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S U M A R

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Section
HYDROTECHNICS

CONTENTS

BULETINUL INSTITUTULUI POLITEHNIC DIN IAŞI
Publicat de
Universitatea Tehnică „Gheorghe Asachi” din Iaşi
Volumul 64 (68), Numărul 1, 2018
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ANALISYS OF LAND USE AND LAND COVER USING SATELLITE IMAGES CASE STUDY – GALAȚI COUNTY

BY

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Abstract. Remote sensing is a practical and economical alternative to the classical methods of obtaining data, like field measurements and land survey data, in order to obtain data about land use and land cover. Classical methods are time and money consuming, which is why remote sensing is currently widely used by various agencies in country and abroad, for data collection and retrieval of information. With the launch of Copernicus programme, European Space Agency put at users’ disposal, optical and SAR satellite images, that can be use, in numerous investigations and analysis.

This article contains information about Sentinel-2A optical images, as well as data acquisition and visualization. The aim of this study is to analyses the land use and land cover, using supervised classification, minimum distance algorithm.

Keywords: satellite images; Sentinel-2A; land use; land cover; minimum distance method.

1. Introduction

In remote sensing, the concepts of land use and land cover are used alternatives, but their meaning is completely different. Land cover includes everything that lies above the terrestrial crust, *i.e.* vegetation, urban areas,

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water, bared soil etc., while land use refers to the purpose of each class in part defines equivalent categories of service from cadaster.

Land use term is used in studies of global monitoring and management of soil resources, while land cover is used in various applications such as urban expansion, management activities of extraction of natural resources, the delineation of damage caused by various natural disasters such as tornadoes, earthquakes, floods, fires, etc., protection of wildlife habitats etc.

Sentinel-2 is a multispectral mission, that provide high resolution optical imagery, which has as objectives land observation, including: vegetation, soil and water cover, inland waterways and coastal areas; land use and change detection maps, disaster relief support; climate change monitoring etc. Sentinel-2A has been launched on June 2015, while Sentinel-2B was launched on February 2017. The mission has been designed as a dependable multispectral Earth observation system that will ensure the continuity of Landsat and SPOT observations and improve the availability of data for users.

2. Study Area, Materials and Methods

The study area is located in South- South Est of Galati County (Fig. 1) and comprises the municipalities of Valea Mărului, Corni, Cudalbi, Băleni, Fârţăneşti, Măstăcani, Grivița, Costache Negri, Suhurlui, Rediu, Cuca, Scânteieşti, Folteşti, Liești, Pechea, Frumuşița, Fundeni, Tudor Vladimirescu, Piscu, Slobozia Conachi, Cuza Vodă, Smârdan, Tulucești, Nămoloasa, Independența, Scheia, Şendreni, Vânători, and also Târgu Bujor and Galați city.

Area of study is 2265 km2, given the elevation between 5-10 in southern county and 310 m respectively in the North.

In order to analyze land use and land cover, we used optical satellite images, taken by Sentinel-2A on 28 April 2016.

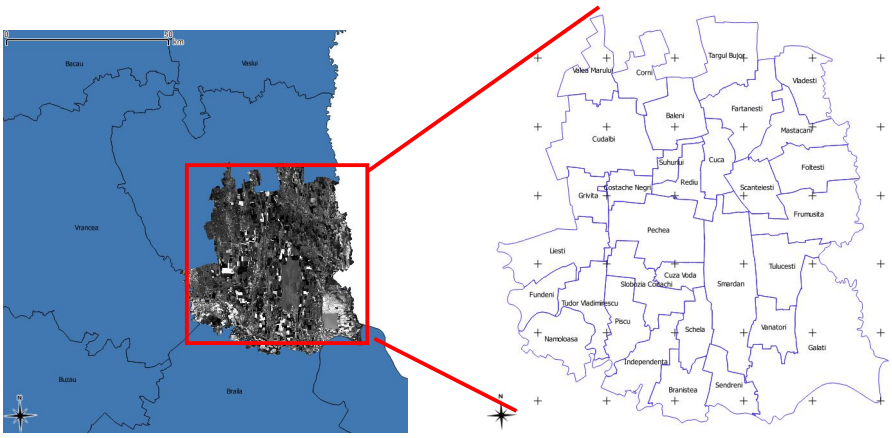

Fig. 1 – The location of study area.

Temporal resolution satellite Sentinel-2A is 10 days, but with the launch of the satellite Sentinel-2B it has been reduced to five days. The Multispectral Instrument has 13 spectral bands, from visible and near-infrared to shortwave-infrared, at different spatial resolutions (Fig. 2).

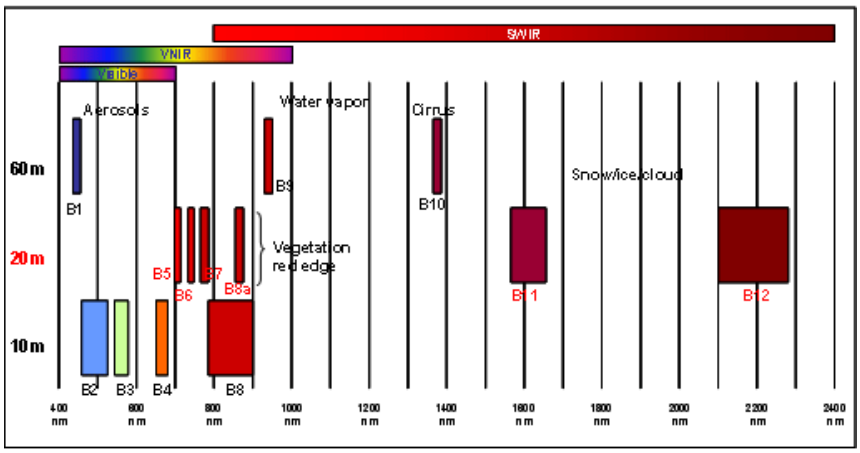

Fig. 2 – Sentinel-2A Spectral Bands
Source: [http://www.cesbio.ups-tlse.fr/us/index_sentinel2.html].

The spatial resolution of Sentinel-2A images depends on spectral bands, having values from 10 meters (B2, B3, B4 and B8), 20 meters (B5, B6, B7, B8a, B11 and B12), up to 60 meters (B1, B9 and B10).

The image used for this study was downloaded from **Sentinels Scientific Data Hub** [https://scihub.esa.int]. The preprocessing and analyzes of satellite image was made using Sentinel Application Platform (SNAP), Sentinel 2 Toolbox.

For data processing, QGIS software and "Semi-Automatic Classification Plugin" (SCP), developed by L. Congedo, were used. SCP is an open source plugin that allowed unsupervised and supervised classification. It also contains tools for downloading imagery, preprocessing, postprocessing, and tools to create new raster.

The satellite image was classified using supervised classification, minimum distance method.

Supervised classification method involves the intervention of the operator in the classification process. Classification is determined by the first class under the supervision of information after which the spectral classes. For each class of information is defined by the operator, representative samples of the collected spectral signatures. These are used in automated classification as reference standards, being compared to each pixel in the image. Supervised classification is a classification method based on pixel.

Minimum distance algorithm involves the calculation of the average spectral values for each category, within each stripe, and also calculation of

Euclidean distance from each pixel classified at the vector. After calculating the distance, the pixel is assigned to the unassigned closest spectral class.

3. Results and discussion

The satellite image used in the application has been atmospheric corrected, using Dark Object Subtraction method. Also, the image was clipped on the outline of the study area.

A first step in implementing the supervised classification is training samples. This process is a subjective one and the results depend on the experience of the analyst. The quality and precision of the final classification depend in large part on the quality formation process of the samples.

In order to classify the image, 4 spectral macro-classes and 12 spectral classes (vegetation, rare vegetation, rape, pasture, forest, soil, water, urban areas etc.) have been determined.

Effective delineation of samples for spectral signatures collection was done through digitization. Pixel value, in order to determine the samples, was equal to the value of NDVI (Normalized Vegetation Index Differences).

In the first stage of the study we realized a supervised classification, using 4 samples: vegetation, bare land, water and urban area (Fig. 3).

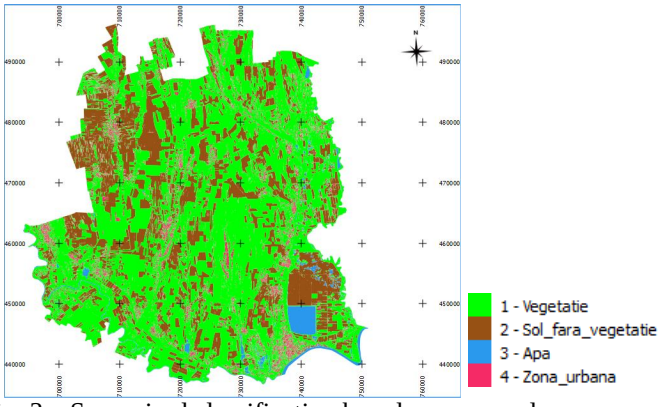

Fig. 3 – Supervised classification based on macro-classes, using minimum distance algorithm.

The vegetation comprises all the green areas within the study area: arable land under cultivation, pasture, forests etc. Soil without vegetation includes arable land without vegetation as well as discovered, completely lacking vegetation. Macro-class running waters comprise water, lakes, reservoirs or natural lakes. Macro-class "urban area" includes residential areas, industrial and commercial zone.

In Table 1 are shown the areas occupied by each macro-class and the proportion in which they are to be found in the study area. Thus, we can observe that prevails in the percentage of 58.67% of vegetation-covered areas, followed

by areas without vegetation (32.44%) and urban areas (6.17%), while areas covered by water occupy a percentage of only 2.72%.

Table 1
Surfaces and percentages obtained from supervised classification, based on macro-classes, using minimum distance algorithm

Macro-class	Surface (km^2)	Percentage (%)
Vegetation	1,328.87	58.67
Bare soil	734.72	32.44
Water	61.53	2.72
Urban area	139.81	6.17
Total	2,264.95	100

In the second stage we classified the image using 12 samples, defined based on analyzes of RGB image and NDVI. For vegetation we defined 5 sample: dense vegetation, rare vegetation, pastures, forest and rape. For bare soil we defined 3 classes. Also, we defined 3 sample for water and 1 for urban area.

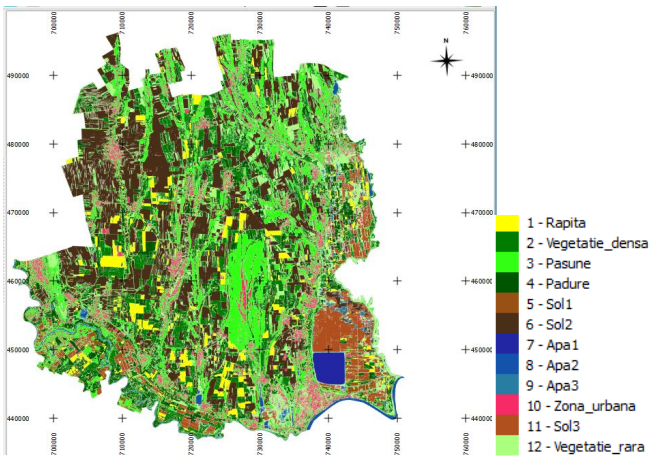

Fig. 4 – Supervised classification based on classes, using minimum distance algorithm.

In Fig. 4 is shown the result of the supervised classification, based on micro classes using minimum distance algorithm. Thus, we can see that in the study area, the vegetation-covered land predominates, followed by bare land, urban areas and area covered by water.

In Table 2 the occupied areas are presented for each class and the percentage by which they are to be found in the study area. Thus, we can see that prevails the area covered by bare soil (24.28%), followed by areas covered by pasture (20.20%). The forest occupied 14.77% from study area, dense vegetation only 11.33 %, while rare vegetation occupies 6.92%.

Table 2
Surfaces and percentages obtained from supervised classification, based on classes, using minimum distance algorithm

Classes	Surface, [km^2]	Percentage, [%]
Rape	123.47	5.45
Dense vegetation	256.66	11.33
Rare vegetation	156.627	6.92
Pasture	457.59	20.20
Forest	334.51	14.77
Bare soil 1	47.84	2.11
Bare soil 2	549.83	24.28
Bare soil 3	137.05	6.05
Water 1	20.30	0.90
Water 2	16.64	0.74
Water 3	24.59	1.09
Urban area	139.81	6.17
Total	2,264.95	100

4. Conclusion

Satellite imagery are used in agriculture, in various applications, such as the mapping of types of agricultural crops, estimation of agricultural production, soil characteristics mapping, monitoring farmers' practices etc. Crop monitoring and assessment of environmental damage constitutes one of the most used applications of remote sensing in agriculture. The satellite images also can be used to identify the types of crops and the demarcation of their land.

Sentinel optical images can be successfully used for the purpose of analysis the land use and land cover. To obtain information about land use and cover we can define macro-classes or classes, depending on the needs of users.

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ANALIZA MODULUI DE ACOPERIRE ŞI UTILIZARE A TERERENURILOR PE BAZA IMAGINILOR SATELITARE
Studiu de caz – Județul Galați

(Rezumat)

Teledetecția satelitară este o alternativă practică şi economică la metodele clasice de obținere a datelor, precum deplasările în teren şi ridicările topografice terestre, în vederea obținerii datelor despre acoperirea şi folosirea terenurilor. Aceste metode sunt consumatoare de timp şi bani, motiv pentru care teledetecția este în prezent folosită la scară largă de diverse agenții din țară şi străinătate, pentru colectarea datelor şi extragerea de informații. Odată cu lansarea programului Copernicus, de monitorizare a mediului, Agenția Spațial Europeană, a pus gratuit, la dispoziție utilizatorilor, imagini satelitare optice şi RADAR ce pot fi folosite în numeroase cercetări şi analize.

Prezentul articol cuprinde informații despre imaginile satelitare optice Sentinel-2A, modul de achiziționare a datelor precum şi vizualizarea acestora. Pentru studiul de caz s-au folosit imagini preluate de satelitul Sentinel-2A, ce au fost clasificate supervizat, utilizând algoritmul distanței minime.

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NAVIGATION FACILITIES ON RIVERS IN ROMANIA HISTORICAL TRAVEL

BY

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Abstract. It presents the situation of inland rivers navigation on the territory of Romania, in the course of history, according to the available documents and data. The information are systematized according to: the historical epochs of Europe: (Antiquity, Middle Ages, Modern Era), the historical regions of Romania (Transylvania, Banat, Walachia, Moldova), the rivers where a continuous and long-term transport has been carried out, with vessels of significant displacement, for the respective period (Mureş, Tisza, Someş, Crişul Alb, Bega, Jiu, Olt, Argeş, Dâmbovița, Ialomița, Bistrița, Siret, Prut).

The transport development on Romania Rivers was based on the essential advantage that all these rivers reach the Danube.

It presents the studies and development on inland waterways, the proposals or achievements of complex navigation systems, and the national scale legislation evolution.

The waterways shipping is cheaper, safe and bulky, leads to the socio-economic development of the area, pollutes the environment to an insignificant degree.

Keywords: waterways; rafting; river port; the Organic Regulations; Bucharest-Danube canal.

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1. Introduction

The huge expanse of the seas and the flow of rivers had awakened, in the soul of primitive man, three deep feelings: fear, attraction and curiosity. Over millennia, these feelings have evolved under the pressure of the essential needs and of the imagination.

On the banks of rivers, lakes and seas, appeared the fishing and the floating displacement, human settlements were founded, and, much later, appeared the navigation.

In Europe, land transport has taken place over short distances, unlike the long roads of caravan in Asia and Africa. On this "*peninsular continent*" (Mellor and Smith, 2006), the land transport was, in fact, a transshipment between the inland waterways, using the two or four wheels carts.

The very poor condition of the land routes in the Middle Ages led to the intensive use of the hydrographical network.

The most of Europe's rivers are modest in size and, in winter, suffer from frost, but in summer, due to low levels; however, the navigation was possible with simple boats.

In the Carpathian-Danubian-Pontic space, the cork and the monoxyle boat were the main and sufficient means for the prehistoric exchanges of the inhabitants, along the Danube, for fishing on the Danube with the help of nets and fences as well as for transport down the rivers and the Danube, to the Sea, two essential products for the economic life of the ancient world: the salt and the wood (monoxyle = craft of 10 - 15 m long, 0.75 m wide, made of a single oak trunk; from Greek monos = single, xýlo = wood http://adevarul.ro/locale/ploiesti/foto-monoxila-ploiesti-barca-istorie-1_5314a737c7b855ff56d5fda1/index.html)

The navigation on the waters of this Carpathian-Danubian-Pontic space is part of the vast human activity on a vast hydrographical network: from central Europe to the centre of Asia and from the Baltic Sea to the Mediterranean Sea (Botzan, 1983). One of the oldest recordings about this vast hydrographical network is "The story of the Argonauts" from the 6th century B.C.E. (uncertain).

The enormous hydrographical network favoured and guided prehistoric and historical migrations from Asia to Europe (Drăgan, 2000), and facilitated the merchants' movement on the Chinese silk and Indian spice routes.

In places where goods or ships were transhipped between two waters, mobile bridges and canals were built, but in the fords, fixed bridges were built. The confluence of two rivers and the mouth of rivers in the sea have favoured the birth of cities.

Europe is characterized by a beneficial configuration of peninsulas and continental seas, which leads to the softening of the climate, and its hydrographical network offers wonderful waterways. These characteristics had a great economic and social significance for the historical evolution of the communities on the old continent.

The Romanian people, closely linked, through millenary occupations, to the fertile land where they formed, have not proved a vocation of maritime navigation, characteristic of peoples born on islands and peninsulas arid. Instead, the inhabitants of this territory, so varied and conducive to life, have proven an unequalled art in the balanced use of water in all its aspects. One of these uses was communication on the water valleys, either onshore along these or by floating, using the raft and the monoxyle boat.

Interesting statements about the navigation on the inland rivers of the Romanian Principalities can be found in many foreign sources, mentioning the rivers: Mureş, Olt, Someş, Siret, Prut, Bistriţa, Trotuş, and Argeş (Bârdeanu and Nicolaescu, 1979).

Since antiquity, the Mureş River has been an intensely used waterway for both commercial and strategic traffic. It was mentioned by Herodotus in 484 BC, under the name of *Maris*: "*These are the native-born Scythian rivers that help to swell it; but the river Maris, which commingles with the Ister, flows from the Agathyrsi*;..") (Herodotus, 1921, book 4, chap. 49, section 1)

The Mureş is, after the Danube, the second river of Romania, after the length and the third, after the catchment aria.

Until the modern age, these rivers have dropped rafts loaded with grain, salt and wood. The timber brought by the same road into the Danube ports was used for the construction of ships in the Galaţi port scaffoldings or was loaded on merchant ships and transported to Istanbul.

2. The Period of Roman Empire Domination

The practice of navigation in the ancient times, on the inland rivers of our country, is evidenced by archaeological excavations and documents, but as regards the works on the rivers, for the navigation purpose, the documents date back to only the Roman Empire domination period.

After the Dacia conquest, the Romans used, for navigation, the largest part of the hydrographical network in natural regime, without canals, dams or locks, but accompanied by the famous Roman roads, well-executed and maintained, parallel to the water courses, some of them being used up today.

The navigation in natural regime was possible because the hydrological regime of the Carpathian-Danubian-Pontic rivers was different from the current one: it was more regular, the differences between extreme levels were smaller, the turbidity smaller, too. The explanation for this phenomenon is the high degree of forestation of land at that time.

The Romans organize the navigation in colleges or brotherhoods, e.g. „*Axiopolis was the seat of a Collegium nautae universi Danubii*". (Stillwell *et al*., 1976) Heavy goods were transported, and for the transport of people (couriers, clerks, merchants), fast races were used (*naves fugaces* or *cursoriae*).

