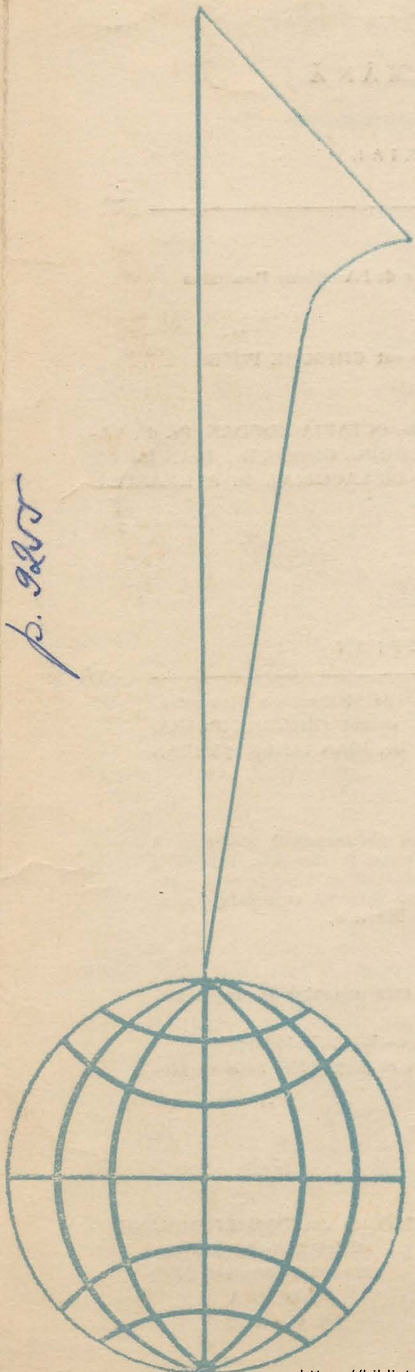

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THE DEMOGRAPHY OF THE ROMANIANS OUTSIDE ROMANIA: BESSARABIA AND NORTH OF BUCOVINA

VLADIMIR TREBICI

La démographie des Roumains d'au delà des frontières de la Roumanie: en Bessarabie et le nord de la Bucovine. Entre les deux guerres mondiales, la surface de la Roumanie a été de 295 049 km². A la suite du pacte Ribbentrop-Molotov, l'URSS a annexé, en 1940, la Bessarabie (44 422 km²), le nord de la Bucovine et le district de Herța (ensemble 6 340 km²), soit une superficie totale de 50 762 km². A la suite de l'annexion du Cadrilatère (le sud de la Dobrogea) à la Bulgarie, la même année, la superficie de la Roumanie est devenue 237 500 km².

La Bessarabie, sans les départements du sud (Cetatea Albă, Ismaïl et une partie de Tighina) et sans une partie du département de Hotin, mais comprenant une partie de la région d'au delà du Dniestr, a une superficie totale de 33 700 km² et représente la République de Moldova d'aujourd'hui. Le nord de la Bucovine, le district de Herța et l'autre partie du département de Hotin forment l'actuelle région de Cernăuți, à une superficie de 8 100 km². Celle-ci est rattachée à la République d'Ucraine, ainsi que le sud de la Bessarabie et la région d'Odessa. Au moment de l'annexion par l'URSS des territoires cités ci-dessus, le nombre total des habitants était de 3 410 000: les Roumains en représentaient 52,5 %.

On examine l'évolution de la population durant la période 1940—1989 selon les statistiques officielles de l'URSS (recensements, annuaires, statistique de l'état civil, etc.). Le nombre des Roumains *(Moldoveni)* au dernier recensement de la population, en 1989, était d'environ 3 500 000, dont 2 795 000 dans la République de Moldova, 185 000 dans la région de Cernăuți, le reste revenant aux autres régions et républiques. On suit de près les phénomènes démographiques — natalité, mortalité — ainsi que d'autres aspects conjoints.

Key words: demography, Bessarabia, Bucovina

Due to certain circumstances a number of Romanians live outside the present national boundaries of the Romanian state (237,500 sq. km). While the historian has the duty to point out and to explain the factors determining this situation along the time, the demographer has the duty — no less important — to seize this process and to stress the role played by the demographic factors. Definitely, the demography of the Romanians outside the national boundaries aims to establish their number, their geographical distribution within countries, areas or continents, the description of the demographical factors, as well as birth and death rates, age and sex structures, migration. The study of other problems, such as the demographic behaviours as cultural models — the nuptial and reproductive ones — can not be undertaken without the help of antropology, ethnology and social psychology. Since the main characteristics identifying a nation are *nationality* and *mother tongue*, the involvement of philology and linguistics is needed in this approach. So, the conclusion is that this kind of study — very ambitious, undoubtedly — implies necessarily the interdisciplinary cooperation between different sciences, as demography, history, geography, anthropology, ethnology, social psychology, philology and linguistics. But the first step must be made by demography.

However the difficulties are considerable în this respect, especially if we take into account that in the last decades this matter has been entirely neglected by the Romanian population studies.

First of all two problems must be enlightened. The former refers to the syntagm "Romanians outside the borders" and the latter concerns the methodology and information sources.

The Romanians live outside the national frontiers in the Republic of Moldova, the Ukraina, in the Balkan peninsula and in Hungary. Romanians live also in Canada, the United States, Austria, Germany, France and Australia. While the first category represents native populations, settled and linked with the respective land from immemorial times, the second one is made up of Romanian emigrees both from Romania and Balkanic countries not very long time ago because of political or economic reasons. Only the latter category represents the Romanian diaspora.

The second problem already mentioned refers to the population censuses from the last century as main information sources. The registered characteristics are: citizenship, nationality, sometimes ethnical origin, mother tongue, usual language, religion, according to the free statements of the population. But in many cases the data do not reflect the reality, except for the cases when the population is obliged by the authorities to declare themselves as members of the majority nation.

Another information source concerning nationality and mother tongue is represented by the monographs with historical, geographical, ethnographical or linguistic contents, for example the studies of Th. Capidan (1937, 1943) related to Macedo-Romanians or of C. Constante and A. Golopenția (1943) concerning Romanians from the Timok Valley. Travel notes are useful too.

The yearbooks, statistics, monographs worked out by some societies and associations of different nationalities in one country or another, by parishes are also very important. It is worth mentioning that for some nationalities (German or Ukrainian) there are institutes which study systematically the statistics of their fellow countrymen from different countries.

As regards the demographic phenomena of nationalities – subject to the differential demography –, the situation is worse because only seldom the statistics of the civil status gives information in this respect.

In order to know the spatial distribution of the Romanians it is necessary to use the following framework:

1. The Romanians from the territories which belonged to Romania up to 1940: Bessarabia, North of Bucovina, Herța land, South of Dobrogea *(Cadrilater)*;

2. The Romanians from the Balkan peninsula and Hungary;

3. Macedo–Romanians, Megleno–Romanians and Istro–Romanians;

4. The Romanian Diaspora from the western European countries;

5. The Romanian Diaspora from Canada, the United States, Latin America and Australia;

6. People speaking Romanian all over the world (Saxons, Swabians and Jews emigrated from Romania).

We start our approach with the territories which were part of the Romanian state in 1940.

BESSARABIA, NORTH OF BUCOVINA AND HERȚA LAND

The state of these territories before 1940 is known with the help of the studies of Sabin Manuila (1940) and Anton Golopenția (1941). Both are based on the 1930 population census and assess the population number by nationalities in January 1st, 1940. We shall use the study of A. Golopenția which is subsequent to that of S. Manuila. The territory occupied by the Soviet Union in 1940 represents a surface of 50,762 sq. km., with a population of 3,409,669 inhabitants in 1930 and of 3,776,000 in 1940 (estimated), the demographic growth being or 366,000 during the period between 1930 and 1940 or of 10.7% (table 1).

Table 1

The population of the nationalities in the territories annexed by the Soviet Union, in 1930 and 1940 (thousands of persons)

	1930 census		The probable population on 1 January 1940	
	abs.	%	abs.	%
TOTAL	3,410	100.0	3,776	100.0
Romanians	1,787	52.5	2,020	53.5
Carpatho-Russians, Ukrainians	537	15.7	587	15.4
Russians	357	10.5	391	10.4
Jews	275	8.1	274	7.3
Bulgarians	164	4.8	186	4.9
Germans	111	3.5	125	3.3
Others *	179	4.9	193	5.1

* Găgăuzs, Poles, Gypsies.

The share of Romanians increased from 52.5% (1930) to 53.5% (1940), with 13%, of Carpatho-Russians, Ukrainians and Russians decreased from 26.2% (1930) to 25.9% (1940) although their absolute number grows from 894,000 to 978,000. So, the Romanians from the territories included in the Soviet Union represented more than a half of the total (population 53.5%).

The population distribution on areas and nationalities points out distinctive features. A. Golopenția divided the 46 "plăși" representing 11% of the total number of 422 "plăși" in the following areas :

1. The Northern Area comprising 8 "plăși" of Rădăuți, Storojineț, Cernăuți and Hotin counties in which the Ukrainians represent the majority ;

2. The Romanian Middle Area (the Forest) with 28 "plăși" of Rădăuți, Storojineț, Cernăuți, Dorohoi (Herța land), Hotin, Soroca, Orhei, Bălți, Lăpușna, Tighina, Cetatea Albă, Ismail and Cahul counties, where the Romanians have the absolute majority ;

3. The mixed colonized Bugeac Area, having 10 "plăşi" of Cetatea Albă, Tighina, Cahul and Ismail counties, inhabited by Bulgarians, Russians, Ukrainians, Germans and Găgăuzs (table 2).

Table 2

The population of the territories annexed by the Soviet Union—zones and nationalities (1930)

	Population (total)	Romanians	Russians	Ukrainians	Jews	Others
Occupied territories (total)	3,409,669	1,787,364	358,208	537,459	275,419	451,219
%	100.0	52.4	10.5	15.8	8.1	13.2
Area with Ukrainian absolute majority	447,480	53,115	37,635	301,271	31,595	23,864
%	100.0	11.9	8.4	67.3	7.1	5.3
The Romanian Middle Area	2,394,045	1,650,815	204,296	154,864	227,009	157,061
%	100.0	69.2	8.5	6.6	9.3	6.4
The Bugeac Area	568,140	83,432	115,277	81,320	16,815	272,296
%	100.0	14.7	20.3	14.3	2.9	47.8

A. Golopenţia explained also the ethnical features of the nationalities living in the three areas (not mentioned here).

The detailed description of Bessarabia and the processes which took place there are to be found in the book: "The History of Bessarabia" by the Bucovinian historian Ion Nistor (1924), while historical Bucovina is presented in two papers by Vladimir Trebici (1990 – 1991).

As the analysis of the territories annexed by the Soviet Union in 1940 must be minutely drawn up in order to highlight the specific features of the evolution of North of Bucovina (including the Herţa land) on the one hand and of Bessarabia on the other hand, we present them separately (table 3).

Table 3

The area of the occupied territories by the Soviet Union (1940)

	Area (sq. km.)
TOTAL	50,762
Bessarabia	44,422
North of Bucovina (Herţa land is included)	6,340

North of Bucovina includes entirely two counties (Cernăuţi and Storojineţ) and partially Rădăuţi county and Herţa land. The two counties have a surface of 4,424 sq. km., so the part of Rădăuţi county and Herţa land represent together 1,916 sq. km. Historical Bucovina has lost more than a half of its total area; the remaining part,South of Bucovina is included nowadays in Suceava county, together with parts of the former counties Baia, Botoşani and Dorohoi (in 1989 Suceava county had a 8,555 sq. km. area and 698,724 inhabitants).

The surface of 6,340 sq. km. was mentioned by A. Golopenţia for the first time and afterwards by Grigore Nandriş (1962) in a paper written in cooperation with Sabin Manuila.

Which was the destiny of those 2,020,000 Romanians living in the occupied territory in an area of 50,762 sq. km.?

Before undertaking the analysis, let us remember that the facts are to be presented separately for North of Bucovina (Herţa land included) and for Bessarabia.

As regards the former we know precisely the structure of the population on in Cernăuţi and Storojineţ counties (4,424 sq. km. and 476,088 inhabitants) in 1930 (table 4).

Table 4

The population of the main nationalities from Cernăuţi and Storojineţ counties (1930)

	Total	Romanians	Ukrainians	Jews	Germans	Poles	Russians
Total	476,088	136,184	213,762	66,569	28,576	23,228	4,877
%	100.0	28.6	44.9	14.0	6.0	4.9	1.0
Cernăuţi	306,194	78,589	136,380	51,247	19,586	15,243	3,295
Storojineţ	169,894	57,595	77,382	15,322	8,990	7,985	1,582

* Hutzuls are included.
Note. 0.6 represent other nationalities.

If the Romanians number increased with 13% during the 1931 – 1940 period, their estimated number in 1930 reached 154,000. We must add approximately 50,000 – 60,000 Romanians from the annexed part of the former Rădăuţi county and the Herţa land, so their total number in North of Bucovina was of 200,000 persons.

Having in mind that the total population estimated by Gr. Nandriş for 1946 was of 545,267 inhabitants, the share of Romanians represented about 37% of the population in the occupied territory (6,340 sq. km.).

As concerns Bessarabia, the ethnic structure of the population is shown in table 5.

Table 5

The population of the main nationalities of the Bessarabian counties (1930)

County	Total	Romanians	Russians	Ukrainians	Jews	Bulgarians	Gagauzs	Germans
Total	2,864,402	1,610,757	351,912	314,211	204,858	163,726	98,172	81,089
%	100.0	56.2	12.3	11,0	7.2	5.7	3.4	2.8
Bălţi	386,721	270,942	46,569	29,288	31,695	66	8	1,623
Cahul	196,693	100,714	14,740	619	4,434	28,565	35,299	8,644
Cetatea Albă	341,176	63,949	58,922	70,095	11,390	71,227	7,876	55,598
Hotin	392,430	137,348	53,453	163,267	35,985	26	2	323
Ismail	225,509	720,20	66,987	10,655	6,306	43,375	15,591	983
Lăpuşna	419,621	326,455	29,770	2,732	50,013	712	37	2,823
Orhei	279,292	243,936	10,746	2,469	18,999	87	1	154
Soroca	316,368	232,720	25,736	26,039	29,191	69	13	417
Tighina	306,592	163,673	44,989	9,047	16,845	19,599	39,345	10,542

Considering the same increase of the number of Romanians in Bessarabia as in North of Bucovina their estimated number in 1940 was about 1,820,000. In this way the total number of Romanians was of 2,020,000 on the territory of 50,742 sq. km. as mentioned by A. Golopenția in his paper (1941).

An important question rises from here : which would have been the number of the Romanians 50 years later? The Union Census of 12 January 1989 registered the number of 3,498,000 made up of 3,352,000 "Moldavians" and 146,000 Romanians. In this total number are included also the "Moldavians" from the eastern part of the Nistru which are assessed to be about 600,000 – 800,000 by A. Golopenția in 1941 – 1943, when he led the research teams of the Central Institute of Statistics in the area between the Nistru and the Bug and then as far as the Dniepr. So, adding for comparison the "Moldavians" across the Nistru, the number will be about 2,600,000 – 2,800,000. Therefore, the increase between 1940 and 1990 was of about 35% or an average yearly rate of 0.6% which is demographically speaking, a low rate as it should have been at least 1% yearly.

Consequently, the total number of Romanians at the beginning of 1989 (the date of the union population census) could have been 4,400,000, so with 1,000,000 persons more than in reality. When considering the difference we must take into account the hypothesis assumed (the yearly increasing rate of 1%) and the estimation for the first year of analysis (1940). Nevertheless we must keep in mind this difference.

Under the same hypothetical circumstances, the number of Romanians from Northern Bessarabia and Herța land would have been of about 330,000 in 1989. Or the number of the Romanians (including also "Moldavians") from the Cernăuți Region (comprising parts of the two former counties Rădăuți and Hotin) was 185,000 in 1989. There is a significant deficit too.

BESSARABIA, NORTH OF BUCOVINA AND HERȚA LAND DURING THE 1940–1990 PERIOD

Under normal conditions the number of the population is influenced by two factors : the natural increase (the balance between births and deaths) and the external migration (the difference between emigration or in-migration). Under outstanding circumstances there act also other factors than the demographic ones, but having demographic impact.

We must accept for the very beginning that we do not know for sure what does the contribution of each factor consist in, but one makes assessments, gives different testimonies, collects archive data.

From the administrative point of view, the territory occupied by the Soviet Union has been reorganized as follows (fig. 1) :

(a) The Republic of Moldova having an area of 33,700 sq. km. and including part of historical Bessarabia and part of the territory across the Dniestr (ex – Moldavian Republic, the capital being Tiraspol);

(b) The Cernăuți Region made up of the former counties Cernăuți and Storojineț, parts of Rădăuți and Storojineț counties and the Herța land, totalizing an area of 8,100 sq. km. ;

(c) The Odessa Region, including Southern Bessarabia (most of Tighina, Cetatea Albă and Ismail counties);

The Cernăuți and Odessa Regions are parts of the of Republic Ukraine (Kiev is the capital), having an area of 603,703 sq. km. and 51,707,000 inhabitants in 1989.

A bigger number of Romanians lives in the Transcarpathian Region (part of the Maramureș principality), included also in the Ukraina Republic.

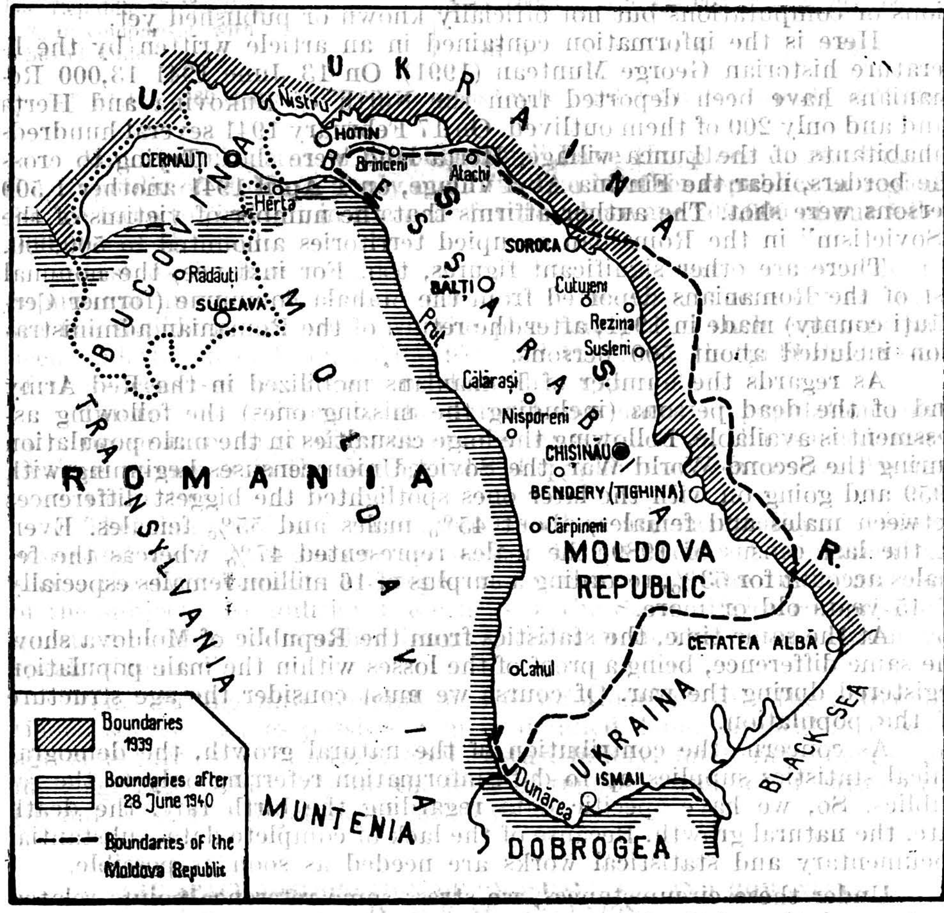

Fig. 1. —[Bessarabia, North of Bucovina and Herța land during the 1940—1990 period.

A complete analysis of the Romanians number in the abovementioned territory during the 1940 — 1990 period must take into account the following factors:

(a) The Romanian refugees from 1940 and 1944;

(b) The deported Romanians in 1940 — 1941 and after 1944;

(c) The Romanians murdered in 1941;

(d) The Romanians who died in the Soviet "gulag";

(e) The Romanians mobilized in the Red Army in 1941 and 1944 — 1945 and the assessment of the dead and the missings;

(f) The results of the Romanians denaticnalization process and its impact.

Unfortunately, the contribution of these six factors to the evolution of the Romanian population is only partially known without having the quantitative figures of each of them. Maybe there is information in the archives, maybe some institutions or persons have already made estimations or computations but not officially known or published yet.

Here is the information contained in an article written by the literature historian George Muntean (1991). On 13 June 1941 13,000 Romanians have been deported from the North of Bukovina and Herţa land and only 200 of them outlived. On 17 February 1941 several hundreds inhabitants of the Lunca village, Herţa land were shot. Trying to cross the borders, near the Fîntîna Albă village, on 1 April 1941 another 1,500 persons were shot. The author affirms that the number of victims of the "Sovietism" in the Romanian occupied territories amounted to 500,000.

There are other significant figures, too. For instance, the nominal list of the Romanians deported from the Mahala commune (former Cernăuţi county) made in 1941, after the return of the Romanian administration included about 500 persons.

As regards the number of Romanians mobilized in the Red Army and of the dead persons (including the missing ones) the following assessment is available. Following the huge casualties in the male population during the Second World War, the Soviet Union censuses beginning with 1959 and going on with the later ones spotlighted the biggest differences between males and females, about 45% males and 55% females. Even at the last census of 1989, the males represented 47% whereas the females account for 53%, recording a surplus of 16 million females especially of 45 years old or more.

At the same time, the statistics from the Republic of Moldova show the same difference, being a proof of the losses within the male population registered during the war. Of course we must consider the age structure of the population.

As concerns the contribution of the natural growth, the demographical statistics supplies up to date information referring only to the republics. So, we have specific data regarding the birth rate, the death rate, the natural growth. Because of the lack of complete data, substantial documentary and statistical works are needed as soon as possible.

Under these circumstances, we stress some reference points related to the evolution of the Romanians number ("Moldavians") at the census of 1959, 1979, 1989 (table 6).

Table 6

The number of Romanians („Moldavians") in the Soviet Union in 1959, 1979, 1989

	1959	1979	1989
Total	2,320,000	3,097,000	3,498,000
— Romanians	106,000	129,000	146,000

So, the number of Romanians ("Moldavians" and Romanians) in 1989 was of about 3,500,000.

Table 7

The total number of Romanians and „Moldavians" in the Soviet Union and the Republic of Moldova

	1959	1979	1989
Soviet Union	2,320,000	3,097,000	3,498,000
The Republic of Moldova	1,887,000	2,536,000	2,795,000
% in comparison with Soviet Union	81.3	81.6	79.9

* At the 1989 census 2,477 "Romanians" were registered in the Republic of Moldova.

Almost four fifths of "Moldavians" have the place of residence in the Republic of Moldova; only one fifth live in other republics or regions. So, we have to find out in the near future where are 700,000 of our fellow countrymen located.

Just as in Romania, the main statistical sources concerning the population number, different structures — including the ethnical one — are the population censuses. In the post-war period such censuses have been undertaken in 1959, 1970, 1979 and 1989. So, the published results of these censuses have been used in this approach.

Information related to the natural movement of population (birth rate, death rate, nuptiality, divorce rate) is found in the general statistical yearbooks or in the demographical (population) yearbooks. We have used them too.

The characteristics we are interested in are nationality *(natsionalnosti)* and mother tongue *(rodnoi jazyk)*. As in the case of Romanian censuses, the two elements are registered according to the free statements of the subjects. In addition the census in the Soviet Union comprises the question: "Mention another language spoken in the Soviet Union you speak fluently".

The turning into account of the information from the abovementioned sources makes possible a more detailed demographical analysis — age structure, sex structure, civil status, family, birth rate, death rate, marriage rate — but only on the level of republics and not of nationalities (in our case, the Republic of Moldova).

THE SPACE DISTRIBUTION OF "MOLDAVIANS" AND ROMANIANS IN THE SOVIET UNION

Considering the total of 3.5 million "Moldavians" and Romanians (1989), actually 3,352,352 "Moldavians" and 146,071 Romanians and the share of 20% living in other republics of the Soviet Union, we must determine their "diaspora". It is the first step in view to point out the emigration process which affected them.

Althoungh it is artificial we go on making the distinction between "Moldavians" and Romanians as they usually appear in the Soviet statistical sources. Firstly, in the Republic of Moldova there are only "Moldavians" *.

In the general results of the 1989 census there are no Romanians. Oddly in the Cernăuţi Region 100,317 Romanians and 84,519 "Moldavians" were registered and in the Transcarpathian Region other 29,485 "Romanians" are enlisted at the same census.

So, the conclusion is that from the total of 146,071 Romanians 89% live in the two regions.

Secondly, we must consider the mother tongue. While more than 90% of the "Moldavians" admit that their mother tongue is "Moldavian", only 53% of the Romanians from the Cernăuţi Region and 98% of those from the Transcarpathian Region own up "Romanian" as their mother tongue. Furthermore, the share of the Cernăuţi Region is decreasing continuously from a census to another, showing a strong process of denationalisation. So, only the Moldavians from the Republic of Moldova and the Romanians from the Transcarpathian Region preserve their mother tongue.

Let us come back to the diaspora of the Moldavians in the Soviet Union.

Table 8

The number of Moldavians (without Romanians) in the main union republics at the 1959, 1979, 1989 censuses

	1959	%	1979	%	1989	%
Soviet Union — total —	2,214,000	100.0	2,968,000	100.0	3,352,000	100.0
The Republic of Moldova	1,887,000	85.2	2,526,000	85.1	2,795,000	83.4
Ukraine	243,000	10.9	294,000	9.9	325,000	9.7
Kazakhstan	62,000	2.8	102,000	3.4	173,000	5.2
Other republics	8,000	0.4	16,000	0.5	26,000	0.7

The tendency for "emigration" of the Moldavians from the Republic of Moldova is certified by their share decrease in their own republic and their absolute and relative growth in the Russian Federation and the Kazakh Republic.

Outside the Republic of Moldova there are 327,000 (1959), 442,000 (1979) and 557,000 (1989) Moldavians. The research of this phenomenon must take into account on the one the regions affected and on the other hand the character of emigration for economic or other reasons according to the theory of "pull-and-push" migration.

We have more detailed data for 1989.

From the total of 3,352,352 Moldavians, the 1989 census registered only 83.4% "at home" and 557,603 spread on the whole territory of the Soviet Union, especially in the Ukraine, the Russian Federation and the Kazakhstan.

If we want to know how many Moldavians and Romanians have been deported, where, and what was their destiny, the answer cannot be found in the population censuses of 1959, 1970, 1979 and 1989.

* At the 1989 census 2,477 "Romanians" were registered in the Republic of Moldova.

