions for the man-environment solutions for a long term.

Ecotechnics is a young field, at the border between ecology and the technical sciences; it is at its beginning and at the same time in full swing of development. In its achievements are involved people from various specialties who, modifying their older concepts, work together to attain a common purpose, the future of mankind. They start from the basic principle that people not only cannot separate themselves from nature, on the contrary, the more they study and care for it, the better they shall live.

Ecotechnics strives to reach a deep mutation - that of achieving economic develop-ment based on ecological principles. This fact has been very well understood by Lester Brown, who considers that we are at a crossroad where we either embark upon the ecological economy, or we shall fall into chaos (2,3).

Ecology, engineering, economy and finances should contribute directly to the achievement of ecotechnologies. This is therefore an interdisciplinary field with a great future, on which all the activities within the process of sustainable development should be based (2,4). The directions to be embarked upon are the following:

- a better management of the natural resources;
- the preservation of non-renewable resources;
- the use and re-use, the development and diversification of the products obtained from renewable resources;
- the increase of the weight of alternative energy;
- the re-ecologization of the technological processes;
- the change of the way of life in the human settlements;
- the transition to the ecological management of the territory;
- the optimization of the exploitation of the agricultural land;
- the restoration of the soil bonity through ecological procedures;
- the turning to good account of the biological resources;
- the drawing up of special legislation on environmental protection;
- the education of the population on ecological principles.

Ecotechnologies are often confused with biotechnologies, being called “ecological biotechnologies”. Analyzing this situation, Mitsch and Jorgensen (1989) have made a very clear distinction between ecotechnologies and biotechnologies (Tab.1). They have shown that biotechnology deals with the manipulation of the genetic structures with the view of creating new organisms allowing man to obtain new medical products (enzymes, medicines, rare raw materials etc.), while ecotechnics aims at the optimization or acceleration of the natural processes of self-regulation, of the acceptance by nature of the introduction of the new species desired by man.

A characteristic feature of ecotechnics is the fact that its effects are for a long term, man interfering only as a favouring factor of the natural processes (which may be physical, mechanical, chemical or biological ones). In the case of ecotechnics, nature is the one doing what is more important and, naturally, doing it better than man could imagine.

Table 1. A comparison between ecotechnologies and biotechnologies (after Mitsch & Jorgensen, 1989, modified)

Characteristics	Ecotechnologies	Biotechnologies
Basic unit	the ecosystem	the cell
Fundamental principles	ecological	genetic
Control	forcing the functions of the ecosystem, controlling the organisms	genetic structure
Designing	self-organizing with little human support	only by man
Biodiversity	maintained, stimulated	changed
The costs of maintenance and development	reasonable	enormous
Power basis	solar	fossil combustible materials

We can draw the conclusion that ecotechnics is an important branch of applied technology and an important range of ecotechnologies can be achieved within it. Many of these have been drawn up and are currently accomplished in many Western-European countries, in North-America, Australia, New Zealand and Japan, but only after detailed local studies are performed to better adapt them to the specific local conditions. In Table 2 we list synthetically the most important ones, their number increasing at present in a spectacular way.

Table 2. The main ecotechnologies achieved by the year 2000

1)	Ecotechnologies to maintain the natural ecosystems in optimum working conditions
-	Environmental control (monitoring) biosystems - installations for the automatic supervision of the behaviour or physiology of certain plants or animals - sensors in
-	conditions of water or air pollution
	Technical works for the conservation of the protected areas
	Technical works for the maintenance of biodiversity
	Arrangements for ecotourism in the protected zones
2)	Ecotechnologies for the ecological management of the ecosystems
-	Works to maintain the protective potential of soil
-	Works to prevent land erosion
-	Works to prevent soil saltiness
-	Works to stop the process of eutrophication of stagnant waters
	Works to maintain the quality of waters in the basins where aquaculture is practiced
3)	Technologies for the restoration of the ecosystems affected by human impacts
	3.1 Ecotechnologies in the terrestrial environment
-	Reforestation (regenerative ones, forest belts, the creation of
-	new forest massifs)
-	Restoration of hardened and over grazed pastures
-	Restoration of the reliability of the soils exhausted by
-	overexploitation
-	Stopping soil erosion
-	Restoration of the slopes affected by construction works for
-	lines of communication
-	Restoration of the land affected by hydrotechnical works
-	Stabilization of running waters banks
-	Re-covery of ancient, out of exploitation quarries
-	Re-covery of garbage piles
-	Covering sterile waste dumps
	Restoration of the reliability of the soils deteriorated by oil
-	extraction works
-	Stabilization with vegetation of the seaside or lacustrine
-	areas subject to erosion by water or by wind
-	3.2 - Ecotechnologies in the aquatic environment
-	Restoration of river beds faultily arranged
-	Restoration of river beds between two accumulation lakes
-	Systems of acceleration of the self-purification processes
-	Fighting the eutrophication process
	Restoration of the ecological balances in accumulation lakes
	Systems of tertiary purification ponds
	Arrangement of pits resulting from the extraction of building materials
	Systems of preventing the erosion of running waters, stagnant or sea shores
	Ecological restoration works of estuaries
4)	The establishment and management of artificial ecosystems
-	Biological systems used in water treatment
-	"Biological" steps of waste waters purification
-	Systems of domestic or zootechnical solid wastes treatment
-	Intramural or extramural ecological arrangements (parks,
-	various types of green areas, systems of eliminating organic residue from these, etc.)
	Ecological arrangements in gardens and houses.

REZUMAT

Ca urmare a evoluției extraordinare a cercetărilor ecologice, îndeosebi a celor de ecologie aplicată, această ştiință interdisciplinară, predominant biologică, s-a implicat tot mai mult în viața şi activitatea oamenilor. În prezent ecologia oferă soluții în numeroase domenii ale vieții, ca de ex. gospodărirea ecologică a terenurilor naturale şi a celor antropizate, a menajarea terenurilor, prevenirea şi combaterea poluării, ingineria mediului, sanogeneză, protecția mediului înconjurător etc.

Pe parcurs s-au amplificat activitățile de remediere a terenurilor afectate sau a celor degradate de variatele impacte umane. Aşa au apărut diverse ecotehnologii pe care autorul le-a grupat sub numele generic de ECOTEHNIE. Prin ecotehnie se înțelege „ansamblul activităților care au la bază conceptele ecologice de refacere a echilibrelor şi stabilității ecosistemelor sau grupelor de ecosisteme şi care se rezolvă prin mijloacele tehnicii".

În lucrare sunt trecute în revistă principalele activități încadrate în acest nou domeniu al ecologiei aplicate. Tot odată, pentru evitarea unor confuzii, este evidențiată diferența dintre ecotehnologie şi biotehnologie.

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