The most intense transport was conducted on the Mureş and Olt rivers, tributaries to the Danube, then down to Sava River and until Italy.

On Mureş, the navigation was starting at *Apulum* (Alba Iulia), continued - through *Micia* (Deva), which, back then, was a large port - to the

confluence with Tisza and, from here, to the Danube.

The control of the Mureş River has always been one of the key military strategies. Thus, during the military operations of the beginning of the Second Dacian War of Trajan, it is assumed that the "*vexillatio*" formed of the troops of Pannonia Inferior, headed by the governor of the province of Pannonia, Aelius Hadrianus (the future Emperor Hadrian), would have penetrated to the heart of Dacia on the Mureş Valley, probably also using the river fleet - Classis Flavia Pannonica.

The existence of a "*collegium nautarum*" at *Apulum* is an indication that the water transport was intense, in the Roman Era.

The raw materials (gold, iron, salt, and wood) were exported to Rome and other Western provinces, by waterway. The lack of salt in neighbouring Roman provinces (the two Pannonias and the two Moesias) can explain the regularity of massive export on Mureş River.

This fact, together with the high density of civilian dwelling (through the two cities) and with the presence at *Apulum*, of the legion and of the governor of Dacia, make here the most important civil river port of Roman Dacia.

The Romans improved, for navigation, the lower course of the main rivers of Dacia and built port-cities at their mouths, as: *Sucidava* and *Turris* on the Olt River, *Daphne* on the Argeş River, *Piua Petri* on the Ialomiţa River.

The ships used mainly to patrol the river courses were *liburnae* (a liburna was a type of small galley used for raiding and patrols, by the Roman navy). This hypothesis is supported by the finds made at the important naval fort of Mogontiacum on the Rhine River, from the 3rd century C.E. (Museum of Ancient Seafaring in Mainz, 2017) and at the reliefs of the Trajan's Column in Rome. During the reign of Trajan (98 - 117 C.E.), the Danube fleets Pannonica and Moesica seems to include 125 main boats and 100 smaller vessels. To these, more 100 boats were added along the main tributaries.

From the 4th century, new types of vessels were introduced into the river fleet: *lusoria*, *actuaria* and *iudiciaria*, which now had a flatter bottom, ideal for meandering rivers (*navis lusoria* - a small military vessel that served for the troop transport; *navis actuaria* - a type of transport ship used by the Roman navy, was therefore suitable for the transport of supplies and horses; the ship had sails and up to 30 oars - 15 on each side, was short, narrow at bow and stern, and wider midships, had a flat hull, so that could run aground without being damaged, could go ashore both forwards and backwards, since it was equipped with rudders fore and aft; *navis iudiciaria* - a travelling court that can judge a person anywhere, was a ship fast and stable).

3. The Middle Ages

3.1. The Early Middle Ages

After the withdrawal of the Romans from Dacia (3rd century C.E), the Byzantine Empire maintains, for a relatively short period, the state of the ports-fortresses, of waterways and roads.

It follows a long period of growth and decline in the economic life of the inhabitants, corresponding to the migratory waves of the peoples of the north-eastern Black Sea.

The Roman and Byzantine constructions are totally or partially destroyed. Consequently, the sure sources attesting to navigation and facilities developed for this purpose on inland rivers are very late.

Among them, there is a document of the Byzantine Emperor Constantine VII, in 948 C.E., where is mentioned the Mureş River under the name Muresis (*Mureios*) (Köpeczi, 2001) and a document reporting that the Romanian Voivode Ahtum has established a system of customs duties in all port-cities on Mureş and Tisza (Botzan, 1990). As a result, in 1028, the king Stephen I of Hungary, refusing that royal rafts carrying salt to be taxed, enters into conflict with the Romanian Voivode Ahtum.

For the navigation purposes on the Mureş and Tisza rivers, the ports were built, the most important being *Urbs Morisena* (known in 1197 as Cenad) and Vladimirescu (downstream of Lipova).

Another document, dated 1222, attests the navigation on Olt and Mureş of commercial vessels. Thus, the Pope Honorius III confirms the donation made by the King Andrew II of Hungary to the Teutonic Knights in the Burzenland (the Land of Bârsa) (Botzan, 1983) "*... He also granted you to be free on the river named Olt, six ships and the same on the river called Mureş ...*")

On the Crişul Alb River, in the 14th-15th centuries, it was sailing even with monoxiles of 10 meters long. A specimen discovered in the 80s, in a swampy area, at Răpsig, along the Crişul Alb River, was brought to the Navy Museum in Constanța (Muzeul Marinei Române, 2017).

3.2. The Late Middle Ages

3.2.1. *Navigation Facilities on Bega and Timiş Rivers*

The first extensive works of regularization were carried out in Banat, in the basins of the Bega and Timiş rivers.

The main purpose of these facilities was to clean up the marshes and the riverside navigation.

Giovanni Andrea Gromo wrote in 1564, in the book "Summary of King John's Rule in Transylvania" that "*Lugoj is a large open city, through which passes the navigable river Timiş*." (Călători străini despre Țările Române, 1980)

The Passarowitz Peace Treaty (1718), by which Serbia, Banat and Oltenia pass from Ottoman occupation to the Habsburg one, had beneficial effects on economic development in these areas, including on river navigation.

For a cheap, safe and fast transportation of raw materials and merchandise, from Banat to the central Europe, the Bega Canal was built between 1728 and 1780. The Bega canal, started at Făget, is navigable for barges of 600 tons, over a distance of 115 km from Timişoara up to the confluence with Tisza River.

At the same time, the junction with the Timiş River is made, through two secondary canals, used for drainage and for water supply.

The Bega canal still operates today, crossing the port city of Timişoara, modernized after 1944.

3.2.2. *Navigation Facilities on Mureş and Someş Rivers*

In the poem "*Stauromachia, id est Cruciatorum Servile Bellum*", published in Vienna, in 1519, Stephanus Taurinus describes the Mureş and Someş rivers.

The first is described as an important auriferous river of Dacia (or Transylvania): "*aurifer fluvius ex Alpibus Transilvań*". Springing from the Transylvanian mountains along the border with Moldova, it flows firstly along the Szekler Fields, then, already navigable, bathes almost half of Dacia.

And the Someş River, in turn, appears to be navigable, the author pointing out that this river passes through the city of Cluj, then turn to east and "*bending to the north becomes navigable, in order to the King's Salt Office can carry the ships loaded with salt, every years* (….)" (Stephanus Taurinus Olomucensis, 1519; Popescu-Spineni, 1978).

Antonio Possevino presents, in 1584, a perfect topography of the four rivers, namely the Marisio, the Aluto, the Chrisius, and the Szamos, recalling also that the latter and the first are navigable for ships, with the aid of which the salt is transported to Hungary:

"No river enters Transylvania: but four famous rivers come out: the Marisio, the Aluto, the Chriso, and the Szamos. However, the Marisio is the greatest of all: that came from those mountains of Transylvania, which touched Moldavia ... Thus, on this Marisio are ships carrying salt (and else if you want) to Hungary. The Szamos is the fourth river, who is born in Transylvania's yugs towards Moldova, and firstly flowing toward the East, and then came up Gyalu, a former bishop's castle, it extends towards the West, and by bathing the villages of Kolozsvàr, returns to the East; but it came not far from the territory of Bistricia for a valley, bending towards the Lower Pannonia, surrounds as a compass the city of Szatmar, having encountered the land of Németi at the ridge: and it is so navigable that it can hold some small ships, with which, the salt of Transylvania is carried in Hungary, at certain times of the year, ...".

(Libro Primo. Capo 1. *„Nissuno fiume poi entra in Transilvania: ma quattro celebri n'escono. Il Marisio, l'Aluto, il Chriso, il Szamos. Però il Marisio è maggiore di tutti: conciossia cosa che scaturendo strabo da que' monti della Transilvania, i quali toccano la Moldavia …. Così pel detto Marisio, vanno le navi, coi quali si porta il sale (et se altra cosa si vuole) verso l'Ungheria. Il Szamos è il quarto fiume, il quale nasce ne i gioghi di Transilvania verso la Moldavia, et prima scorrendo verso Oriente, et dappoi appresso Gyalu, castello già episcopale, si stende verso l'Austro, et bagnando i borghi di Kolozsvàr, ritorna verso l'Oriente; ma dappoi non lungi dal territorio di Bistricia per una valle, piegando verso la Pannonia inferiore, circonda a*

guisa di compasso la città di Szatmàr, havendo all' incontro su la ripa la terra di Németi: et è tanto navigabile, che può reggere alcune piccole navi, per le quali si porta in certi tempi dell'anno il sale di Transilvania nell'Ungheria,...) (Antonio Possevino, 1913, First book, Chapter 1).

Transylvania and Banat were particularly rich lands, as Nicolaus Olahus wrote in the book "*Hungaria et Attila*", in 1763 (Nicolai Oláhi, 1763):

"*Chapter 14. On The Transylvania*

II. The people, the members well-compacted, warlike, armed, and their robust horses, good and foreseen. The whole area, now plain, now woods, alternately, it has: water watershed ... of the fertile field: of wines, gold, silver, iron, and of other metals, further, full of salt; of the oxen, bears, and of fish with his abundant ….

III. The rivers of Transylvania. In Transylvania, there are Saio, Bistrica, two Santos (Large and Small), two Kewres (once called Quick and White), and Marisus. And they were afterwards increased by a variety of rivers, as well within, as without the Transylvania, the majority of them are navigable."

(*Caput XIV. De Transilvania*

II. Gens adhaec, membris bene compacta, bellicosa, armata et equis robustis bonisque provisa. Regio tota, nunc planitiem, nunc sylvas, alternatim habet: aquarum divortiis, … agri fertilis: vini ferax, auri, argenti, ferri, aliorumque metallorum, praeterea salis plena; boum, ursorum, piscium abundantissima....

III. Fiumina Transilvaniae. In hac Transilvania, Saio, Bistricia, duo Samos (Magnus et Parvus), ac duo Kewres, olim dictus Velox et Albus; Marisus. Quae postea diversis aucta fluviis, tam intra, quam extra Transilvaniam, maiori eorum parte sunt navigabilia.) (Antonio Possevino, 1913, First book, Chapter 1).

3.2.3. *Navigation Facilities on the Olt River*

Antonio Possevino wrote in 1584, in his "Transylvania Geography", about the river Alutus:

"*The Aluto then emerges in the roots of the mountains of Ciculia, passing through the Barczense territory, in which is the Corona city, flows towards Cibinus (also city) near a Tower, which call Red and where they permanently oversee the floods and any arrival of the Turks. Then a narrow valley, having by both of the parties very high mountains, descends into Walachia called Transalpina: neither very far from Nicopolis, it discharges in Ister or Danube (which we want to say). That river leads some docks, rather than ships, with which wood or salt is sent, or other things*."

(Libro Primo. Capo 1. „*L'Aluto poi nascendo parimente nelle radici de' monti di Ciculia, passando pe'l territorio Barczense, nel quale è Corona città, scorre verso Cibinio (pure città) vicino ad una Torre, la quale chiamano Rossa*

dove et pe'l dubbio dell' inondationi, et perchè forse non fossero sopravvenuti da Turchi, sogliono que' cittadini tener' una continova guardia. Indi per una stretta valle, havendo da amendue le parti altissimi monti, scende nella Valachia chiamata Transalpina: né molto lungi da Nicopoli si scarica nell' Istro o Danubio, che dire vogliamo. Porta quel fiume alcune zatte, più tosto che navi, colle quali o il sale, o altre cose si mandano fuori.") (Antonio Possevino, 1913, First book, Chapter 1).

4. The Modern Era

4.1. Navigation Facilities on the Upper Olt, Made under the Habsburg Occupation

The Passarowitz Peace Treaty (1718), so the Habsburg occupation, had beneficial effects on the economic development of Oltenia.

The Austrians begin planning the navigation on the Olt River, on the gorge areas between Câineni and Râmnicu Vâlcea, in the period 1718-1723. (Wolf, 1893, p. 335) The Olt River becomes navigable from Turnu-Roşu up to the Danube, which facilitates the connection between Transylvania and the Black Sea.

In the eighteenth century, the navigation on the Olt River was directed and controlled by the "*Chamber of Commerce and Crafts*" in Braşov.

A document from 1784 shows that Püthner of Sibiu obtains the privilege of transporting up to Brăila, „*with its boats, woolen cloth, glass, horseshoes*", sailing on Olt, then on the Danube. (Botzan, 1990)

In 1819, "*Gheorghe Aron's boats also*" acquired navigation rights on Olt, but only downstream from Turnu-Roşu customs. (Manoliu, 1984)

In 1830, in Sibiu, "*societies to release on the Olt water, large trees and planks up to Danube*" are established.

In 1837, "*the wood leaves from the Băloiu forest, as rafts floating on the Olt River, following the route on the Danube up to Brăila*" confirming another document. (Antipa, 1921; Wolf, 1893).

4.2. Navigation Facilities on the Lower Olt, Made by Walachia

Walachia attempts to carry out regulation works on the Olt River only from the mid-nineteenth century (Wolf, 1893). Thus, in 1836, Mihail Ghica reports to the "People's Assembly" that they had difficulty to start the works because „*there were no engineers with a well-founded hydro-science, and to hire engineers from Austria requires too much expenditure*".

Increased navigation on the Olt River required the construction of a port and so, in 1859**,** it was proposed that the Corabia village to become a port city named "Alexandru Ioan Cuza". On this request, the Prince Cuza responds with a counter-proposal: "*It is approved, but with the name Mircea, in the memory of a leader with whose facts, the Romanian history is full.*"

Due to lack of financial sources, the action is postponed. Although the port was not built, however, in 1877, at Corabia, the construction of an important pontoon - bridge to use in the war of independence began.

From the 20th century, the changes in the hydrological regime, the development of internal transport routes and means of transport, and economic priorities have a low national interest for navigation on most rivers in Romania.

Starting with 1974, the Olt is regularized and arranged hydro-energetically with a cascade of accumulations and hydroelectric power plant. (Druță *et al.*, 2000) The Lower Olt was arranged for navigation with two waterways and two ports, in Slatina and Drăgăneşti.

The hydraulic works of Olt were designed to avoid and reduce the material and cultural losses. An example is *the Hermitage of Neagoe Basarab* (1512) on an island of the Olt, which, by an original process, was raised 6 m from its original position, to be protected from floods.

4.3. Navigation Facilities on the Jiu River

The regularization works of the Jiu River began in 1869. The following year, the Ministry of Public Works asks the Austrian engineer Kopetinski to prepare a study on the Jiu River navigability. The Kopetinski's study states that, the Jiu River can be used in natural regime only for wooden rafts until the confluence with the Gilort River. Downstream from this confluence, Kopetinski planned the route correction, embankment works, reducing the length from 270 km to 122 km, in order to increase the longitudinal slope from 0.45 ‰ to 7 ‰. By these treatments, it can provide the navigation depth of 1 m, required by the 12 tons displacement vessels.

At the technical level and with the financial possibilities of the time, the project could not be realized.

Later, the idea is repeated in 1881, when Eduard Hommaire of Hell publishes in Bucharest, another study for the canalization of Jiu River "*River Navigation in Romania and the Project of Prince Gheorghe Bibescu*", but neither this project has finalized (Hommaire de Hell and Bibescu, 1881).

Today, the Jiu River is regularized and hydro-energetically developed over a large part of its route, the main accumulations until 2000 being: Valea Sadului, Curtişoara, Turcineşti, Vădeni, Tg. Jiu, Turceni.

4.4. Navigation Facilities on Argeş, Dâmbovița and Ialomița Rivers

The Argeş River springs from the Făgăraş Mountains through two waters, Buda and Capra, and, following a 340 km route, flows into the Danube, near Oltenița. Concerning the Argeş River navigation projects, there is a document of 1855 in the newspaper "Zimbrul", which says: "*... that the discussions were underway to make the Argeş in Walachia navigable, which will facilitate the Austrian trade with the Principalities Romanian*". This project also included the extension of the port of Oltenița.

A long time ago, the Dâmbovița River was a tributary of the Argeş River, upstream of Bucharest, but now, Dâmbovița crosses this city, which it has often flooded. About the works on Dâmbovița River in order to protect the capital city, there is more information, out of which some will be presented.

Thus, in 1781, Joseph Moesiodax published in Vienna the book "*Theory of Geography*", in which he also presented the map of Walachia. (Iosif Moesiodax, 1781; Popescu, 2016) On this map, appears the Argeş - Dâmbovița canal, drawn as a bypass, right in the village of Lungulețu, to discharge the excess flow of Dâmbovița into Argeş. As mentioned, a canal maintenance team, made up of "*trenchmen*", was permanently stationed in the village.

Later, along the river sector that runs through the city of Bucharest, there were executed maintenance works and works to dredging the Cişmigiu Lake. Moreover, a navigable canal was designed on Dâmbovița, up to the Danube.

Although it is not navigable even today, yet, in recent years, the Dâmbovița River has undergone hydroenergetic works on the upper course and a good work of regularization and sanitation on the territory of the capital.

Another river that offers sailing opportunities is Ialomița, for which studies have been conducted since the 19th century. Thus, Ion Ionescu from Brad, in the nineteenth century, and then Dimitrie Leonida draw up the project of a navigable waterway, lateral to Ialomița, between Târgovişte and Crivina. The diversion canal was equipped with two locks.

After the Second World War, Romania has the technical and material availability to make the Argeş River a waterway and so Bucharest to become a port. Currently, the Argeş River is arranged hydro-energetically by a cascade of dams, reservoirs and hydropower plants.

4.5. Navigation Facilities on the Prut, Siret and Bistrița Rivers

In Moldova, the Prut and Siret rivers, as well as some tributaries of the Siret, have been used for navigation since antiquity, but certain testimonies are relatively recent.

The Polish-Moldavian or Polish-Walachian trade routes were running from the Baltic Sea, on the Vistula, continuing on the Prut or on the Siret up to the Danube and the Black Sea. About all these, wrote in the eighteenth century, the Turkish traveler Evliya Çelebi (Botzan, 1990; Călători străini despre Țările Române, 1980), as follows: "*... The Port of Gdańsk was the port of the Iassy, where there were six major chambers of commerce*."

The navigation on the Prut River is confirmed by Ion Neculce in "*Chronicle of Moldova*". He writes that, in 1713, after the disaster of defeat from Stănileşti (1711), the Prut has been cleaned and restored navigation: "*Neculai Voda Mavrocordat put Constantin Costache Stolnicu, with a Turkish Pasha and hundreds of people, to clean the Prut River of trees and trash. Others pull the bread barges up to Tuțora and, from there, load the bread into the wagons going to Hotin*." (Neculce, 1955).

In 1787, A. M. d'Hauterive will submit to Prince Alexandru Ipsilanti (1786-1788) a study for the establishment of the Prut and Siret waterways. He proposes the regularization of the two rivers after their natural course and opposes the idea of linking the Siret and the Prut through a canal crossing the city of Iassy. (Royer-Collard and Martin, 1857)

In 1812, the Organic Regulations, Article 158, provided for the Siret and Prut rivers to be navigable after their connection through the Bahlui River: "*If the need would require - in time - to clean them and make them more conducive to navigation or to make communication channels, for example the union of the Siret with the Prut across the Bahlui River, that communication would be very useful for the commerce of the capital ...*" (Regulamentele Organice ale Valahiei şi Moldovei, 1944)

In 1845, the "Vasile Alecsandri Spatar Society" was established for the transport on Prut, downstream of Sculeni point.

There have been other offers for the development of the Prut and the Siret in exchange for the concession of navigation, such as the request of Neculai Roşca Codreanu in 1852 or the offer of a French company represented by Royer-Collard and Martin-Rey in 1857 (Royer-Collard and Martin Rey, 1857).

The economic interest in the Prut waterway was so great that studies were made on the possibilities of navigation on its upper course.