Table 9

The distribution of Moldavians in the main republics of the Soviet Union (1989)

Republic	Number	%	Republic	Number	%
Moldavians total	3,352,352	100.0	Georgia	2,842	0.08
Moldova R.	2,794,749	83.4	Turkmenistan	2,466	0.07
Ukraine	324,525	9.68	Azerbaijan	1,915	0.06
Russian Fed.	172,671	5.15	Kirgyzstan	1,875	0.06
Kazakhstan	33,098	0.99	Latvia	1,450	0.04
Uzbekistan	5,955	0.18	Estonia	1,215	0.04
Belarus	4,964	0.1	Tadjikistan	879	0.03
Lithuania	3,223	0.1	Armenia	525	0.02

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THE REPUBLIC OF MOLDOVA

After mentioning their distribution in the Soviet Union, let us analyze them at their own home, i. e. in the territories occupied by the Soviet Union which have initially belonged to Romania. We start with the Republic of Moldova and go on with the Cernăuţi Region. In the first case the statistical information is rich because it is a union republic.

The Republic of Moldova has an area of 33,700 sq. km. and 4,338,000 inhabitants, the population density being of 129 inhabitants/sq. km., higher than in Romania (97.5 in 1989). Unlike other republics, the Republic of Moldova is not divided into regions, but only into departments (40). Let us remember that in 1940 historical Bessarabia had an area of (44,422 sq. km. with 9 counties. By loosing the north (part of Hotin county) and south and adding the territory across the Nistru, its surface is now of 33,700 sq. km. The urbanization level is of 47%, whereas the share of the rural population represents 53% ; the urbanization level is lower than in the former Soviet Union (66%), the Republic of Ukraine (67%) or in the Baltic Republics (71%).

The Moldavians represent two thirds of the total population (64.5% in 1989) recording a small decrease of their share (table 10).

The allogenous populations totalize 1,540,000 persons. Most of them are Ukrainians and Russians (1,162,000) or more than a fourth of the total population (26.8%). The growth rate is different in the last 30 years, the highest one being registered by Russians (+ 92%) and Gagauzs (+ 60%). The other nationalities : Moldavians (48%), Ukrainians (43%), Bulgarians (43%). In the same period the Jews' number decreased with

Table 10

The population of the Republic of Moldova according to the main nationalities (1959 and 1989)

	1959	%	1989	%	1989/1959 %
Population	2,884,000	100.0	4,335,000	100.0	150.3
Moldavians	1,887,000	64.5	2,795,000	64.5	148.1
Ukrainians	421,000	14.6	600,000	13.8	142.7
Russians	293,000	10.2	562,000	13.0	191.9
Gagauzs	96,000	3.3	153,000	3.5	160.1
Bulgarians	62,000	2.1	88,000	2.0	143.4
Jews	95,000	3.3	66,000	1,5	69.1
Byelorussians	6,000	0.2	20,000	0.5	333.0
Gypsies	7,300	0.3	12,000	0.3	159.3
Germans	3,800	0.1	7,300	0.2	190.9
Poles	4,800	0.2	4,700	0.1	99.1
Other nationalities	8,100	0.3	27,000	0.6	—

one third. We can assume that the number of Moldavians, Gagauzs, Ukrainians and Bulgarians increased due to the the natural growth — their birth and death rates are approximately the same—while the number of Russians grew because of the in-migration flows. The proportion of the Russian urban population, much higher than that of Moldavians, shows the immigration trend.

An important remark refers to the mother tongue. In 1989, from the total of 3,352,000 Moldavians living in the Soviet Union, 91.6% declared that their mother tongue is "Moldavian". In the Republic of Moldova the proportion is higher. In the same year from the total number of Romanians of 146,000, only 60.9% stated Romanian as their mother tongue.

The proportion in the Cernăuţi Region is even lower, decreasing from a year to another. It is worth mentioning that in the case of Moldavians from the diaspora the proportion of those who preserved Moldavian as their mother language is lower than in the Republic of Moldova. Possible explanations are: mixed marriages, education in Russian (or Ukrainian) language, gradual assimilation in a foreign environment.

In 1970 a proportion of 97.7% of Moldavians from the Republic of Moldova have Moldavian as mother tongue increasing in accordance with the age structure: with the population of 60 years old or more the proportion was of 99.1%.

Here are some concise remarks regarding the demographic regime in the Republic of Moldova. The available data do not refer to the nationalities — neither in Romania — but because the Moldavians represent 65% of the republic population, we can consider that they have the strongest influence upon the demographic behaviour.

The age structure of the population in the Republic of Moldova is a transitory one from the young population to the old population, process particular to the whole Europe. In 1959 the proportion of the old population (60 years old or more) was of 7.7%, reaching 12.6% in 1989. The mean age of the whole population was of 32 years and the median age of 30 years. The aging of the population is stronger in the rural area. The demographic "pressure" (the number of young and old people in comparison with the number of grown-ups) is very strong in the case of the rural population compared with the urban one – 81% – 55% – phenomenon which should be analyzed in great detail.

The sex structure of the Republic of Moldova's population shows a profound disproportion between males and females: 908 males for 1,000 females (in Romania the ratio is 973/1,000), being a result of the male casualties and of deportations.

The nuptiality is similar with the one in Romania; the nuptial model ("Eastern European Marriage Pattern") is the same in Romania as well as in the Republic of Moldova: the marriage is precocious, universal, the ratio of the unmarried persons being very low. The age at the first marriage was in 1988 of 24 years for males and 21.8 years for females with a difference of 2.2 years (similar values being registered in Romania).

The birth rate is higher than in Romania, the death rate is lower because of the younger structure of the population. A tendency of birth rate decreasing has been registered lately in the Republic of Moldova: from a rate of 28 – 29 live-births/1,000 inhabitants (in 1960 – 1961) to a rate of 21 – 22 in 1984 – 1988. The general death rate increased from 6 – 7 deaths/1,000 inhabitants (1960 – 1961) to 11 – 12% in 1983 – 1988. The infant mortality has systematically decreased, its level comparable with that of Romania is lower nowadays: 20.4 deaths under 1 year per 1,000 liveborn children (the Republic of Moldova) and 27‰ (Romania).

As regards life expectancy the Republic of Moldova ranks among the last. In 1988 the life expectancy of males was of 64.3 years and of females of 71.3 years, lower than in Romania or compared with Byelorussia with 67 and 75.9 years or Ukraina with 66.4 and 74.8 years.

The demographic transition has not been finished yet: it belongs to the "Romanian pattern", subpattern of the historical region of Moldova, as it was described in a reference work (Trebici, Hristache, 1986).

Female fertility in the Republic of Moldova is much higher than in Europe and higher than in Romania. Total fertility rate (number of children per 1 female in the life period between 15 and 49 years of age) was of 3.5 children (1958 – 1959), of 2.6 children (1969 – 1970), of 2.4 children (1980 – 1981), increasing at 2.6 children in 1988.

As the rate of generation replacement is of 2.12 children it means that in the Republic of Moldova there are favourable conditions for the extended reproduction. Having a net reproduction rate of 1.2 – 1.3 girls to one woman, the generation of daughters is with 20 – 30% higher than the generation of mothers.

The mean age of mothers at the birth of their last child was of 29.4 years in 1958 – 1959 and decreased to 26.5 years in 1988. Since this indicator is very important measuring the distance between successive generations, it proves that during a century the population of Moldova will have 4 generations, so a faster speed of replacement.

Therefore, the population of Moldova has a very high reproductive potential which will determine an important birth rate for a long time on ("demographic inertia").

It is worth mentioning that Moldavians accept mixed marriages to a lesser extent than other nationalities.

The adhesion of the Moldavians at the Romanian cultural models and their natural vocation for family and maternity are pointed out by the results of the field inquiry undertaken at the end of July 1991 at the same time in Romania and the Republic of Moldova (IRSOP, INSOC). To the question concerning the age when a female should get married the answer was 22.1 years in Romania and 22.5 years in the Republic of Moldova ; regarding males, the answer was 23.5 years (Romania) and 25.3 years (Moldova). It comes out that there are significant differences concerning the number of children : 1.65 children (Romania) and 2.37 (Moldova).

In order to make a deeper analysis of the population phenomena it is necessary to know some characteristics, such as : the level of urbanization, the internal migration which unfortunately is impossible for the time being.

THE CERNĂUŢI REGION

We have already mentioned how the Cernăuţi Region was set up, being made up of two counties from the North of Bucovina (Cernăuţi and Storojineţ), the Herţa land and parts from Rădăuţi and Hotin counties, having a surface of 8,100 sq. km., 940,801 inhabitants and a density of 116 inhabitants per sq. km. (fig. 2).

The ethnical structure of the population at the last census was as follows (table 11) :

Table 11

The population of the main nationalities from the Cernăuţi Region (1989)

Nationalities	Number	%
Total	940,801	100.0
Ukrainians	666,095	70.8
Romanians	100,317	10.7
Moldavians	84,519	9.0
Russians	63,066	6.7
Jews	16,469	1.8
Others	10,335	1.0

The Ukrainians and Russians represent 77.4% of the total population, while the Romanians and Moldavians less than one fifth (19.6%).

The Romanians totalizing 146,000 in the Soviet Union are actually concentrated in the Cernăuţi and Transcarpathian Regions, so 129,802 (100,317 + 29,485). Paradoxically, in the Cernăuţi Region both Romanians and Moldavians are recorded in the same locality by the population statistics.

The spatial distribution of the Romanians and Moldavians is very different in the six departments of the region : Hliboca (Adîncata), Noua Suliţă, Storojineţ, Hotin, Secureni and Coţmani. From the total of 417

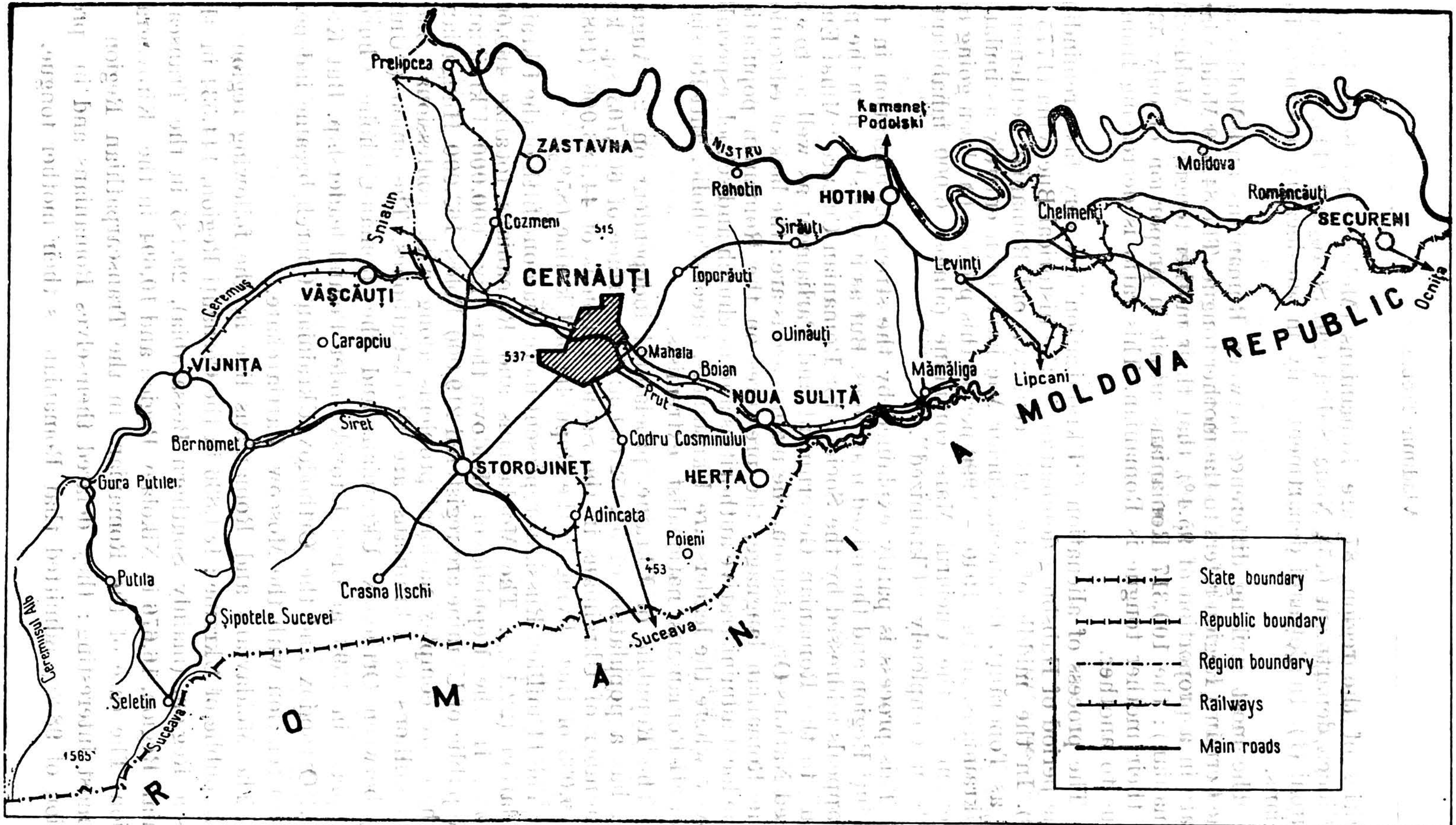

Fig. 2. — The Cernăuţi Region.

localities of the region, 87 are Romanians (Moldavians) being located in Hliboca department (45), Noua Suliţă (29) Storojineţ (11), Hotin (1), Secureni (1). In Coţmani department only in one locality are there Romanians.

The most striking difference between Romanians and Moldavians in the Cernăuţi Region refers to the mother tongue. The 84,519 Moldavians declare in a proportion of 95.4% that their mother tongue is Moldavian (Romanian); the 100,317 Romanians admit in proportion of only 53% that their mother tongue is Romanian. This ratio is decreasing from a census to another.

The process of alienation ("Ukrainization") is very fast, reminding of the period of Habsburg domination in the historical Bucovina (1775 — 1918). In the middle of the 19th century, old Romanian settlements, such as Toporăuţi, Rarancea, Cuciur Mic have been entirely assimilated by Ukrainians. In the 1940 — 1990 period this process has been going on, for example, the Cuciurul Mare commune (almost 6,000 inhabitants) has been completely "Ukrainized".

This process is partly explained by the strong in-migration in the Cernăuţi Region and the mixed marriages. But as it was shown in the public appeals addressed by the Society for Romanian Culture "Mihai Eminescu" to the Romanian Government and Parliament as well as to the United Nations Organisation, the main reasons are : the lack of education in the Romanian language, the pressures on the Romanian population by the local administrative authorities and in church and school, especially in Lvov where the leaders are Ukrainians, Greek-Catholic, anti-Russians and anti-Romanians nationalist extremists.

The Republic of Ukraine, proclaimed independent on 25 August 1991, has a population of 51,452,034 and a surface of 603,703 sq. km. the number of Ukrainians in the Soviet Union is of 44,186,006 (1985), 37,419,033 of them living in the Republic of Ukraine (85%).

The 11 million Russians represent more than one fifth of the Ukraine population (22.1%). The Moldavians and Romanians totalize 460,000 persons. In the Republic of Moldova there live 600,000 Ukrainians. In Republic of Ukraine are registered 219,000 Poles, 163,000 Hungarians. So there are complex national problems along with confessional ones. Some millions of Ukrainians are Greek-Catholics. The union ("Uniaţia") between Orthodox Ukrainians and the Roman-Catholic Church took place in 1596 at Brest-Litovsk under Poland leadership. But Kiev is still Orthodox and the Orthodox Ukrainian Church became independent in relation with the Moscow Patriarchate.

The Moldavians and Romanians live in the following regions of the Republic of Ukraine : 184,836 in the Cernăuţi Region, 144,534 in the Odessa Region, (mainly Southern Bessarabia), 29,485 in the Transcarpathian Region, 16,676 in Nikolaev Region and 10,694 in the Kirovograd Region. The case of the Romanians in the Transcarpathian Region is the most interesting : they delared themselves Romanians and in proportion of 98.2% admitted that Romanian is their mother tongue.

On the left bank of the Tisa, in Romania, in Maramureş county there live 32,723 Ukrainians (1977). The Romanians from the Transcarpathian Region (Užgorod) unfold their national-cultural activity without any obstacles from the local authorities.

Instead of conclusions, let us say that the studies concerning Bessarabia and Bucovina will be continued. The demographer should be accompanied by the historian, so that the political factor will know for sure what is the best strategy to be applied.

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L'IMPACT DU GIGANTISME INDUSTRIEL SUR L'ÉVOLUTION DES VILLES DE ROUMANIE *

CLAUDIA POPESCU

The impact of the huge industrial plants upon the evolution of the towns in Romania. The article discusses the impact of the huge industrial plants (with more than 5,000 employees) upon the structural, spatial, functional, social and ecological evolution of Romania's towns. 140 big enterprises are spread in 70 towns of different size being, in this way, a representative feature for the national industry. The relation between towns and big enterprises is analysed through two possible scenarios from a theoretical point of view. The paper points out the negative implications of this relation.

Mots-clé : industrialisation, gigantisme industriel, villes, Roumanie

Processus géographique des plus dynamiques et complexes, le changement urbain s'est manifesté avec une grande intensité dans le cas des villes de Roumanie.

Considérée, au niveau de l'économie, nationale, comme la seule voie viable de développement, l'industrie avait, naturellement, le même rôle au niveau des villes. L'industrie s'inscrit parmi les causes multiples ayant déterminé le changement urbain, mais elle s'imposait, malheureusement, non pas par ses formes générales, mais par l'une des formes particulières — le gigantisme industriel. Au premier abord, on pourrait considérer exagéré de parler de gigantisme industriel dans le cas de la Roumanie. Pourtant, une analyse plus poussée permet de remarquer que, dans l'industrie roumaine de la fin de 1989, le processus de concentration industrielle avait revêtu des formes exacerbées, en flagrante non — concordance avec les ressources matérielles et énergétiques du pays, avec le maintien d'un équilibre entre l'industrie et les autres secteurs économiques, avec l'assurance d'une relation efficiente entre le développement urbain et le développement industriel.

L'impact du gigantisme industriel sur l'évolution des villes de Roumanie est d'autant plus évident, si l'on tient compte du fait que les grandes entreprises industrielles (avec plus de 5 000 travailleurs) sont situées exclusivement dans l'espace urbain.

L'industrialisation etait une prémisse permanente de l'urbanisation, les deux processus se trouvant dans une relation d'équilibre jusqu'à la seconde moitié de la septième décennie quand, par l'apparition du gigantisme industriel, entre industrialisation et urbanisation apparaît un déséquilibre qui s'accentue après 1980.

Il existe, théoriquement, deux scénarios concernant l'impact du gigantisme industriel sur l'évolution des villes. Dans un premier scénario, le gigantisme industriel est greffé sur la structure d'une ville

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* Communication présentée lors du IX[e] Colloque franco-roumain de géographie, Paris, mai 1991.

faiblement industrialisée. Les grandes dimensions de l'industrie provoquent la désorganisation de la structure initiale des villes en perturbant les relations qui existent entre les composantes de la ville et entre la ville et le milieu environnant ; une structure de transition s'esquisse, soumise peu à peu à l'organisation structurelle, à l'établissement de nouveaux sens dans les relations de la ville. Finalement, on aboutit à une nouvelle structure. C'est le cas des villes petites et moyennes, à main-d'œuvre excédentaire et dont le potentiel dépasse la capacité industrielle. Par suite de l'apparition des grandes entreprises industrielles, ces villes se sont transformées en centres industriels qui attirent la main-d'œuvre et dont la capacité industrielle dépasse le potentiel de la ville.

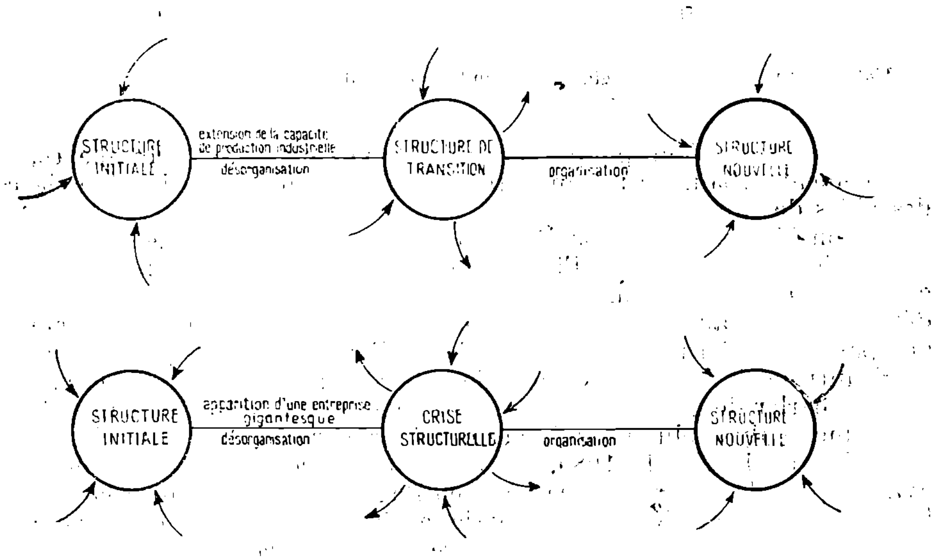

Fig. 1. L'évolution du gigantisme industriel: en haut, l'évolution lente; en bas, l'évolution violente.

Un second scénario repose sur l'apparition du gigantisme industriel dans le cas d'une ville déjà fortement industrialisée. A partir de la structure initiale, par une industrie de grandes dimensions, on aboutit à une crise structurelle. Lorsque la désorganisation s'accentue, cette crise peut se transformer en un véritable chaos, caractérisé par le dépassement des limites de développement de la ville. C'est pourquoi il s'impose de redimensionner l'industrie, dans le but d'organiser une nouvelle structure efficiente de la ville. C'est le cas des grandes villes avec cinq ou six entreprises gigantesques qui produisent une crise spatiale et fonctionnelle difficile à traverser.

Dans les deux cas le gigantisme industriel se manifeste comme une intervention violente, qui n'est pas en concordance avec le potentiel de la ville, la complexité de son impact dépendant, en principal, de deux variables : l'intensité du gigantisme industriel et le niveau initial d'industrialisation.

En pratique, la relation villes—gigantisme industriel est une relation complexe, le gigantisme industriel se manifestant en tant qu'élément qui exerce une pression sur les villes sous rapport évolutif, structurel, spatial, fonctionnel, social et écologique.

Pour ce qui est de *l'évolution temporelle* du gigantisme industriel, rappelons que 1975 représente le début de ce processus, qui s'est consolidé continuellement. Avant 1975 il y avait en Romanie 40 entreprises à plus de 5 000 travailleurs ; après 1975, 89 autres entreprises ont dépassé ce nombre de travailleurs et 11 nouvelles entreprises ont été construites.

Les grandes entreprises se composent, d'une part, d'entreprises qui ont été conçues comme entreprises gigantesques et, d'autre part, d'entreprises qui ont été aggrandies. Il s'ensuit donc que le gigantisme industriel connaît deux types d'évolution : lente et violente (fig 1).

Le gigantisme industriel s'est réalisé par deux voies :

Une première voie est la croissance continue du nomber des grandes entreprises industrielles (de 7 en 1955 à 140 en 1989) et la croissance de leur nombre de travailleurs (de 50 000 travailleurs en 1955 à plus de 1,2 millions en 1989) (fig. 2).

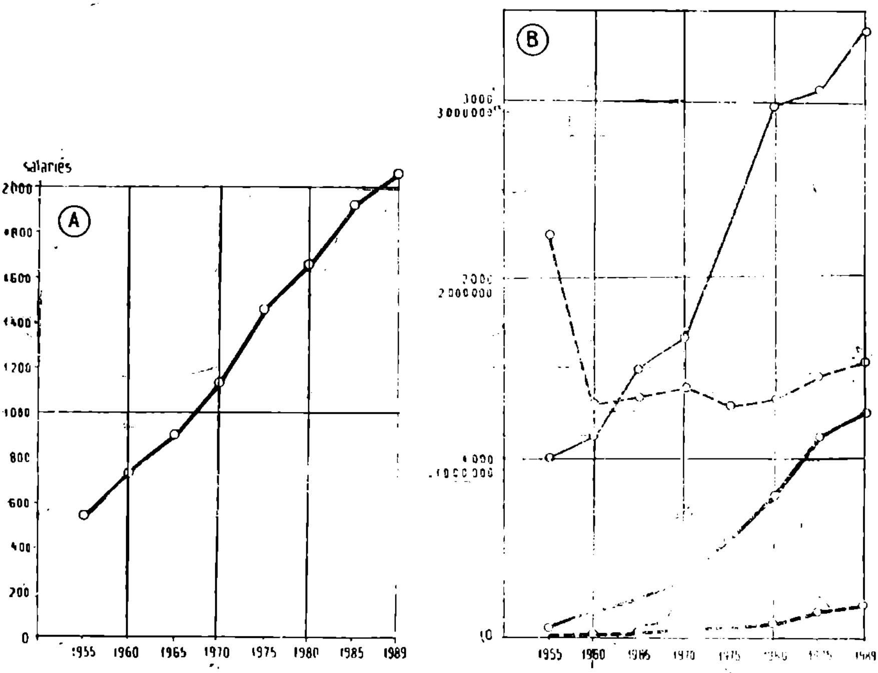

Fig. 2. L'évolution de la grandeur moyenne des entreprises industrielles (A) et l'évolution du nombre des entreprises industrielles et du nombre de travailleurs (B) : en haut, l'évolution du nombre total des entreprises et de leurs salariés ; en bas, l'évolution du nombre des entreprises à plus de 5000 ouvriers et de leurs salariés.

La même année, le poids des grandes entreprises était significatif : 37,4% du nombre total des travailleurs, 9,7% du nombre total des entreprises industrielles et 35,4% de la production de l'industrie nationale (fig. 3).

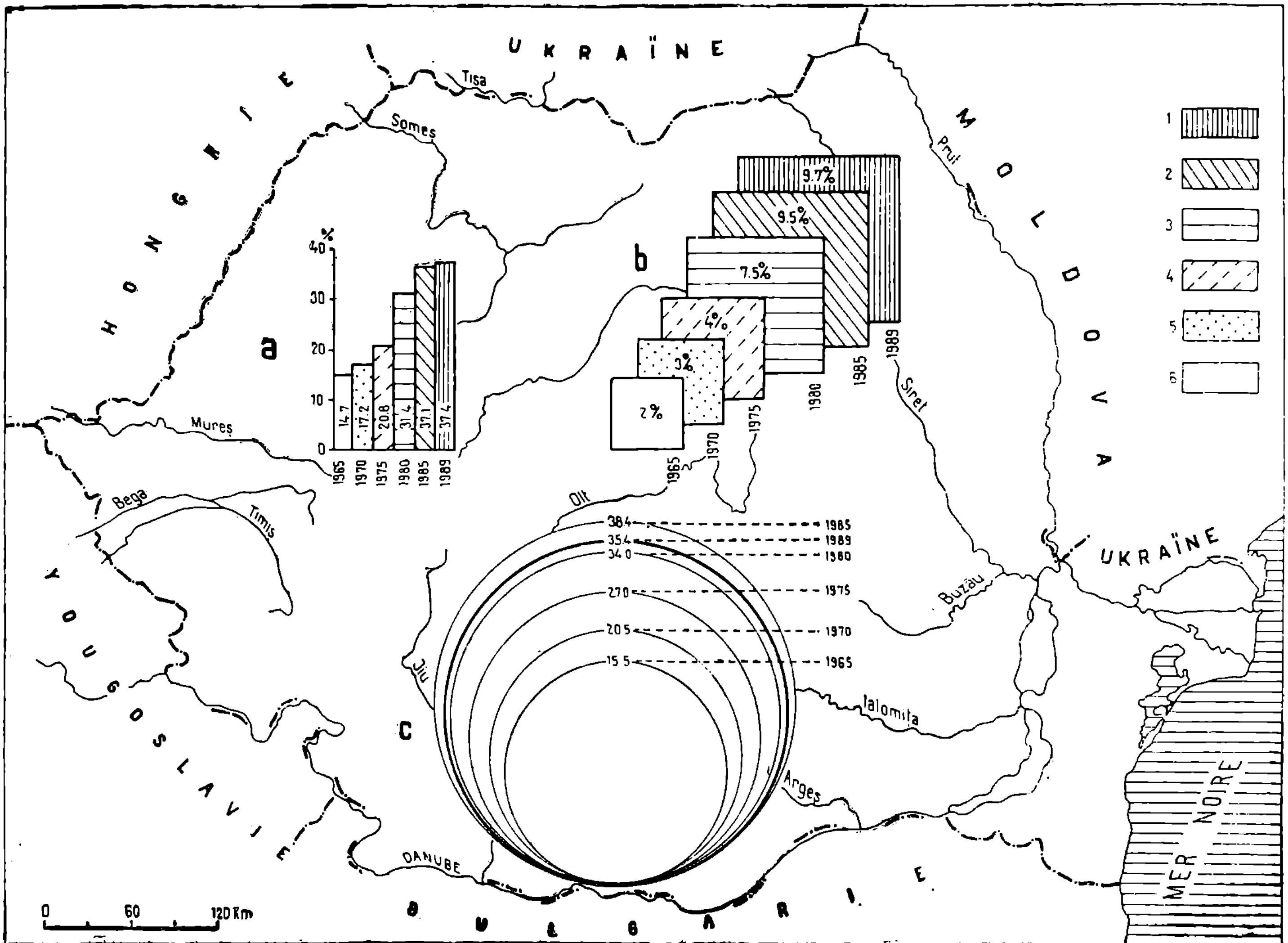

Fig. 3. Taux des entreprises industrielles à plus de 5 000 travailleurs par rapport: *a*, au nombre total de travailleurs de l'industrie; *b*, au nombre total des entreprises industrielles; *c*, à la production totale industrielle.

La croissance continue du nombre des grandes entreprises industrielles s'est produite, certes, au détriment des catégories inférieures d'entreprises. Il faut remarquer que tandis que le nombre des entreprises ayant jusqu'à 2 000 travailleurs décroît, le nombre des entreprises ayant plus de 2 000 travailleurs va toujours croissant, ce qui relève l'intensité du processus de concentration industrielle.

Une seconde voie de réalisation du gigantisme industriel fut la croissance de la grandeur moyenne des entreprises, de 500 travailleurs en 1955, à plus de 2 000 travailleurs en 1989, une croissance supérieure étant enregistrée dans les entreprises métallurgiques (en moyenne 4 500 travailleurs par unité industrielle) et dans les entreprises de construction de machines (2900 travailleurs en moyenne).

Le résultat de ce processus de concentration industrielle fut la distribution des grandes entreprises en 36 sur les 40 départements du pays (90% du nombre total de départements) et en 70 sur les 260 villes du pays (26% du nombre total des villes du pays).

La répartition territoriale des grandes entreprises industrielles ainsi que les données présentées ci-dessus démontrent que le gigantisme industriel est un processus généralisé et représentatif pour l'industrie roumaine. Le nombre des entreprises gigantesques, y compris leur impact, est différencié, variant de 1 à 5 --6 entreprises et culminant par 19 grandes entreprises à Bucarest.

En ce qui concerne la structure, remarquons la prédominance des entreprises de la construction de machines, sidérurgiques, chimiques, métallurgiques, c'est-à-dire des branches dites grands consommateurs de matières premières et d'énergie, importantes sources de pollution (fig. 4). Les statistiques officielles démontrent qu'en 1989 on importait plus de 70% du nécessaire de pétrole, plus de 90% de la quantité de minerais de fer, environ 60% du charbon cokéfiable, tout le nickel et le molybdène nécessaires, une grande partie du cuivre et bien d'autres matières premières ; par exemple, le gas et même de l'énergie électrique.

D'autre part, les capacités de production de ces branches sont surdimensionnées ; par exemple, les capacités existant en sidérurgie pour la production de la fonte et de l'acier dépassaient en 1989 de plus de 30% le nécessaire réel de l'économie roumaine et cela dans les conditions où l'exportation des produits de la structure actuelle de ces entreprises n'était pas efficiente.

Quoiqu'il semble que le gigantisme industriel n'est caractéristique qu'aux grandes villes du pays (les villes dépassant en Roumanie 100 000 habitants), voilà qu'il a pénétré également dans l'industrie des villes moyennes et petites. De grandes entreprises industrielles sont présentes dans 4% du nombre total des petites villes du pays, dans 45% du nombre des villes moyennes et dans 95% du nombre des grandes villes.

En poursuivant la relation entre le gigantisme industriel et la croissance démographique des villes, on voit clairement que le moment de la mise en œuvre des entreprises à plus de 5 000 travailleurs est placé non seulement dans la période de maximum de croissance démographique, mais il est suivi d'une évolution ascendante intense du nombre des habitants.

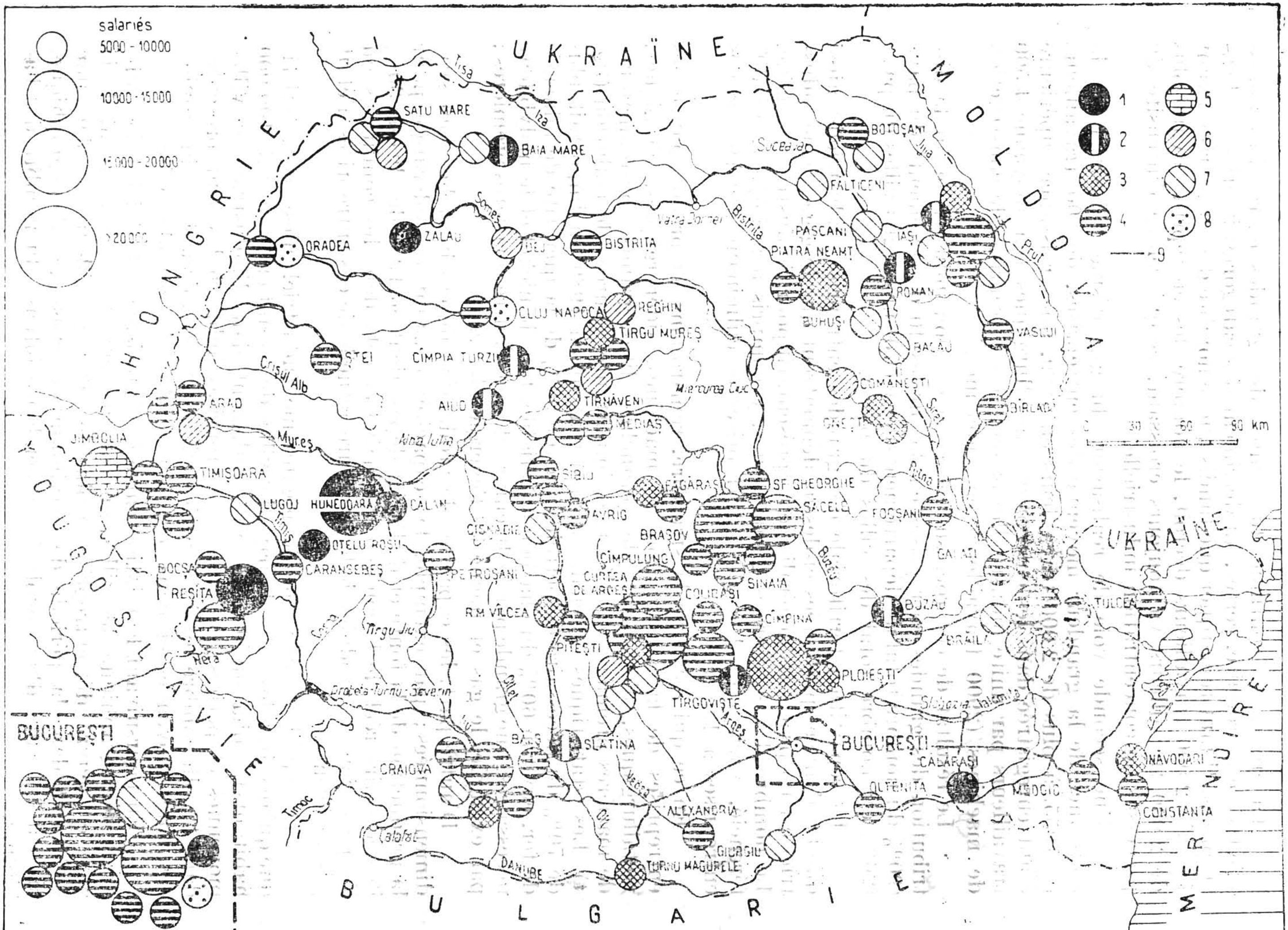

Fig. 4. Répartition des grandes entreprises industrielles (plus de 5 000 salariés). *1*, Sidérurgie; *2*, métallurgie; *3*, industrie chimique; *4*, industrie des constructions métalliques; *5*, industrie des matériaux de construction; *6*, industrie du bois; *7*, industrie textile; *8*, industrie

Evidemment, les entreprises géantes sont de grands consommateurs de main-d'œuvre en entraînant entre 5 000 et 25 000 travailleurs. Leur impact est démontré également par le taux de la population occupée dans ces colosses industriels. Il est significatif que dans plus de la moitié des villes, plus de 50% de la main-d'œuvre occupée en industrie s'était concentrée dans ces entreprises et un quart enregistraient un taux de plus de 75%.

Sous le rapport **spatial**, on pourrait parler de deux niveaux de perception de l'impact du gigantisme industriel :

— le niveau national, où on doit remarquer la répartition uniforme de ces entreprises dans le territoire du pays, le caractère uniforme de l'industrie — pour la réalisation duquel on a tant œuvré — démontrant, pour la première fois, ses effets négatifs ;

— le niveau local, concrétisé par les problèmes spécifiques de l'organisation de l'espace urbain. En général, l'emplacement des grandes entreprises dépend de leur âge, les plus anciennes étant dispersées à l'intérieur des villes, les nouvelles étant concentrées sur des plates-formes industrielles.

La plupart des problèmes engendrés par les grandes entreprises relève de l'insuffisance de l'infrastructure des transports, du taux réduit des zones commerciales et des espaces verts, le nombre de ces derniers étant de beaucoup au-dessous du niveau des standards internationaux.

Sous le rapport **fonctionnel**, l'impact du gigantisme industriel sur les villes est donné par l'indice d'emploi des capacités de production des entreprises analysées. L'exemple le plus pertinent est celui de Bucarest qui, à la différence des autres capitales européennes, reste une ville fortement industrialisée. Aucune de ses 19 entreprises à plus de 5 000 travailleurs ne fonctionné à sa capacité, mais avec seulement 50 — 80% de celle-ci.

Les problèmes fonctionnels deviennent très complexes, si l'on tient compte des possibilités réduites de restructuration industrielle de ces entreprises, de leur rigidité accrue vis-à-vis des exigences du marché, du manque de concurrence dans le cas des entreprises uniques pour la production de certains produits, ou de l'absence de spécialisation pour d'autres produits.

Sous l'aspect **social**, on doit souligner que l'énorme effort d'investissement fait pour la construction de ces grandes entreprises s'est réalisé au dépens du niveau de vie de la population du pays tout entier et des villes respectives notamment. Ce qui plus est, maintenir en service ces colosses industriels implique la croissance des subventions du budget de l'Etat pour financer les déficits chroniques qu'ils enregistrent d'une année à l'autre. Mais l'effet le plus prégnant que le gigantisme industriel a sur la population urbaine c'est la hausse du chômage et l'apparition d'un type spécifique de chômage — « le chômage technique » (les travailleurs ne sont payés que de 60% de leur salaire mensuel), ce qui a mené à la dégradation de la vie urbaine et de la condition humaine même.

La ville de Bucarest, qui détenait 13,5% du volume de la production industrielle du pays en 1989, est aujourd'hui aussi un exemple de chômage technique affectant les travailleurs des grandes entreprises en proportion de 25 à 40%. Il s'agit, évidemment, d'un chômage masqué, qui ne pourra pas longtemps résister sans prendre les dimensions réelles de l'impact du gigantisme industriel dans le plan social.

Sous rapport **écologique**, on remarque l'impact violent et aigu du gigantisme industriel sur les villes. Les grandes entreprises sont d'importantes sources de pollution. En 12 sur les 16 villes où l'on a enregistré un dépassement de concentration des substances polluantes en 1989, il existe des entreprises à plus de 5 000 travailleurs. Dans quelques-unes de ces villes il s'agit d'un déséquilibre écologique très profond, qui a des conséquences non seulement sur le milieu environnant, mais aussi sur la vie des plantes, des animaux et, certes, sur la vie des hommes.

Voilà succinctement présenté, dans ses coordonnées majeures, l'impact du gigantisme industriel sur l'évolution des villes de Roumanie. Nous nous trouvons dans une période difficile et contradictoire de transition de l'économie hypercentralisée vers l'économie de marché et l'un des premiers pas à faire serait de diagnostiquer le plus exactement possible ce que nous avons déjà, le stade actuel dont nous partons, pour mieux choisir les voies les plus adéquates pour l'avenir.

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PRÉSENCE D'UN RELIEF DE MODELAGE SOUS-AÉRIEN ENTRE LE BADÉNIEN ET LE SARMATIEN, SUR LES UNITÉS DE PLATE-FORME *

LIVIU IONESI, NICOLAE BARBU, BICA IONESI

The presence of a fossil levelled surface between the Badenian and the Sarmatian in the platform regions. The paper analyses the evolution of the foreland of the Romanian Carpathians between the Upper Badenian (Kossovian) and the Sarmatian. The bio-stratigraphical investigation of the terminal part of the Badenian and of the beginning of the Sarmatian proves, without any doubt, an interruption of the sedimentation between these two layers in the whole foreland and the appearance of a land exposed to the subaerian modelling. The analysis of the microscopic and macroscopic fossil vegetation and fauna from the Lower Sarmatian deposits shows that this land had a height of no more than 400—600 m and that the climate was temperate warm. For this relief, realised between the Kossovian and the Sarmatian in the foreland regions the name of the Moldo-Walachian surface has been suggested. The transgression of the Sarmatian waters began in the Upper Buglovian, reaching its maximum during the Lower Bassarabian.

Mots clé : paléogéographie, Badénien, Sarmatien, l'avant-pays carpatique, le plateau Moldave

On connaît bien que l'évolution paléogéographique d'une région est dépendante des progrès de la stratigraphie, notamment de ceux biostratigraphiques. Par l'inventaire aussi exact que possible du contenu fossile (végétal et animal) et par l'analyse des dépôts accumulés, on peut apporter des précisions quant aux rapports entre les bassins d'accumulation marine et la terre limitrophe, à l'ambiance biotique et à l'aspect morphologique.

Au Badénien supérieur, après une longue étape d'exondation qui a englobé tout l'avant-pays des Carpates Roumaines, période pendant laquelle, sous l'action des facteurs exogènes, un relief s'est modelé (que Paraschiv, 1980, appelle, dans *Le Plateau Moldave*, la surface Dorohoi), une importante transgression marine s'est produite, les eaux envahissant une grande partie de l'ancienne terre ferme, à savoir : la Plate-forme Moldave, la Plate-forme de Bîrlad, la partie NO et O de la Plate-forme Covurlui, la partie N et O de la Plate-forme Valaque (avec une interruption entre Vedea et Olteț) et la Dobrogea du Sud.

Les régions qui se sont préservées en tant que terre ferme sont : l'Orogène alpin précoce de la Dobrogea du Nord (prolongé également au Nord du Danube), la Dobrogea Centrale, le territoire présent du Delta du Danube et la partie centrale et sud de la Plate-forme Valaque. Les eaux de la mer badénienne supérieure (kossovienne) avaient une salinité normale, sans pour autant exclure l'existence de certaines conditions de

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précipitation de quelques évaporites (gypse), qui, sur la Plate-forme Moldave sont assez répandus et constituent la formation médiane évaporitique. Nous nous rapportons exclusivement à l'avant-pays.

Il faut encore préciser qu'au Badénien supérieur, la rive Est du bassin d'accumulation superposé au Plateau Moldave a fonctionné comme un seuil élevé, partiellement (NE) envahi, plus tard, par les eaux. En témoigne l'absence du gypse et la présence des rudites.

Il est intéressant à signaler que, en ce qui concerne la faune marine, celle de la Plate-forme Moldave est de facture Est, alors que dans la Dobrogea du Sud, on constate une interpénétration des éléments est et des éléments Ouest (Ionesi et Nicorici, 1990). La faune de Crivineni (Molasse des Carpates Orientales) est, visiblement, de facture Ouest, ce qui suggère une barrière entre les eaux de la Plate-forme Moldave—la Plate-forme de Bîrlad et celles de la zone de Molasse.

En Roumanie, à la suite des recherches connues (Macarovici, Atanasiu, Trelea, B. Ionesi, Chiriac, Muțiu, etc.), on a considéré que la mer kossovienne, une fois installée, a continué d'exister au Sarmatien ; cependant, il y a eu des changements dans le milieu géochimique marin, à savoir le passage vers un milieu saumâtre à effets violents sur la faune. Ces modifications sont mises sur le compte de l'élévation de l'arc alpin et de l'installation du bras de mer devenu la Paratéthys, où, par la perte des liens avec la mer Téthys, les eaux sont devenues saumâtres. Sans doute, le déroulement des événements a-t-il été, en grandes lignes, conforme à ce modèle, mais les précisions biostratigraphiques de la partie finale du Badénien et, surtout, de la base du Sarmatien prouvent, sans aucun doute, une interruption des sédimentations entre ces deux étages sur l'aire du bassin dacique se trouvant devant les Carpates (Fig. 1). L'interruption de la sédimentation s'est concrétisée dans l'apparition d'une terre ferme soumise au modelage sous-aérien. C'est uniquement une situation locale, spécifique, paraît-il, des régions limitrophes de l'Orogène Carpatique et de celui de la Dobrogea du Nord.

Dans la Dobrogea du Sud et la Plate-forme Valaque, la lacune est très évidente, par le manque d'une partie du Badénien, l'érosion des dépôts accumulés et leur conservation uniquement en lambeaux épais de 5 m tout au plus. La transgression de la mer sarmatique, dans la Dobrogea du Sud, s'est produite dans le Volhynien supérieur, sur une aire très réduite dans la partie SO (B. Ionesi et L. Ionesi, 1973), l'extension maximale des eaux ayant lieu au Basarabien, lorsqu'elles occupent toute la Dobrogea du Sud et même une petite portion (SE) de la Dobrogea Centrale (au nord de la faille Capidava-Ovidiu).

La situation est presque similaire dans la Plate-forme Valaque, où il semble que la transgression s'est produite un peu plus tôt, vers la fin du Bouglovien ou au début du Volhynien (Bandrabur, 1971), l'extension maximale des eaux étant signalée aussi au Basarabien inférieur. Même dans cette situation, dans la Dobrogea du Sud, pendant le Basarabien, on mentionne la présence d'un biotope de côte, représenté par des îles dans la mer, attesté par une biocénose à oiseaux, phoques, mammifères semiaquatiques, chéloniens et lacertiliens (Grigorescu, 1978). Probablement, le biotope de côte était-il aussi présent sur la Plate-forme Valaque, mais il est difficile à déceler des biocénoses spécifiques par des forages.

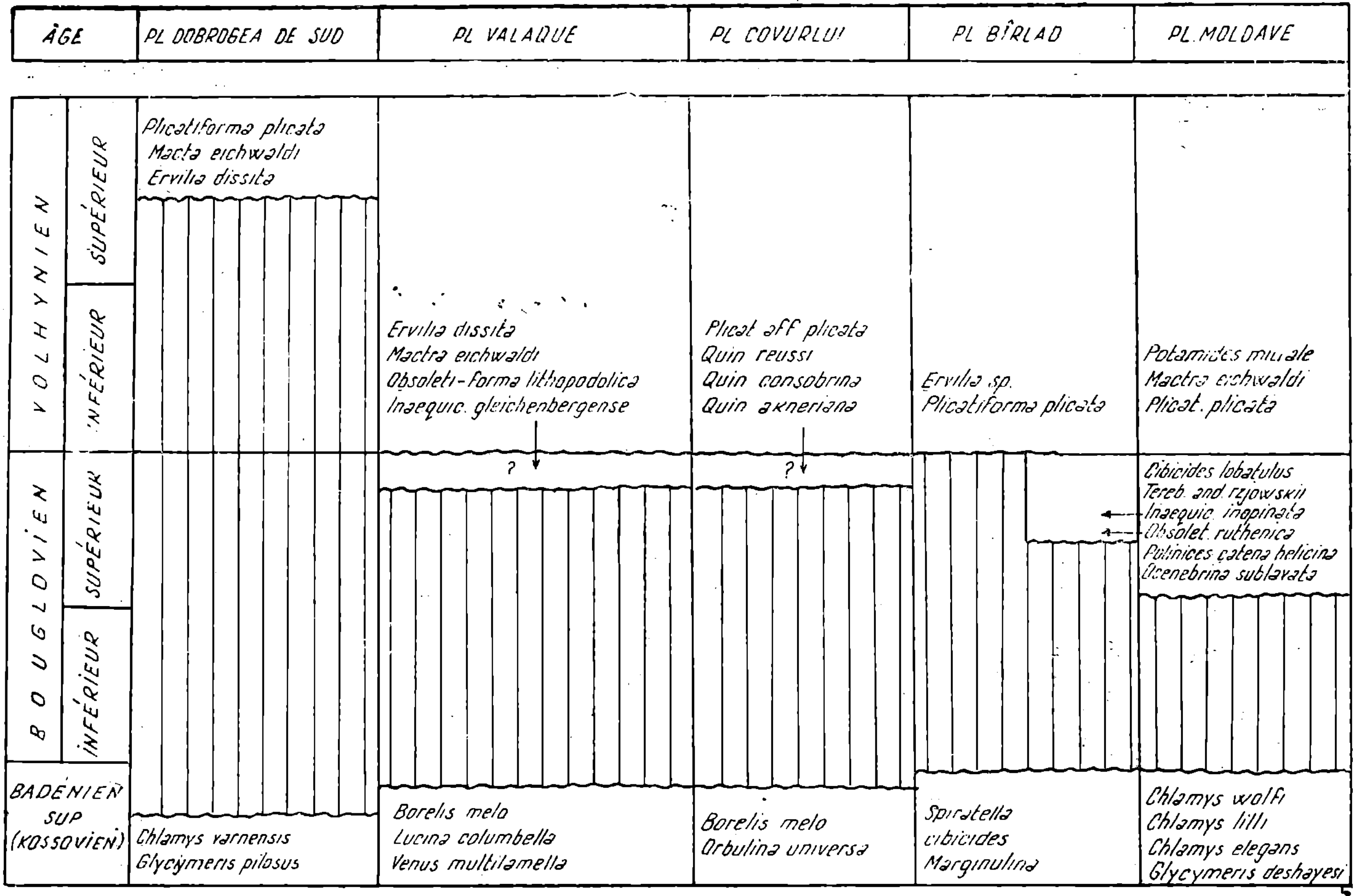

Fig. 1. — Discontinuité stratigraphique entre le Badénien et le Sarmatien sur les unités de plate-forme.

Dans le cadre de la Plate-forme Covurlui (le Promontoire enterré de la Dobrogea du Nord), le Sarmatien n'apparaît pas à la surface, mais la micro-et la macrofaune découverte dans des carottes a permis de préciser que la transgression de la mer s'est produite à partir du NNO, dans le Volhynien, en avançant doucement vers le sud, mais sans le couvrir entièrement, car une partie du coin sud-est est resté terre ferme.

Pour la Plate-forme Moldave et la Plate-forme de Bîrlad, les événements ont été communs, nous allons donc les présenter ensemble. En faveur de l'interruption de la sédimentation plaident les arguments suivants:

1. L'absence de la partie finale du Kossovien, à savoir des ainsi nommées couches à *Venus konkensis*, signalées plus au nord, par un forage de la zone Cernăuţi (Zhizhichenko, 1953).

2. La disposition, dans le même forage, sur les dépôts mentionnés, d'un niveau à faune d'eau douce, qui reflète l'installation locale d'un lac sur une aire de terre ferme.

3. Dans les affleurements de la rive droite du Prut, ni un tel niveau ni les couches à *Venus konkensis* n'apparaissent.

4. Les dépôts sarmatiens qui se posent sur le Badénien (ainsi qu'il résulte des affleurements et des forages) contiennent une faune saumâtre évoluée, avec très peu de restes badéniens *(Ocenebrina, Polinices, Spaniodontella)* et quelques espèces caractéristiques *(Cibicides lobatulus, Quinqueloculina karreri ovata, Inaequicostata inopinata, Obsoletiforma ruthenica, Terebralia andrzjowskii*, etc.), qui dénotent l'âge Bouglovien supérieur et, donc, l'absence de celui inférieur (L. Ionesi et B. Ionesi, 1982, 1983, 1990).

5. Dans la partie NE de la Plate-forme Moldave, où l'on peut observer les relations stratigraphiques, le Sarmatien se pose sur le Badénien supérieur par des unités lithologiques différentes. De la sorte, à l'ouest de Horodiştea, la succession du Sarmatien commence avec les argiles de Bajura (55 — 100 m), après lesquelles suit le tuf dacitique de Hudeşti (2 — 5 m) et, ensuite, les argiles bentonitiques de Darabani-Mitoc, au niveau desquelles paraissent, entre Mitoc et Ştefăneşti, les biohermes à *Serpula*. À l'est de Horodiştea, les argiles de Bajura sont absentes, ce qui fait que les argiles bentonitiques ou les biohermes à *Serpula* se disposent directement sur le Badénien.

6. Dans le forage de Nicolina-Iaşi, le Bouglovien est représenté uniquement par les biohermes à *Serpula* (20 m), qui sont disposées directement sur le Badénien (B. Ionesi et Brânzilă, 1990). Dans le forage de Muntenii-de-Jos (bord sud-est de la Plate-forme Moldave), sur le Badénien supérieur se trouvent également des marnes à faune similaire au Bouglovien supérieur du NE de la plate-forme (B. Ionesi, 1989).