Thus, Ion Ionescu de la Brad published, in 1866, the monograph of Dorohoi city, where reads: "*The Prut can become navigable on its upper course for small boats.*"

By its geographical position, the Prut was at the intersection of the interests of the great powers, Russia and Austria, and that is why the navigation was interrupted for a long time. To resume the navigation on the Prut, on the distance of 725 km, in 1893, a collaboration agreement between Romania, Russia and Austria is concluded. (Chiru, 1893)

In 1902, in Romania, is legalized the "*Rules of navigation and police on the Prut*" (Vermeulen, 1928).

After the Second World War, the Prut River is laid out for various uses, by building the Stânca-Costeşti accumulation.

The Siret River springs from the Eastern Carpathians Mountains, on the territory of Ukraine. It is 647 km long, of which 559 km in Romania, enters the country near the Siret city and flows into the Danube, near the Galaţi port. The Siret has the largest hydrographical basin in Romania. (Ministerul Mediului, 1992).

Projects and studies for a Siret waterway are few and relatively recent. Among these, we mention the navigation design study drawn up in 1836 by Neculai Roşca Codreanu.

On the Siret River, even in the first half of the century 20, still the wooden rafts were sailing: "*As in Brăila harbour, a basin with silos was built. And, because it is the wood export center, originated from the rafts coming on Şiret, a new basin was built, especially for cutting wood*." (Bart, 1933).

Currently, the Siret River is developed hydroelectric, partially.

The Bistrița River, the main tributary of the Siret, was navigable the middle of the 19th century (Scurtu and Minuț, 1978), as shown in the Organic Regulations in 1832: "*The Moldova and Bistrița rivers, who give in Siret, will serve as before to lower the rafts with wood and wood to last, without disturbing the ponds, mills and bridges lying on these waters*." (Regulamentele Organice ale Valahiei şi Moldovei, 1944, Chap. V. Section II, Art. 158).

After the Second World War, the Bistrița River was developed for multipurpose but the dams built stopped the rafting.

5. Complex Navigation Systems. Laws.

In addition to the studies and the navigation facilities on inland rivers, there have been numerous proposals or achievements of complex navigation systems as well as national scale legislation.

In the 18th century, regularization works were carried out on many rivers and were dug canals for industrial purposes "*to act mills, fulling mills, sawmills*" (Royer-Collard and Martin Rey, 1857). An example is the Zănoaga Canal, 4.7 km long, built in the Reşița area for the transport of logs. Another example is the canal for rafts, 23.3 km length, carried out in the Semenic Mountains.

In 1818, the Rulers Ion Gheorghe Caragea (1812-1818) in Walachia and Scarlat Callimachi (1812-1819) in Moldova elaborated a Code of Laws by which: "*… the small and large rivers as well as their banks and lagoons will become a public wealth*" (Article 398) (Vermeulen, 1928, p. 174) and that "*Each owner is allowed to strengthen the bank on his side, against the power and speed of the river, but no one is forgiven for doing this reinforcement, by which it would be possible to move the usual river flow, to obstruct the floating of vessels on this river, the fishing, the operation of water mills, and other rights of others*." (Article 554)

Later, the Organic Regulations (1828-1834) impose some measures such as: in Walachia (1831) "*... for floating on the five large rivers crossing Walachia, i.e. Jiu, Olt, Argeş, Dâmbovița and Ialomița*" and in Moldova (1832) "*The Siret and the Prut that cross the country to the South and flow into the Danube will serve the descent of merchandise and products without any payment for their floating*." (Regulamentele Organice ale Valahiei şi Moldovei, 1944)

It follows other laws, such as: the *Civil Code* of 1865, then the *Constitution* of 1865 which state that "*the rivers and navigable rivers belong to the state*".

After the Principalities Union, a policy of promoting studies and river navigation projects has been carried out, but without finalizing this one.

Such projects were initiated by the Italian engineer Eduardo Gioia in 1874 and by the engineer Constantin Chiru (Chiru, 1893) in 1890.

Another offer is given by Ed. Hommaire de Hell, in 1881, proposing

"*setting up associations for the river navigation design on rivers of Walachia and on the Siret River*", but under the tutelage of a design and construction company in France. (Hommaire de Hell and Bibescu, 1881)

Following the 1877 War, Romania gained the independence from the Ottoman Empire and, so, the access direct to the Black Sea and to its ancient ports. The Merchant Navy of Romania was very small, most of the ships sailing in Romanian waters being foreign. Aware of the great economic potential of Romania's direct access to the Black Sea, P.S. Aurelian and others advocate for indigenous navigation on the Danube and the Black Sea, supporting the creation of maritime and river shipping companies.

In 1890, the Romanian River Navigation Service (N.F.R.) was established and, in 1895, the Romanian Maritime Service (R.M.S.) - the first state-owned enterprises, that transformed the Romanian Merchant Navy into an essential factor in the national economy. (Atanasiu, 1981; Aurelian, 1887)

In 1928, the famous engineer J. H. Vermeulen, who worked alongside Ferdinand Lesseps to carry out the Suez Canal (1869), was invited by the Minister of Public Works, Gr. C. Cantacuzino, for the development design of Muntenia Rivers. Vermeulen proposes a canal for navigation, irrigations and water supply, derived from the Danube, at Turnu Severin and ending the same into Danube, but at Galați (Vermeulen, 1928) This project was particularly complex, but from a technical and financial point of view it was not feasible at that time and, perhaps, even today.

In 1924, the "Water Law" was promulgated whereby "*water management and its economic use are state issues*".

In the interwar period, characterized by a great technical and economic development, Romania can make the following balance sheet: in 1928, it has 700 km of inland waterways under the national regime (Prut, Siret, Mureş, and Bega) and 1,075 km of international waterways on Danube.

An overview of navigation resources is presented by the academician Dorin Pavel in his book "*Hydraulic Forces Development Plan in Romania*" in 1933. He states that "*only in Transylvania were executed until that year such special works and that, in 1927, the navigation was insured on Mureş for a distance of 368 km, on the Criş on the length of 219 km up to Bichiş, and on Someş on 98 km up to Satu Mare*".

During the same period, Dimitrie Leonida made a very interesting project of a navigable canal between Galați and Bucharest.

Subsequently, Alexandru Davidescu will add to this project the use of water for riparian lands irrigation.

After the Second World War, in 1946, it should be noted Dorin Pavel's project for achieving a waterway on Someş River up to Baziaş. This project will be partially realized in the Criş rivers area, a few years later.

Now, the projects for two large navigation systems, totalling 1,500 km, are beginning to outline, namely:

a) the South-eastern system comprising: the Siret-Mostiştea Canal,

including works on the lower course of the Siret River to become navigable and the Bucharest-Danube Canal, including works on the lower course of the Ialomița River to become navigable;

b) the Western system comprising: the Someş - Bega Canal, that include works on the lower course of the Someş, Mureş, Timiş, and Bega rivers to become navigable.

5.1. The Waterway Bucharest - Danube

Nicolae Cucu elaborated the "project sketch" for the construction of the Bucharest - Oltenița waterway, in 1880**.**

After the First World War and after the Romanian Unification, in the country, elite of specialists is trained in all technical and scientific fields.

The economic and strategic importance of a waterway between the country's capital, Bucharest and the Danube became more and more obvious.

As a result, Alexandru Davidescu published in Buletinul AGIR no. 4, April 1927, the study "*The Bucharest - Danube Canal*", where he showed the way to accomplish this work and the beneficial consequences.

The scientist Dimitrie Leonida demonstrated "*the technical possibility of carrying out the Argeş-Bucharest-Danube Channel in good economic conditions*", in the study "*The Channel Argeş-Bucharest-Danube*, published in the journal „Energia", no. 11-12, April 1927. The navigation facilities of this channel were: length of 70 km, width of 10 - 30 m, depth of 3 m, and 4 locks on the route. As a result, in August 1929, the Romanian Parliament passed the "*Law for the construction of the Argeş-Bucharest-Danube Canal and for the electrification of the Bucharest-Braşov railway line*" no. 2749/1929.

The project has no financial conditions to fulfill because of the economic recession of 1929-1933. But Dimitrie Leonida will not abandon this work, for which he will study for 40 years. (Avădanei, 2012).

Another proposal is launched in 1930, when engineer P. Bejan publishes the "*Study of the Argeş-Bucharest-Danube Canal*". It is envisaged to make the navigable canal by deflecting the Argeş River in the Buda point, up to Bucharest, on a length of 17 km. Then, the route continues with a fall of 18 m near the Bellu cemetery, fall that is capitalized by the location of a hydroelectric power station in the Valley of Complaint. From here, the canal is navigable up to the Danube, having several hydropower stations on the route. Engineer Bejan failed to complete the project because of the general economic crisis that began during this period.

In 1932**,** Cincinat Sfinţescu published an extensive work on the Bucharest modernization "*For Bucharest - New Urban Studies*" where, in the 3rd volume "*The communication and transport ways in Bucharest*", he shows the need for the Bucharest-Danube waterway and presents various solutions studied. (Avădanei, 2012).

In 1933, Dorin Pavel drew up the project for "*The Argeş-Bucharest-Danube Navigable Canal*" with 4 locks of 42 m wide and 3 m deep. Neither this project will be carrying out because of the difficult historical events that follow.

In 1940**,** Prof. Dorin Pavel coordinates the study „*Hydraulic arrangement of the Bucharest Region from the mountain to the Danube*" according to which, after draining the lakes in northern Bucharest, the Dâmbovița and Argeş rivers will allow the access of the 1,000-ton barges from Danube River. (Avădanei, 2012).

In July 1984**,** following the studies and analyzes, it was decided that Bucharest would be linked to the Danube both through Argeş and Dâmbovița.

6. Conclusions

The navigation evolution on the Romanian rivers, both by historical stages, as well as on hydrographic basins, leads us to some conclusions.

The main advantage of the transport on the Romanian rivers is that all reach the Danube, being part of its watershed. Thus, the river shipping in this Carpathian-Danubian-Pontic area is a link in the extensive activity carried out on the European hydrographic network.

The indigenous population used, always, the rivers in peaceful purposes, for the needs of the community and for trade.

The amplitude and diversification of the navigation facilities on the inland rivers have evolved with the commercial and strategic interests of the time's powers, for the various wealth available on Romania territory; reliable data begin from the period of the Roman Empire domination.

Until the Modern Era, most of the hydrographic network was used for navigation, in natural regime, because the hydrological regime was more regular due to the high degree of afforestation of land at that time.

In the twentieth century, the changes in the hydrological regime, the development of terrestrial and air transport, as well as the economic priorities reduced the national interest for inland shipping in our country. However, the economic and strategic importance of a waterway connection between the country's capital, Bucharest, and the Danube, has become increasingly evident and, as result, numerous technical and economic studies and projects have been carried out.

The inland waterways transport provides an inexpensive, bulky, safe and fast transportation of materials and goods. And, moreover, is the most environmentally friendly mode of transportation, today.

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AMENAJĂRI PENTRU NAVIGAȚIE PE RÂURILE DIN ROMÂNIA
Periplu istoric

(Rezumat)

Se prezintă situația navigației pe râurile de pe teritoriul României, în decursul istoriei, după documentele şi datele accesibile. Informațiile sunt sistematizate după: epocile istorice ale Europei: (Antichitatea, Evul Mediu, Epoca modernă), regiunile istorice ale României (Transilvania, Banat, Valahia, Moldova), râurile pe care s-a practicat transportul continuu, de lungă durată, cu ambarcațiuni de deplasament semnificativ pentru epoca respectivă (Mureş, Tisa, Someş, Crişul Alb, Bega, Jiu, Olt, Argeş, Dâmbovița, Ialomița, Bistrița, Siret, Prut).

Dezvoltarea transportului pe râurile României s-a bazat pe avantajul esențial că toate aceste râuri ajung la Dunăre.

Se prezintă studiile şi amenajările pe căile navigabile interioare, propunerile sau realizările de sisteme de navigație complexe precum şi evoluția legislației la scară națională.

Transportul pe căi navigabile este mai ieftin, mai sigur şi mai voluminos, conduce la dezvoltarea socio-economică a zonei, poluează mediul într-o măsură nesemnificativă.

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STUDY OF ECOLOGICAL INTERACTIONS IN THE FOREST ENVIRONMENT

BY

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Abstract. This paper treats the problem of interactions in the forest environment and their effects. The composition, structure and functions of the forest at one point are conditioned by changes in the environmental context over time, but its internal environment, its protective function is determined precisely by the structure and state of the forest at each stage of its evolution. Forest vegetation has a high capacity to oppose random variations of environmental factors, even when they exceed the boundaries of their tolerance zone.

Keywords: environment; forest; ecosystems; vegetation; climate changes.

1. Introduction

From an ecological perspective, living organisms are constituted in populations that interact with each other, conditioning each other's existence, state and functionality, but are in the same complex interactions with the a-biotic environment in the space occupied by the living community (biocenosis).

At the same time, the forest system formed - the forest as a whole - influences and it is influenced by other neighboring ecosystems, integrated at a higher level - forest biomes (extensive forests of different types, covering a

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landscape). Over these complex interactions in which the forest is engaged overlap with the social-human environment, consisting predominantly of the forest-technical actions, but also of other antrophic factors, which derive from other human actions and is redistributed above the forest, conditioning its existence, the condition, its functionality.

The specific environment of the forest, resulting from complex interactions between living organisms as biochemical and biochemical factors and the abiogenic environment or the forest resort (biotope - habitat), including the cosmic, geographic, orographic, edaphic, hydrological, geochemical environment) has the character of a global ecological result - which configures the conjuncture environment (soil, climate, etc.) specific to the forest at one point.

The resulting forest environment is of a conjectural nature because many ecological factors vary in their random concentration and, due to the complex interaction between them, changing the concentration of one alone leads to the change of all and the resultant - the forest environment.

Initial, the character of the environment is dominated by the abiogenic environments – litho-logy, orography, soil, climate of the site or biotope, but after the forest closes and the stabilization of its biocenosis, its environment is predominantly determined by biochemical and biochemical factors.

So, anthropogenic factors - which act directly on the forest (forests measures, sports hunting and poaching, grazing domestic animals) and indirectly (chemical pollutants from agriculture, industries, transport, radioactive isotopes and their energies) can strongly disturb the forest environment due to interactions complex with both the living world and inorganic environments.

Permanent exchanges of substance, energy and information between living components and between them and the abiogenic environment, which have extremely intense and directs over the long existence of the forest, have allowed for the establishment of a biochemical balance (balanced numerical ratios among populations) of an ecological balance (between them and their surrounding environment).

In a complex and diversified structured forest, these fluctuations do not affect the integrity and apparent stability, the almost continuously interrupted equilibrium is quickly restored not to its predecessor parameters, but to another level, often higher, thanks to feed-back circuits.

In the relationships between forest-living animals (plant and animal species) represented by populations with a variable population, with a generation structure and age that changes over time and factors of their external environment, each ecological factor has a specific action, even when has the same strength.

There is an optimal level of concentration of all ecological factors at which each species reaches its maximum diversification and development, a level that is not usually achieved, the coincidence of the optimum concentration of all ecological factors with a low probability.

2. Experimental

In the existence of the forest, in its evolution, the relationships between the abiotic factors and the vegetation are decisive; consequently, their knowledge, the general and the particular aspects are of particular importance, both for the correct execution of the forests measures and for the design of a new forest or for the ecological reconstruction of the destroyed ones.

The existence of different plant species, their flocks, the degree of individual development, the structure of the plant populations depend on the whole abiotic factors and not on the concentration and the action of each of them, as well as on their variation regime over time, namely the succession of the ecological conjunctions static - for long periods of time, yearly, seasonally, monthly.

On the other hand, phenology, typology and phenomenology of forest vegetation are expressions of adaptation of plants not to the variations of each ecological factor, but to these ecological conjunctions that have succeeded over time.

So, when analyzing a resort for forests purposes, it must be described in terms of all ecological factors and the interaction between them, with their entire variation regime (in the past, today, predictable).

At the same time, vegetation is analyzed and if a certain degradation state (more or less advanced) is found, then a static cause should not be sought, but a set of causes that led, through interaction, to this result and more rarely the factor minimal that caused the collapse, exclusion of a species or more species, even when the other factors were if not optimal, at least tolerable.

Forest vegetation has a high capacity to oppose random variations of environmental factors, even when they exceed the boundaries of their tolerance zone, if these variations are often repeated in the existence of the forest, each time having similar intensities, meanings and durations.

On the other hand, the abiogenic environment of the resort with a certain geographical position, altitude, relief, soil, etc., is strongly modified by the vegetation of the forest, its structure, the nature and development of the forest, but also the other levels in which in essence, the climate is changed.

Consequently, we can speak, taking on the ecological factors, their specific influence on the plants, the animals, the life of the forest, but also the influence of the life of forests, animals, plants on the abiotic ecological factors.

3. Results and Discussions

Regarding the interactions between climate and the forest life, vegetation receives and modifies all the climate factors (heat, light, humidity, wind), resulting in a particular climate - forest fito-climate, differentiated as a microclimate from the one above or around the forest.

This, in turn, changes the soil climate and influences the life, not only of the plants themselves, but also of the animals.

In the interaction between light and heat, the solar radiant energy,

composed of light and heat radiation, emitted as a constant (1.98 cal / cm^2 / min) is retained in a proportion of approx. 53% of the earth's atmosphere by retreating and retaining, with only 47% reaching the ground when it is discovered or at the surface of the forest's crown.

The upper part of the forest canopy behaves like a screen in the way of cosmic radiation, in general, and solar radiation, in particular.

Thus, it reflects in the atmosphere about. 20-25% of this radiation (albedo) absorbs 35-70% of it and only 5-40% penetrates the forest. The forest soil reaches only 0.01 cal / cm^2 / min of the entire solar constant, while on the ground discovered the intensity of the solar radiation reaches 1.5 cal / cm^2 / min.

The intensity of solar radiation is unevenly distributed in space and time, due to the shape and the movement of the plant, depending on: latitude, longitude (geographical position), altitude, local orography (relief), obtaining a regional and zonal character with values that give macroclimate more extensive territories (geographical areas, geographical regions, etc.). At the local level, the shape of the slopes, the size of the slopes and their orientation, and shading are determinants of the degree of sunstroke.

Ultraviolet radiation has a lower weight in terrestrial light, and they are retained in the ozone layer, and infrared, with very high calorific power, are partially retained by water vapor from the earth's atmosphere as well as carbon dioxide, so that the entire spectrum the solar radiation from the ground and its covering vegetation is weighted by the characteristics and the state of the atmosphere in a life-saving direction, with all its forms of manifestation.

Nebulosity (cloud cover with clouds, cloud type, and ceiling height position determines the intensity of light at different latitudes.

Through photosynthesis, all the luminous energy is brought to the same denominator as the geochemical - and under this form (of chemical energy) it is then circulated on the flow of the substance in the body of each plant through trophic chains into the body of all animals, contributing to all the transformations of the substances from an ecosystem and the entire biosphere.

All transformations have resulted in a great diversity of living organic substances and plant and animal products and a wide variety of forms of energy (metabolic energy, movement, locomotion, nervousness) as well as rhythms of activity (life), of production.

The light budget inside the forest is diminished compared to the one reached at the top of the canopy with the value of the albedo (% of the light received, which is reflected in the atmosphere).

The average values of the luminous albedo are 20-25%, but its variation limits are much higher, depending on the characteristics of the stands, their massiveness and density, the closure mode and profile shape, the crown leaf characteristics, the size, position, color, condition of their surface.

Obviously, the intensity of light inside the forest decreases gradually or sharply from upper to lower floors, in any forest, more or less, depending on the nature of the trees.

For example, in an oak tree, with a lower albedo, with wider crowns,

with irregularly shaped leaves, having a more uneven layout, the amount of light absorbed will be lower and thus the budget and the light regime under the arbores will always be more favorable than in the beech one, allowing only 15% of the active photosynthetic radiation to pass through the canopy, absorbing 80% of the incident radiation in its photosynthetic device and 70% of the photosynthetic active.

4. Conclusions

Each climatic factor does not separately affect the individuals and the populations of the forest, but only in interaction with all the others.

For life and for forest, a big importance has the state of the atmosphere, not only directly, through the ecological functions of its gas (O_2, CO_2, N_2, etc.) but indirectly by its ability to modify the regime of the most important climatic factors - light and heat.

All transformations are conditioned by the rhythm of solar energy supply, especially bright, much more intense and directly into the plant world and less bland and indirect in the animal world, which has managed to gain some independence from the cosmic rhythms, through improving the respiratory system.

Consequently, the composition, structure, but above all the state and functionality of the forest, the life of the forest are conditioned by the distribution of light and its effects, in terms of illumination duration, intensity of light and quality.

The forest influences not only its own light budget, but, through its shadow stretching in different directions during the day, over a distance greater than the average height of its tree, tempered and modeled the budget and the light and heat regime of the perimeters around other ecosystems (meadows, agricultural ecosystems) or uncovered lands.

The tree influences the light regime of the lower vegetation floors by absorbing and retaining on average 35 to 70% of the incident light, and in some cases up to 98% of the full light.

The amount of light that the other floors receive depends not only on the direct one left by the tree, but also on the diffuse (50-75%) that either passes through the leaves (through refraction) or is reflected from the inner leaves of the canopy, not to the atmosphere, above the canopy, but to the ground or lower floors or the leaves below, on the same floor, at the bottom of the crown.

Forest species have generally known demands on the intensity of light, which, in the case of trees, refers to the values of the light intensity characteristic of the biotope, its geographic position, altitude, shape, relief, slope, exigencies that satisfy the installation and tree development.

Also, the plants in the lower floors have exigencies to this factor and a specific behavior to its variation, only if they are satisfied or not, causing them different modifications, not so much the budget and light regime of the place as

the structure and the face behavior the light of the fir tree (albedou, absorption, shading).

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STUDIUL INTERACȚIUNILOR ECOLOGICE ÎN MEDIUL SILVIC

(Rezumat)

Este tratată problema interacțiunilor ecologice din mediul silvic și efectele lor. Compoziția, structura și funcțiile pădurii la un moment dat sunt condiționate de schimbările conjuncturii de mediu în decursul timpului, dar mediul său intern, funcția sa protectoare sunt determinate tocmai de structura și starea pădurii în fiecare etapă a evoluției sale. Vegetația forestieră are o înaltă capacitate de a se opune variațiilor aleatorii ale factorilor ecologici, chiar și atunci când acestea depășesc limitele zonei lor de toleranță, dacă aceste variații se repetă des în existența pădurii, de fiecare dată având intensități, sensuri și durate asemănătoare.

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LIMITING THE INFLUENCE OF THERMAL STRATIFICATION FROM ACCUMULATIONS ON THE DOWNSTREAM BAY

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Abstract. Planet's freshwater resources are scarce, because 97.3% of the total water is salty while the fresh water is limited to only 2.7%. Besides, it is unevenly distributed in the world.

The water reservoirs created by the construction of dams make possible the accumulation of additional water reserves in deficient countries; but they also have other purposes, such as generating electricity and the hydrological regularization of water courses.

In terms of environmental impact must be taken into account basic elements such as the surface of the water accumulation and the degree of change in water flow, including both habitat modification and other elements specific to the ecosystem and how ecosystems are affected downstream.

In the current context of limiting the negative influence of human activity on the environment, besides the quantitative satisfaction of the water requirements, it is necessary to meet the requirements of water based on quality criteria, including the downstream discharge.

Keywords: dimictic lakes; stratification of lakes; downstream water; environment; water reservoirs; hydrobiology.

1. Introduction

At the planetary level there are about 45,000 large dams (large dams are considered those taller than 15 m) and over 800,000 small dams with an overall

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storage capacity of 7,000 km^3. The existing dams ensure a 70% increase in the availability of freshwater. Thus, the main reasons for building dams are: facilitating the use of available water, reduction of water level variability of different watercourses, storing water in case of crisis due to some prolonged droughts, regulation of flow for different uses, increased safety in cases of catastrophic flooding, the generation of electric power.

The impact of dams on downstream ecosystems is complex and has both social and environmental components. If the human population in areas affected by construction of a dam must be evacuated, social impact is simple, yet very drastic. The downstream impact is rather represented by a set of impacts related to the time period and volume of changes of the river level, the quality of the river bed, and the connections between hydrological conditions and flooded areas.

The impact of dams on downstream areas clearly involves substantial changes in the dynamics of some parameters and characteristics of the environment. The precise estimation of the effects of a dam construction at the time of its design is almost impossible. There is a high level of uncertainty in terms of prognosis and the type of impact for different areas and the evolution in time of the negative effects.

This mode of operation is particularly met in the case of accumulators whose main role is to ensure a minimum flow downstream during periods of drought. Even in this limiting situation, to ensure an unspoiled biotope downstream of the dam, the evacuated water must meet certain quality criteria. A concrete example of this type is the Lavaud dam - France. In summer, a strong stratification phenomenon occurs in the lake, which also causes an uneven distribution of water quality in the lake.

It is necessary to find a mode of exploitation that allows the downstream discharge of a flow having the quality parameters controlled according to the requirements of the beneficiaries. This is possible if the dam is provided with three water inlets at different rates. The difficulty lies in the fact that the evacuated flow is controlled by a single valve, with no data on the distribution of the flows through the three openings of the plugs.

In this paper I will focus on the knowledge of the ABA Prut-Birlad patrimony and finding solutions for limiting the influence of the thermal stratification from accumulations on the downstream bay.

2. Thermal Stratification of Water

The evolution of the thermal structure of a reservoir is complex. In the case of a natural lake, the weather conditions are the major component of water stratification. In the case of a dam, the destabilization of water bodies caused by volume changes in inputs or withdrawals plays an important role. In the literature, the term water stratification is reduced to the thermal approach, although the same phenomenon also concerns dissolved oxygen.

Lakes are not just water tanks uniformly mixed. They are in fact highly

dynamic systems, characterized by complex processes, and a variety of subsystems that vary seasonally and according to longer cycles. Stratification of lake water is due to variations in density, caused by temperature variations. The density of water increases with decreasing temperature and reaches a maximum at about 4°C. The result is a thermal stratification; distinct layers tend to be formed during the summer months, in deep lakes. The phenomenon of stratification of lake water can prevent the dispersion of effluents from the tributaries and thus increases the concentration of pollutants near the shore. However, in most cases, the lake water remains mixed throughout the winter.

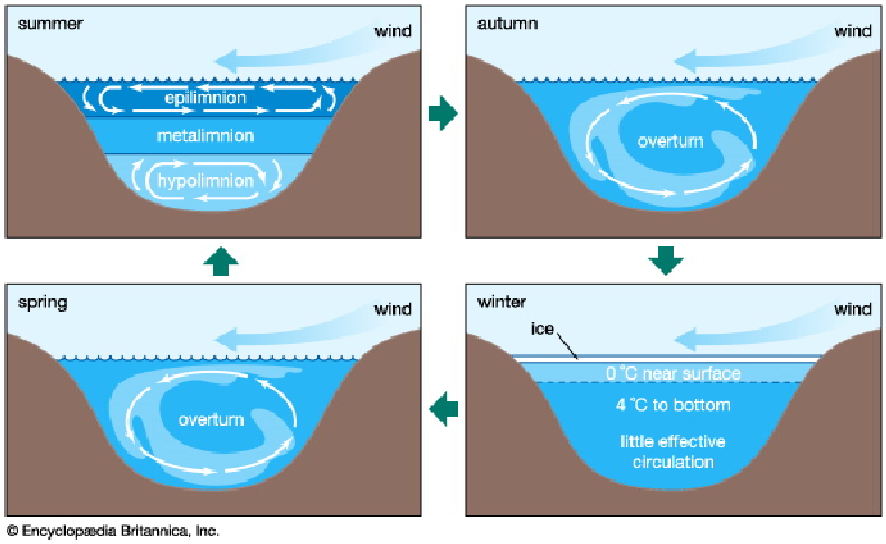

Fig. 1 – Stratification of deep lakes in the seasons of the year.

Understanding environmental processes is the first step to forecasting such evolutions. Furthermore, a good understanding of stratification is required not only to prognosticate the future of our lakes but also to better interpret the past from lacustrine sediment cores (Kjensmo, 1988; Brauer, 2004).

A considerable portion of the lakes on Earth are permanently stratified. Deep lakes especially show this feature. As a consequence, many of the largest lakes (*e.g.*, Caspian Sea, Baikal, Tanganyika, Malawi-Nyasa) and many middle size and small lakes do not circulate completely in the vertical and do not show a homogenized, overturning water body at any time during the annual cycle. The permanent stratification has decisive impact on the redistribution of dissolved substances, such as nutrients or oxygen, and hence determines the biocenosis that can form in the lake (Gaedke *et al.*, 1998; George & Hewitt, 2006; Thackeray *et al.*, 2006).

Observations of stratified lakes probably date back to long before the start of scientific literature on the environment. The Romans likely already knew about stratification.

In Romania, the "Romanian Waters" National Administration has in its structure 11 Water Basin Administrations, organized on hydrographic basins, the National Institute of Hydrology and Water Management and Complex Exploitation Water storage of Costeşti Rock. I asked for field measurements at office Operation monitoring parameters for pollutant, temperatures and so on, but the request for concrete data (field measurements) has not been honored so far. Having the example of the Lavaud - France dam that shows the necessary parameters, I will use this data to build the two computational programs. The first allows us to calculate the flows through the three openings according to their size, the water level in the lake and the flow or opening of the bottom drainage. The second program indicates the flows to be taken through each of the three openings and the openings dimensions, so that the water quality criteria are met.

2.1. Pârcovaci Reservoir

Is located in the water basin of Prut and is located on the Bahlui River.

The lake reservoir has a volume of 17.9 million cubic meters at the maximum level of verification (1.2 × 0.1%) corresponding to the share of 178.67 mdMN and a volume of 7.9 million cubic meters at the corresponding level of calculation (1%) Share of 177.23 mdMN.

The dam is made of homogeneous soil, with trapezoidal section, protection from upstream concrete slabs. The main construction features are as follows:

– the maximum length of the dam H = 25.00 m;
– length of the canopy: L = 290 m;
– crown width: l = 6.75 m;
– crown ground: 178.70 mdMN;
– capacity overflow: 176.00 mdMN;
– normal retention level - 171.00 mdMN - 2.750 mil m^3;
– ridge level D.A.M. - 176.00 mdMN - 6.400 mil m^3;
– leveling - 178.70 mdMN - 8.750 mil m^3.

2.2. Puşcaşi Reservoir

- Location Water Basin of Prut in the Racova river meadow The nearest town - Vaslui (about 7 km).
- Characteristics:
- dam - from homogeneous land (clays and sandy clays);
  - crown length - 890 m;
  - maximum height - 16 m;
  - crown width - 5 m;
- storage lake - characteristic levels and volumes:
- normal retention level - 115.50 mdMN - 6.2 mil m^3;
- ridge ridge level - 116.83-117.14 mdMN - 9.91 mil m^3;
- coronation level - 119.50 mdMN - 17.5 mil m^3.

2.3. Mitigation Solution for the Influence of Water Stratification Phenomenon in Lavaud Lake on Downstream Waters

Generally, the aim of operating a storage lake is to ensure the consumers water needs and/or to prevent the effects of drought or flood. In the case of Lavaud dam, located in the Department of Charente (France), it is necessary to take into account the phenomenon of water stratification for its operating system. This operation system is facilitated by the fact that the dam is provided by construction with three water intakes located at different levels. Studies on water stratification, and thus on stratification of water dissolved chemical elements, are largely conditioned by the precise knowledge of the flow rates imposed by three openings of the dam. Similarly, temperature and, generally, the quality of water discharged into the lake can be verified only in terms of a precise knowledge of the flow discharged by three openings. The flow that passes downstream the Lavaud dam can be monitored by a single remotely located valve. In this situation there is no information on the flow distribution through the three openings, therefore, the operation of the dam, taking into account the phenomenon of stratification, is difficult.

A mitigation solution for downstream problems caused by water stratification consists of determining the following (problem solved by two specially designed computer programs):

i) the flow rates collected by the three openings, depending on the flow discharged through the bottom outlet, in order to provide solutions to the operational problems of the dam;

ii) the flow rates as well as the openings of the three valves, made under conditions imposed on quality of evacuated water.

Location and Specifications of the Dam

The dam is located in the Lavaud Department of Charente, at the birth of the Charente River. The dam has a capacity close to 10 million m3. The structure of flow control device consists of an intake tower with three openings (including the bottom outlet) located at 220, 215 and respectively 211 NGF respectively. The openings sizes are: for the two at the top 0.80 m × 0.80 m, and 1.10 m × 0.80 m for the bottom valve. The bottom outlet duct is common with the spillway. The drain flow and return flow are regulated by two separate valves: a valve covering the range of small flow: 50 L/s at 1 m m3/s, and a valve covering the large flow: 800 L/s to 12 m^3/s.

Management of the Dam

The Lavaud dam (Fig. 2) stores water during winter. The water level in the lake was at the lowest end in September In late April, the dam reaches its maximum level, stabilized at around 224 m (NGF Level General of France).

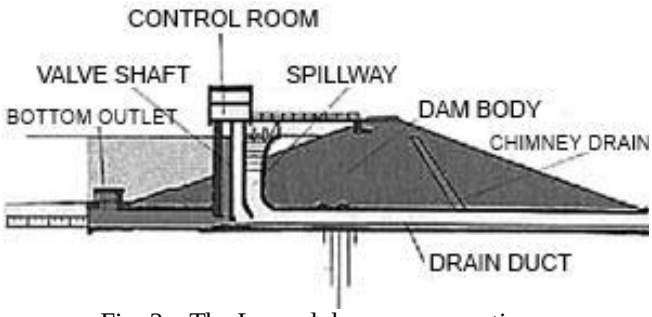

Fig. 2 – The Lavaud dam – cross section.

a) *Dam management - imposed requirements*

During the filling period, the in stream flow will be in any case below the 1/10 of the annual average flow, or below 60 L/s or the sum of the flows entering the reservoir by Charente river and its tributaries, whichever is lower at 60 L/s.

Regarding Lake Lavaud, thanks to the studies undertaken by Christophe Guglielmin, the stratification of the water was established using an original method. The stratification for two consecutive years had the following development: June 1...June 22, no real stratification is recorded; June 29...July 12, stratification begins essentially with that of dissolved oxygen; July 20…August 23, stratification is well defined, corresponding to the warm period of the year; August 16...September 6, the studies indicate a good stratification of dissolved oxygen; the water withdrawal of August 30th indicates a return to original state in the intermediate zone reflecting the end of a state of stratification; September 13…September 27, these withdrawals characterize the absence of stratification. The stratification for second year is similar.

The tracking method used to provide indications is fairly accurate but it has still significant inaccuracies since the inputs and outputs of water are not precisely known. The water inlets are positioned at levels corresponding to their density layers, carrying with them the surrounding water bodies. The water catchment mobilizes a horizontal layer of the reservoir whose height depends on the flow and thermal stratification.

To increase accuracy, a method for calculating the flow rates was required.

b) *The main physicochemical parameters of water and classification of the lake*

Dam LAVAUD, like most reservoirs in temperate regions, is presumably of dimictic type. This means that it undergoes complete mixing in the fall and spring while it has stratification in summer and winter. The main indicators of water quality are: temperature, dissolved oxygen and percentage of saturated oxygen, pH, conductivity, total suspended solids (TSS) and total organic carbon (TOC); ammonium, nitrate and phosphate, the Kjeldahl Nitrogen, the BOD5, COD and nitrite (Fig. 3). The maximum values of the main dissolved elements in Lavaud Lake are shown in Table 1.

Table 1

The Main Elements Dissolved in the Water Of Lavaud Lake with their Maximum Values, Recorded at Maximal Depths, Corresponding to the Water Discharge Level of 209 M

Element	2005 – Maximum concentration, [mg/1]	2006 – Maximum concentration, [mg/1]	Normal value, [mg/1]
Total Fe (Fe2+, Fe3+)	28.54	34.94	0.01...2.0
MnJ+	4.25	6.77	0.01...2.2
Ortho POz	0.5	0.67	0.01...14
NH£	5.67	8	0.1...8
F~	3.699	0.67	0...5
cr	10.77	10.54	0.5...2
NOz	0.81	0.46	0.1...2
NO^	3.429	4.17	5...80
5042~	8.34	5.31	250

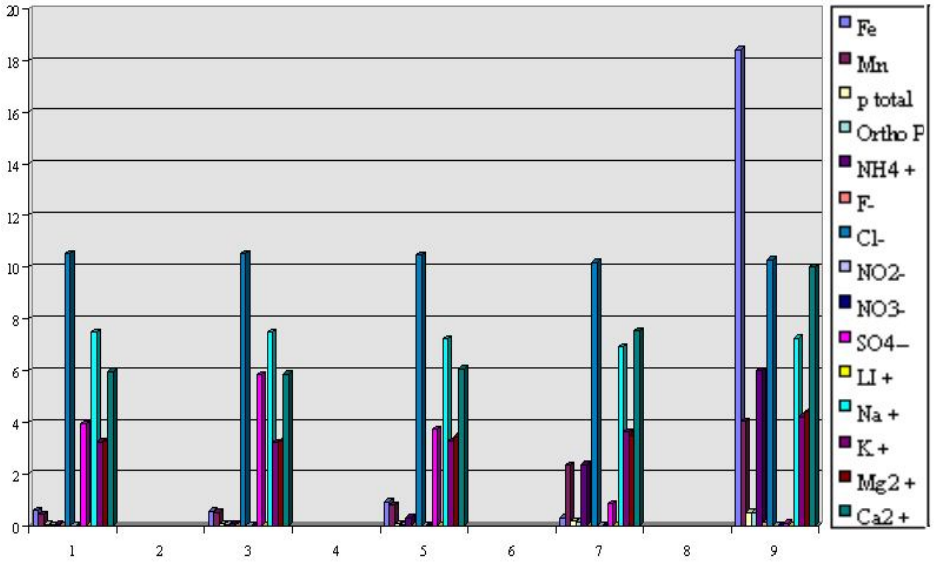

Fig. 3 – The evolution of dissolved elements in the Lavaud lake, second year, [mg/l].

c) *Problems needed to be solved for Lavaud dam operating*

These problems have in view:

A – calculation of withdrawal rates;

B – minimization of pollutants dissolved in downstream water of a dam at an imposed temperature using Simplex method.

A. *Calculation of Withdrawal Rates*

In the case of Lavaud dam there is only one remote control valve to adjust flow rates and evacuated three water intakes located at different levels. To operate the dam taking into consideration the real stratification of water, it is

necessary to know the three flow rates that pass through the openings in the situation in which the height of the openings and the value of evacuated flow is modified.

To solve this problem, we matched the expressions of flow rates that pass through the three openings, with the flow discharged through the bottom outlet, the charge for each opening being expressed in terms of the variable height of the water tower. Varying the height, at a given time, the equality of both terms of the relationship is obtained. In that moment, the appropriate values for the flows $Q_1...Q_3$ represent the flows are looking for:

$$Q_{\text{botton}} = Q_1(z) + Q_2(z) + Q_3(z), \quad (1)$$

or

$$\mu_{\text{fond}} b_{\text{fond}} h_{\text{fond}} \sqrt{2gz_{\text{fond}}} = \mu_1 b_1 h_1 \sqrt{2gz_1} + \mu_2 b_2 h_2 \sqrt{2gz_2} + \mu_3 b_3 h_3 \sqrt{2gz_3}, \quad (2)$$

where: b_i, h_i are the intakes openings; μ_1 – the flow coefficients, z_i – the variable loads + linear head-losses of the openings at a given time.