Bref, après le Kossovien, il y a eu une retraite des eaux et l'installation d'une terre ferme. Une nouvelle transgression s'est produite dans le Sarmatien, d'abord dans le Bouglovien supérieur sur la Plate-forme Moldave et sur la Plate-forme de Bîrlad et, peut-être localement, sur la Plate-forme Valaque. Dans le Volhynien, les eaux se sont très peu répandues sur la Plate-forme Covurlui, un peu plus sur la Plate-forme Valaque et dans le coin sud-ouest de la Dobrogea du Sud. La transgression maximale a eu lieu dans le Basarabien inférieur. C'est probablement toujours à cette époque-là qu'elles pénètrent sur le territoire du Delta.

Un autre aspect que nous allons essayer de déchiffrer est celui qui se rattache au « paysage » de la terre ferme qui a existé entre le Kossovien et le Sarmatien. On peut l'étudier d'après les sediments érodés et déposés dans les bassins d'accumulation persistants, ainsi que d'après l'environnement biotique (flore, faune).

On n'a pas encore la certitude que sur les côtés est et sud de l'Orogène carpatique, respectivement dans la Molasse péricarpartique, il y a eu une continuité de sédimentation, donc un possible bassin d'accumulation. Il paraît qu'ici aussi, il y a eu interruption. Dans ce cas, les eaux de la terre respective étaient drainées vers le S, le SE et le NE (Podolie).

Quant à la morphologie, en partant de l'analyse de l'inventaire végétal des dépôts sarmatiens, les chercheurs sont unanimement d'accord que les plantes d'altitude élévée sont absentes. Compte tenu de la micro- et de la macroflore, les hauteurs n'auraient pas dépassé 400 — 600 m (Petrescu [1], Givulescu, 1990 a, b ; Codrea, 1990 ; Marinescu et al., 1990).

Les mammifères identifiés (micro- et macro) dans les dépôts sarmatiens inférieurs de quelques bassins de l'Ouest reflètent la même chose (ex. la faune du bassin du Crișul Alb — Rădulescu et al., 1990).

Sur la Plate-forme Moldave exondée, une plaine d'accumulation marine est restée, légèrement inclinée dans la direction de la retraite de la ligne du rivage et sur laquelle s'est installé, bien sûr, un réseau hydrographique, initialement conséquent à l'inclinaison vers le S, SE et NE (Podolie), ainsi que vers certains bassins d'accumulation lacustre locale, ultérieurement manifestant des tendances d'évolution.

On ne dispose pas encore de données suffisantes (altitudes, énergie de relief, éloignement et variation de la ligne du rivage, etc.) pour préciser le degre de modelage sous-aérien dans divers secteurs. Nous pouvons seulement apprécier, à quelques réserves près, jusqu'aux nouvelles attestations, que le relief avait dépassé la phase de plaine faiblement fragmentée du point de vue hydrographique et que prédominant était un paysage de plateau à altitude réduite et à processus modérés de lit majeur et de versant. La variation en épaisseur du Badénien supérieur peut être l'effet d'une sédimentation marine différenciée dans l'espace et le temps et, seulement en partie, celui des processus fluvio-dénudationnels en régime de terre ferme, car, on suppose que des superficies primordiales assez étendues s'étaient conservées. Dans l'ensemble l'épaisseur du Badénien s'accroît sensiblement vers l'Ouest, où elle arrive à 450 m. Des données de forage, il résulte que les isobathes de la base du Badénien se trouvent entre 0 — 100 m (au NE) et — 1500 m (devant l'orogène) et entre 2000 — 5000 m sous l'orogène.

Par contraste, dans la Dobrogea du Sud, le degré d'évolution est beaucoup plus avancé ; il en résulte un relief à fragmentation collinnaire et à intense processus de modelage sous-aérien. C'est ce qui nous suggère le temps plus long d'évolution en régime continental et la conservation du Badénien uniquement sous forme de lambeaux rares et peu épais (moins de 5 m).

Pour les autres unités de plate-forme (Valaque, Bîrlad, Covurlui) on envisage une situation géomorphologique intermédiaire, que l'on dé-

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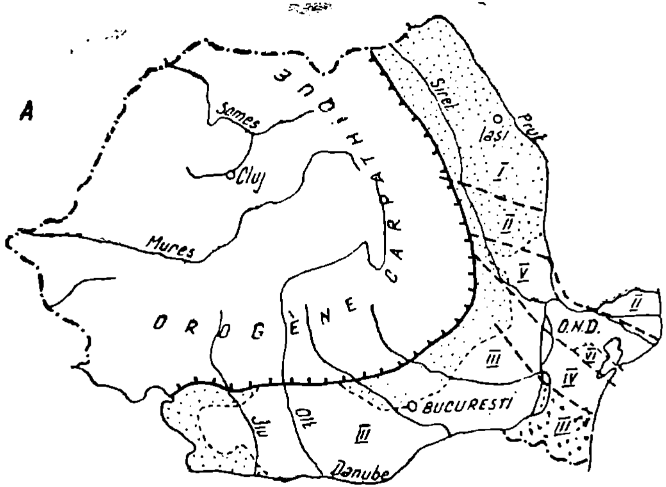
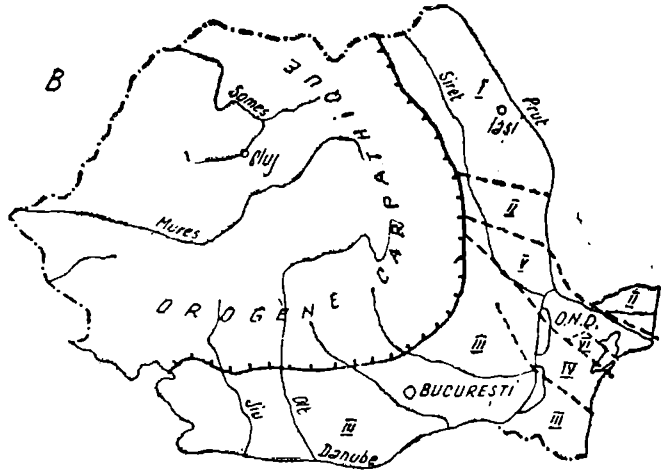
[1] Intervention dans le cadre du symposium sur le Miocène, Cluj, 1990.





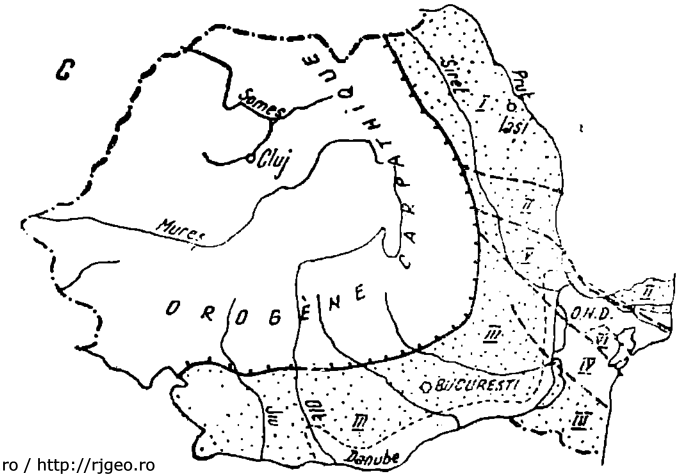


Fig. 2. – Extension de la terre ferme (régions en blanc) et des bassins de sédimentation (régions en pointillés) dans l'intervalle Badénien supérieur – Sarmatien sur les unités de plate-forme: **A**, dans le Badénien supérieur; **B**, entre Badénien et Sarmatien; **C**, en Sarmatien.
Plate-formes pré-alpines: Moldave (I), Bîrlad et le Delta du Danube (II), Valaque et la Dobrogea du Sud (III), Dobrogea Centrale (IV).
Orogène de la Dobrogea du Nord (O.N.D.).
plate-formes alpines: Covurlui (V), Babadag (VI).

duit du temps d'évolution sous-aérienne et de l'état d'extension et de conservation du Badénien (Fig. 2).

Dans le cadre du relief présarmatien (aux limites mentionnées : jusqu'à 400 — 600 m), l'altitude maximale se trouvait, probablement, dans le Kratogène de la Dobrogea du Nord, prolongé vers le Sud, dans la Dobrogea Centrale et même à l'Est (le territoire du Delta). Au fait, cette aire a fonctionné comme terre ferme durant le Badénien également.

D'après le contenu bionomique (y compris la présence des herbivores) du Sarmatien inférieur, on conclut qu'il y dominait un climat tempéré-chaud, à forêts, pâturages, marécages. Mais, il faut également prendre en considération le fait que, entre le Badénien et le Sarmatien il y a eu une crise climatique — la baisse de la température moyenne, attestée par le remplacement de la flore tropicale et la diminution des éléments subtropicaux en faveur des éléments tempérés. Dans les associations floristiques du Miocène supérieur, les pinacées détiennent le rôle principal. D'après Pokrovskaja (1956), la végétation subtropicale du Miocène inférieur autour de la mer Noire est remplacée, dans le Miocène supérieur, par des espèces ligneuses et herbeuses de climat tempéré.

Les causes des événements produits à la limite Kossovien-Sarmatien aussi bien en ce qui concerne l'expulsion des eaux et l'apparition d'une terre ferme soumise aux agents exogènes que la modification climatique, doivent être corrélées avec les mouvements géodynamiques moldaves, concrétisés dans le parachèvement de la structure en nappes de charriage et dans la fixation du bord de l'avant-pays sous l'Orogène Carpatique, du segment oriental, tout comme du segment méridional. Le moteur générateur des mouvements est représenté, probablement, par une vitalisation des phénomènes de subduction entre les plaques limitrophes. Ce phénomène a produit, vers la fin, une élévation, tant sur l'avant-pays que sur l'orogène, mais de petite ampleur.

La modification climatique (la baisse de la température) pourrait avoir pour cause la légère élévation et les grandes éruptions volcaniques du Badénien et du Sarmatien, la cendre expulsée dans l'air pouvant écraner la pénétration de la chaleur solaire. Evidemment, ceci reste une supposition.

Pour le relief réalisé, entre le Kossovien et le Sarmatien, sur les unités d'avant-pays, attaché à celui de l'Orogène de la Dobrogea du Nord, nous suggérons la dénomination de surface moldo-valaque.

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LES TRANSFORMATIONS MORPHO-HYDROGRAPHIQUES ET L'ÉQUILIBRE ÉCOLOGIQUE DANS LE DELTA DU DANUBE *

PETRE GÂŞTESCU

The morphohydrographical changes and the ecological equilibrium in the Danube Delta. In the conditions of the evolution of a deltaic space, the morphohydrographical changes are frequent under the influence of the liquid and solid discharge, with obvious results during the high-waters periods.
In the case of the Danube Delta, the morphohydrographical changes were produced by natural way up to the end of the 19th century, when the works for the Sulina arm rectification began in view of its use for sailing. We can appreciate that the major morphohydrographical changes in the Danube Delta are due to human actions: the construction of canals for the improvement of fish production (the period Grigore Antipa 1900–1935), the reed managements (1960–1970) and agricultural and fishing managements (1970–1990).
As a result of different managements about 30% from the Danube Delta surface were taken off from the natural conditions and numerous changes were produced in the hydrographical network. The surface covered by lakes was also reduced by means of imposed drainage.
The construction of some managements and closing of some canals with a well-defined function in the circulation of water produced perturbations in the ecological equilibrium of the areas which have remained under natural hydrological conditions too. Taking into account the new status of the Danube Delta and of the Razim-Sinoie lake complex as a Biosphere Reserve, the water-circulation system acquired a special importance. This is the reason why, in the paper, several proposals are made.

Dans les conditions d'un espace deltaïque, les transformations morpho-hydrographiques sont fréquentes et significatives compte tenu de la fragilité des constructions morphologiques et des artères hydrographiques par rapport au grand volume d'eau véhiculé par la rivière principale vers le bassin marin où elle se jette.

Les transformations morpho-hydrographiques dans le cas du Delta du Danube sont dues, d'une part, à l'evolution naturelle normale et, d'autre part, à l'intervention de l'homme.

Si jusqu'au milieu du XIX^{e} siècle on peut parler seulement d'une évolution et, par conséquent, des transformations morpho-hydrographiques naturelles, dès la constitution de la Commission européenne danubienne (1856), le Delta subit des modifications anthropiques de plus en plus grandes, qui ont culminé avec les actions généralisées en vue de créer différentes catégories d'aménagements (agricoles, du roseau, sylvicoles et piscicoles). On peut dire que les trois dernières décennies, les modifications anthropiques dans le Delta du Danube ont dépassé celles naturelles.

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Il est utile de rappeler quelques aspects concernant les dimensions de la genèse et de l'évolution de cette unité géographique.

Le Delta du Danube a une superficie de 4 152 km ^{2}, dont la majeure partie — 3 446 km ^{2}, soit 82% — se trouve sur le territoire de la Roumanie. Dans cette superficie est inclus le delta proprement dit, délimité au nord par le bras Chilia et au sud par le bras Tulcea, ensuite par Sfîntu Gheorghe (2 544 km ^{2} soit 61%), et les portions marginales (732 km^2 sur la rive gauche du bras Chilia, y compris de delta secondaire de ce dernier qui appartient à l'Ukraine, et 876 km^2 sur la rive droit des bras Tulcea et Sfîntu Gheorghe, y compris l'unité Dranov). Par sa genèse et ses particularités géographiques, le complexe lacustre Razim—Sinoie, situé au sud, dans l'ancien golfe marin Halmyris, diffère du delta ; c'est pourquoi nous ne l'incluons pas dans la superficie du Delta du Danube. C'est d'ailleurs ce qui explique la grande différence qu'on remarque entre les chiffres que nous venons de mentionner et les chiffres avancés dans d'autres travaux (5 800 km^2 ou 5 640 km^2).

Selon l'opinion de nombreux hommes de science roumains et étrangers (Gr. Antipa, 1914 ; C. Brătescu, 1922 ; G. Vâlsan, 1934 ; H. Slanar, 1945 ; M. Pfannenstiel, 1950 ; V. P. Zenkovich, 1956 ; I. Gh. Petrescu, 1957 ; N. Panin, 1983, 1989 ; N. Mihăilescu, 1989 etc.) qui l'ont étudié, le Delta du Danube s'est formé dans un golfe à partir du Pléistocène supérieur (phase Allerød), lorsque le niveau marin oscillait entre —60 m et —50 m par rapport au niveau actuel. A cette étape s'est esquissé un cordon littoral dénommé « cordon initial » qui a commencé — suivant des déterminations effectuées au C ^{14} — dans la partie centrale environ 10 800 ans av. J.-C., continuant jusqu'à 7 500 avant J.-C. (N. Panin et al., 1983 ; N. Mihăilescu 1989). La formation de ce cordon initial correspondant à l'axe central de l'alignement de levées Jibrieni, Letea et Caraorman, qui a fermé le golfe en le transformant dans un liman, peut être considérée comme le moment qui marque le commencement de la formation du Delta du Danube, c'est-à-dire 11 000 années av. J.-C.

L'évolution du Delta du Danube est étroitement liée à celle de ses trois bras — Sfîntu Gheorghe, Sulina et Chilia — qui ont formé successivement une série de deltas secondaires, dont quelques-uns ont éte reconstitués dans l'actuelle morphologie par l'analyse détaillée des images prises par des satellites, des aérophotogrammes.

Les trois bras ont des âges différents, le plus ancien étant Sfîntu Gheorghe (au sud) et le plus jeune Chilia (au nord). Cette hiérarchisation peut être observée aussi dans les descriptions des érudits anciens portant sur les bouches du Danube (Hérodote, Polybe, Strabon, Pline l'Ancien, Claude Ptolémée, Eratosthène, etc.) (I. Gh. Petrescu, 1957). En même temps, l'évolution des bras du Danube du sud au nord se fait remarquer, à l'heure actuelle, par la répartition du débit d'eau : le bras le plus jeune, c'est-à-dire Chilia, est le plus actif, prélevant 58% du débit du Danube avant la première bifurcation (P. Gâştescu, B. Driga, 1983).

Les informations fournies par les anciens, tout comme les hypothèses formulées par les scientifiques mentionnés mettent en évidence, sur le fond général de consolidation et d'augmentation lente en surface, des étapes de moins de 200 — 300 ans, durant lesquelles le delta est en retrait, à la suite de la hausse du niveau marin, donc, à la suite des phases de transgression de la mer Noire, phénomène manifesté depuis au moins 100 ans et continuant jusque de nos jours. C'est pour la même raison que le Delta du Danube n'enregistre d'accroissements que devant ses bouches (le delta secondaire du bras Chilia, le plus important, et celui du bras Sfîntu Gheorghe), tandis qu'entre ces dernières le retrait de la côte est visible d'un année à l'autre. Des études ont été effectuées dans ce sens, visant l'estimation des rythmes annuels de retrait (P. Gâştescu, B. Driga, 1977, 1980, 1984, 1986).

Les études entreprises par l'Institut de Géographie durant la période 1976 — 1990 en vue d'une connaissance détaillée des caractéristiques morpho-hydrographiques ont permis de dresser une carte actuelle à l'échelle 1 : 75 000, imprimée en 1983.

Le traitement des informations ainsi que l'analyse de la carte ont abouti à une série d'estimations quantitatives sur l'hypsométrie et la morpho-hydrographie du Delta du Danube. Ainsi, par rapport au niveau « 0 » de la mer Noire, 20,5% du territoire du delta se situe au-dessous et 79,5% au-dessus de cette côte, dont 54,6% revient aux terrains situés entre 0 et 1 m. Si l'on y ajoute les terrains situés entre —1 et 0 m, soit 17% et 1 et 2 m soit 18%, il résulte que 89,6% de la superficie du delta se déploie sur un écart de 3 m, fait qui présente une importance considérable pour l'adoption des mesures d'organisation de l'espace géographique, étant donné la spécificité des processus liés au régime hydrique du Danube et au niveau des eaux marines.

Cette carte a permis en même temps de délimiter les catégories morpho-hydrographiques suivantes : les levées marines (27 000 ha, 8%) représentées par Letea, Caraorman, Sărăturile et celles du sud du bras Sfîntu Gheorghe (Crasnicol, Flămînda, Perişor) qui ont une positon perpendiculaire aux bras et sont constituées de sables organiques et inorganiques, modelés initialement par les vagues et à présent par le vent ; les levées fluviales (20 000 ha, 6%) qui accompagnent les bras du Danube et les principaux ruisseaux, plus étendues au pic du delta où elles revêtent des aspects de plaines alluviales atteignant des hauteurs de 2 — 5 m, et s'amincissant vers la mer, où leur hauteur baisse (0,5 — 1 m) ; les plaines continentales (territoire prédeltaïque) (8 850 ha, 2,6%), témoins d'érosion de la Plaine du Bugeac, formées de dépôts lœssoïdes, représentées par le champ de Chilia et la partie centrale de la levée Stipoc ; les terrains marécageux, couverts d'eau en fonction du niveau du Danube, qui sont situés entre — 0,5 m et +1 m, occupant la majeure partie de la superficie du delta (67,2%) ; les lacs, qui sont situés dans les dépressions au-dessus de 0 m, au pic du delta, et au-dessous de —0,5 m, vers le nord de la mer, s'associant en des complexes lacustres (environ 668 lacs totalisant 31 262 ha, soit 9,3% en 1964 et 480 lacs totalisant 25 000 ha, soit 8% en 1990, à cause des dessèchements pour les aménagements agricoles et sylvicoles) ; les bras, les ruisseaux et les canaux principaux qui englobent environ 9 950 ha (2,8%), les bras principaux occupant, à eux seuls, 7 800 ha.

Le tableau morpho-hydrographique et respectivement celui du paysage a évolué, au fur et à mesure de la formation de l'alignement des levées marines vers, des cordons littoraux et des levées fluviales sous l'action des processus de transport et d'accumulation. Les modifications morphologiques sous l'action des facteurs naturels se sont remarquées par : le modelage aérien du matériel sablonneux sur les levées de Letea et de Caraorman, surtout là où un relief typiquement de dunes s'est constitué, à présent dans des phases différentes d'évolution (fixées, semi-fixées et mobiles) ; l'accumulation du matériel fluvial à l'embouchure du Danube avec la formation des deltas secondaires (typiquement le delta secondaire de Chilia, qui à un rythme d'avancement variable, entre 40 — 80 m/an) ; l'abrasion marine de la rive entre les bouches du Danube à un rythme moyen de 3,7 m/an ou 47 hectares/an (le secteur le plus vulnérable étant devant le lac Roşu, avec 17,5 m/an) ; la formation d'alluvions des levées fluviales pendant les inondations. L'impact de l'action anthropique dans la sphère de ces catégories morphologiques sur les processus naturels est plus réduit. On peut souligner le fait que par la construction des digues et par le protection des terrains contre les inondations le processus d'alluvionnement a été annulé.

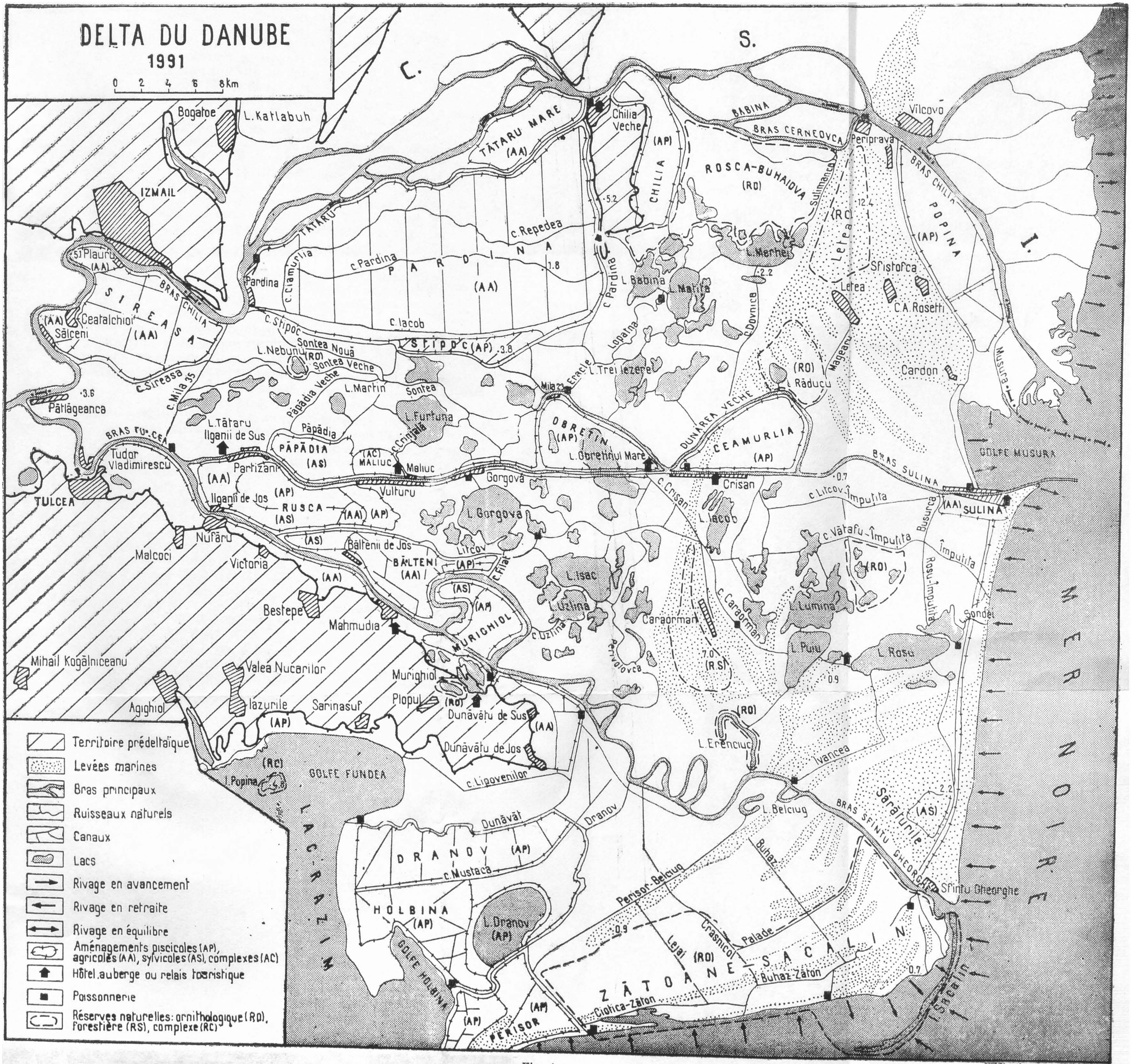
L'effet indirect sur l'évolution du rivage est la réduction du volume annuel d'alluvions apportées par le Danube (de 67 millions de tonnes à 45 — 48 millions de tonnes) à la suite de la retention de celles-ci dans les réservoirs du bassin hydrographique (affluents et cours principal). La diminution du volume d'alluvions entraîné par le Danube et la hausse sensible (2 — 4 mm/an) du niveau marin, considéré comme une petite transgression, détermine le processus d'abrasion marine et la retraite du rivage.

L'engrenage hydrographique du Delta du Danube représenté par les bras principaux, les ruisseaux et les lacs a subi le plus grand impact anthropique et évidemment avec des conséquences sur tout l'ensemble d'écosystèmes deltaïques.

Les bras principaux et les ruisseaux ont évolué avec le temps en fonction des facteurs néotectoniques, des oscillations du niveau de la mer Noire et du processus d'alluvionnement. Les témoignages des érudits antiques mentionnés plus haut révèlent qu'au III^{e}, II^{e}, I^{er} siècles av. J.-C. et au I^{er} siècle A. D. le Danube présentait à l'intérieur du delta 5,6 et 7 bras et autant d'embouchures dans la mer. Certainement, dans la conception de ces érudits ou de ceux qui leur ont fourni les informations, certains ruisseaux plus grands pouvaient être pris pour des bras.

De la carte existante au milieu du XIX^{e} siècle malgré la relativité de la précision cartographique, on peut voir la configuration hydrographique du delta.