B. *Minimization of some pollutants dissolved in downstream water of a dam at an imposed temperature using Simplex method.*

The operating conditions of the dam have been imposed in order to guarantee a minimum downstream flow, with respect to the quality parameters of the discharged water. The quality criteria imposed are often contradictory, because of the previously presented stratification phenomenon. For example for a small concentration of iron dissolved in water, at the same time is required to avoid exceeding a maximum temperature for the downstream water in the river. Iron ion is found in small amounts on the surface of the lake, but the water is colder at the bottom of the lake where the iron concentration is maximal. Obviously, in this situation it is necessary to find an optimum which is framed within the imposed operating conditions.

Precisely, one must find the flow rates discharged by three (or two, in the last period of the summer) water intake openings, whilst the mixture meets these requirements. We solved this problem using the well known Simplex Optimization Methods.

3. Computer Programs for the Proposed Dams Management

To solve the first problem, the operation of the dam taking into account the real situation of water stratification, that is, to know the three flows that pass through the openings, the first computer program was designed. It calculates the flows that pass through the three openings of the tower, when one changes the water intake openings and the flows that pass through the bottom outlet. Normally, the values of the flow passing through each opening cannot be measured directly by remotely operating the bottom outlet.

The entering data are: the lake water surface lavel, the downstream flow, the height of the three opening.

The flow coefficients are entered as constants as in the code lines. For a better accuracy, their values should be verified by field measurements. As output data there were obtained the flow discharged by three (or two for low lake levels) openings.

The second program is a program that solves the problem of minimization of a certain pollutant, respecting the restrictions downstream the dam. The entering data are: water level in the lake, concentrations of the contaminant (*e.g.*, iron) in front of each opening, maximum values allowed for restriction (*e.g.*, the temperature downstream the dam).

As output data the program gives the flows that must be evacuated by the three (or two for low lake levels) openings and the minimum value of the pollutant resulted under the given conditions. The code lines of the first program can be provided if required.

3.1. Results and Disscussions

3.1.1. *Some Results Regarding the Calculation of Flow Rates Running the Program No.1*

The program was run having as input data the flow rates evacuated by the bottom outlet during the second year. As there is no data on the dimensions of the openings for this period, several tests for different values of the openings were done. Subsequently diagrams of flow rates by three openings for the same opening of 10 cm for all outlets are presented. Note that the flow rates, which go through the catchment at the lower level, is increasing in the same time the discharged flow is higher, whilst the flows passing through outlet at a higher level is diminishing. The flow rates passing through the middle outlet remain almost constant, with a slight tendency of growing. It means that in general for the same opening of the catchment, mainly water at a lower level is discharged downstream the dam. That is, the quality of discharge water will be influenced by the quality of water in these layers.

The changing of the flow rates evacuated by three openings is more evident for flow rates larger than 0.5 m^3/s. At 1.35 m^3/s appears a delimitation of evacuated flows due to the too small openings of the catches. As the evacuated flow rates exceeded this value, in reality, it appears that the openings were larger.

Since running the program for openings of 0.2 m height, does not produce limitations of the withdrawal, we can say that such a situation may be similar to that existing in the second year.

Obviously an infinite number of combinations between the openings are possible, this mean that thanks to this program it is possible to know the real rates of water withdrawals, and the actual modeling of sedimentation can be possible. We recall that the results obtained using this program can become more precise if real values of the discharge coefficients are determined by direct measurements.

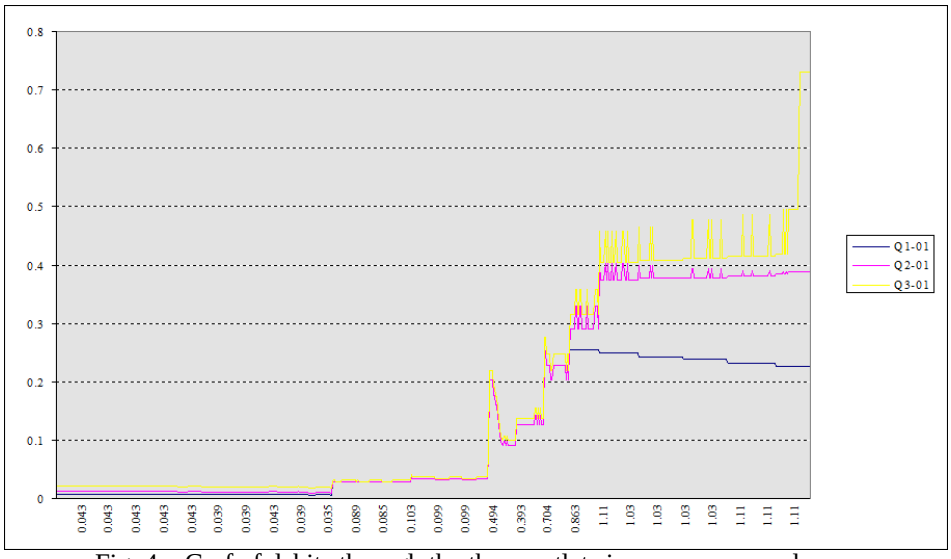

Fig. 4 – Graf of debits through the three outlets in summer second year.

3.1.2. *Some Results as Regards the Calculation of Flow Rates for a Requested Downstream Water Temperature of 15°C,and a Minimal Iron Concentration, with the Program no. 2*

During the summer, the water user, situated downstream of the dam, requests that the water delivered by accumulation meet certain conditions. The most common requests are from the *Fishermen's Association* that relate especially to the temperature of water released from the lake.

A modeling for the months of July and August in the first year was carried out, for a required water temperature of 15°C under the conditions of minimizing the total iron content. The requested flows comprised between 0.5 and 2 m^3/s. The program allows the processing of all values encountered in any real situation. Obviously, up to now, it was difficult to fulfill these demands especially since the flow discharged through each opening were unknown.

The program can be used for any demands since the optimized parameters can be modified at any demand. There are presented the data as a result of running the program, with the recommended flows and openings for the three water intakes of the tower. Regarding the second year, the data are more accurate, since the flows are known.

From the above, it is seen that problem of operating the lake so that its impact on existing wildlife downstream of the dam is minimal, can be solved using two computer programs. Note that starting from the adjusted value of total evacuated flow using the only remotely adjustable valve, the program No. 1 calculates the values of Q_1 - Q_3 flows passing through the three openings (e.g. of 0.1 m) of the dam's intake tower, at different elevations (Figs. 4,..., 6). This is very important because the pollutants concentration varies depending on

depth, due to stratification of lake water. From Table 1 we see that at the lake bottom (209 m), the concentration of the pollutants is maximal. For example, Total Fe reaches a concentration of 34.94 mg/L, far exceeding the allowable value of 2 mg/L. As a logical consequence, one can improve the water quality discharged from the lake, if smaller flows are allowed to pass through the bottom opening, where the concentration of the pollutants is maximal. Similarly, the same can be said for another important environmental factor for wildlife that can be adjusted using the flow, namely the temperature of evacuated water. Lower values of the temperature (12º…13ºC) are also recorded at the lake bottom. The required optimal value for evacuated water is 15ºC, while minimizing the concentration of the pollutants. Achieving this minimum is possible using program No. 2. This gives the values of the required heights for the intake tower openings in July and August when stratification take place. Note that at the beginning of the period is recommended that the h1 opening value (at the lake surface) should be maximum (about 0.25 m), and the bottom should be minimal (< 0.05 m), while the in the next period, there are no longer taken any flow through the top opening, since water level in the lake is below this elevation (Fig. 7), the height of other openings alternating depending on the month, in order to ensure the temperature criteria and a minimal for pollutants. The numerical values of the openings in the tower, as well as the values of pollutant element (Total Fe) for the studied two years consecutivesare presented in Tables 2 and 3. Note that the minimum concentration value achieved downstream the dam, using the proposed two programs, does not exceed the value of 20.33 in the most unfavorable month (first year), when the maximum concentration in the lake is 28.54 mg /L. Some measured data of the physical parameters of the lake for the second year are graphical presented.

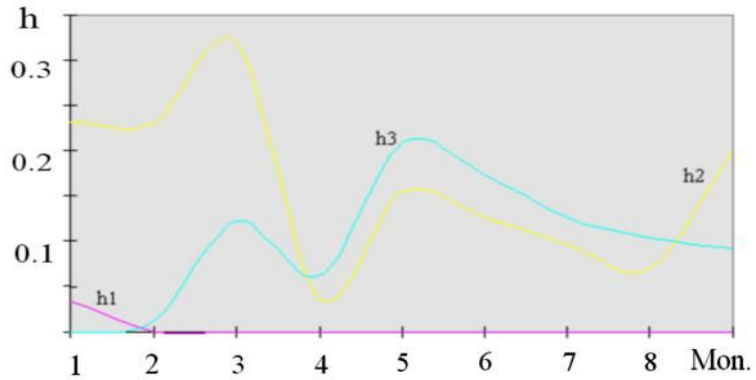

Fig. 5 – Graph of openings(m) calculated for a water demand of 15°C and minimum of total iron content (July-August, first year).

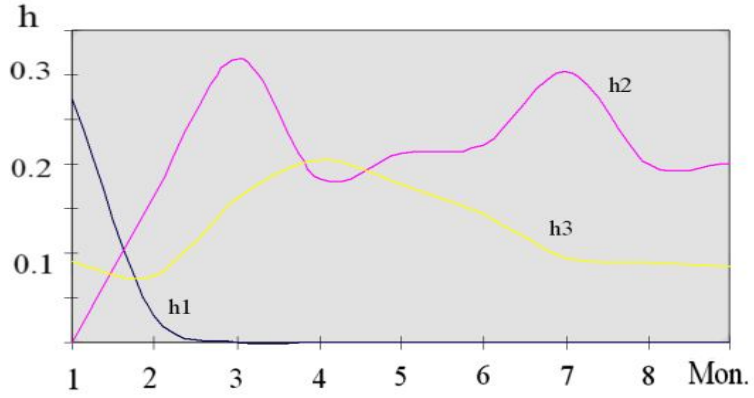

Fig. 6 – Graph of openings [m] calculated for a water demand of 15°C and minimum of total iron content (July – August, second year).

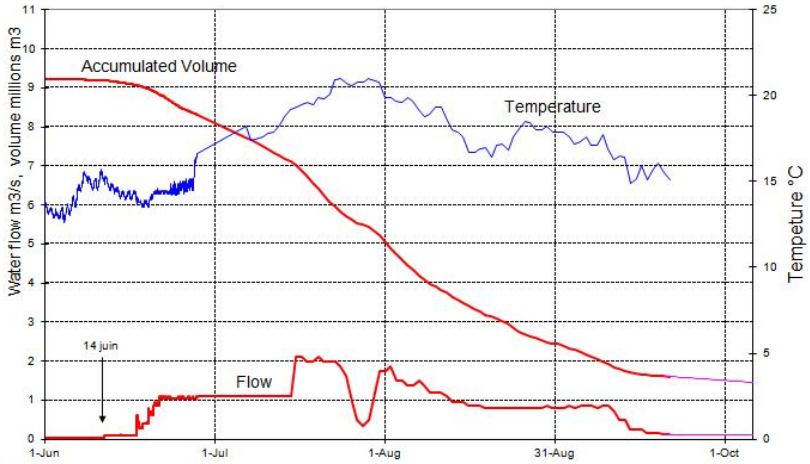

Fig. 7 – Flows, [m^3/s], and temperatures, [°C], recorded at the water surface level - summer (second year).

Table 2

Quality Classes of Surface Waters Physical and Chemical Quality (*Low Grid*)

Parameters	Units	Excellent	Good	Accept.	Mediocre	Classwise
Class		1A	1B	2	3	FC
Dissolved oxygen	mg O2/l	7	5-7	3-5	1.5-3	1.5
Oxygen saturation	%	90	70-90	50-70	50-20	20
CBO5	mg O2/l	3	3-5	5-10	10-25	25
NCO	mg O2/l	20	20-25	25-40	40-80	80
Amoniu	mg NH4/l	0,1	0.1-0.5	0.5-2	2-8	8

Table 3
Eutrofization Parameters: Azot, Phosphor

Parameters	Units	Excellent	Good	Accept.	Mediocre	Classwise
Azote		N1	N2	N3	N4	N5
Nitrate	mg NO3/l	5	5 - 5	25-50	50-80	80
Nitrite	mg NO2/l	0.1	0.1-0.3	0.3-1	1-2	2
Ammonium	mg NH4/l	0.1	0.1-0.5	0.5-2	2-8	8
Azot Kjeldahl	mg N/l	1	1-2	2-3	3-10	10
Phosphorus		P1	P2	P3	P4	P5
phosphate	mg PO4/l	0.2	0.2-0.5	0.5-1	1-2	2
Total Phosphorus	mg P/l	0.1	0.1-0.3	0.3-0.6	0.6-1	1

3.1.3. *Thermal Stratification of Water, Determination of Parameters Necessary for Modeling*

Water stratification in lakes is due to variations in water density caused by temperature variations. Water density increases as the temperature decreases, reaching a maximum of around 4 degrees Celsius. Thus a thermal stratification occurs, in deep lakes the distinct layers tend to form in the summer months. The deepest areas, the farthest from the sun, remain cold and consequently the densest, forming the lower layer called hypolimnion. The upper heated areas of the sun form the superficial layer called epilimnion. Between them develops the intermediate layer called mezalimnion characterized by fast thermal transitions. The stratification phenomenon can prevent the dispersion of effluents leading to the concentration of pollutants in certain areas.

The superficial, warmest layer also contains the largest amount of living organisms in the lake, algae production is also greatest in the superficial area, where the sun easily penetrates. The upper layer is also the richest in oxygen, which dissolves in the water in contact with the atmosphere. A second layer of high productivity is formed immediately above the hypolimnion, due to the upward diffusion of nutrients. Productivity is lower because the amount of light that can penetrate is smaller. Sometimes an oxygen deficiency may also occur due to the decomposition of organic matter.

At the end of the fall, the superficial waters cool down, become denser and lower, causing the water to rise from the deep layers and thus cause the lake water to be homogenized. Generally throughout the winter the lake waters remain homogenized. Sometimes in the cold season there may also be a reverse layer with a cold top layer having a temperature close to zero degrees and a warmer layer of about 4°C in depth.

The superficial, warmest layer also contains the largest amount of living organisms in the lake, algae production is also greatest in the superficial area, where the sun easily penetrates. The upper layer is also the richest in oxygen, which dissolves in the water in contact with the atmosphere. A second layer of

high productivity is formed immediately above the hypolimnion, due to the upward diffusion of nutrients. Productivity is lower because the amount of light that can penetrate is smaller. Sometimes an oxygen deficiency may also occur due to the decomposition of organic matter.

The amount of oxygen dissolved in the water of a lake depends on the photosynthesis activity, that is, on the light and temperature. Thus, it is normal to find a significant oxygen production in the epilimnion. On the contrary, in hypolimnion, where photosynthesis is reduced, the dissolved oxygen content is small, while the materials resulting from the decompositions produced by the anaerobic bacteria contribute to the massive consumption of oxygen. In the eutrophic lakes, oxygen supersaturations (sometimes up to 200%) can occur in the epilimnion and its total deficiency due to the decomposition of organic matter by the anaerobic bacteria in the other layers. The wind plays an important role in the oxygenation of deep lakes. In regions with cold winters, frost can stop gas exchanges with the outside, while light-beam radiation penetrates the ice with limited photosynthesis. Snow over ice can drastically reduce its transparency and consequently oxygenation of water. Regarding the studied lake, there is a pronounced thermal stratification (a difference of 7°C between the surface and the layer at the depth of 7 m) between July 15 and August 31, accompanied by a net stratification of the dissolved oxygen.

The stratification phenomenon can be mathematically modeled using vertical uni-dimensional EOLE models. The calculation principle is based on quantification of turbulent kinetic energy (ECT), whose surface input allows the potential increase of the energy of the water column, trained by dense and non-turbulent water in the mixed layer.

For that calculation I wrote the program:

```
   clear all
cota_lac=input('Share in the lake  = ');
qt=input('Total outflow =');
    z=0;
    n=3;
  if 'Share in the lake  <221
    n=2;
    z=1;
  end
    min=100;
    max=1;
      for i=1:n
    t(i+z)=input(sprintf('Water temperature at socket no. %d = ',i+z));
        if (t(i+z)<min)
           min=t(i+z);
        end
        if (t(i+z)>max)
           max=t(i+z);
        end
    end
```

```
t(4)=input(sprintf(''Allowable downstream temperature = '));
        while (t(4)<min )OR(t(4)>max)
disp(sprintf('Allowable value between %d si %d',min,max));
t(4)=input(sprintf('Allowable downstream temperature = '));
       end
        min=100;
        max=1;
        for i=1:n
         C(i+z)=input(sprintf(''Concentration of pollutant at socket no.%d
=',i+z));
           if (C(i+z)<min)
              min=C(i+z);
           end
           if (C(i+z)>max)
              max=C(i+z);
           end
        end
        if n==3
        A=[t(1:3);-eye(3)];
        b=[qt*t(4);0;0;0];
        [x,fval]=linprog(C./qt,A,b,[1 1 1],qt);
        end
        if n==2
        A=[t(2:3);-eye(2)];
        b=[qt*t(4);0;0];
        [x,fval]=linprog(C(find(C))./qt,A,b,[1 1],qt);
        end
  disp(sprintf('The minimum concentration is = %5.2f',fval));
  disp(sprintf('The optimum flows are :  '));
  if n==3
     disp(sprintf('q1 = %5.2f',x(1)));
  end
  disp(sprintf('q2 = %5.2f',x(n-1)));
  disp(sprintf('q3 = %5.2f',x(n)));
```

The program allows for the calculation of flows passing through openings in an infinite number of combinations of valve openings. We have now exemplified a flow calculation for a constant opening of the 0.1 m sockets at a variable drainage flow rate recorded in second year.

3.1.4. *The Main Parameters of Water Quality in the Lake, their Evolution with the Development of the Stratification Phenomenon*

The main parameters of water quality are: temperature, dissolved oxygen and its saturation percentage, pH, conductivity, suspended matter, total organic carbon, specific pollutants such as ammonium ions, nitrates and phosphates. Other additional parameters are equally important: biochemical oxygen demand (CBO5), chemical oxygen demand and nitrite. According to the

French rules, five quality classes can be distinguished in terms of surface water quality:

CLASS 1A : Characterized by pollution-free waters, the quality of which is "excellent"..

CLASS 1B : Characterized by poor quality soils, so-called "good", which can satisfy all uses.

CLASS 2 : Their quality is "acceptable", ie good enough for irrigation, industrial use, as drinking water after proper treatment, for animal welfare and restrictive for fish farming.

CLASS 3 : Quality is mediocre, suitable only for irrigation and navigation. Aquatic life can subsist, but it becomes random in times of low flow and high temperatures.

CLASSWISE : The maximum tolerated values for class 3 are exceeded for one or more parameters. They are considered unfit for most uses, constituting a threat to public health.

3.1.5. *Minimizing the Concentration of Some Pollutants in Downstream Water*

The exploitation conditions of the dam during the summer require, in addition to ensuring a minimum downstream flow and compliance with certain quality parameters of the discharged water. The quality criteria imposed are often contradictory, due precisely to the stratification phenomenon presented above. For example, for a minimum amount of iron dissolved in water, it is also necessary to avoid overtaking a maximum water temperature in the downstream river sector. Iron is found to be minimal at the surface of lake water, and water is colder at the bottom of the lake, where the iron concentration is maximum. Obviously in this situation it is necessary to find an optimum that would fit the required operating conditions. Specifically, the flows discharged through the three (or two in the last exploitation period of the lake in summer) must be found in openings of the water intakes so that the resulting mixture meets these conditions.