Le processus naturel de réglage du sous-système hydrographique a commencé à être visiblement affecté par l'homme avec les travaux de correction du bras Sulina pour la navigation maritime (1862 — 1902). Ultérieurement, la modification du réseau hydrographique s'est amplifiée progressivement en fonction des différentes exigences économiques : pour l'amélioration de la production piscicole en régime naturel (l'étape Grigore Antipa jusqu'en 1935, avec des conséquences favorables dans l'écologie du delta), pour l'exploitation du roseau (les années '60), pour les aménagements piscicoles (les années '70 et '80), pour les amenagements agricoles et sylvicoles (les années '70 et '80). Beaucoup d'autres canaux, certains à dimensions plus grandes, ont été construits les deux dernières



DELTA DU DANUBE
1991
0 2 4 6 8 km
C. S. I.
MER NOIRE
Bogatoe
L. Katlabuh
IZMAIL
Plauru (AA)
SIREASA
BRAS CHILIA
Ceatalchioi
Sălceni
(AA)
c. Sireasa
Pătlăgeanca
BRAS TULCEA
TULCEA
Tudor Vladimirescu
Pardina
TĂTARU
TĂTARU MARE (AA)
c. Ciamurlia
c. Pardina
c. Repedea
PARDINA (AA)
c. Iacob
c. Stipoc
STIPOC (AP)
Sontea Nouă
Sontea Veche
L. Nebunu (RO)
c. Mila 35
Chilia Veche
CHILIA (AP)
ROSCA-BUHAIDOVA (RO)
BABINA
BRAS CERNEOVCA
Periprava
Vîlcovo
BRAS CHILIA
POPINA (AP)
Sulimanca
Letea
(RC)
L. Merhei
L. Babina
L. Matița
c. Pardina
Lopatna
c. Dovnica
Sfiștofca
Letea
C.A. Rosetti
Cardon
Musura
L. Trei Iezere
Eracle
Mila 23
(RO) L. Răducu
Magearu
DUNĂREA VECHE
CEAMURLIA (AP)
OBRETIN (AP)
L. Obretinul Mare
GOLFE MUSURA
BRAS SULINA
Sulina (AA)
Păpădia Veche
L. Martin
Sontea
L. Furtuna
L. Tătaru
Ilganii de Sus
Păpădia
PĂPĂDIA (AS)
(AC) MALIUC
Maliuc
c. Crînjala
Partizani
(AA)
Gorgova
Crișan
c. Crișan
c. Litcov-Împuțita
Ilganii de Jos
RUSCA (AS)
(AA) (AP)
Vulturu
L. Gorgova
L. Iacob
c. Vătafu-Împuțita
Busurca
Împuțita
Rosu-Împuțita
(RO)
Nufăru
Malcoci
Victoria
(AS)
Băltenii de Jos
BĂLTENI (AA)
Litcov
(AP)
c. Hliat
L. Isac
L. Uzlina
c. Uzlina
Perivolovca
Caraorman
c. Caraorman
L. Lumina
L. Puiu
L. Roșu
Sondei
(RS)
Bestepe
Mahmudia
MURIGHIOL
Murighiol
(AP)
(AS)
(AA)
Mihail Kogălniceanu
Valea Nucarilor
Iazurile
Sarinasuf
Plopul
(RO)
Dunăvățu de Sus
Dunăvățu de Jos
Agighiol
(AP)
(AA)
(RO) L. Erenciuc
Ivancea
L. Belciug
Sărăturile
(AS)
BRAS SFÎNTU GHEORGHE
Sfîntu Gheorghe
(RC)
L. Popina
GOLFE FUNDEA
c. Lipovenilor
LAC RAZIM
Dunăvăț
Dranov
DRANOV (AP)
c. Mustaca
HOLBINA (AP)
L. Dranov (AP)
GOLFE HOLBINA
(AP)
PERIȘOR
(AP)
Perisor-Belciug
Buhaz
Lejai
Crasnicol
(RO)
Palade
ZĂTOANE
SACALIN
Buhaz-Zăton
Ciotica-Zăton
I. Sacalin
Territoire prédeltaïque
Levées marines
Bras principaux
Ruisseaux naturels
Canaux
Lacs
Rivage en avancement
Rivage en retraite
Rivage en équilibre
Aménagements piscicoles (AP), agricoles (AA), sylvicoles (AS), complexes (AC)
Hôtel, auberge ou relais touristique
Poissonnerie
Réserves naturelles: ornithologique (RO), forestière (RS), complexe (RC)

Fig 1

décennies dans d'autres buts. Parmi ceux-ci, on mentionne le canal Crişan pour l'exploitation des sables (action à laquelle on a renoncé), le canal Sondei pour le transport de l'outillage de forage de grande profondeur, le canal Mila 35 pour la réduction de la voie de transport entre Tulcea et les localités situées sur le bras Chilia (Pardina et Chilia Veche). De même, la plus significative action de modification hydrographique des dernières années (1985 — 1990) est la rectification des méandres du bras Sfîntu Gheorghe, réduisant la voie navigable sur celui-ci de 108 a 70 km (Fig. 1).

Par la rectification du bras Sulina, une redistribution du débit liquide et solide s'est produite sur les principaux bras. Ainsi sur le bras Sulina, l'écoulement a haussé de 7 — 8% à 18,8% et sur le bras Chilia, il a baissé de 70% a 59%. Une autre redistribution est préconisée aussi par la rectification récente du bras Sfîntu Gheorghe.

Bien que, pratiquement le réseau hydrographique s'est enrichi de nombreux canaux, l'absence d'une union des intérêts ainsi que l'omission de la nécessité d'un système de circulation global pour assurer l'alimentation en eau des écosystèmes naturels, ont mené à l'intensification du processus d'eutrophisation jusqu'à une phase critique pour l'équilibre écologique.

Par comparaison aux ruisseaux, les lacs ont subi un processus de grande réduction par suite des aménagaments d'enceintes agricoles. Les exemples les plus évidents sont les dépressions Pardina où ont été asséchés 120 lacs, ayant une superficie de 3 660 hectares et Sireasa avec 40 lacs, à une superficie de 600 hectares.

Les travaux pour les aménagements (agricoles, sylvicoles, du roseau et piscicoles), grâce auxquels on a éliminé du circuit naturel de l'eau environ 100 000 hectares (30% de la superficie du delta) ont beaucoup déréglé les rapports hydriques entre les bras du Danube et les aires intérieures. Ainsi, le secteur fluvial du delta où le degré d'aménagement par des endiguements est plus grand, il ne bénéficie plus d'une circulation active des eaux à cause de la fermeture des deux canaux extrêmement importants — Sireasa et Litcov — qui ont été construits à la recommandation du savant roumain Grigore Antipa, ayant une direction d'alimentation et de drainage de ouest à est, dans le sens du cours de l'eau sur les principaux bras. L'un de ces canaux — Litcov — a éte rouvert en 1990.

Un autre aspect négatif de l'intervention de l'homme dans le sous-système hydrographique est aussi la construction des canaux de liaison entre les bras du Danube et certains complexes lacustres, des canaux courts de quelques kilomètres qui produisent des processus intenses de colmatage dans les périmètres lacustres proches (Furtuna, Gorgova, Uzlina).

De l'analyse de l'état actuel du Delta du Danube par rapport à son état naturel, avant l'intervention de l'homme, on peut certainement affirmer que le système hydrographique et la circulation de l'eau constituent le facteur déterminant qui peut assurer l'existence et la structuration spécifique des écosystèmes deltaïques.

L'implication anthropique les dernières décennies sans tenir compte des lois de l'évolution de ces écosystèmes a contribué à dérégler beaucoup d'aires deltaïques, même celles restées dans le soi-disant régime hydrologique naturel.

Il est évident que le retour du Delta du Danube à la situation des années '50 est impossible ; c'est pourquoi, pour améliorer les conditions de cette recemment déclarée Réserve de la biosphère, il s'impose d'élaborer une stratégie de redressement écologique. Parmi les facteurs du redressement écologique compte aussi le redressement de la circulation de l'eau, tant dans les aires en régime naturel que dans les aménagements existants.

Dans ce sens, il est utile de prendre en considération les suggestions suivantes :

— l'élaboration d'un modèle global de la circulation de l'eau à l'intérieur du delta ;

— la circulation de l'eau à l'intérieur du delta (excepté les principaux bras) doit être faite par des artères ayant le cours de l'ouest vers l'est selon le modèle des canaux Sireasa et Litcov, ce qui réclame de rouvrir et de donner une dimension correspondente à ceux-ci ;

— éviter les liaisons (canaux) courtes, transversales, entre les principaux bras et certains complexes lacustres (exemples : le canal Crînjală et le lac Furtuna, le canal Filat et le lac Gorgovăţ, le canal Gorgova et le lac du même nom, le canal Uzlina et le lac Uzlina) pour réduire les processus d'alluvionnement ;

— la réalisation de certains déchargements des eaux de l'intérieur du delta vers la mer Noire par de petits canaux, non pas de la dimension du Canal Sondei ;

— la réactivation de certains canaux pour assurer le rythme de renouvellement du volume de l'eau des lacs ayant un degré élevé d'eutrophisation (c'est l'exemple des canaux Sulimanca, Dovnica et les lacs Merheiul Mare et Merheiul Mic) ;

— la fermeture des canaux Mila 35, Crişan qui ont des conséquences défavorables dans l'équilibre ecologique des vastes aires deltaïques (processus de colmatage, etc) ;

— la réalisation d'artères hydrographiques actives à l'intérieur de certains aménagements agricoles (Pardina, Sireasa) et leur connexion au réseau hydrographique du delta ;

— pour établir le rôle du rythme de renouvellement de l'eau dans les complexes lacustres par rapport au processus de l'eutrophisation il est nécessaire de faire des expérimentations écologiques sur de lots représentatifs ;

— la régénération des forêts de type galerie formées d'espèces indigènes pour l'accroissement de l'efficience des zones écotonales.

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PARTICULARITÉS FAUNIQUES-ZOOGÉOGRAPHIQUES DU DELTA DU DANUBE

CONSTANTIN DRUGESCU

Fauna-zoogeographical peculiarities of the Danube Delta. The Danube Delta biome is famous as one of the European regions where wild life is very rich and diverse (birds and fishes in particular). From a zoogeographical point of view, it has the following peculiarities: (a) it is the link between the arctic and the tropical zones; (b) it establishes the transition from the Mediterranean and the Balkan-Mediterranean fauna to the Ponto-Turanian and central-Asian ones; (c) it improves both quantitatively and qualitatively the faunas in the neighbouring regions; (d) it represents a zoogenetic framework.

Key-words: zoogeography, the Danube Delta.

Vivant dans une région d'*interpénétration* des grandes superprovinces biogéographiques ponto-caspienne et sous-mediterranéenne balkanique, *à la croisée des grandes voies de migration* des oiseaux et en présence d'une *mosaïque de biotopes* (surtout aquatiques et amphibies), la faune du Delta du Danube a comme principale caractéristique la *concentration tant sous le rapport taxonomique que sous l'aspect de la population* d'un grand nombre d'animaux.

Une image suggestive en est donnée par le fait que, bien que la surface du Delta du Danube ne représente que 1,4% du territoire de la Roumanie, dans cette région vivent 221 espèces, voire 45,5% du total de la faune de vertébrés (amphibiens, reptiles, oiseaux couveux, mammifères) de Roumanie. Cette grande agglomération faunique, connue au niveau européen justement par ses indices supérieurs de diversité et d'abondance présente pourtant quelques particularités lui conférant une unicité absolue dans le paysage zoogéographique paléarctique. Ainsi, bien que la richesse faunique de cette région se manifeste tant sur la terre que dans le milieu aquatique, il faut souligner qu'en général, les espèces aquatiques et amphibies sont dominantes, dont les plus importantes et les mieux représentés sont les poissons et les oiseaux qui font du Delta du Danube l'une des régions les plus renommées de l'Europe.

Parmi les espèces de poissons il s'impose de remarquer spécialement la brème *(Abramis brama)* et le carassin *(Carassius auratus gibellio)*, ce dernier ayant une croissance toute particulière due à la réduction des effectifs de carpe *(Cyprinus carpio)* et de l'eutrophisation des eaux. Bien qu'avec des populations plus réduites, dans le spectre ichtyofaunique du Delta du Danube, on remarque particulièrement des éléments ponto-caspiens tels les huirons : *Huso huso* (huiron), *Acipenser güldenstaedti* (esturgeon) et une autre variété d'esturgeon *(A. stellatus)* qui vivent dans la mer Noire mais qui viennent déposer leurs œufs dans le Danube, le sterlet *(Acipenser ruthenus)*, vivant seulement dans le Danube et le hareng *(Alosa pontica)* (le hareng du Danube qui entre dans

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le Danube au printemps (mars—mai) pour la ponte ainsi que les cyprinidés *Leuciscus borysthenicus* (le gardon ordinaire) sur l'aire circum ponto-égéenne *(Gobio kessleri antipai)* endémique dans le Danube inferieur), à partir de la ville d'Oltenița jusqu'à la mer Noire) et le gobi *(Benthophiloides brauneri)*, vivant en Roumanie seulement dans les bras du Delta du Danube.

En ce qui concerne l'avifaune, parmi les nombreuses variétés sédentaires et migratrices caractéristiques du Delta du Danube, à cause de leur densité élevée pendant l'été, nous mentionnons le cormoran pygmée *(Phalacrocorax pygmaeus)*, le grand cormoran *(Ph. carbo)*, le héron bihoreau *(Nycticorax nyctocorax)*, le pélican commun *(Pelecanus onocrolatus)*, le pélican frisé *(P. crispus)*, le héron cendré *(Ardea cinerea)*, le héron pourpre *(A. purpurea)*, le héron garde-bœufs *(Ardeola ralloides)*, la spatule blanche *(Platalea leucorodia)*, la grande aigrette *(Egretta alba)* l'aigrette garzette *(E. garzetta)*et l'ibis falcinelle *(Plegadis falcinellus)*, tous des oiseaux migrateurs couveux.

Dans la région du littoral, les espèces dominantes pendant l'été sont les hirondelles de mer *(Sterna sandvicensis* — la sterne caugek, *S. hirundo* — sterne Pierre-Garin, *S. albifrons* — sterne naine), les guépiers *(Chlidonias nigra* — guifertte épouvantail, *Ch. leucoptera* — guifertte à ailes blanches) et les mouettes *(L. melanocephalus* — mouette mélanocéphale, *L. minutus* — mouette pygmée) eux aussi des oiseaux couveux migrateurs. Parmi les sédentaires, il faut mentionner la mouette rieuse *(Larus ridibundus)*, l'espèce de mouette la plus fréquente vivant en Roumanie et le goéland brun *(Larus argentatus)*. La densité élevée de ces oiseaux tout au long du littoral roumain s'explique aussi par la grande quantité de matière végétale entraînée et émiettée par le Danube (dénommée par les habitants de la région « camca »), à laquelle s'ajoutent des crustacés, des vers polychètes et d'autres espèces du zoobenthos. Dans cette matière végétale (la « camca »), jusqu'à l'entrée en putréfaction, la huitre *(Aloidis maeotica)* représente la nourriture préferée de *Larus ridibundus* et de *L. argentatus*.

L'aspect varié zootaxonomique du Delta du Danube s'individualise également dans l'espace géographique roumain et européen par un nombreux contingent d'endémites propres, en conférant à cette région des propriétés de « centre zoogénétique ». Cette particularité zoogéographique est caractéristique des deux levées (Letea et Caraorman) dont l'isolement de longue durée et les conditions naturelles ont favorisé l'apparition de nouveaux taxa spécifiques, à savoir *Chamaesphecia deltaica*, *Euchromius bleszinskiellus* (lépidoptères), *Astochia caspia sienkiewiczi* (diptères), etc.

A cause de certaines conjonctures géohistoriques et écologiques particulières, dans le cadre du centre zoogénétique du Delta du Danube on peut distinguer deux sous-centres spéciogènes représentés par des espèces strictement locales.

Ainsi, le noyau spéciogène de la levée de Letea est formé par *Scambus dobrogensis*, *Hoplocryptus dobrogensis*, *Choroschizus mucronatus*, *Hygrocryptus rufithorax*, *Hemiteles albotrochanteratus*, *Asphargis acqualis* (hyménoptères,), *Rhagio medeea* (diptères), *Oegocomia caradjai*, *O. bacescui* (lépidoptères), etc. et celui de la levée de Caraorman par *Chilo cristophi antipai*, *Coleophora draghiella*, *C. quercivorella* (lépidoptères), *Parablatus bituberculatus*, *Mesolensis melanurus*, *Schyzopyga coxator*, *Crematus inflatipes*, *Hygrocryptus biannulator* (hyménoptères), *Carabus concellatus sulinensis* ((coléoptères), etc.

Outre la grande diversité taxonomique zoogéographique et la richesse de la population de certains groupes, la faune du Delta se caractérise par un *dynamisme accentué* tant au cours d'une année que le long des siècles.

Il y a deux causes principales qui influent sur la modification continue de la structure des communautés d'animaux de cette région, à savoir l'évolution naturelle des composantes deltaïques et la pression humaine indirecte et directe.

Les plus puissants changements qualitatifs eu quantitatifs dans la formation saisonnière des associations aviennes sont dus aux migrations.

Du total de 278 espèces enregistrées au Delta du Danube, 44 seulement sont sédentaires, les autres étant migratrices : 132 hôtes d'été (les couveux), 35 hôtes d'hiver (qui ne couvent pas), 50 de passage, 17 erratiques et accidentelles.

Cet aspect étant bien connu, nous n'allons pas y insister. Il nous reste à souligner que l'intensité de ce phénomène est différente dans les grands milieux du Delta. Ainsi, dans l'habitat aquatique le nombre d'espèces migratrices est au-dessus de 95%, dans celui amphibie de 87%, tandis que dans celui terrestre seulement de 58%.

De même, chez les poissons il y a un véritable va-et-vient entre la zone du littoral et celle danubienne.

Un exemple intéressant de transformation continue des complexes fauniques locaux est celui de l'enrichissement ou de l'appauvrissement des populations des sous-espèces de la bergonnette jaune : *Motacilla flava flava* (bergonnette printanière), la forme du nord et *M. flava fellegg* (bergonnette à la tête noire), la forme du sud. Pendant la crue des eaux, prédominent les exemplaires proches à la forme du nord, vu qu'ils préfèrent les biotopes à grande humidité. Lorsque les eaux sont basses la forme du sud est plus abondante.

Dans le même contexte, il faut noter qu'en hiver le cygne muet d'été *(Cygnus olor)* quitte le Delta du Danube pour les régions du Sud, étant remplacé par le cygne d'hiver sauvage *(C. cygnus)*, venu du nord de la Sibérie et qui passe l'hiver surtout dans les lacs du bord de la mer et dans le complexe lagunaire de Razim. Ce phénomène, connu sous le nom de *vicariante écophénologique* a été observé aussi chez le canard nyroca *(Aythya nyroca)* qui passe l'été au Delta du Danube, étant remplacé en hiver, quand il quitte la région pour le Sud, par le canard milouinan *(A. marilla)*.

Toujours par des modifications naturelles des facteurs du milieu s'explique la pénétration dans la région de nouvelles espèces, à savoir : *Acrocephalus agricola* (1952), *Hippolais pallida* (1958), *Emberiza melanocephalus* (1967), *Streptopelia decaocto* (1967), *Dendrocopos syriacus* (1968), *Serinus serinus* (1971), *Passer hispaniolensis* (1973), *Nyctereutes procyonoides* (1951), *Ondatra zibethica* (1954). A remarquer, l'apparition pendant les hivers froids des bandes de loups arrivés du sud de l'Ukraine.

Un moment important dans l'évolution faunique du Delta du Danube est marqué par l'établissement de certaines collectivités humaines (vers l'an 1800). Par la construction des logements, l'inventaire zootaxonomique de la région s'enrichit d'une série d'espèces anthropophiles : l'hirondelle de fenêtre, l'hirondelle, le moineau domestique, le picvert, la tourterelle à collier, le rat noir, la souris domestique, le serpent domestique, le cafard, etc.

Quelques autres espèces ayant existé avant l'arrivée de l'homme se sont concentrées ultérieurement dans des périmètres anthropisés, où maintenant ils prospèrent : le cigogne blanc, la chouette, le martinet noir, etc.

L'élevage et l'agriculture ont attiré une cohorte spécialisée d'insectes nuisibles. Très nuisibles s'avèrent les taons *(Hybomitra ciureai, H. acuminata, Tabanus bovinus, T. autumnalis)* chez les animaux et la punaise des céréales *(Eurygaster integriceps, Tanymecus dylaticollis)*, la guêpe de la paille d'avoine *(Cephus pygmaeus)*, les vers filiformes *(Agriotes* sp.*)*, etc. chez les plantes.

Parmi les vertébrés, le corbeau freux *(Corvus frugilegus)*, le moineau friquet *(Passer montanus)*, la souris — forme sauvage de la souris domestique *(Mus musculus spicilegus)*, provoquent de sérieux dommages aux cultures de blé, d'orge et de maïs.

La coupe des saules *(Salix alba, S. fragilis)* et leur remplacement par des plantations de peupliers noirs euro-américains ont entraîné l'aggravation des conditions de nidification et de guêt de la proie par certaines espèces comme le pygargue à queue blanche *(Haliaetus albicilla)* et le faucon sacré du Danube *(Falco cherrug)* dont le nombre est en baisse de quelques centaines à quelques paires d'exemplaires seulement. De même, la destruction des saulaies (formées d'exemplaires touffus, partiellement et continuellement inondés de *Salix cinerea)* a entraîné l'élimination des colonies mixtes de hérons crabiers *(Ardeola ralloides)*, hérons bihoreaux *(Nycticorax nycticorax)*, aigrettes garzettes *(Egretta garzetta)*, cormorans pygmées *(Phalacrocorax pygmaeus)* et ibis falcinelle *(Plegalis falcinellus)*. Il est à remarquer que la liaison cénotique entre ces oiseaux et la *Salix cinerea* est bien consolidée dans les écosystèmes deltaïques et qu'elle a comme support les lieux de nidification abrités par la couronne de cette espèce de saule.

Lorsque les vieux arbres creux, où ils pouvait nidifier, ont disparu, le nombre des canards col-vert s'est, lui aussi, réduit. Il s'impose de souligner également la diminution quantitative de la seule espèce typique des saulaies — le rémiz penduline *(Remiz pendulinus)*.

La disparition des saulaies, dont les creux constituent aussi une niche favorable pour l'achèvement du cycle biologique de certaines espèces, a déterminé en même temps la diminution du nombre des oiseaux insectivores : la mésange bleue *(Parus coeruleus)*, le rossignol *(Luscinia luscinia)*, les pics *(Dendrocopos major, Picus canus)*, l'oriol *(Oriolus oriolus)*, la fauvette épervière *(Sylvia nisoria)*, la fauvette des jardins *(Sylvia borin)*, le verdier d'Europe *(Carduelis chloris)*. A présent, ces oiseaux se rencontrent dans le paysage local seulement sous forme d'exemplaires migrateurs.

Le Delta du Danube a traversé une nouvelle étape de remaniement faunique à partir de 1976 — 1980. Cette étape a débuté par les travaux

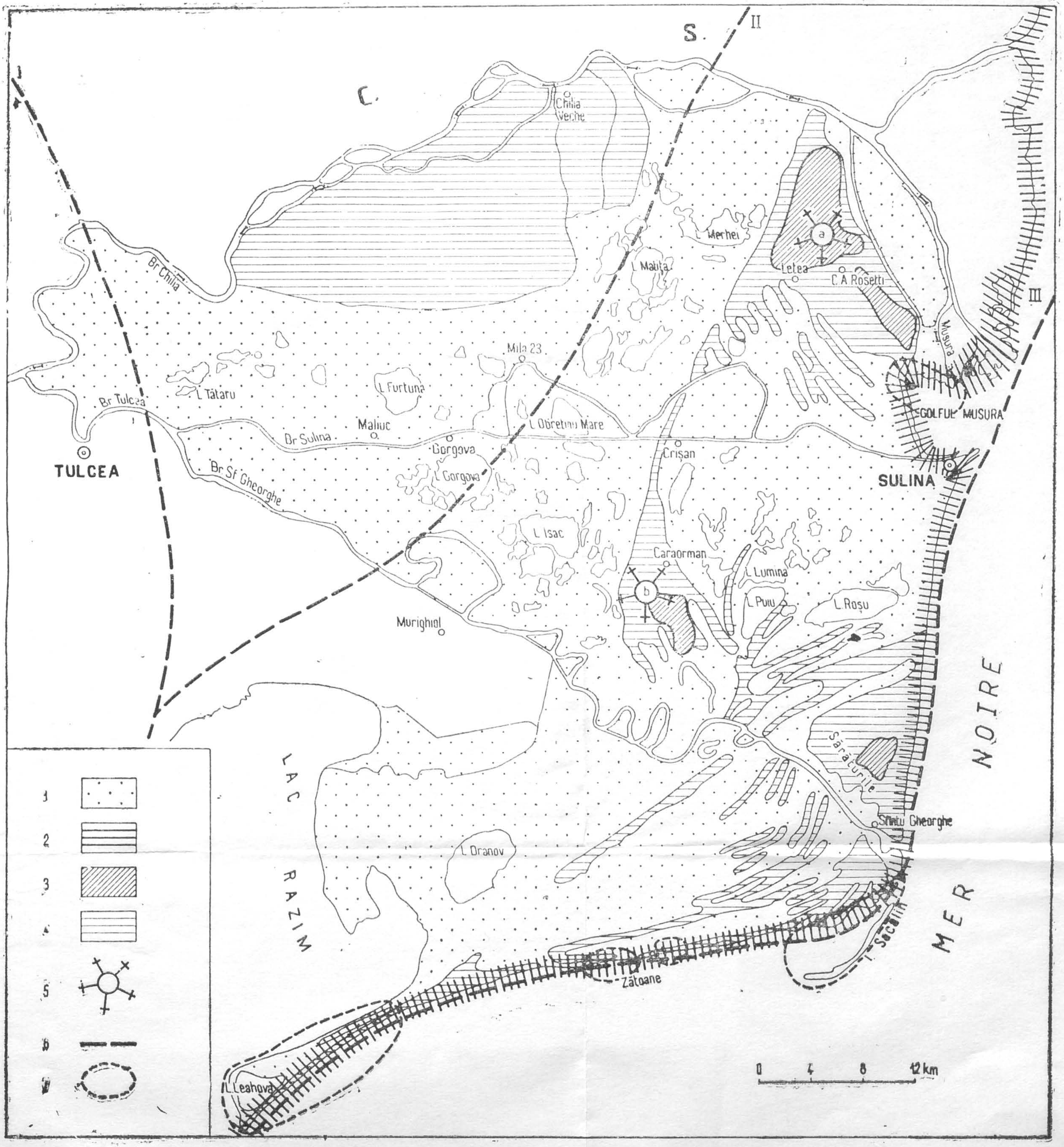

Fig. 1. Esquisse zoogéographique du Delta du Danube. Complexes fauniques: 1, cormoran pygmée, cormoran huppé, héron bihoreau, héron cendré, héron pourpre, héron garde-bœufs spatule blanche, grande aigrette, aigrette garzette, ibis falcinelle, pélican blanc, pélican frisé; 2, guiferttes sternes, mouettes; 3, pic épeiche, pic vert, rossignol, merle, pigeon colombin, rollier d'Europe, mulot sylvestre, renard, coronelle lisse, crapaud vert, rainette; 4, alouette des champs, cochevis huppé, bruant proyer, pipit rousseline, perdix grise, caille des blés, lièvre ordinaire; 5, sous-centres endémogènes (a. Letea; b. Caraorman); 6, routes des migrations (I. est-elbique; II. pontique; III. sarmate); 7, quartiers d'hivernage (le golfe de Musura; la « melea » et l'île de Sacalin; Zătoane; Leahova).

de dessèchement de larges surfaces couvertes d'eaux et leur introduction dans le circuit agricole et a eu pour conséquence la diminution des effectifs dits « de marais », ainsi que l'expansion et la croissance du nombre des nuisibles. L'absence des surfaces aquatiques et de la rosaie a provoqué aussi la réduction des effectifs de grèbe huppé *(Podiceps cristatus)*, grèbe au cou noir *(Podiceps nigricollis)*, grèbe jougris (*P. griseigena)*, grèbe catagneux *(P. ruficollis)*, brante roussâtre *(Netta rufina)*, pouron commun *(Aythya ferina)*, canard nyroca *(Aythya nyroca)*, oies, canards tadornés, mouettes, guiferttes, sternes, phrygmites, etc.

L'aire où vivent ces oiseaux se réduit, ceux-ci se concentrant autour ou sur les lacs plus profonds ou plus grands.

L'homme a également restructuré d'une manière directe les composantes biotiques du diome deltaïque surtout en introduisant de nouvelles espèces à valeur cynégétique élevée : *Myocastor coypus* (1962), *Phasianus* sp. (1967) et *Capreolus capreolus*. En ignorant leur rôle dans le maintien de l'équilibre biocénotique, l'homme a cassé les œufs des oiseaux ichtyophages (tels les pélicans blancs) ou il a tué leurs petits.

La faune de ces régions se fait aussi remarquer par certaines particularités étho-physiologiques des espèces. Un exemple de comportement phénologique adéquat aux conditions du delta est offert par le canard col-vert *(Anas platyrchynchos)* et par le canard nyroca *(Aythya nyroca)* qui nidifient à une certaine hauteur dans les régions inondables. D'autres espèces, telle la foulque macroule *(Fulica atra)* rehaussent leurs nids à chaque inondation, en y ajoutant d'autres étages, déposant à chaque niveau un nombre d'œufs.

Chez certaines espèces — canard, sarcelle, brante, pouron, oie et fernache — à la suite de l'inondation du nid et par manque d'espace de nidification, plusieurs femelles d'une même espèce ou d'espèces différentes déposent leurs œufs dans le même nid. En l'absence de ces espaces de nidification, le héron, l'ibis falcinelle et le cormoran-pygmée forment, dans les vieilles saulaies *(Salix cinerea)* d'immenses colonies mixtes.

Sous l'aspect strictement spatial, dans le cas où les espèces aquatiques et amphibies prévalent, la faune terrestre est disposée sous forme d'îles qui occupent d'importantes surfaces sur les levées de Letea, Caraorman, Sărăturile ou la plaine de Chilia.

Les surfaces boisées des levées de Letea, Caraorman et Sărăturile sont, certes, dominées d'animaux dendrophiles, représentant de véritables oisis de faune sylvicole, dont nous mentionnons comme espèces représentatives : le verdier *(Hyla arborea)*, la rainette *(Bufo virdis)*, la coronelle lisse *(Coronella austriaca)*, le rollier *(Coracias garrulus)*, le pigeon *(Columba oenas)*, le merle *(Turdus merula)*, le rossignol *(Luscinia megarhynchos)*, le pivert *(Picus canus)*, le pic épeiche *(Dendrocopos major)*, le mulot sylvestre *(Apodemus sylvaticus)*, le renard *(Vulpes vulpes)*, etc.

La caractéristique faunique des terrains ouverts du champ de Chilia et des levées marins est donnée par l'alouette *(Alauda arvensis)*, le bruant *(Emberiza calandra)*, le cochevis *(Galerida cristata)*, la perdrix *(Perdix perdix)*, la caille des blés *(Coturnix coturnix)*, le pipit rousseline *(Anthus campestris)*, le lapin *(Lepus europaeus)*, le musareigne carrelet

(Sorex araneus), espèces qui, en général, entrent dans la composition des noyaux des formations fauniques des terrains cuverts, situés à des altitudes inférieures en Romanie.

Les levées marins et fluvio-marins à biotopes sablonneux plus vastes se font remarquer par la présence de deux éléments tourano-pontiques: la vipère *(Vipera ursini renardi)* et le lézard de sable *(Eremias arguta deserti)*. Ces deux reptiles ont une grande importance paléofaunique, étant des *relicti* post-glaciaires datant de l'époque de l'optimum climatique post-glaciaire (atlantique), considérée comme une étape importante dans la constitution de la faune du Delta du Danube. C'est à cette époque que pénètrent les éléments de la vague érémique est-méditerranéenne; les éléments de la vague touranienne s'ajoutent ultérieurement.

D'une valeur spatiale particulière est aussi le lézard agile euxinique *(Lacerta agilis euxinica)*, endémite ouest-pontique localisé exclusivement sur les levées marins du delta et sur les levés du littoral jusqu'au nord de Mamaia.

Sur les terrains sablonneux vivent aussi des invertébrés: les locustes arênicoles *(Calliptamus barbarus, Sphingonotus coerulans, Acrotylus insubricus)*, le myrméléonide *(Mirmelon formicarius)*, la mouche *(Satanas gigas)*, etc.

Une autre caractéristique zoogéographique du territoire deltaïque roumain peut être observée pendant l'hiver lorsque le Delta du Danube constitue une région d'hivernage pour certains oiseaux-hôtes d'hiver. Pendant les années normales du point de vue thermique, ces espèces du nord, tout comme les sédentaires, se rassemblent autour des grands lacs de certains tourbillons, sur les bras principaux du Danube et à l'embouchure des canaux dans les bras du Danube. Lorsque les eaux se glacent, une partie des oiseaux sédentaires et les espèces venues du Nord se concentrent dans les lieux plus favorables de l'immédiate proximité de la mer Noire ou du littoral (« musura », « melea »), où le mouvement permanent de l'eau et son degré accru de sallinité empêchent la formation de la glace, formant de véritables « quartiers d'hivernage » de l'avifaune, dont les plus importants sont le golfe de Musura (cygne, canard, harle, oie cendrée, grèbe, mouette), la « melea » et l'île de Sacalin (canard col-vert, oie rieuse, cygne sauvage, harle, mouette), Perişor-Zătoane (cygne sauvage, canard col-vert, oie rieuse), Periteaşca-Leahova (cygne, canard col-vert, oie rieuse, harle) et le lac Sinoie avec de levées afférentes du complexe lagunaire de Razim (cygne, oie cendrée, oie rieuse, canard col-vert, canard morillon, pouron commun, sarcelle d'hiver, canard siffleur, canard oilot, foulque macroule, arle, etc.). La concentration toujours plus grande de la faune aquatique pendant l'hiver, dans le périmètre des eaux saumâtres du lac Sinoie est due à l'endiguement des lacs Razim et Goloviţa (qui formaient autrefois un vaste „quartier d'hivernage"), dont les eaux se sont adoucies et se glacent pendant l'hiver, ce qui rend difficile la vie des oiseaux.

Au niveau du pays, il s'impose de souligner la contribution du Delta du Danube à l'enrichissement de la faune des régions avoisinnées ou éloignées d'une série d'éléments qui réalisent des déplacements plus ou moins grands pour diverses nécessités vitales, surtout pour la nourriture. Ainsi, sur les terrains environnants peut-on voir de nombreux mouettes et cygnes blancs, venus compléter leur nécessaire alimentaire. Dans ce contexte nous devons mentionner : la locuste migratoire *(Locusta migratoria)*, dont les larves se nourrissent du roseau, avec trois centres principaux de couvaison — les levés de Sfîntu Gheorghe, Letea et le champ de Chilia. Pendant les années de reproduction exceptionnelle, cette locuste invahit tout le pays.

Sur le plan paléarctique le Delta du Danube joue un rôle particulier en premier lieu parce qu'il maintient la relation entre les faunes des régions arctiques et tropicales, vu qu'il est traversé du Nord au Sud et inversement par trois des principales routes de migration des oiseaux : *la route est-elbique*, (par l'ouest), fréquentée de : cygnes, oies rieuses, canards col-vert et oies cendrées, cailles des blés, tourterelles de bois, grues cendrées, de nombreux oiseaux de proie, etc. ; *la route pontique* (par les régions centrales) fréquentée de : canards col-vert, oies cendrées, grues cendrées, cygnes blanches, oies rieuses, étourneaux sansonets, pigeons, cailles des blés, outardes barbues, etc. et *la route sarmate* (par l'est), que prennent les canards col-vert, les bécasses des bois, les bécassines, les pigeons, etc.

En second lieu, on doit mettre en évidence le fait que le Delta du Danube fait le passage entre la faune méditerranéenne et sous-méditerranéenne balkanique et la faune pontique-touranienne et centrale-asiatique. Une preuve en est la participation de divers groupes d'éléments zoogéographiques à la création de la faune de vertébrés de cette région (amphibiens, reptiles, oiseaux couveux, mammifères, etc.). Ainsi, sur les fonds fauniques centre-européen (43 %) et paléarctique (19 %) s'interpolent des éléments ponto-touraniens et centre-asiatiques (13,4 %), ainsi que des éléments méditerranéens et sous-méditerranéens (10,4%), européens ouest-asiatiques (5,4%), euro-sibériens (2,7%), etc.

En guise de conclusion, soulignons deux particularités exceptionnelles du biome du Delta du Danube, à savoir : sa grande diversité zootaxonomique (qui lui confère les qualités de complexe faunique à part parmi les unités zoogéographiques roumaines et européennes et son importance dans la réalisation et la conservation des connexions fauniques entre les régions du Nord et du Sud, balkaniques et pontiennes, entre la zone du littoral et la zone danubienne.

La conjoncture géo-historique de la formation du Delta du Danube et les conditions de milieu tout à fait spécifiques offertes par ce territoire lui assurent une position-clé dans la vie de l'ichtyofaune et de l'avifaune (mais aussi d'autres groupes d'animaux) avec des conséquences zoogéographiques dépassant de beaucoup ses propres limites géographiques.

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THERMAL PERTURBATIONS AND THEIR STRESSING EFFECTS ON FISH BIOCOMMUNITY OF THE NORTHERN COASTAL ZONE OF LAKE ONTARIO, THE PICKERING-DARLINGTON AREA

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Perturbations thermiques et leur effet stressant sur les biocommunautés de poissons dans la zone côtière nord du lac Ontario, le secteur Pickering-Darlington (Canada). L'article présente deux catégories de perturbations thermiques: le déchargement d'eau chaude à la centrale nucléaire Pickering et les phénomènes de upwelling—downwelling (sources d'eau froide). On décrit la dynamique thermique des eaux pendant le déchargement des eaux chaudes et dans les conditions naturelles, ce qui détermine ΔT (°C); on y caractérise le régime thermique des deux conditions. On présente ensuite les caractéristiques des processus d'upwelling—downwelling, le mécanisme de production et une typologie originale. Suit l'analyse des effets sur la communauté de poissons (en général) et sur l'espèce la plus abondante, *Alosa*. Les décharges d'eau chaude modifient le profil thermique des espèces attirées par le déchargement. C'est une première démonstration — semble-t-il — dans la littérature, basée sur le concept moderne du profil biologique.

Key words: hydrothermal regime, ecological effect, fish biocommunity, Ontario (lake), Pickering Nuclear Station, Canada

Ecological effects of two kinds of thermal perturbations are listed: thermal discharges of power stations and upwelling—downwelling events. Main features of the two perturbations are described briefly. A classification of upwelling—downwelling events is proposed here for the first time. Perturbation effects on fish community are analyzed in the area of Pickering nuclear station discharge. Analyses are based on indexes of diversity, on a global level, and on alewife, as a representative species attracted in discharge. It is proved that alewife thermal profile is changed in discharge and the species has a possibly increased mortality.

1. THERMAL PERTURBATIONS UNDERTAKEN FOR STUDY

The littoral area of Great Lakes, usually termed as Coastal Boundary Layer (CBL) (Csanady, 1972a), is possibly the most perturbed hydrologic area of a lake body due to its ecotone status. Its features are issued by complex interactions between Aquatic and Terrestrial Ecosystems and Physics of the Atmosphere. CBL is a narrow littoral band of around 10 km wide offshore, featured by frequent thermal perturbations. Two kinds of thermal perturbations are studied as effects for Pickering — Darlington area: 1) thermal discharges (TD), produced by power generating stations; 2) natural thermal perturbations, known under the generic name of upwelling—downwelling events (UDE).

Figure 1 shows the general dynamics of water temperature of CBL in Pickering — Darlington area during 1980. It also shows the two kinds of thermal perturbations, TD & UDE. Lower curve indicates thermal dynamics in ambient water along the year. Upper curve shows the same dynamics but in the discharge A of Pickering Nuclear Generating Station. Thermal difference between discharge and ambience (ΔT) is due to lake discharge of heated waters of the station cooling system (TD). On both curves there can also be observed some irregular perturbations, which are shown as a quick thermal decrease and a return to the level. These perturbations are produced by UDE. Both kinds of perturbations, ΔT produced by TD and UDE, produced by natural processes, will be briefly analyzed below, before identifying their effects on the fish community.

The study of thermal perturbations in Pickering—Darlington area is using a ten year data base (1977 — 1987) of temperature, current and wind records which were analyzed by a software package written by the author in Pascal and illustrated with graphs made in HARVARD, QUATROPRO & GRAPHER.

2. THERMAL DISCHARGE & THERMAL PLUMES

The case of thermal dynamics in ambient waters, station discharged waters and the difference of the two is shown as a statistical issue by data in Table 1. In order to get a better correlation with data in Figure 1, a monthly statistics is used based on the same case of year 1980 for water temperatures in both discharge and ambience. Both the table's data and the graph show different pictures for the thermal regime in ambient waters and in discharge.

Table 1

Monthly statistics of water temperature variation (Celsius degrees) for: (A) ambience, (B) difference between discharge and ambience, (C) discharge A of Pickering station, during 1980

	January			February			March		
	A	B	C	A	B	C	A	B	C
Minimum Value	0.90	17.60	18.70	1.50	17.70	20.20	0.90	16.90	18.40
Maximum Value	3.70	25.20	27.00	3.80	24.40	26.20	3.40	23.80	25.10
Range	2.80	7.60	8.30	2.30	6.70	6.00	2.50	6.90	6.70
Mean	2.27	21.50	23.77	2.23	22.04	24.28	1.84	21.01	22.85
Median	2.30	21.80	24.50	2.00	22.40	24.50	1.80	20.70	23.10
Std. dev.	0.68	1.64	1.92	0.64	1.34	1.24	0.68	1.91	1.71
CV (%)	0.30	0.07	0.08	0.28	0.06	0.05	0.37	0.09	0.07
Skewness [g1]	−0.08	−2.08	−4.71	0.57	−2.41	−2.53	0.31	0.15	−1.69
Kurtosis [g2]	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00

	April			May			June		
	A	B	C	A	B	C	A	B	C
Minimum Value	2.60	18.50	22.40	4.50	2.70	8.40	5.10	11.50	20.40
Maximum Value	5.70	24.90	25.70	8.60	19.60	24.50	11.60	17.40	24.40
Range	3.10	6.40	3.30	4.10	16.90	16.10	6.50	5.90	4.00
Mean	4.24	20.22	24.34	5.55	10.87	16.43	7.88	14.80	22.68
Median	4.20	20.00	24.40	5.40	8.70	16.00	7.95	14.60	22.90
Std. dev.	0.68	1.15	0.66	0.89	6.78	6.71	1.61	1.38	1.07
CV (%)	0.16	0.05	0.02	0.16	0.62	0.40	0.20	0.09	0.04
Skewness [g1]	0.06	3.24	−0.38	1.68	9.39	4.85	0.52	−0.04	−0.74
Kurtosis [g2]	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00

	July			August			September		
	A	B	C	A	B	C	A	B	C
Minimum Value	4.80	12.50	18.90	7.50	10.50	25.50	4.90	10.40	21.50
Maximum Value	15.00	18.80	28.70	20.50	18.60	31.30	19.90	20.10	30.90
Range	10.20	6.30	9.80	13.00	8.10	5.80	15.00	9.70	9.40
Mean	7.64	16.51	24.15	14.58	14.58	29.16	10.96	14.98	25.94
Median	6.70	17.00	23.60	13.80	15.80	29.00	10.95	15.35	25.80
Std. dev.	3.02	1.68	2.28	3.86	2.54	1.62	4.05	2.92	2.56
CV (%)	0.39	0.10	0.09	0.26	0.17	0.05	0.37	0.19	0.09
Skewness [g1]	12.53	−1.84	1.59	2.19	−2.33	−1.22	4.38	−0.94	3.09
Kurtosis [g2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	October			November			December		
	A	B	C	A	B	C	A	B	C
Minimum Value	4.00	15.00	21.60	3.20	14.70	20.40	1.40	16.00	20.90
Maximum Value	8.60	20.60	26.10	6.00	18.50	22.80	6.30	22.00	24.50
Range	4.60	5.60	4.50	2.80	3.80	2.40	4.90	6.00	3.60
Mean	6.37	18.30	24.67	4.85	16.85	21.70	3.27	19.56	22.83
Median	6.60	18.60	24.80	4.90	16.80	21.70	3.30	19.40	22.70
Std. dev.	1.23	1.62	1.11	0.78	0.88	0.59	0.85	1.45	0.94
CV (%)	0.19	0.08	0.04	0.16	0.05	0.02	0.26	0.07	0.04
Skewness [g1]	−0.04	−1.41	−1.26	−0.16	−0.22	−0.09	0.98	−0.74	−0.08
Kurtosis [g2]	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00

a. *Temperature variation in the discharge* is generally flat, kept at high values averaging 21 — 25°C. Nevertheless there are two kinds of exceptions, identified well for data of 1980 (Fig. 1):

1) temperature could be well below the flat level, due to a major UDE of around 15 °C, case found in May (Fig. 1, no. 1);
2) the same thermal level could be also well exceeded due to maximum thermal stratification stage (SSt), fact shown during August — September (Fig. 1).

The discharge is physically expressed by thermal plumes, identified as distinct area of water, with significantly higher temperatures compared to the ambience. The plume geometry has a three dimensional picture, with different depth levels. The "winter" plumes are usually identified as having a smaller extent in depth compared to "summer" plumes.

Plume extent depends both on discharge flow and wind—current orientation. Three classes could be roughly identified: 1) the offshore plume, more or less perpendicularly oriented to the shore line with higher extension in open waters; 2) the along-shore plume, oriented along the shore; 3) the onshore plume with smallest extent due to a strong wind which blows it back to the shore.

The gradient structure of plumes plays an important role in both attraction or repulsion of the nekton to or from the shore. Based on gradient diffusion of the thermal information a plume could be well perceived by fish at a large distance of the original discharge point (5 —8 km offshore).

b. *The temperature variation in ambient waters* is also kept flat but exclusively for the short phase of winter stagnation (December to March). During this time water temperature averages values below 4°C (Table 1), floating above this more dense layer.

The summer stratification usually starts in May for Lake Ontario and ends last part of October. Eight out of twelve months, the thermal dynamics is bell shaped, jointed around SSt which encompasses mid July to end September. During SSt thermal values exceed 8°C and achieve average values of 14 and even 15°C. This process, well shown during 1980, barely achieves 12°C during cold years, such as 1986. The high values are also altered for some months by UDE. July 1980, as a case, has an exceptionally low average (Table 1) due to a major, long UDE (Fig.

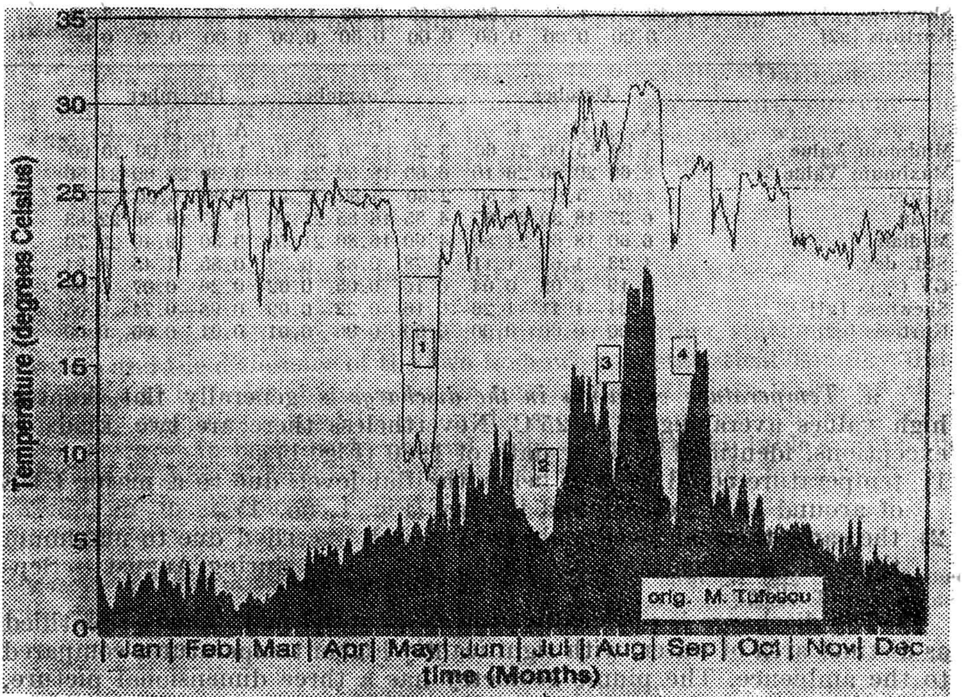

Fig. 1. — Monthly thermal dynamics.

1, no. 2). Temperature dynamics appears to perform a longer SSt duration and generally a better shown summer stratification for waters in a natural status, i. e. such as ambient waters, rather than for discharge waters where, generally, temperature variation is much more under the mask of TD.

c. *Dynamics of thermal differences* between discharge and ambience, or ΔT, is subsequently more or less dependent on the ambient thermal variation and the UDE, as both are factors producing a rich temperature variation. During the cold phase of the year, December to April, ΔT records the highest values, averaged around 20°C as a general feature. Concerning the warm phase, ΔT is much reduced by the process of thermal stratification of the ambient waters. Major UDE, abundant this time, induce adverse temperature variations of the ΔT. When a major UDE is issued with a prevalent magnitude for the discharge waters, ΔT is pretty much reduced as magnitude.This is the case of the May UDE (Fig. 1, no. 1), when ΔT achieves the lowest level (around 5°C).Opposite effects are issued when UDE are produced with high strengths in ambient compared to discharge waters. This time ΔT gains some strength. A good case is shown by the July UDE (Fig. 1, no. 2), which is prevalent in ambient waters.

d. *The Upwelling—Downwelling Events*, generally synchronized, appear manifested with different strengths. In the case of year 1980 four major UDE are shown up (Fig. 1, no. 1 — no. 4), one clearly in discharge (no. 1) and three in ambient water (no. 2 — no. 4). Each of the four has synchronic events in the same area of CBL, despite the fact they have a different magnitude, here smaller.

By the ecological importance of UDE, as producer of thermal shock, the next section abstracts some specific features of these processes which are further necessary for environmental effects.

3. UPWELLING-DOWNWELLING EVENTS

a. *UDE are identified* as high temperature variation (10 — 15°C), produced in a short time (couple of hours to couple of days). An event is usually recorded by a quick temperature decrease, process which is termed as upwelling (UP). It is followed by flat cold values, which is the stressed level phase (SP). A third component, designed as downwelling phase (DP), is performed by a return of temperature to normal when, more or less, the thermal stratification is reestablished. These processes are better identified during summer stratification within CBL.

UDE are produced yearly with a general frequency of five to six events of high magnitude, usually during summer stratification. Conclusions for this study are based on a total of 64 major UDE, recorded hourly during a period of ten years (1978 — 1988).

b. *The cause of large scale UDE* is usually a synergic action of different factors such as wind direction and speed, shape and orientation of the lake with respect to the prevailing wind direction, geostrophic circulation and internal oscillation (Mortimer 1963, Csanady 1972b, Bennett 1973, Clark 1977). For a lake with the northern shore east—west oriented, which is the case of the area undertaken for study, an eastern quadrant wind (i. e. oriented to the east), is identified as a factor responsible for UDE production. Eastward wind direction in a vectorial combination with Coriolis force performes a composed vector termed "Ekman drift" (ED) with offshore orientation. ED is assumed to be the active force of UDE production, by moving surface waters offshore and inducing upwelling (UP) hydrostatic compensation effects. Complomentary to upwelling production, ED could also keep the cold waters on the surface performing a stressed level phase (SP). SP is characterized by apparently stable or oscillatory temperatures of a cold level, the same as in the case of hypolimnetic water migration. When eastward wind is reversed as direction coldwaters return back to hypolimnion, identified as a downwelling phase (DP). Consequently, temperature gets back to its normal level.

c. *For a statistical examination*, UDE are here classified in relation to the following stages of summer stratification (ST) : 1) Warming stage (WSt), May — July ; 2) Maximum thermal stratification (MSt), August — mid September ; 3) Cooling age (CSt), end September — end October.

Table 2 figures the statistical features of UDE which could indicate the magnitude and frequency of thermal variation they produce in the coastal boundary layer of Pickering—Darlington area.

Table 2

A statistical description of thermal variation produced by major UDE during summer stratification

A. General Statistics

Parameter	All	WSt	MSt	CSt
Sample Size	64	27	18	19
Average variation (°C)	9.70	8.32	12.35	9.14
Standard Deviation	3.27	3.08	2.54	2.73
Maximum variation (°C)	18	17	18	14
Lower Quartile (°C)	7	6	10.3	7
Upper Quartile (°C)	12	11	14	11.5

B. Monthly dynamics of thermal variations

	May	June	July	Aug	Sep	Oct
Number of UDE	2	17	9	16	10	10
Average variation (°C)	5.25	8.22	9.83	12.39	10.70	7.67
Standard dev.	0.353	3.402	2.610	2.600	1.602	2.714

Major UDE perform thermal perturbations averaged to 10°C, much facilitated by the maximum thermal stratification stage, when the average is 12.35°C. The maximum recorded perturbation for studied area is of 18°C. Analysis of monthly dynamics of thermal variations induced by UDE shows that they increase in magnitude from May to August, when a maximum average of 12.4°C is achieved. The average magnitude is kept high in September (around 11°C).

d. *The UDE classification* we introduced is based on variation of the three components which perform an upwelling—downwelling event: UP, SP, DP (please see these above). These three components could have at least two different alternatives as follows. (1) UP could be performed as a straight temperature decrease (S) or as an oscillatory process (0); (2) SP could be well visible (+) or too short to be visually detected (—); (3) DP, as UP, could be a straight (S) or an oscillatory (0) process. Combinatory analysis of these alternatives shows eight classes of event dynamics. They are described as structure and assessed as occurrence frequency by table 3.