We have solved this problem using the Simplex method as an optimization method. An optimization problem is generally characterized by the existence of a goal and a series of restrictions. Obviously, it is impossible to consider all the elements in reality, but only the most important components. The process of formulating an optimization problem begins by defining the following terms:

– Decision variables: unknown values that can be controlled. Each decision variable has a definition limit;

– State variables: (or dependent) are the quantities that define the status of a system. These variables are normally dependent on decision variables;

– Particular or auxiliary variables;

– Goal function: Goal that is maximized or minimized;

– Restrictions: Limitations to be met in obtaining the final solution.

In linear programming optimization, the goal and restrictions must be

formulated in linear form. In most models of water resource management, the common goal is to maximize or minimize water flows or volumes. In the specific case of the analyzed situation, it is the minimization of the pollutant concentration.

The problem can be solved mathematically using the Simplex algorithm (Dantzig, 1963). The Simplex method is iterative. The algorithm first identifies a basic admissible solution (if any) and then starts from it improves it to an optimal solution, or informs that the optimum is infinite.

The algorithm is based on solving a matrix system of equations, the standard form being the following (Kinzelbach, 1986):

The program was obtained by adapting to the specific conditions required by the studied accumulation of a library program [65]. I will only present the extra routines:

```
{Optimal solution using the Simplex algorithm, flows, openings}
clear all;
nlac= input("Share in the lake  (m)=');
    c=input('enter c (c<=3.501) =');
if (c>3.51)
 c=input('enter c (c<=3.501) =');
end
niv(1) = 221;
niv(2) = 217.5;
niv(3) = 206.85;
niv(4) = 206.85;
dt=1.5;
zv=.2;
lm=.025;
for i=1:4
zeta(i)=.5;
if i==3
       zeta(i)=.24;
end
if i==4
   zeta(i)=.2;
end
miu(i)=.62/((1+zv+zeta(i))^.5);
b(i) = .8;
v(i)=0;
 end
i = 1;
while i < 4
 h(i)=input(sprintf('opening of the prize no. %d este (<0.81!)= ',i));
            if h(i)>.81
       i=i-1;
   end
            i = i + 1;
   end
h(4)=1.1;
```

```
prec=1;
for t = nlac-niv(4): -0.1: 0
i = 1;
          sq=0;
      while i < 5
         sarc(i) = nlac-(niv(4)+t+(lm*v(i)^2*(niv(i)-niv(3)))/(dt*2*9.81));
              if niv(i)>=(t + niv(4))
                 sarc(i) = nlac - niv(i);
              end
              if (i ==4)
                  sarc(i) = t-(lm*v(i)^2*(niv(i)-niv(3)))/(dt*2*9.81);
              end
              if sarc(i)<0
                 sarc(i)=0;
              end
                 q(i) = miu(i)*b(i)*h(i)*(2*9.81*sarc(i))^.5;
              if i<4
                 sq=sq+q(i);
              end
                 i = i + 1;
      end
                 v(i)=sq/(3.1458*(dt/2)^.5);
                 q(4) = c;
              if ((sign(prec)~=sign(q(4)-(q(1)+q(2)+q(3))))&(t<(nlac-niv(4)-.02)))
                 disp(sprintf('Pentru Q drain-bottom = %d',q(4)));
                 h4 = q(4)/(miu(4)*b(4)*(t*2*9.81)^.5);
                 if q(4)>.799
                    disp(sprintf('( h_fund = %d)',h4));
                    disp(sprintf('Debitele  prizelor sunt:'));
                    disp(sprintf('Q1= %5.3d',q(1)));
                    disp(sprintf('Q2= %5.3d',q(2)));
                    disp(sprintf('Q3= %5.3d',q(3)));
                    disp(sprintf('Q4= %5.3d',q(4)));
                    disp(sprintf('H_lac = %5.3d',(nlac - niv(4))));
                 end

               elseif t<= 0.005
                     j = 1;
                 while j < 4
                    sarc(j) = nlac - niv(j);
                 if sarc(j)< 0
                    sarc(j) = 0;
                 end
                    q(j) = miu(j)*b(j)*h(j)*(2*9.81*sarc(j))^.5;
                    j = j + 1;
                 end
                    qp = q(1)+q(2)+q(3);
                 if qp<c
                    f = 0;
```

```
                disp(sprintf('For Q bottom-drain = %5.3d',qp));
                h4 = 1.1
                if q(4)>.799
                disp(sprintf('(h_fund= %d)',h4));
                end
                disp(sprintf('Debitele  prizelor sunt:'));
                disp(sprintf('Q1= %5.3d',q(1)));
                disp(sprintf('Q2= %5.3d',q(2)));
                disp(sprintf('Q3= %5.3d',q(3)));
                disp(sprintf('h_tour= %5.3d',f));
                disp(sprintf('H_lac = %5.3d',(nlac - niv(4))));
                disp(sprintf('(Limitat de prize, val. ceruta = %5.3d)',c));
                            end
            else
                lf = niv(3) - dt;
                sq=0;
                for j=1:3
                    if (nlac - niv(j))<= 0
                       q(j) = 0;
                    else
                       q(j)=miu(j)*b(j)*h(j)*(2*9.81*(nlac-niv(j)))^.5;
                    end
                  sq=sq+q(j);
                end
                for j=1:3
                  q(j)=q(j)*q(4)/sq;
                end
                  disp(sprintf(For Q bottom-drain = %d',q(4)));
                  h4 =q(4)/(miu(4)*b(4)*((nlac-niv(4))*2*9.81)^.5);
                if q(4)>.799
                  disp(sprintf('(h_fund= %d)',h4));
                  disp(sprintf('Debitele  prizelor sunt:'));
                  disp(sprintf('Q1= %5.3d',q(1)));
                  disp(sprintf('Q2= %5.3d',q(2)));
                  disp(sprintf('Q3= %5.3d',q(3)));
                  disp(sprintf('h_tour= %5.3d',(nlac-niv(4))));
                  disp(sprintf('H_lac = %5.3d',(nlac - niv(4))));
                  prec=q(4)-(q(1)+q(2)+q(3));
                end
                            end
end
```

During the summer season, water users downstream of the dam, asks for the water delivered from the storage to meet certain conditions. The most frequent requests come from the Fishermen's Association and refer in particular to the temperature of the water discharged from the lake. We made a modeling for the months of July and August two year consecutive of a water temperature demand delivered of 15ºC under the conditions of minimizing its iron content. Requested flows ranged between 0.5 and 2 m^3/s and cover the entire range of actual flows recorded in the operation of the accumulation. Obviously, by the

time the study was completed, it was difficult to meet these requests. The flows out through each socket were unknown, for a certain opening and variable level in the lake. The program allows these requests to be met. Following program run, the recommended program flow rates are taken to be drawn through each of the three sockets as well as their opening heights so that the required conditions are met. The modeling results are presented in the Tables 4 and 5 and Fig. 8.

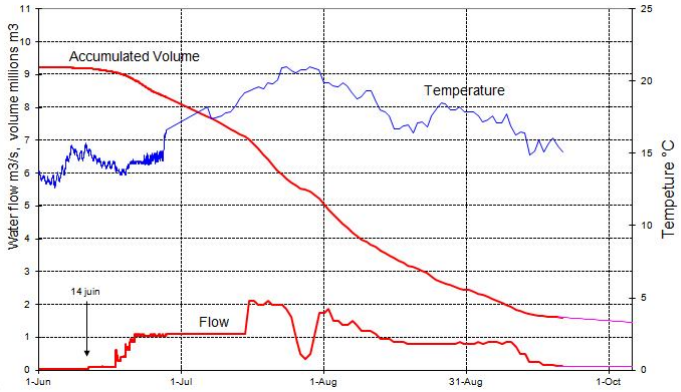

Fig. 8 –Evolution of temperatures, discharge rate and lake volume/first year.

Table 4

Calculation Results for Water Demand at 15°C and Minimum Iron,July–First Year

Data	Cota priză	Cota lac	Qt	T	Fe	Fe_min	Q1-m^3/s	Q2-m^3/s	Q3-m^3/s	h1-m	h2-m	h3-m
6.07	219	223	1	21.9	0.34	0.7	**0.08**			**0.034**		
	217			14.4	0.73			**0.92**			**0.233**	
	206.85			11.9	8.64				**0**			**0**
12.07	219	223	1	25.5	0.34	0.94	**0**			**0**		
	217			15.3	0.39			**0.91**			**0.23**	
	206.85			12	6.47				**0.09**			**0.012**
20.07	219	222	2	28	0.27	0.94	**0**			**0**		
	217			16.9	0.64			**1.14**			**0.318**	
	206.85			12.5	6.85				**0.86**			**0.121**
27.07	219	220	0.5	-	-	8.02	**0**			**0**		
	217			24.4	0.25			**0.09**			**0.036**	
	206.85			12.8	9.84				**0.41**			**0.061**
2.08	219	220	1.8	-	-	6.53	**0**			**0**		
	217			22.4	0.31			**0.41**			**0.155**	
	206.85			12.8	8.38				**1.39**			**0.209**
9.08	219	220	1.5	-	-	8.34	**0**			**0**		
	217			23.3	0.33			**0.34**			**0.126**	
	206.85			12.6	10.65				**1.16**			**0.175**
16.08	219	219	1	-	-	10.36	**0**			**0**		
	217			23.1	0.65			**0.2**			**0.096**	
	206.85			13	12.76				**0.8**			**0.126**
23.08	219	219	0.8	-	-	13.77	**0**			**0**		
	217			24.6	0.68			**0.14**			**0.07**	
	206.85			12.9	16.63				**0.66**			**0.103**
30.08	219	218	0.8	-	-	20.33	**0**			**0**		
	217			20.9	0.96			**0.24**			**0.2**	
	206.85			12.5	28.54				**0.56**			**0.092**

Table 5
Calculation Results for Water Demand at 15°C and Minimum Iron,Second Year

Data	Cota priză	Cota lac	Qt	T	Fe	Fe_min	Q1 m^3/s	Q2 m^3/s	Q3 m^3/s	h1 m	h2 m	h3 m
2.07	219	222	1.11	20.4	0.13	1.6	0.46			0.272		
	217			19.4	0.58			0			0	
	206.85			11.2	2.63				0.65			0.091
9.07	219	222	1.11	18.8	0.16	5.74	0			0		
	217			18.4	0.32			0.59			0.164	
	206.85			11.2	11.8				0.52			0.074
16.07	219	221	2.12	23.4	0.08	6.62	0			0		
	217			18.9	0.15			1			0.318	
	206.85			11.5	12.43				1.12			0.162
23.07	219	221	1.99	24.5	0.24	9.05	0			0		
	217			23.1	0.26			0.58			0.183	
	206.85			11.7	12.63				1.41			0.205
30.07	219	220	1.74	23.5	0.16	12.42	0			0		
	217			22.7	0.64			0.56			0.212	
	206.85			11.3	18.08				1.18			0.177
6.08	219	219	1.37		-	13.63	0			0		
	217			22	0.43			0.46			0.221	
	206.85			11.5	20.23				0.91			0.143
13.08	219	218	0.943	-	-	14.24	0			0		
	217			20.2	0			0.36			0.302	
	206.85			11.8	23.3				0.58			0.095
20.08	219	218	0.783	-	-	16.79	0			0		
	217			23.3	0.62			0.24			0.199	
	206.85			11.4	23.8				0.55			0.089
27.08	219	217	0.783	-	-	12.04	0			0		
	217			20.2	0.59			0.28			0.2	
	206.85			12.1	18.42				0.5			0.086

4. Conclusions/Recommendations

In this work I tried to understand what processes create stratification and which approaches can be taken to evaluate fundamental parameters such as distribution of density and conductance.

Among the various impacts on the environment produced by artificial lakes is water stratification. It occurs mainly during summer, and as result, the chemical and physical structure of the lake water and of the downstream water as well, is modified. Also, the temperature of the downstream water varies as compared to the natural status. This may have impact for the existing wild life in the river.

We are proposing a solution for minimizing the effect of water stratification consisting of an operating method based on the use of two special conceived programs. Although the solution was proposed particularly for Lavaud dam in France (studied within the framework of a joined EU program) this specially designed software package may be used for any similar artificial lakes including Accumulation Pârcovaci or Puşcaşi, with minimal structural changes (ex. additional water intakes at different levels).

The use of these two programs made possible an environmental friendly way of management for the Lavaud dam the same can be for the accumulation Pârcovaci or Puşcaşi**.**

The first program within this package makes possible an accurate application of the water stratification modeled for Lavaud dam because it provides the real values of the flow rates at each opening.

The second program enables the management of water quality downstream the Lavaud dam, as a response to a corresponding request.

The examples of running the programs allow the reconstruction of the real cases of dam operating during the years 2005 and 2006. This facilitates eventual calibrations of the programs by tuning the flow coefficients to match the already measured data.

The use of these two programs should be interactive, based on real field-data.

Graphics of the variation of the dissolved chemicals and water temperature in the lake and downstream the lake is also presented.

Humanity needs to be prepared for the changes it imposes upon the Earth, especially in times of global change and of direct human impact on the hydrological cycle. The anthropogenic impact of the last decades on our aquatic environment has shown that a responsible use of our natural resources is mandatory to guarantee sustainable conditions. Over the last decades, not only have new large water bodies been created on the Earth's surface e.g., reservoirs, but also entirely novel aquatic systems developed in the aftermath of mining in abandoned opencasts (*e.g*., Miller *et al*., 1996; Kru¨ger *et al*., 2002). In addition, the hydrological regime of many lakes has been modified to the extent that lakes have fundamentally changed their appearance, e.g., Aral Sea (Le´tolle & Mainguet, 1993; Cre´taux *et al*., 2005), or their stratification pattern has been altered by human impact, *e.g*., Dead Sea (Gat, 1995) and Mono Lake (Jellison & Melack, 1993) or by climatic variability, *e.g*., Caspian Sea (Peeters *et al*., 2000).

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LIMITAREA INFLUENȚEI STRATIFICĂRII TERMICE DIN ACUMULĂRI ASUPRA BIEFULUI AVAL

(Rezumat)

Resursele de apă dulce ale planetei sunt limitate, deoarece 97,3% din totalul apei este sărată, în timp ce apa proaspătă este limitată la doar 2,7%. În plus, este distribuit inegal în lume. Țările industrializate, care cuprind doar o treime din populația lumii, dispun de majoritatea resurselor de apă dulce disponibile. În multe zone, lipsa resurselor de apă dulce este o problemă mare, așa cum se întâmplă în țările în care aceste rezerve sunt mai mici de 1 000 m^3 pe persoană.

Rezervoarele de apă create prin construirea barajelor fac posibilă acumularea unor rezerve suplimentare de apă în țări cu deficit, dar au şi alte scopuri, cum ar fi obținerea energiei electrice, regularizarea hidrologică a cursurilor de apă etc. În ceea ce priveşte impactul asupra mediului, trebuie luate în considerare elementele de bază cum ar fi suprafața acumulării de apă şi gradul de schimbare a debitului de apă, incluzând ambele habitate. Modificarea şi alte elemente specifice ecosistemului şi modul în care ecosistemele sunt afectate în aval. În contextul actual al limitării influenței negative a activității umane asupra mediului, pe lângă satisfacerea cantitativă a cerințelor de apă, este necesar să se îndeplinească cerințele apei pe baza unor criterii de calitate, inclusiv descărcarea în aval. Acest mod de exploatare se întâlneşte în special în cazul acumulărilor al căror rol principal este cel de asigurare a unui debit minim pe sectorul aval în perioadele secetoase. Chiar şi în această situație limită, pentru asigurarea unui biotop nealterat aval de baraj, apa evacuată trebuie să îndeplinească anumite criterii de calitate. Se impune găsirea unui mod de exploatare care să permită evacuarea în aval a unui debit având parametrii de calitate controlați în funcție de cerințele beneficiarilor. În cazul Administrației Naționale "Apele Române " aproape toate barajele sunt prevăzute cu o priză de apă situată în turnul de manevră care au două nivele de captare a apei la cotele 163,9 mdMN şi respectiv 171,00 mdMN cum este cazul acumulării Pârcovaci datele fiind reale dar şi în cazul celorlalte acumulări. Deci ar fi vorba mai mult de o adaptare decât modificări constructive care nici acestea nu ar fi imposibile şi costisitoare.

Stratificația apei din lacuri este datorată variațiilor de densitate a apei cauzată de variațiile de temperatură. Fenomenul de stratificație poate împiedica dispersia efluenților conducând la concentrarea poluanților în anumite zone. În literatură, în general, când se vorbeşte despre statificația apelor se face de fapt referire doar la stratificația termică a apelor cu toate că fenomenul priveşte deopotrivă şi oxigenul dizolvat.

Se propune o limitare a influenței stratificației termice din acunulări asupra biefului aval pe unul din lacurile administrate de ABA Prut-Bârlad dar solicitarea de

date concrete (masurători din teren) nu a fost onorată pâna în prezent. Neavând fizic timpul necesar căci era o operație de durată am ajuns în spațiul virtual şi am găsit un lac asemănător ca parametri cu lacurile din România şi voi face modelarea pe aceste date şi voi propune o soluție pentru lacurile noastre. Un exemplu concret de acest tip este barajul Lavaud - Franța. În timpul verii, în lac apare un puternic fenomen de stratificare care antrenează şi o distribuție neuniformă a calității apei din lac. Dificultatea constă însă în faptul că debitul evacuat este controlat de o singură vană, neexistând date asupra distribuției debitelor prin cele trei deschideri ale prizelor. Cercetările au fost finalizate prin furnizarea a două programe de calcul. Primul permite calcularea debitelor ce trec prin cele trei deschideri în funcție de dimensiunile acestora, de nivelul apei din lac şi de debitul sau deschiderea stavilei golirii de fund. Al doilea program indică debitele ce trebuie prelevate prin fiecare din cele trei deschideri şi dimensiunile deschiderilor, astfel încât să se respecte criteriile de calitate pentru apa evacuată. viețuitoarelor din mediul acvatic. Lucrarea prezintă o soluție de atenuare a acestui fenomen, precum şi un program de calculator pentru controlul deschiderii evacuatorilor unui baraj, în scopul de a minimiza efectul de stratificare al apei. Această soluție de atenuarea fost propusă pentru barajul Lavaud, Franța (în cadrul unui program de cooperare european). Sunt prezentate de asemenea, grafice de variație ale substanțelor chimice dizolvate precum şi ale temperaturii apei din lac şi din aval acest pachet software special conceput poate fi utilizat pentru orice lacuri artificiale similare, cum ar fi Acumularea Pârcovaci sau Puşcaşi, cu modificări structurale minime (ex. Aporturi suplimentare de apă la diferite niveluri).

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ABOUT ALLAIS EFFECT AND EARTH´S ELECTROCONVERGENCE

BY

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Abstract. The matter I have to deal with and over come is to build a relational theory of interaction as the one according to which “Allais effect” is a natural result of relations among natural bodies/Earth´s electromagnetic fields variation and anomalies Allais pendulum movement. I assume the definitions of the natural body, the (ge)entropic matrix of natural body, the natural body matrix of predominant influence, the electroconvergence of the natural body and the interposition between natural bodies in terms of the well-known previous notions. The Earth and itsen tropic matrix interaction (especialy, *Ps*, *Pv*, *Po* and *Pv*\vortex) depending on the impact of environmental flows (Sun, Moon, planets). It reveals the connection between"anomalies" pendulum movements and systematic and sudden variation energy of the location of the block, due to interaction between Earth’s matrix and Sun, respectively, Moon matrix (eclipse phenomenon, alignment/conjunction of celestial corps, etc.).

Keywords: effect Allais; paraconical pendulum, Earth’s matrixelectro-convergence, *Pv*, *Po*, *Pv*, *Pv*\vortexes/EM fields.

1. Introduction

Natural body was considered either as the primary object of the world (Thales, Heraclitus Parmenides, Empedocles) or an abstract concept (Anaximander, Antiphon, Zenoof Citium, Zenoof Elea) be used as the basic

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element for the development of the atomic theory of matter (Leucipiuus, Democritus, Epicurus). The philosophy separates the real world in her existence (ontic) and "the world" of constructs (ontological) (Aristotel, 1995; Crivoi, 2012). Science operates according to the scheme: hypothesis- prediction- denial- rejection of the hypothesis Fig. 1.

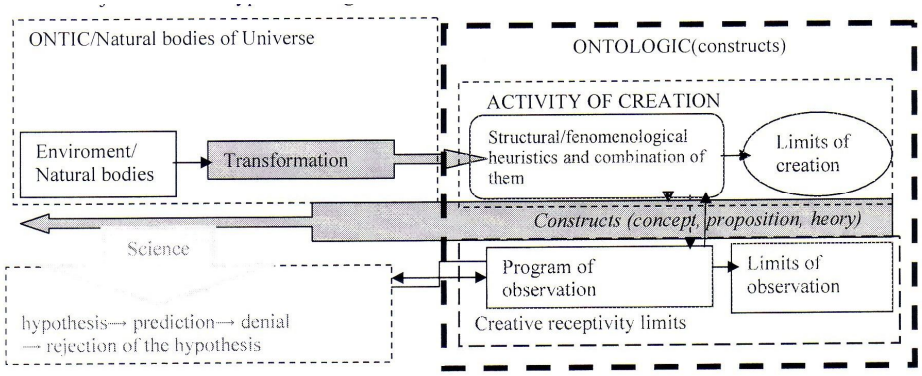


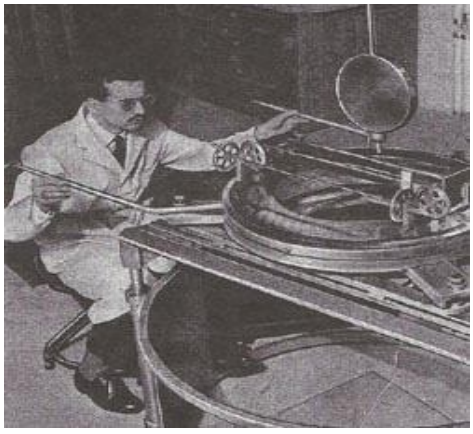
Fig. 1 – Scheme relationship between ontic and ontological (electroconvergence's of natural bodies in the Universe paradigm).

The present work discusses Allaisexperiment (experimentumcrucis) who confirm the veracity ofthe theory of(electro) convergence ofnaturalbodies (Aristotel, 1995; Eberhard, http://www.goede-stiftung.org/...). Maurice Allais started the fuss by conducting an experiment at his Paris laboratory in which he released a Foucault pendulum every 14 minutes – for 30 days and nights – recording the direction of rotation in degrees. It just so happened that the experiment coincided with the 1954 eclipse, and it was during the solar phenomenon that the pendulum took an unexpected turn, changing its angle of rotation by 13.5 degrees. Allais said the rotation of the pendulum was normal both before and after the eclipse. The angle φ between an arbitrary orientated linethrough the origin and the *Y*-axis is the nautical-azimuth. For a "normal" pendulum the bob's angular velocity in the *X*-*Y*-plane was first calculated in 1851 by G.B. Airy as: $\omega_0 = \pm p(1\text{-}a^2/16l^2)\times 3/8\times A/l\times a/8$ (Allais, 1959), Fig. 6 *b* (Heck, http://www.goede-stiftung.org/…). The effect Coriolis causes rotations of *A* in dependence of the observation place's latitude *L*: $\omega_{Cor} = = \omega_{Earth}\sin L$. In M. Allais' think, near-isotropic paraconical pendulums did not show the Airy effect (for local perturbations) in any measurable way, making their angular velocity equal to: $\omega = \omega_{Cor} + \omega_{Allais} = -\omega_{Earth.}\sin(L) \pm \sin[2(x-\varphi)]$. The last term:

$$\omega_{Allais} = \pm \sin[2(x-\varphi)], \quad (1)$$

is referred to as Allais effect term in this text. M.Allais does not define parameter *k*. Parameter *x* in the Sinus, following M.Allais, is the azimuth of his

effect on Earth's surface (Allais, 1999). He later repeated the experiment and got similar results. But his work has polarised scientific opinion. Some had said there were flaws in the Frenchman's methods, whilst others claimed to have witnessed the unusual effect as well (Eberhard, http://www.goede-stiftung.org/...; Răzlescu, 1984; Russell Bagdoo, http://www.iasoberg.com/...). Explanations have included the anisotropy of space – the condition of having different properties in different directions – gravitational waves and solar radiation. The 1999 total eclipse will help to settle the arguments. Laboratories on four continents have set up pendulums and gravity meters to test the effect. The high number of participants will help to eliminate any systematic errors from skewing the results. He later repeated the experiment and got similar results**.**



Effects of a solar eclipse upon a paraconical pendulum. (After M.F.C. Allais).

Fig. 2 – Effect of solar eclipse upon a paraconical pendulum (The Allais effect) (Allais, 1959).

Eclipse effect were studied by Javerdan, Rusu, Antonescu, Olenici, Mihaila, Saxl and Allen, Tomaschek, Mishra and Rao, Kamerlingh

Onnes,Wanand Yang, Leo Savrov, and other. The results were mixed and debatable. The construct (paradigm/theory/proposition/concept) is born and dies but observation dates remain for new interpretations.

2. About (Electro) Convergence's Natural Bodyparadigm

Theoryof (electro) convergence ofnaturalbody is based on twoassumptions: a) natural bodydefining "Aristotleplace"/space/universe; b) movement ("fall" of Aristotle "place") personalizes local time /spaceby inducing elicoidal/curviliniar movement that initiates, maintains and transformes natural bodies (electro) convergence of the structural-phenomeno-logical universe, Fig. 3.

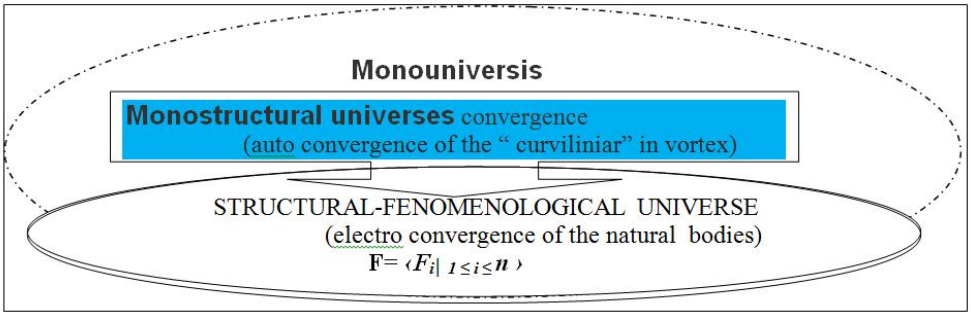


Fig. 3 – **Structural-**phenomenological **Universe** (natural bodie's electroconvergence).

"Small infinity" is characterized by uniformity. "Potential" and "local update" is due to the heterogeneousand further, the appearance of systems. The electroconvergence's paradigm allows building a relational theory of space whereas it is based on ontological concepts "natural body" (Aristotel, 1995; Crivoi, 2014). Time *T* and space, *S* (sizes/global properties of the material world) are linked in the process of formation/transformation of natural bodies. "Natural Body" (*P*) constitute the factual "item"/"thing"/effect that personalises (meta) physicalany pair (σ), [space, time] of natural bodies multitude, Σ, from the universe.Each property, p_n,of a natural body, P, can be represented through a specific function: $\mathbf{F} = <F_{i|\,1 \le i \le n}>$. Theforms of motion (electric, magnetic, termic, mecanic,...,) ensure the matrix natural bodie's/corps interactionwith the environment/ Natural body/corps of preponderant influence. Each interaction categorie between the natural body and enviroment can be associeted with a transpher of generalised charges between matrix of the natural bodies. The charge can be effective (electrical charge) or conventional charge in another situation. The variation of the internal system energy is the consequence of "generalized infinite small deformation" d*X* (*X*:*F* – mechanical strength, *a* – liniar acceleration, *p* – pressure, *V* – electrical potention ...) under the action of generalized force, *Y* (x/φ – linear/angular displacement, *m* – mass, *H* – liniar momentum), according the relation:

$$\mathrm{d}U = \sum \delta L_{\mathrm{def}} = \sum_{j=1}^{n} X_j \mathrm{d}X_j,$$

analysis of the body naturallyon different levels of the (Ortho)existence is possibleusing the relation: $\Sigma xS \rightarrow R$, where S, is themultitude of the conceivaible unit systems(size/quantity). Each value of the function F, is anatural bodie'staterelative to theenvironment/context. Every natural body has its own state space. The sum of all the same statesis called the concevaible state space. Property low-likespace of a natural body constitute a subset S_{Lx}, of concevaible property space, Figs. 3 and 4.

According to the associated sizes the natural bodycan be imaginary, virtual (nonmass), real (mass). "Natural nonmass body"/("aristlle place") is the factual item of thestructural organisational and functional nonobservable Universe emergence where the phenomena and the conversion does not prevail (orthoexistence). "Natural mass body" defines structural and phenomenological Universe. Each naturalbody/corp has a "matrix". The matrix represent the space of causal and random potentiallymanifestation. "Entropic body mass matrix" represents the space of manifestation of potentialityspace and potential causal random natural body".

Natural body/corps of preponderantinfluence" represents the natural body/corps of interaction whose (entropic) matrixmaterializes the causal potential and the random potential of the natural body/corps, Figs. 3 and 4. Matter's conjugated movement form assures the interaction.

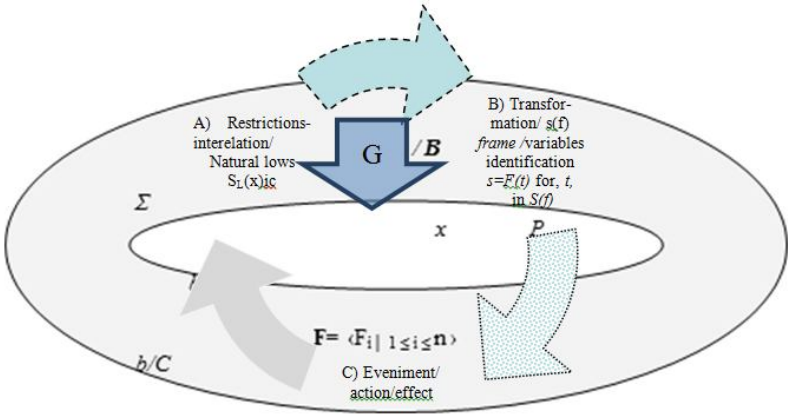


Fig. 4 – Concevaible state space (a), respectivly, law-like space of a natural body, (b) (Crivoi, 2012) G – gravitational interaction.

The local natural corpstransformation (effect)is directly related with the structure, the organization and the functions according to the scheme:

Effect = Stucture + Organisation + Functions.

According this scheme can be interpretates Universe's natural bodiesand experiment's dates of observation. The structural-fenomenological

Universe is the result of natural (non)massbodie's electroconvergence (neutrin, foton,…,) and natural mass bodie's/corps electroconvergence (…, neutrin/foton, neutron/electron proton, …,comet, satellit, planet, star, galaxie,…,) (Crivoi, 2005).

2.1. About Earth's Electroconvergence and Effect Allais

Earth´s/planet's electroconvergence is a level of natural bodies electroconvergence in the Universe.The Earth (multistratum spherical screen) with her entropic matrix (cylindrical shape plasmatic layer) generates its structure, organization and functions at the micro level and macro level according with the parameters of the influenced matrix corps of Universe. The Sun is the natural body/corps of preponderant influence for Earth's environment interaction. Them esurements (Fourbush) demonstrated the priority of the corpuscular Sun radiation on the Earth. "The solar wind" ($i = \dot{q} = \mathrm{d}q/\mathrm{d}t$ – electrical flux , $\dot{m} = \mathrm{d}m/\mathrm{d}t$ – mass flux , $S = \mathrm{d}s/\mathrm{d}t$ – entropical flux, $H = ma$ – boost mechanical flux) impact the Earth and interactes with her matrix in terms of conjugated motion matter forms (Earth matrix, Sun matrix). Earth embedded within entropic matrix, *P*, and placed in the entropic matrix of the Sun, *S*, (especially influenced the natural body/corp of Earth's) is structured, organized and interaction functions as power/energy, w, given by:

$$\rho w_P = \rho u_P + \rho \frac{v_P^2}{2} + \rho \varphi_P + \left(\frac{1}{2} \varepsilon_P E_P^2 + \frac{1}{2} \mu_P H_P^2 \right) + \rho g_E r_S + \rho g_E r_L \qquad (2)$$

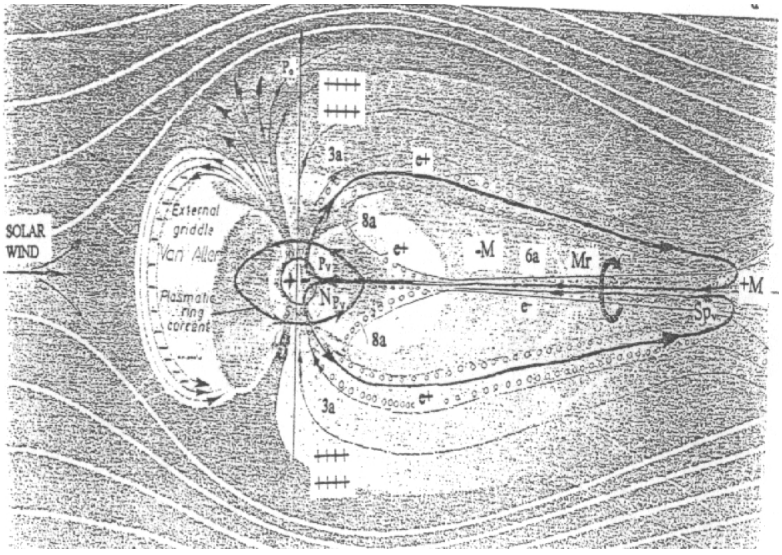
where: ρ is the density of volume, u – specific internal energy [J/kg], v_P – velocity of the earth [m/s], φ – chemical potential (mass), E – electrostaticfield strength [V/m], H – magnetic field and the amount of energy characterizing the electromagnetic field which propagates with [Oe], c – the speed of light [m/s], g – gravitational/electrostatic [m/s^2], r – the distance between the Earth and the body electrostatic influence [m], (E) predominant (*Sun-S*, respectively, Moon-L. with the electrical charges, q_S/q_L), Fig. 4 (Aristotel, 1995; Bunge,1984; Crivoi, 2005; Crivoi, 2014; Crivoi, 1994; Crivoi & Bursuc,1994; Crivoi, 2012). The energy is"a physical size that depends on the instant physical condition of the system".

2.1.1. *Earth's Electroconvergence*

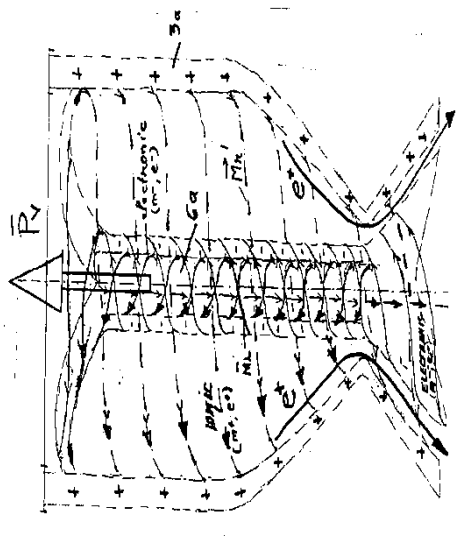
According to "(electro)convergence effect" (Crivoi & Bursuc,1994) the solar wind plasma current strongly ionized constantly emitted by the Sun, formed of protons and electrons-having the density of 200-800 kilometers per sec,.- due to the impact with the Earth, the wind laminates kinetic parameters and electrical one of what differentiates from the fluidic medium in which penetrates. According to the (electro)convergence effect the continue cylindrical

layer (3a) by "local'' influence (Cooper neutron/electron pair decupling) converges in macroscopic area (4a/S_{Pv}). There is maintained in the inner area of the layer (3a) a minimum (electrostatic/barometrical) centre (–M) and a maximum centre (+M) in (electro)convergence area (4a/S_{Pv}) which determines a transit movement of plastic mass between these two point/zones (–M, +M). The cylindrical layer (3a) continually eliminates the charged mass particles (m^-, m^+) from inner area (–M) by through mechanical inductance and interactions of electrostatic origin; so, this movement of electrostatic charge (6a) took place continually between M(–) and (M+). This "printed field" (6a) has as "source" the environment and "the transport phenomena" triggered in the (electro)convergence area (4a). This "transport phenomena"in electrostatic frame maintains and generates the coaxial movement of the plasmatic penetration current (6a), coaxialandopposite cylindrical layer (3a). This coaxial movement of the "printed field" (6a) determines an electromotive tension whose consequence is the appearance of a rotate moment (Mr) which simultaneously actions on the two plasmatic currents (3a, 6a,), Fig. 5 *a*. Having both the mass and the speed smaller than of the layer (3a) the penetration current (6a) is strongly submitted to on action of twisting so that additionally to the movement of transition there is a rotation one. This penetration plasmatic current (6a) becomes vortex, with a continuous accelerated rotate movement, as the departure appears from the (auto) convergence area (4a), during is movement towards the Earth. The vortex movement unleashes the separation an electrical charge (m+, m-) on radial peripherical circuits according to their mass (m_{ion}, $m_{electron}$), Fig. 5 *a* (Crivoi & Bursuc,1994). Plasmatic particles will have an spiral trajectory function your mass and charge. There are preponderant "linked" smallerparticlesmass ($m_{electron/positron/neutrino/\ldots}$) in the penetration current (6a). The amount of the particles that executes spiral movement determines a fluido-electrical (self), 6a, which generates an electromagnetic field, *Pv*. The phenomenom is caracterised by the fact that it "link" the movement of lectrostatic particles (m+, m–) so the lines of growing electromagnetic field, as it getting done to the Earth. The electromagnetic field generated by plasmatic masses from the penetration vortex (6a) by the vector (magnetic moment), $\overrightarrow{Pv}$ has the North Pole on the Earth-Sun axe in the elliptical plan at the distance between 50,…,150 kilometers from the Earth, and the South Pole in the area of (electro)convergence, (4a/S_{Pv}).The electromagnetic field of the vortex, *Pv*, close themselves penetrating the Earth's atmosphere. The parameters of vectors, $\overrightarrow{Pv}$, (and, environmental/ local, $\overrightarrow{Pv}$ prim, generated by protonic/plasmatic layer, 3a) are function by the variation of the Sun matrix (environment parameters/solar "wind", relative position between the Earth and Sun/Moon, and other). The (electro)convergence realized by the interaction between Sun matrix /"solar wind" and the Earth entropic matrix is characterized by the presence of the two specific circuits for the electrostatic charged particles: a) the (preponderant) spiral ionic circuit (m^+, e^+) on the route: current/vortex,

(6/6a) – the connection spiral cone (8a) – the cylindrical layer, (3a) – (electro)convergence area (4a) – environement, and b) the (preponderant) spiral electronic circuit (m^-, e^-) on the penetration vortex route (6a) between the mirror of electromagnetic belonging to the effect (Np_v, S_{pv}).



a



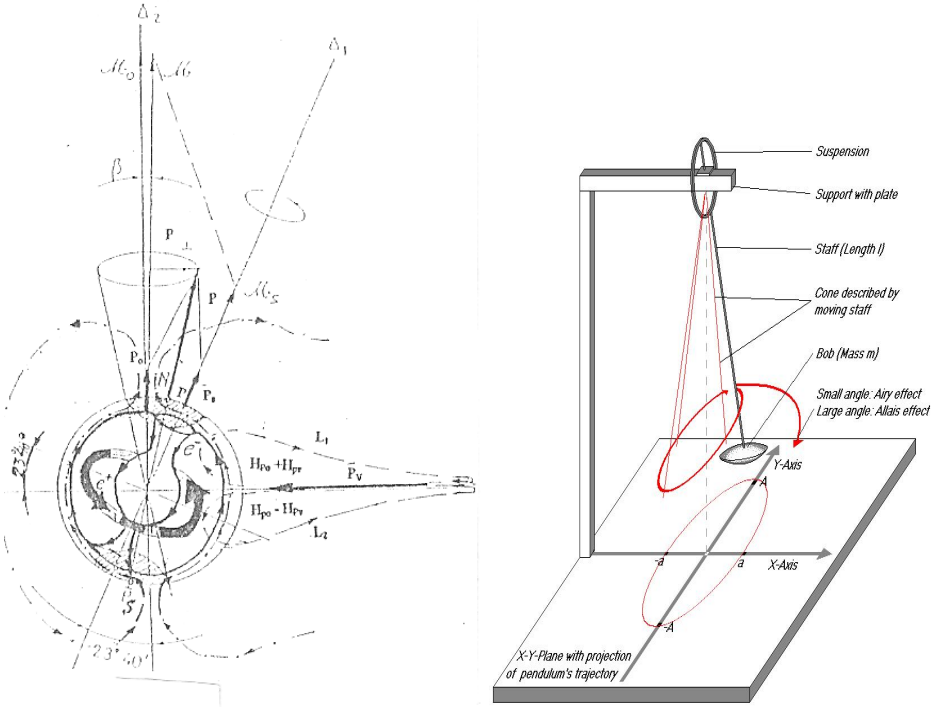
b

Fig. 5 – The (electro)convergence Earth's effect: *a* – Earth'/planetar's electroconvergence; *b* – *Pv* vortex (m^+, m^- circuit) (Crivoi, 2005).