At a first glance it could be identified that types of UDE which are missing the stressed level phase are rarely identified as major events, all together covering only 17.18% of total events (types 5 — 8). This fact is associated with a possible reduced power of the Ekman drift which vanishes before generating the stressed level phase. Between the four most frequent events, the less important as frequency are those having a straight downwelling phase (types 3,4). This fact might again be explained as due to the absence of any Ekman drift action during downwelling, which once more indicates a reduced power of the synergic forces which generate the upwelling phase of these kinds of UDE. The oscillatory nature of the downwelling phase of the two most frequent UDE (types 1,2) indicates that during this phase some reversal episodes could act as a sign of Ekman drift return. These two kinds, S + 0 & 0 + 0, encompass 59.4% of total recorded UDE.

Table 3

Description & frequency of UDE types

	Type	Description	N	(%)
1	S + O	straight UP, a SP, oscillatory DP	23	35.94
2	O + O	oscillatory UP, a SP, oscillatory DP	15	23.44
3	O + S	oscillatory UP, a SP, straight DP	8	12.5
4	S + S	straight UP, a SP, straight DP	7	10.94
5	O – O	oscillatory UP, no SP, oscillatory DP	5	7.80
6	S – S	straight UP, no SP, straight DP	3	4.69
7	S – O	straight UP, no SP, oscillatory DP	3	4.69
8	O – S	oscillatory UP, no SP, straight DP	0	0

All these remarks have the meaning that usually a main UDE has a high probability to be produced only when a powerfully Ekman drift is generated, which is still active after the UP production.

4. THERMAL EFFECTS ON FISH COMMUNITY

Thermal discharge of a power station exercises constant effects on the aquatic ecosystem by its thermal plume. Plume active area, usually restricted to 1 – 2 km, is much more enlarged by gradient processes, which produce attraction or repulsion on pelagic fish from abroad the area of direct intluence. These effects are usually effecting fish foraging or spawning migration to the shore. They actively search for an optimal environment. Discharge waters, attractive as temperature, have also the negative side by low oxygen content and increased trace pollutants (metals & organic contaminants). Depending on species and even genotype sensitivity, the environmental advantage or disadvantage is prevalent producing attraction or repulsion. The issued effects are very dynamic in the way that an attraction could become repulsion in the measure that specimens are swimming across the plume.

The other thermal perturbation, UDE, is produced with intermittence in a much larger area, i. e. all the CBL. Ecological effects they perform is a sequence of hypothermic and hyperthermic shocks. Major events might have significant impacts on the biotic community, depending on ΔT magnitude which is not buffered by physiological mechanisms of fish thermoregulation. Association of UDE with thermal plumes could significantly magnify the negative effects.

The results shown by this study are only related to ecological effects measured on the fish community in the discharge area of the Pickering nuclear station. The study is specifically oriented to identify how thermal effects reshape the fish community system.

a. *Fish community of studied area.* The pelagic fish community which migrates ashore is initialized by a number of spawning species which are jointed by predators and indirect related species. Despite some simplification the shore community has a relatively large number of species. This is shown below as a list of component species in Pickering thermal discharge, ordered and ranked in a descending order:

1) Alewife *(Alosa pseudoharengus)*; 2) Channel catfish *(Ictalurus punctatus)*; 3) Lake trout *(Savelinus namaycush)*; 4) White sucker *(Catostomus commersoni)*; 5) Round whitefish *(Prosopium cylindraceum)*; 6) White perch *(Morone americana)*; 7) Rainbow smelt *(Osmerus mordax)*; 8) Brown trout *(Salmo trutta*)*; 9) Carp *(Cyprinus carpio*)*; 10) Coho salmon *(Oncorhynchus kisutch*)*; 11) Longnose sucker *(Catostomus catostomus)*; 12) Rainbow trout *(Salmo gairdneri*)*; 13) White bass *(Morone chrysops)*; 14) Gizzard shad *(Dorosoma cepedianum)*; 15) Lake chub *(Couesius plumbeus)*; 16) Lake whitefish *(Coregonus clupeaformis)*; 17) Rock bass *(Ambloplites rupestris)*; 18) Redhorse sucker *(Moxostoma macrolepidotum)*; 19) Brown bullhead *(Ictalurus nebulosus)*; 20) Lamprey *(Petromyzon marinus*, not a real fish, belongs to *Agnatha)*; 21) Chinook salmon *(Oncorhynchus tshawytscha*)*; 22) Longnose gar *(Lepisosteus osseus)*; 23) Smallmouth bass *(Micropterus dolomieui)*; 24) Walleye *(Stizostedion vitreum)*; 25) Northern pike *(Esox lucius)*; 26) Freshwater drum *(Aplodinotus grunniens)*.

The number in front of the species name is its numeric indicator used for graphical and analytical reasons. Species binary nomenclature is indicated in brackets. Five species out of the twenty-six do not belong to the biogeographical region of Atlantic Drainage Basins, as indicated by W. B. Scott & E. J. Crossman (1973); they were introduced from different geographical areas and adapted to new conditions performing local populations. These are marked by asterisks.

A global structure of fish community ashore in Pickering area is evaluated in Figure 2, based on monthly catches during 1986 outside thermal discharges, for undisturbed environment. Species abundance, as total 1986 catches, in a log2 base. Species are designated by numerical indicators. For practical reasons the last three species in the list (walleye, northern pike, freshwater drum), which are missing in 1986 records of ambient environment, were excluded from calculations.

Fish community structure in natural ambience is dominated by two species: alewife(71.68 per cent) and channel catfish (18.28 per cent), both covering 90 percent of total fish abundance. The next two species in ranking sequence, lake trout & white sucker, add only 6.9 per cent, and the following step of two species is much more reduced as value, i.e. 1.67 per cent. This high slope of reduction from the most abundant species to the least one is shown by a Shanon—Weaver index of information of 0.9526 and a Simpson index value of 0.5498.

b. *Global change of fish community in thermal discharge.* Sum of total catch in thermal discharges is shown for comparison by Fig. 2 as chi-square difference versus the ambient records. These results are taken, for convenience, as positive when significant attraction effects are identified, and as negative for repelling effects. Differences, as species abundance

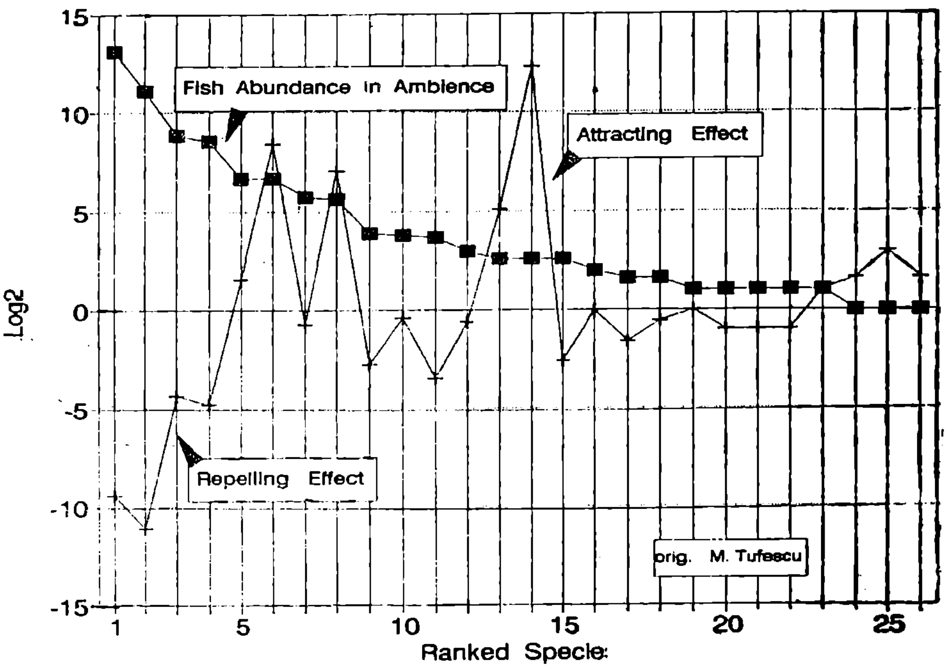

Fig. 2. — Global change of fish abundance in discharge.

between discharge (DIS) and ambient (AMB) areas, are also figured through community indexes of diversity (Table 4).

Indexes of community heterogeneity (Westman, 1991) are different as values : Shannon-Weaver's index (H') is higher in ambient and Simpson's L is lower. All three global indexes of diversity, (N0, N1, N2) (Pielou, 1990), are superior as values in ambience. Two indexes of richness, the total abundance (Ab) and Margalef's R1 are also superior as levels in ambient. The five indexes of evenness (E1 — E5) in Hill's classification (Putman and Wratten, 1991) are generally also higher in ambient environment versus discharge, except E2.

Table 4

Fish community as indexes of diversity

	H'	L	N0	N1	N2	Ab	R1	R2	E1	E2	E3	E4	E5
DIS	0.85	0.67	20	2.35	1.50	7742	2.12	0.23	0.28	0.12	0.07	0.64	0.37
AMB	0.95	0.55	23	2.59	1.82	12190	2.34	0.21	0.30	0.11	0.07	0.70	0.51

As concerns the differences in species abundance (Fig. 2) the following three situations may be identified in a global evaluation :
a. Species alternatively attracted and repelled; this is the case of the dominant species : alewife.
b. Species globally repelled by discharge conditions. These involve the most abundant species such as : channel catfish, lake trout and white sucker.
c. Species globally attracted by discharge conditions. This group involves less abundant species such as : white perch, brown trout, gizzard shad.

A number of six species found in ambient environment are missing in discharge : channel catfish, lake chub, rock bass, chinook salmon, longnose gar and lamprey. Three other species, missing in ambience, were found in discharge conditions : walleye, northern pike and freshwater drum. Excepting the channel catfish all other species, in both situations, were caught in very small number and the issued difference could not be related to the thermal discharge effect.

Species showing attraction or repulsion effects due to thermal discharge, have a peculiar dynamics when examined in more detail ; the above classification might be used only for global information.

c. *Monthly dynamics of attracting repelling effects in discharge conditions* is shown by Figure 3 in terms of attracting and repelling effects measured by chi-square as abundance differences of discharge versus

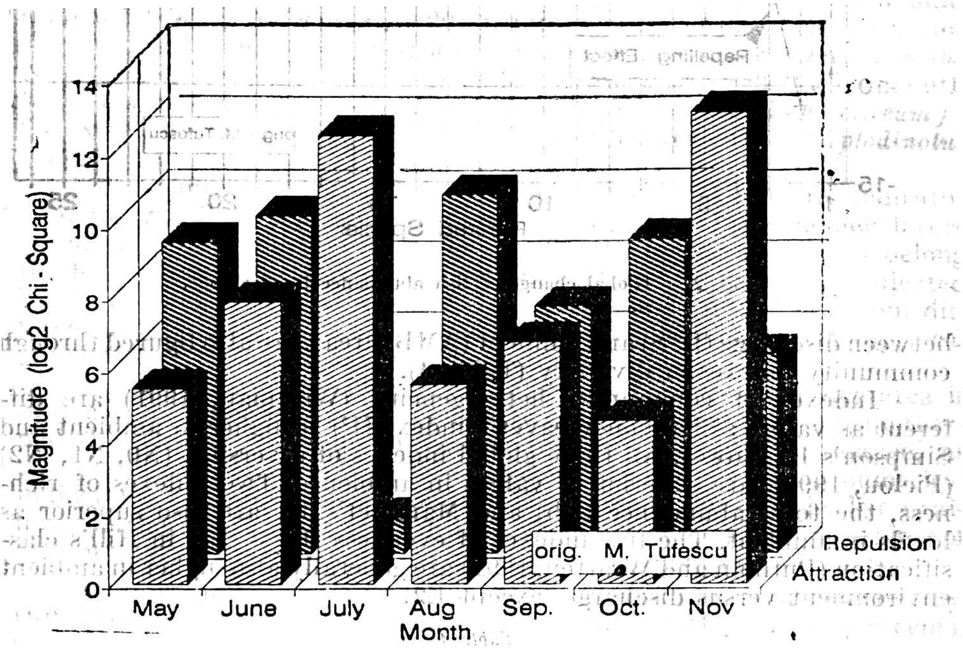

Fig. 3. – Monthly discharge effects.

ambience records. The two categories of effects show a very peculiar pattern each month. During May the discharge attraction effects prevails. The next month, June, it slightly decrees in magnitude, but keeps going the same way. During July the situation is totally reversed and repulsion effects are very highly prevalent. The next month, August, the attraction prevalence is the highest recorded. September shows balanced attraction—repulsion effects. October simulates the August prevalence of attraction effects but much slighter as magnitude. November is the second month of highly repelling effects, well prevalent but compared to July the attraction effects are better shown.

The topic of monthly dynamics has as target to highlight the global change of the fish community. Once more, it should be underlined that the fish community is a very heterogeneous system based on largely different ecological trends of the individual components. In this case an examination on species level ecology should be made to get the necessary information. For a better illustration of the system features, as shown by Figure 3 and the above text as general trends, the case of alewife is explained in the next section. Apart from its dominant abundance, this species shows a prevalent attraction by thermal discharge conditions. A target of this examination is to finger out what are the detrimental results of an apparently positive effect — the thermal attraction.

d. Ecological consequences of thermal attraction. As a pelagic fish alewife migrates inshore, just for spawning, starting in late March or April (Graham, 1956). Inshore migration lasts until late July. Schools migrate inshore at night and back offshore next day, performing half-day waves of back and forth migrations. A school's size is large. Our gillnet records show inshore catches of five hundred to fifty hundred specimens just for a school fraction. The inshore migration is oriented toward river discharges and inside the river itself for a certain while. Two main conditions are searched for spawning : water temperature around 12°C or more, and a quiet shallow bottom of sand or gravels. As temperature is a key factor of spawning migrations (Scott and Crossman, 1973), the inshore schools are easily attracted along thermal gradient of the thermal discharges. Alewife is subject to the highest percentage of attraction records shown by Figure 3, except July and November when repelling is clearly prevalent.

Schools' attraction along thermal plumes has an important effect on alewife spawning. Inshore migration along thermal gradient usually does not fulfil the scope of the process, i. e. the normal action of spawning. This hangs on the fact that main factor which guides the process, the thermal increase, is ecologically misleading. Achieving 12°C, the school does not find the expected environment for spawning. As the discharge waters easily have higher temperatures during the months of alewife spawning (Fig. 4), the inshore migration keeps going to higher temperatures. In the same direction the dissolved oxygen is decreasing quickly in the measure that alewife specimens show anoxia behaviours in high proportion in thermal discharge. In this circumstance the spawning is made as a stress result or the school returns offshore without spawning. Both issues mean lost energy.

Due to oxygen depletion or thermal associated physiology, adult alewife was found to have the upper incipient lethal temperature at 23.5°C when temperature of acclimatization is 10°C (Otto, Kitchel and Rice, 1976; Wismer and Christie, 1987). Both temperatures are peculiar for the Pickering area, the first value is specific for thermal plumes (Fig. 1)

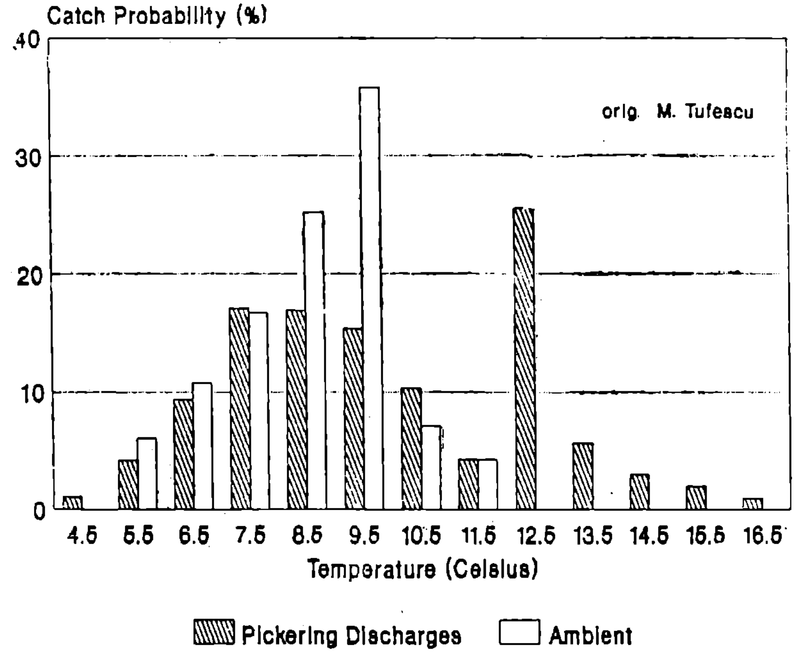

Fig. 4. — Alewife's thermal profile.

the second, or even lower, for pelagial waters of fish provenance. Critical thermal maximum is 28.5°C for 10°C acclimatization temperature.

Consequently to the plume attraction, the alewife spawning ecology is perturbed at least in three ways as shown below.

1. Genetically imprinted temperature which usually initializes the spawning, is misleading in thermal discharge and alters the thermal profile of the populations in this area. Figure 4 shows the thermal profile of alewife in thermal discharge versus ambient conditions. It highlights that thermal preference is enlarged up to 15.5°C for schools in discharge versus 12.5°C in ambient conditions. The same kind of perturbation was also found by us for white perch (Fig. 5) which is mainly attracted by discharge conditions.

2. The mortality factor is increased both for spawning adults and hatching larvae in improper conditions. In Bride Lake, Connecticut, Kissil (1974) found a survival rate of 0.0013 per cent of hatching larvae from eggs spawned by anadromous alewife. That means one larvae survives out of 80,000 eggs in normal conditions, a ratio highly restricted for thermal discharge area. If this ratio is used unchanged, it means that one surviving larvae is issued at the cost of all spawning eggs of four females between two to four years as age. The reproductive group of alewife in Great Lakes is 96 per cent performed by fish aged two to four years.

3. A direct issue of an enlarged thermal profile is shown by a perturbed calendar of the offshore migratory return for pelagic fish like ale-

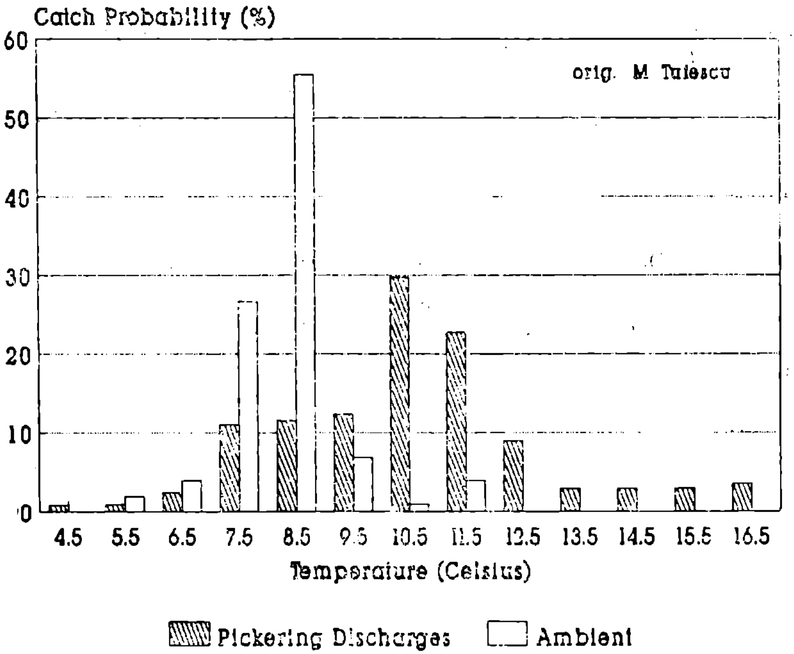

Fig. 5. — Thermal profile of White Perch.

wife. This result is characterized by late attraction effects of thermal discharge which keeps nearshore alewife schools beyond July. Figure 3 shows high levels of fish attraction in thermal discharge during August, September and even October. Around 90 percent of these attracting effects are displayed by alewife. The November high numerical reduction of alewife in thermal discharges of Pickering station is, in fact, the final act of the return back to pelagial.

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VARIATION SÉCULAIRE DE LA TEMPÉRATURE MOYENNE DE L'AIR SUR LE TERRITOIRE DE LA ROUMANIE

MARIA ILIESCU

Die Jahrhundertabweichung mittlerer Lufttemperatur in Rumänien. Die Untersuchung der Abweichungen der mittleren Temperaturwerte im Laufe der Jahre, das Unterstreichen der charakteristischen Jahre und Zeitintervalle sowie des Abweichungstrends der Lufttemperatur in Rumänien ist auf das Vorhandensein jahrhundert- und Jahrestemperaturwertreihen von 15 unter verschiedenen physisch-geographischen Bedingungen befindlichen Pegel zurückzuführen. Die synthetische Darlegung der erzielten Schlußfolgerungen unterstreicht gewisse Gesichtspunkte der sekulären Abweichung des thermischen Bereichs in Rumänien und besitzt sowohl wissenschaftliches als auch praxisbezogenes Interesse, zwecks Information für in der Problematik dokumentierter Wissenschaftler.

Mots-clé: température de l'air, variation séculaire, Roumanie.

Le problème de la variation et des fluctuations du climat a fait l'objet de l'attention des météorologues et des climatologues et aussi des autres chercheurs en domaines très différents : géographes, géologues, hydrologues, écologues, pédologues, astronomes, biochimistes, sylviculteurs et, dernièrement, d'un nombre toujours croissant de mathématiciens et de physiciens. La complexité du climat fait qu'il ne peut pas être étudié globalement, mais seulement suivant son évolution par composantes, dont le plus souvent la température de l'air et les précipitations atmosphériques.

Il est évident que les variations des éléments météorologiques apparaissent à toutes les échelles temporelles, depuis des jours, semaines, mois, saisons, années, jusqu'aux décennies, siècles, millénaires et ères géologiques. La cause de ces variations, bien que longuement étudiée et mise en discussion, n'est pas, de nos jours, complètement éclaircie. Est en même temps connue la périodicité diurne et annuelle dans la variation de certains éléments et phénomènes météorologiques. Néanmoins, les variations des processus atmosphériques se caractérisent plutôt par leur rythme, n'ayant pas une variation strictement périodique. Elles ont une amplitude d'oscillation inconstante et des demi-périodes d'oscillations inégales, la cyclicité naturelle dans l'évolution du climat n'étant pas encore connue.

Les causes de la variation du climat sont très complexes et on ne pourrait pas les expliquer de façon unilatérale. L'évolution de cette variation est « dirigée » par des influences différentes, qui n'agissent pas toutes dans un même sens. Ainsi : les modifications des éléments de l'orbite terrestre ; les changements continuels de la position de l'axe de rotation de

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la Terre ; la radiation solaire, en tant qu'une source essentielle d'énergie des processus atmosphériques de la Terre qui n'est pas constante (en outre, le régime de la radiation reçue et rendue par la surface terrestre et par l'atmosphère comprend des variations déterminées par la modification de la teneur en CO_2 de l'air, par les modifications accidentelles de l'opacité atmosphérique sous l'action de l'activité volcanique) ; les mouvements tectoniques de l'écorce terrestre, etc. L'accroissement et la fonte des calottes glaciaires, l'évolution de la couche de neige et de la nébulosité, l'évaporation à la superficie des océans, aux latitudes de l'Equateur, la variation sur la verticale de la circulation océanique sont des éléments qui, par certains mécanismes physiques, ont des réactions suffisamment prolongées et des répercussions sur les variations du système climatique en contribuant, à leur tour, à la détermination du climat.

Les effets de la circulation générale de l'atmosphère sont les plus manifestes dans les modifications non périodiques, à brève échéance, du temps. Ces modifications se produisent continuellement sur la Terre, mais leurs nature et intensité ne sont pas partout identiques. Comme exemple, on peut signaler la variation d'une année à l'autre des valeurs moyennes mensuelles, saisonnières et annuelles de la température de l'air aux stations météo de la Roumanie et de l'Europe centrale et du Sud-Est, dans lesquelles on a effectué des observations les 100—200 dernières années. La circulation atmosphérique, beaucoup plus intense pendant la saison froide de l'année, engendre des changements non périodiques de la température de l'air beaucoup plus importantes que celles des périodes de chaleur (fig. 1, tableau 1). Ainsi, les températures moyennes très basses des mois de janvier 1858, 1864, 1893, 1896, 1942, 1963, 1964 et 1985 et également, les très hautes valeurs moyennes des mois de janvier 1895, 1915, 1919, 1921, 1936, 1948, 1983 et 1988 se trouvent dans un écart d'environ 9 — 18°C. Les refroidissements et les hausses de température sont évidents sur tout le territoire étudié, mais avec des intensités locales différentes. On observe le même phénomène à la variation de la température pendant les mois d'été, bien que l'écart soit moindre, de 4 — 7°C seulement en juillet, par exemple. On a remarqué des juillets froids en 1913, 1979, 1984 mais aussi de très chauds en 1895, 1928, 1936, 1938, 1946, 1950, 1987. Les fluctuations de la température moyenne de l'air sont plus amples, en général, en Europe centrale et dans les zones septentrionales de la Roumanie, que sur les côtés sud et sud-est de la région étudiée et cela pour tous les mois de l'année, pour les saisons et les moyennes annuelles.

Pour faire ressortir les variations d'ensemble, à plus longue durée et la tendance de variation de la température de l'air, les valeurs moyennes mensuelles, saisonnières et annuelles, calculées à l'aide des mesurages fournis par les observations météo de plus d'un siècle, ont été traitées en utilisant la méthode des moyennes glissantes sur différents intervalles de temps, à pas d'une année.