3a – the continue proton cylindrical layer; 4a/(S_{Pv},+*M*) – the electroconvergence area where aredecoupled/excited “pair electrons/neutrons Cooper"; (–*M*) – the (inner 3a)/minimum (electrostatic/barometrical) point/center; (+M) – extremum point in (electro)convergence area (4a); (6a) – the penetration current (coaxial vortex) has as “source” the environment /“ the transport phenomena” triggered” in the (electro)convergence area 4a/(S_{Pv}); (8a) – the connection spiral cone ; Mr- rotation moment, $\overrightarrow{Pv}$, $\overrightarrow{Po}$, $\overrightarrow{Ps}$, (–) – the magnetic moment of the vortex, *Pv*, *Po*, *Ps*; e^+ – proton in (3a); e^- – electron /neutron (6a); (+)/(–) – positive/negative polarization of the Earth/Van Alenn griddle ; N_{Pv}/S_{Pv} – North/South pole of the vortex (field electromagnetic), $\overrightarrow{Pv}$.

NASA articles demonstraites the fact that “the magnetotail […] and Earth's magnetic tail extends at least 200 Earth radii in the anti-sunward direction well beyond the orbit of the Moon at about 60 Earth radii, while Jupiter's magnetic tail extends beyond the orbit of Saturn. On occasion Saturn is immersed inside the Jovian magnetosphere” (https://www.sott.net/article/ 229308-Planetary-Alignments-and-the-Solar-Capacitor-Things-are-heatin-up).
The inner griddle “Van Allen” appears as a consequence of some possible nuclear reactions between the cosmic particles of high energy. This inner griddle “Vann Allen” (Po and Ps vortex) realizes the energetic exchange between external griddle “Vann Allen” and the Earth. The differentiated polarity of the Earth (body) (“+”, for the terrestrial area faced to the Sun and ,“– “ , for the darkened terrestrial area) made by the Sun matrix, determines the polarization and differentiated of the electrostatic particle from external griddle “Van Allen”/all griddle (– , +). According this different polarized area combined with Earth’s/microbodie ‘s electroconvergence can be defined local intra/peri/terrestrial paraconicall pendulum interaction/effect 14). The permanent Earth”s electrostatic dis-equilibrium generated by the (electro)convergence effect combined with differentiated polarisation of the external griddle “Van Allen” (– , +) by the Earth (+ , -), determines a massive continuous ring shaped movement of the electrical charges in the internal griddle (ring shaped current/ring vortex) together with the appearance of a field electromagnetic vector, $\overrightarrow{Po}$, perpendicular on plane of the ecliptic, figure 6a.This conclusion contradicts the actual theory according to which a magnetism of the body from the cosmic space is given by the rotation of that body. The giromagnetism theory cannot explain the periodical changing of the magnetic field polarity of the body from the cosmic space. The penetration of the electromagnetic field line , $\overrightarrow{Po}$, in plasmatic medium property (of) the Earth (atmosphere, crust) generates a electronic circuit/(spiral vortex) , e^-, and inner ionic ring circuit, e+, shaped on induced by the first current (e^-), Figs. 5 and 6 *a*. This conclusion contradicts the actual theory according to which a magnetism of the body from the cosmic space is given by the rotation of that body. The giromagnetism theory cannot explain the periodical changing of the magnetic field polarity of the body from the cosmic space. The penetration of

the electromagnetic field line , $\overrightarrow{Po}$, in plasmatic medium property (of) the Earth (atmosphere, crust) generates a electronic circuit/(spiral vortex), e^-, and inner ionic ring circuit, e^+, shaped on induced by the first current (e^-), Figs. 5 and 6 *a*.



a *b*

Fig. 6 – The magnetic moment of the electromagnetic field , Po, Ps, Pv and paraconical pendulu*m: a – earth's vortex (EM fields) Pv, Po,Ps* (Crivoi, 2005); *b* – Paraconical pendulum (http://www.flyingkettle.com/allais/eclipses.htm).

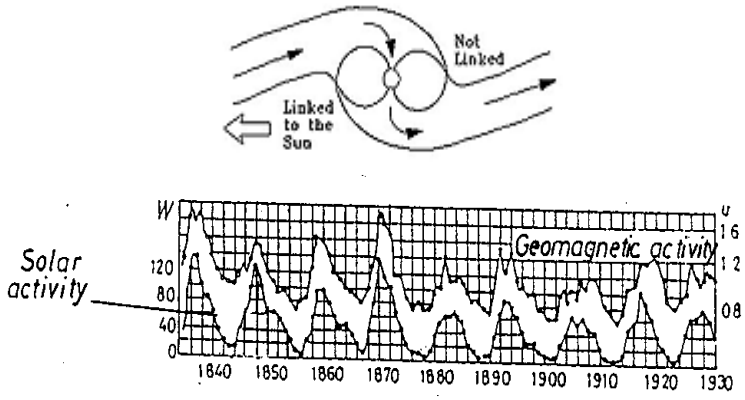


Fig. 7 – The empirical correlation on long term between non gravitational activity of the Sun and geomagnetic activity (Popescu,1981).

The electromagnetic fields lines L_1, L_2 of the penetration vortex, $\overrightarrow{Pv}$, following the route with greatest magnetic permeability (the contact area of the inner plasma of the Earth with the terrestrial surface what has lower temperature than Curie temperature, $T^o < T^o_{Curie}$) cross with the electromagnetic field lines given by the vortex/electromagnetic field, $\overrightarrow{Po}$, shaping both the electronic, e-, and ionic , e+, circuit to the or donated and ring shaped movement of ionic mass, inner Earth decentred with 400 km from the centre of the Earth in plane which makes an interaction electromagnetic fields $\overrightarrow{Po}$, $\overrightarrow{Pv}$, it is its own electromagnetic field of the vector, *Ps* angle 23º40' with, $\overrightarrow{Po}$. Finally this electromagnetic field, $\overrightarrow{Po}$, determined the telluric currents that engage the tough of the earth in the rotation movement. According planet's electroconvergence, the transfer mechanism of the energy from theSun matrix (the preponderant influence body) to the Earth's (Earth-Moon dipole) entropic matrix suppose gravitational and nongravitational (electric, magnetic, electro-magnetic,…, entropic) interaction. There is a empirical confirmation of this mechanism (theory), Figs. 6,…,7) (Crivoi, 2005; Crivoi, 2014; Crivoi & Bursuc,1994; Crivoi, 2012; Popescu,1981). Any variation of the environment (Sun matrix, local matrix) parameters is felt by the (electro)convergence effectof the planet (Earth) and materialized in local variation of natural bodies parameter of the vortexes/ electromagnetic fields, $\overrightarrow{Pv}$, $\overrightarrow{Po}$, $\overrightarrow{Ps}$ (structure, organization, function) who interactions with paraconical pendulum.

2.1.2. *The Allais Effect in Electroconvergence's Natural Bodies Paradigm*

According actual theories the rotation of the semi-major axis *A* with an (azimuth) angle φ relative to *Y* caused by Airy Effect and Coriolis Effect. Together has the angular velocity:

$$\omega_{\text{Airy}} = \frac{\mathrm{d}\varphi_{\text{Airy}}}{\mathrm{d}t} + \frac{\mathrm{d}\varphi_{\text{Cor}}}{\mathrm{d}t} - \mp p\left(1 - \frac{a^2}{16l^2}\right)\cdot\frac{3}{8}\cdot\frac{A}{l}\cdot\frac{a}{8} - \omega_{\text{Earth}}\sin L. \qquad (3)$$

But ω_{Airy} is small: a pendulum with l = 1 m, A = 0.08 m and $a \leq 0.001$ m will take at least up to 66663 s or 18 h 31 min. for a full rotation of the large *A* around *Z*. In Europe –latitude L = 50° N- a full Coriolis rotation takes 112787 s or 31 h 20 min (Heck, 2012). M. Allais modified pendulums during the years from 1954 to 1960. For Maurice Allais's paraconical pendulums (with nearisotropic suspensions by using a very hard material for the plates the pendulum staffs' pins or balls rest on, $\omega_{\text{Airy}} = 0$), the rotations of their semi-major axis' *A* should only be subjected to the Coriolis effect, making their angular velocity equal to: $\omega = \mathrm{d}\varphi/\mathrm{d}t \approx \omega_{\text{Cor}} \approx -\omega_{\text{Earth}}\sin L$. Maurice Allais's paraconical pendulums bob rotations showed, that sometimes and especially in times of solar eclipses, a much higher angular velocity ω than *M*. Allais had anticipated, namely:

$$\omega = \omega_{\text{Cor}} + \omega_{\text{Allais}} = -\omega_{\text{Earth}}\sin L \pm k\sin[2(x - \varphi)].$$

In his Nobel Prize autobiographical speech, Allais stated, "My main idea at the start was that a link could be established between magnetism and gravitation by observing the movements of a pendulum […]. I obtained positive effects, but with other devices I obtained no effect whatsoever....all these phenomena are quite inexplicable within the framework of the currently accepted theories". Acording natural bodies electroconvergence paradigm natural landing mass natural bodies emergences is fundamental matrix of the structural-functional Universe Figs. 4 and 8. Neutrinoflux, *J*d*V*, unbalanced spatial neutron matrix, *N*, (1) and maintains atransport phenomenon and displacement(in counterflow) of entities(pre) mass, m_i.For reasons of logic presentation, we associate pulsating neutrino mass rotating blade/spine, m_i, respectively, neutrino mass, $m_N = \rho dV$, an electric charge, $q = Dm$, where D is the universal magnetic constant.

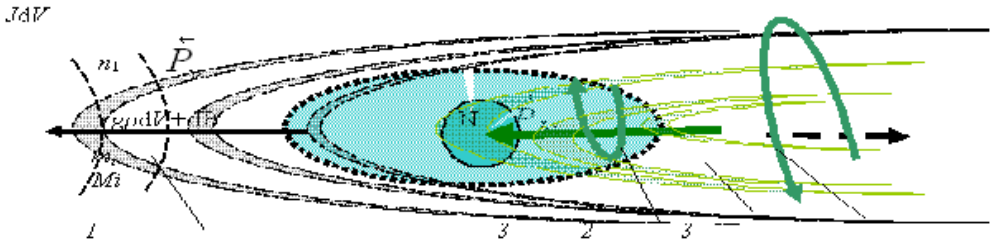


Fig. 8 – Electroconvergence of the micro natural corp, *N*, (...,neutron/ proton/atom,,...,) (Bunge,1984): *1* – clothneutrinos *Mi*, penetrates the transverse plane of neutrinos, n_1; *2* –substantial body wave induced environmental, m_i ; *3* – moment of rotation of the blade, Irespectively mass, m_i ; *Pv*, ^{I}Pv – autoconvergence vortex magnetic moments (*coupling)* of underground neutrino, *Mi*, *respectively*, m_i.

To describe the dynamics of micro natural body, *N*, with mass, $m_N = \rho dV$,is associated with the force of gravity, $dV\rho g$, and neutrino flux, *J*d*V*, (mass moving entities induced environmental) magnetic force, $J \times B dV$, so that it follows the equation for mass magnetic interaction between natural bodies: $F = pdV + JB$. In the event that all neutrino substances, *Mi*, of the moving with the same spee *Dv*, the resultant current of matter, $J = \rho Dv$, so that equation (2) can be written as:

$$F = \rho (g + Dv + B). \qquad (4)$$

Formula (3) represents the equation of gravity for the mass unit of the substance [6]. From the content of formula (3) result joint mass interaction (falling corps) owed the interaction of magneto-mass primary neutrino spenetrating cavities/interstices in the impact area with standing wave sassociated with a natural mass corps, generally, Fig. 8, bob (mass), specially, Fig. 6. Magnetic component of the electromagnetic field, $\vec{P}_o$, is detected on

Earth, while the magnetic component of the electromagnetic field, $\vec{P}_s$, is detectable referential not involved in the rotation of our planet. The geographic coordinate system resulting magnetic moment vector of the Earth $\vec{P} = \vec{P}s + \vec{P}_o$ is on average $\vec{P} = \vec{P}_o = 7.9 \times 10^{25}$gauss cm^3 from Blackett. The natural Microsystems (,…, neutrons, ...,) electroconvergence of the bob (mass *M*), Fig. 6 *b*, "weighted" and move this function Earth'systematic energy variation (diurnal, monthly,…,) and sudden energy variation at Meridian place's paraconicall pendulum (eclipses, occultation, earthquakes, tsunami, magnetic storm, local terrestrial/ocean/periterrestrial conductor operator descharged). According natural bodies electroconvergence paradigm, the gravitational local variation (effect Allais) is linked with the variation of the *Ps*, *Po* and *Pv* vortex ex (and local conductor operator discharged) parameters (Crivoi, 2005; Crivoi, 2016; Crivoi & Bursuc,1994; Crivoi, 2012).The Earth is nuclei of the vortexes *Po*/*Ps*. The interaction between Earth's *Pv*, *Po*, *Ps* vortexes with Earth's periterrestrial zone generates Coriolis effect, $\omega = d\varphi/dt \approx \omega_{Cor} \approx -\omega_{Earth} \sin L$. Intime (diurnal, monthly, ...) the systematic "anomalies" movement of the paraconicall pendulum are function Earth's vortexes/magnetic field sparameters variation who interactes with bob (mass),thus: $\vec{P} = (\vec{P}s + \vec{P}_v)$ - for Earth's periterrestrial day zone; $\vec{P} = \vec{P}_o$ - for Earth's terrestrial/oceanic day zone, $\vec{P} = (\vec{P}s + \vec{P}_v + \vec{P}_o)$ – for Earth's periterrestrial night zone ($h \geq 150$ km), 40º north latitude, $\vec{P} = (\vec{P}s - \vec{P}_v + \vec{P}_o)$ – for Earth's periterrestrial zone ($h \geq 150$ km), south latitude = 0,…,40°, $\vec{P} = \vec{P}s + \vec{P}_v$ – for Earth's terrestrial night zone, Fig. 6 *a*, *b* (Crivoi, 2005; Crivoi, 2016; Crivoi, 2012). Coriolis effect largely depends on disturbances in the surroundings of a paraconical pendulum, mainly of smaller or bigger vibrations of the soil. The large angle of bob (mass) φ_{place} respectively ω_{place} can produce by the natural (terrestrial, ocean, periterrestrial circuit/current, eclipses, transit, occultation,..,)conductors operator discharged, ω_{COD}, or/and artificial disturbances, ω_{AD}, whose add with ω_{cor}, namely:

$$\omega_{place} \approx \omega_{cor} \pm \omega_{COD} \pm \omega_{AD} \approx \omega_{cor} \pm \omega_{Aiery} = -\omega_{Earth} \sin L \pm p\left(\frac{1-a^2}{16l^2}\right) \cdot \frac{3}{8} \cdot \frac{A}{l} \cdot \frac{a}{8} \overrightarrow{Po}. \quad (5)$$

The measurement showed that relative position between Earth`s matrix and natural body/corps matrix of preponderant influence (eclipses, transit, conjunction,…,) can sudden changes of $\Delta\omega$ or $\Delta\varphi$. For example, a measurement cycle of about 50 days showed these coincidences (48%) of sudden changes of $\Delta\omega$ or $\Delta\varphi$ per time *t* with zenith passages of Sun, Jupiter, and Moon (Heck, 2012).

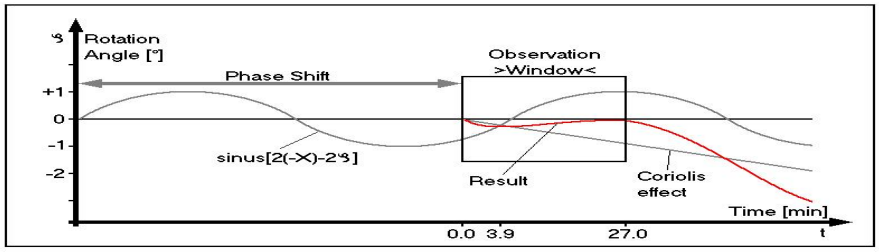


Fig. 9 – Sketch of a measurement of *φ versus t* with the IGF paraconical pendulum (Heck, 2012).

Acording Earth' electroconvergence the Allais effect is in fact Airy effect with a large angle, $\varphi = \varphi_{place}$. The large angle of the bob (mass) is caused by Coriolis effect modified by Aiery Effect an isotropic vortex ex *Po*, *Ps*, *Pv* caused by anisotropic environment (terrestrial, periterestrial, ocean,…) and anisotropic lunar and solar gravity.

3. Conclusion

Acording bodies natural electroconvergence paradigm Allais effect is connection with disturbances in the surrounding of the pendulum**.**

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DESPRE EFECTUL ALLAIS ŞI ELECTROCONVERGENȚA PĂMÂNTULUI

(Rezumat)

Problema pe care ne propunem să o rezolvăm este să construim o teorie relațională a interacțiunii, ca fiind cea în care "efectul Allais" este un rezultat natural al relațiilor dintre corpurile naturale şi variațiile câmpurilor electromagnetice ale pământului şi anomaliile mişcării pendulului Allais. Presupun definițiile corpului natural, matricea (ge) entropică a corpului natural, matricea naturală a corpului influenței predominante, electroconvertarea corpului natural şi interpunerea între corpurile naturale în termenii noțiunilor anterioare binecunoscute. Pământul şi interacțiunea cu matricea tropicală (în special, Ps, Pv, Po şi Pv \ vortex) în funcție de impactul fluxurilor de mediu (Soare, Lună, planete). Acesta dezvăluie legătura dintre mişcările pendulului "anomalii" şi energia sistematică şi de variație bruscă a locului obiectului, datorită interacțiunii dintre matricea Pământului şi Soare, respectiv matricea Lunii (fenomenul eclipsei, alinierea / combinarea corpurilor celeste etc.).