L'utilisation de la méthode des moyennes glissantes fait diminuer l'effet des variations accidentelles, élimine en même temps celui des fluctuations de très brève durée et aussi l'évolution cyclique, au cas où la période pour laquelle on calcule chaque moyenne est un multiple de la durée du cycle et son amplitude est très constante. De cette façon, l'influence

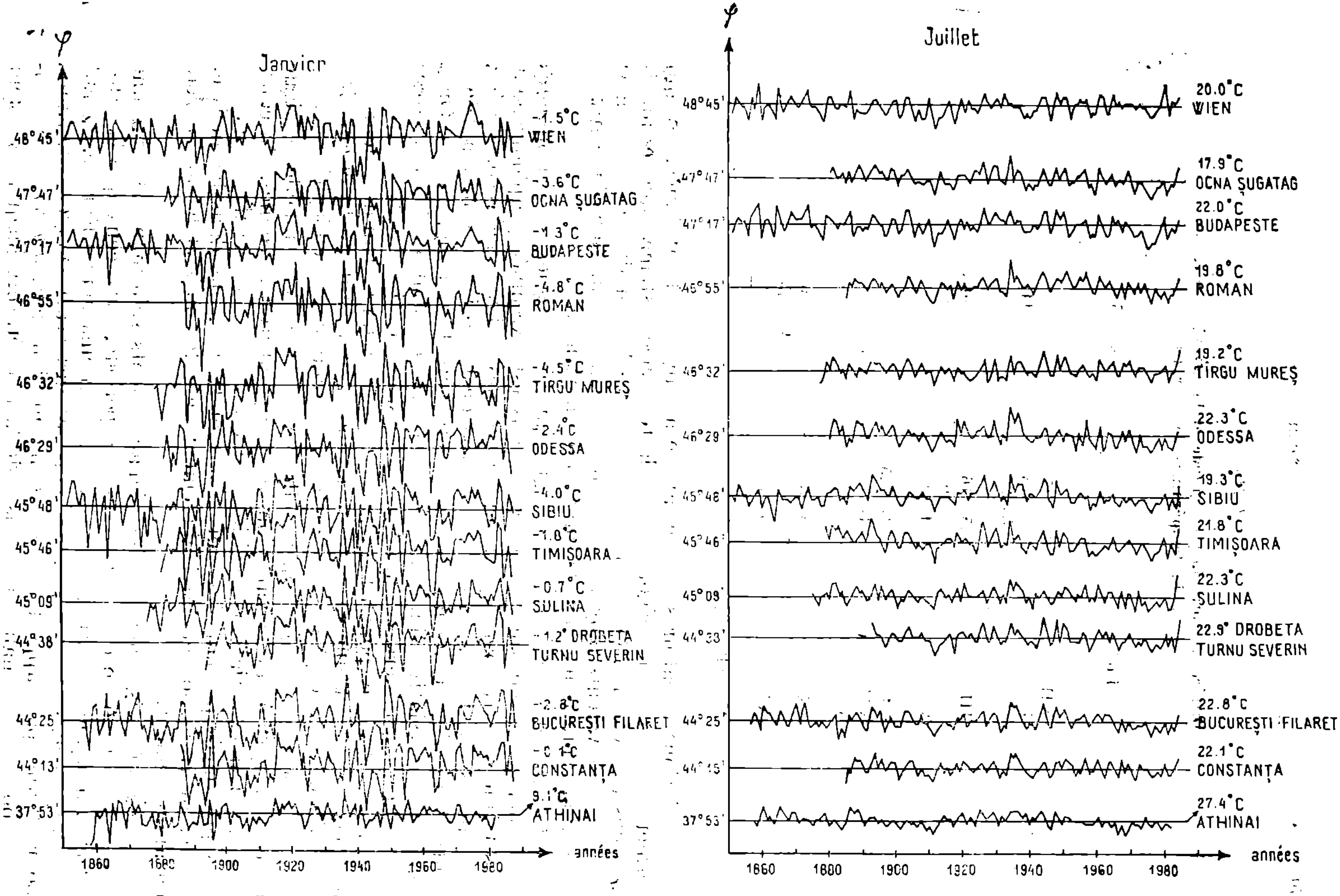

Fig. 1. – Variation de la température moyenne mensuelle de l'air (°C) d'une année à l'autre: I, VII.

Tableau 1

Différence entre la plus grande et la moindre moyenne de la température de l'air (°C)

Mois		Saison
XII	8,5–17	hiver
I	9–18	7,5–11
II	8–20	
III	8,5–16	printemps
IV	6,5–9	5–9
V	4–9,5	
VI	4–7,5	été
VII	4–7	3,5–6
VIII	5,5–9	
IX	6–8	automne
X	7,5–11,5	4–7,5
XI	8,5–13	
Annuelle	3–5	

des variations aléatoires d'une année à l'autre est atténuée, ce qui permet une observation rigoureuse de la tendance systématique des modifications des valeurs. On peut ainsi concevoir le domaine des variations possibles des valeurs moyennes en différents délais, question d'une grande importance pratique pour la prévision climatique.

La marche des moyennes glissantes — mensuelles, saisonnières et annuelles — pour tous les 10 et 30 ans est examinée graphiquement sous forme d'écarts par rapport aux moyennes multiannuelles concernées, les stations étant situées, comme au cas de la variation d'une année à l'autre, dans l'ordre des latitudes, du nord vers le sud (fig. 2 et 3). On a constaté une relative similitude régionale de la variation des moyennes mensuelles, saisonnières et annuelles et aussi de l'évolution des écarts des moyennes glissantes pour 10 et 30 ans (quoique à un niveau de valeur différent), ce qui est une marque de l'apport important de la circulation générale de l'atmosphère à l'échelle continentale et hémisphérique.

L'aspect des courbes mensuelles, saisonnières et annuelles indique un certain rythme de la variation des températures moyennes. On constate aussi une variation spécifique aux différents intervalles analysés, plus prononcée pendant les mois froids et l'hiver, que dans les mois et saisons de transition et particulièrement dans les mois et la saison d'été ou annuellement.

Les refroidissements et les réchauffements sont manifestes sur une aire vaste, en concordance, en tant que période, avec ceux que la littérature roumaine et étrangère a signalé, au moins pour l'Europe. Quant à la tendance, par exemple, des courbes des écarts moyens glissants, pour 10 ans, par rapport à la moyenne multiannuelle *d'hiver*, elles indiquent pour la Roumanie une baisse de la température jusqu'à la valeur

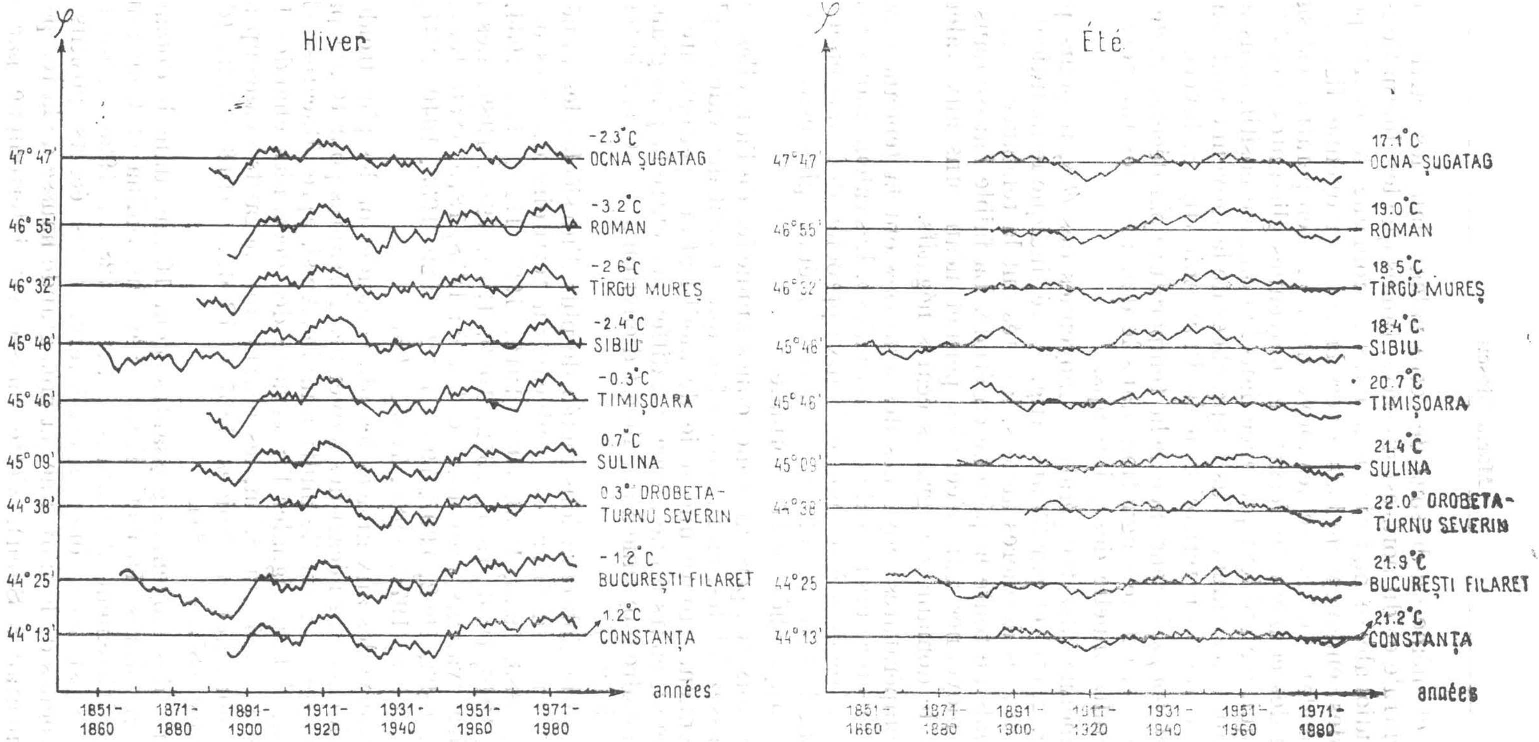

Fig. 2. — Ecart des moyennes glissantes (tous les 10 ans), saisonnières, par rapport aux moyennes multiannuelles (°C): hiver, été.

« normale » et même au-dessous de cette valeur dans les parties septentrionale, centrale et du nord-est du pays, tandis que les fluctuations de la région méridionale se maintiennent dans le domaine des écarts positifs, mais avec des tendances de baisse vers la valeur moyenne (fig. 2, hiver). La même tendance de baisse des moyennes de la température est signalée par l'allure des courbes de l'écart des moyennes glissantes, pour 30 ans, des hivers qui, malgré leur présence dans le domaine positif, dans le nord du pays auront des valeurs plus rapprochées de la moyenne multiannuelle que celles du reste du territoire de la Roumanie (fig. 3, hiver).

Au *printemps*, la tendance de la température par décennies, de même que par 30 ans, est de stagnation dans le domaine très rapproché de la moyenne multiannuelle des printemps.

La tendance des températures moyennes des *étés*, toujours par décennies (fig. 2, été) et par 30 ans, (fig. 3, été, indique le maintient du refroidissement ; les dernières années, les étés ont la tendance d'être parmi les plus froids de toute la période en étude. La faible hausse dans l'évolution des moyennes par décennies permet néanmoins aux valeurs de rester dans le domaine des grands écarts négatifs.

Les températures moyennes des *automnes* ont la tendance, par décennies, de revenir vers les valeurs « normales ». Les valeurs moyennes pour tous les 30 ans tendent à se maintenir aux approches de la moyenne multiannuelle, sur le littoral l'allure de la courbe étant plus estompée et les écarts plus rapprochés de la « normale ».

Quant aux températures moyennes annuelles de l'air, elles ont des variations assez faibles, en raison du fait que ce sont des valeurs globales qui « contiennent » toute une série de modifications permanentes de la température au cours d'une année. La différence entre la plus grande valeur et la moindre moyenne annuelle est d'environ 3 — 5°C sur le territoire du pays (tableau 1).

De la série d'observations météo de plus d'un siècles, les années aux valeurs moyennes supérieures au niveau du territoire du pays ont été : 1872, 1873, 1886, 1900, 1903, 1910, 1916, 1923, 1926, 1927, 1934, 1936, 1937, 1939, 1946, 1950, 1951, 1952, 1960, 1975, 1983, 1989. Les années aux moindres valeurs moyennes ont été : 1858, 1875, 1880, 1881, 1883, 1884, 1888, 1893, 1902, 1907, 1908, 1922, 1929, 1933, 1940, 1941, 1942, 1954, 1956, 1969, 1976, 1980, 1985, 1987.

Les intervalles aux années les plus chaudes ou les plus froides sont mises en évidence par l'écart des moyennes glissantes pour 10 ans par rapport à la moyenne annuelle multiannuelle. Ainsi, après Bucarest—Filaret et Budapest, il faut signaler l'intervalle des décennies chaudes 1857 — 1866 . . . 1866 — 1875 (à Sibiu, les écarts sont négatifs beaucoup au-dessous de la normale) et froides 1867 — 1876 . . . 1916 — 1925 (dont la plus froide est 1875 — 1884).

L'écart des moyennes glissantes pour 10 ans, dans le domaine négatif, à Tîrgu Mureş, Drobeta-Turnu Severin, Sulina et Constanţa fait voir le refroidissement des années 1919—1928 . . . 1929 — 1938 (fig. 2). Le reste des stations ont en cet intervalle des écarts positifs, mais assez rapprochés de la moyenne (la plus grande hausse de la température annuelle apparaît à Sibiu). Cette hausse est interrompue par l'écart

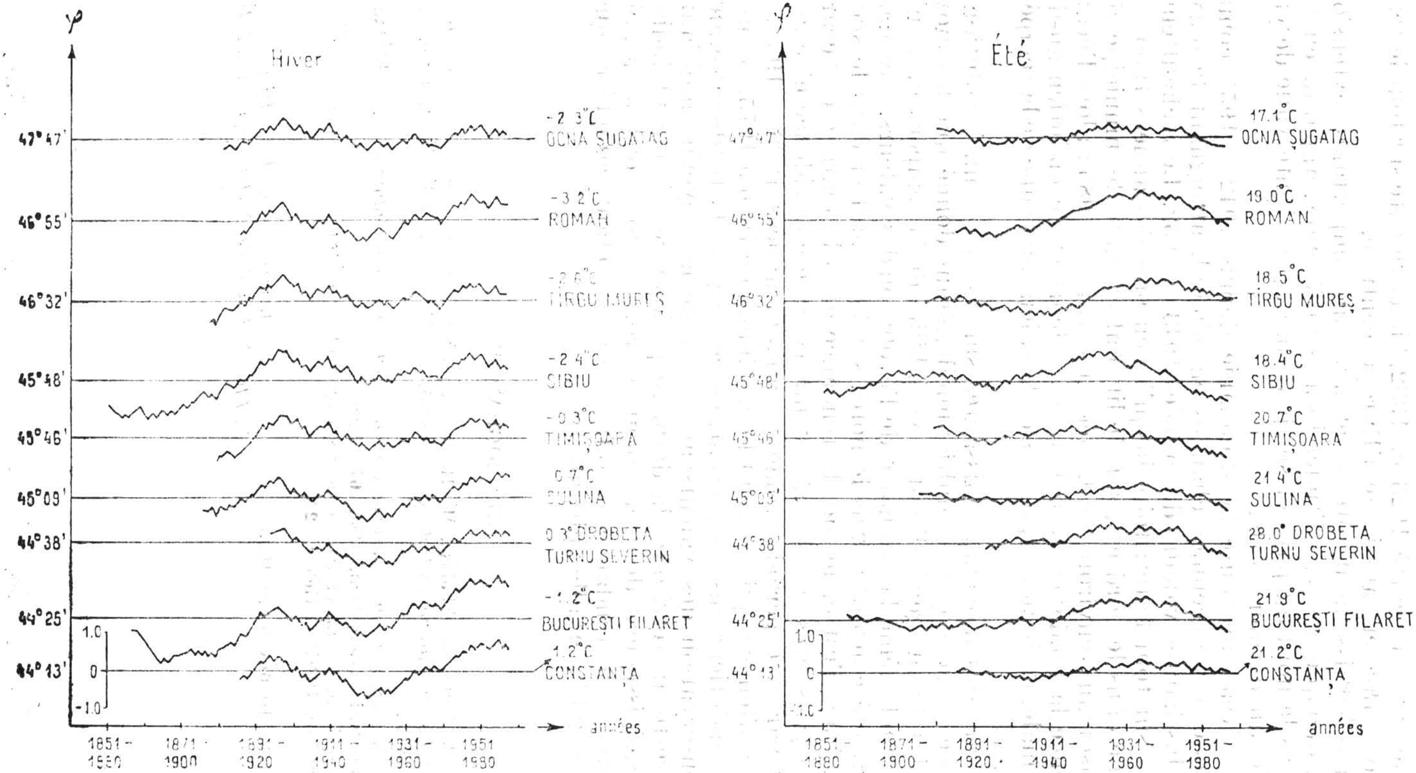

Fig. 3. – Ecart des moyennes glissantes (tous les 30 ans), saisonnières, par rapport aux moyennes multiannuelles (°C): hiver, été.

négatif des valeurs entre 1923 et 1932, bien évidente sur tout le territoire de la Roumanie et, aussi, de l'Europe centrale.

Un refroidissement intense et avec une importante extension territoriale, quoique aux amplitudes locales différentes, apparait en 1940 – 1949. Dans le nord du pays et sur le littoral, c'est l'intervalle décennal le plus froid du dernier siècle.

Au niveau de toute la Roumanie depuis 1942 – 1951 commence une période aux décennies chaudes en général, atteignant le maximum par les plus hautes valeurs des années 1943 – 1952. Le réchauffement se maintient sur tout le territoire jusqu'à peu près des années 1966 – 1975, tandis que dans le nord-est, sur le littoral et dans le municipe de Bucarest jusqu'aux environs de la décennie 1976 – 1985 ; alors l'écart met en évidence la tendance de baisse des valeurs et de maintien au-dessous de la normale, mais aux approches de la valeur moyenne de la température annuelle.

L'écart des moyennes glissantes sur 30 ans a une évolution assez rapprochée de la moyenne multiannuelle, étant donné que les moyennes sur tous les 30 ans généralisent la variabilité de la température, en maintenant quand même la tendance de l'évolution des valeurs. Les moindres écarts ont été constatés dans le nord, sur le littoral et dans le sud-ouest du pays. Dans l'est et le sud, la tendance dans la marche des écarts des moyennes glissantes sur 30 ans est mieux mise en évidence et elle se caractérise par une période froide jusqu'aux années 1906 – 1935, suivie d'un réchauffement qui a atteint le maximum de 1946 à 1975. L'intervalle chaud se maintient aussi à présent, en ces régions la tendance étant celle de la conservation des valeurs au-dessus de la moyenne multiannuelle. Pour le reste du territoire, la dernière période de glissement indique un faible refroidissement dont la valeur se trouve au-dessous de la moyenne multiannuelle, la tendance de refroidissement étant caractéristique également pour l'intervalle suivant.

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SALT MASSIFS AND THEIR NATURAL CURE FACTORS *

ELENA TEODOREANU

Les facteurs thérapeutiques naturels des massifs de sel. On fait une présentation concise des sources et des lacs salés, d'après leurs caractères géographiques, géologiques, physiques et chimiques, en indiquant les principales stations de cure, de même les dépôts de boues minéraux et sapropéliques avec leurs propriétés qui influencent le caractère thérapeuthique, le bioclimat sédatif des régions de massifs de sel et également des salines, avec leurs principales propriétés micro- et bioclimatiques, physiques, chimiques et microbiologiques. A la fin, on discute la mise en valeur touristique et particulièrement médicale de tous ces facteurs, pour la cure interne et externe, balnéaire et climatique dans les stations et dans les salines indiquées pour diverses maladies (rhumatisme, affections gynécologiques, respiratoires, etc.)

Key words: salt massifs, natural cure factors, Romania

Romania's Alpine—Carpathian unit holds an important salinogenic basin. It contains variously-aged deposits displayed over several stratigraphic levels, from the Mesozoic up to the Neozoic. Most of them lie in the Miocene and comprise extended lithologically-varied evaporite deposits: gypsums, mother salt, potassium salts, all of which are of interest to industry and spa and health cure alike.

Geologists use to distinguish several regions in which salt sediments are outcropping [1]:

(a) The Transylvanian Depression shows an almost continuous salt deposit layer that covers some 16,000 sq km; its average thickness is 250 m, reaching 1,000 m — 2,000 m in the diapiric folds. The deposits are associated with sources of methane gas. On the eastern, western and southern slopes the salt is outcropping.

(b) The Moldavian Subcarpathians and the Curvature Subcarpathians are largely overlapping the structural unit of the Precarpathian Depression; one should add to it the Carpathian Flysch zone which lies at the western extremity of the Subcarpathian area.

(c) The hillocks and the Getic Piedmont that stretch between the Olt and the Jiu rivers.

(d) The Maramureș Basin up to the Tisa Valley (extending beyond the border).

The work does not deal with the lakes in the Romanian Plain or with the coastal lakes of the Romanian Black Sea area, because they are of different origins.

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* This is the first part of a synthesis study authored by Elena Teodoreanu, Ph. D., physicist Ludmila Minea and chemist M. Mustață, within the Balneological Institute, Bucharest, Romania.

[1] According to L. Mrazec's *Salt Occurrences Chart*, reported by M. Sturza (1950):

Natural cure factors originating in salt massifs are many and varied.

1. **Salt water springs** are one of the three types of predominant mineral waters, beside sulphureous-sulphite and carbogaseous, that occur in Romania. They contain chlorine and sodium ions and occasionally ions of potassium, bromine, iodine, or boron. Mineral waters are considered to be sodium chlorinated if they contain at least 1 g/l, that is 393 mg Na/l and 607 mg Cl/l, respectively. In general, however, concentrations are high, e. g. 20 g/l – 290 g/l. Mineral waters are widely spread in the territory of this country. Waters turn mineral-rich either through the direct washing of outcropping saliferous deposits by surface waters or through the leaching of these deposits deep-down by underground waters. In the latter case they might become contaminated by the water of the deposit. Strongly mineralized waters occur in the Quaternary deposits overlying salt or salt breccia sediments. Deep salt waters may spring up to the surface either naturally, especially along tectonic accident lines that affect the marl-clay deposits (these waters being chiefly chlorinate-sulphated or bicarbonate), or in places where pervious intercalations (usually chloro-magnesic or calcic) have created conditions propitious to natural drainage. In general, drainage is reduced, except for the aqueous strata of Quaternary deposits, while the water flow is slow or even capillary.

The best known spas and climate resorts, or localities in which salt springs are reported, are the following: Someşeni, Turda, Ocna Mureş, Ocna Sibiului, Ideciu, Cacica, Bălţăteşti, Ocnele Mari, Călimăneşti, Ocna Şugatag, etc. Besides these, the literature lists over 200 localities where they have one or several salt springs.

2. **Salt lakes** are connected with the saliferous formations extent in the geological substrate of these regions. Most of them are of a relatively recent anthropogenic origin (old deserted or collapsed mines). The water comes from precipitations and the salt concentration results from the dissolution of the sediments. Such are the lakes at Coştiui and Ocna Şugatag, Ocna Mureş, Turda, Cojocna, Ocna Sibiului, Ocnele Mari, Ocniţa, Telega, Sărata-Bacău. Some of them are very deep but not very extended. The sinking of banks and the sliding of land often lead to their mudding off and decrease their chemical concentration. Salt lakes formed in a natural way (like the lakes at Sovata), through the sinking of surface rocks into the holes left by the dissolution of the salt (karst phenomenon) are but seldom found. If fresh water streams on the surface of a salt lake, it develops a phenomenon of heliothermia, with the deep water temperature rising by 20 – 30°C, which is effective in spa treatment (Sovata, Ocnele Mari).

3. **Muds** (sapropel and mineral, seldom peats) are linked to the presence of salt lakes and are found in salt massif areas. According to their physico-chemical composition, they are heterogeneous mixtures of organic and mineral substances, having varied structural forms and states of aggregation. In the course of sedimentation and of the slow transformation of terrigenous and biogenous material from lacustrine and marine environments under the impact of specific climatic, hydrologic, lithologic and biologic conditions, muds have acquired therapy-effective physica and chemical properties like the capacity to retain and absorb water;

plasticity and consistency, which constitute mechanical stimulents for the skin; the capacity to retain an as-great-as-possible quantity of heat; mud sorption ability (the degree of mud/skin ion exchange).

Only those muds meeting certain quality indices [2] are recommended for therapy, namely, chemical composition-dependent humidity, texture (few particles bigger than 0.25 mm), overall organic substances/dry substance ratio (a 10% value differentiates mineral from organic muds), an over 50% decomposition degree of vegetal organic remains (in the case of peats), mineralization and ion composition of mud imbibition solution according to mineral water chemical standards (weakly mineralized: <15 g/l; mineralized: 15 g/l — 35 g/l; strongly mineralized: 35 g/l — 150 g/l; salt-satured: >150 g/l), content of sulphuretted hydrogen and sulphides, mud pH (acid: <5; weakly acid: 5 — 7; weakly alkaline: 7 — 8; alkaline: >8).

The principal sapropel mud spas are Bazna, Ocna Sibiului, Ocna Şugatag, Gura Ocniţei, Jibou. Mineral mud cures are given at Turda, Slănic-Prahova, Telega, Sovata, Govora, Săcelu, Sărata Monteoru, Sîngeorz-Băi, Ocnele Mari, Sărmăşel, Sîngeorgiu de Mureş. Salt peat is found at Seike (Odorheiu Secuiesc) and Someşeni, and salt clays at Turda and Cojocna.

4. **The bioclimate** of the salt massifs in Romania, which lie at moderate altitudes of about 200 m — 800 m, usually depressions, inside and outside the Carpathian Arc, represent itself a major cure factor. The geographical elements peculiar to these areas shape a moderate climate: average global solar radiation/year = 110 — 120 kcal/cm²; relief-attenuated general atmospheric circulation; average annual temperature = = 7 — 10°C, with means of 18 — 20°C in July and of −2° to − 6°C in January; low thermal amplitudes, in general, because winters are milder than in the lowlands and the highlands and summers are rather cool, especially at the upper altitude limit; the sun shines 1 800 — 2 100 h/ /year, with over 250 hours in summertime; moderate precipitations, averaging 600 mm — 800 mm falls/year; mild air dynamics, moreover in depressions sheltered from the dominant winds of the region; frequent calm; moderate atmospheric pressure, slightly depressed as against the plain area, viz. 980 — 920 mb.

The characteristic features of the climate in salt massif areas outline a sedative, non-invasive, sparing bioclimate, the more so, counting the maximum number of thermal comfort days in summer, the low-value bioclimatic, pulmonary and cutaneous stress index, the many skin-relaxant and pulmonary-balanced months. The numerous hours of strong insolation on the south-exposed and wind-sheltered slopes at low, but also at higher altitudes entail corresponding temperatures that enhance the curing potential of air, sun, and water in the resorts of local or general interest benefiting by the cure factors discussed above, particularly salt lakes and therapeutic muds.

5. **Salt mines** enjoy a remarkably constant climate, irrespective of external conditions and season. Temperature values range between 10 and 15°C, depending on the mine, with summer-to-winter variations

[2] After Sanda Gheorghievici-Samson, *Cura balneoclimatică. Indicaţii şi contra indicaţii de trimitere la cură*, Chap. *Nămoluri terapeutice*.

of 1 — 2°C, relative humidity 64 — 78%, air currents speed below 0.5 m/s, slightly in excess only in the vicinity of aeration mouths. The atmospheric pressure depends on the depth of the mine location, deep mines recording mild pressure increases. Air equivalent temperatures place salt mines into the category of moderate cooling-included discomfort areas, with a slight hypotonic-to-relaxant and dehydrating-to-balanced cutaneous and pulmonary stress, respectively.

Physico-chemical conditions, in their turn, are peculiar and stable: moderate-to-strong air ionization of small ions, with a generally mild predominance of positive ions, low amounts of large ions, sodium chlorine aerosols. Microbiological tests show few bacteria and fungi and, in view of it, the air very pure, chemical pollution is reduced, carbon dioxide below maximum admitted concentrations, an approximately neutre pH. The salt mines endowed with treatment facilities are Slănic-Prahova, Tîrgu Ocna and Praid; works at Turda mine are underway. Ocna Dej, Ocna Mureș and Cacica mines are closed to the public as the walls of the first two might collapse anytime, and the air of the last one is polluted by the cheese stored in the upper horizon, having aeration mouths in common.

The medical and tourist availabilities depend on the type of natural factor prevailing in the area. For exemple, if the concentration of salt waters is reduced (up to 15 g/l), it is indicated for internal therapy, spraying and aerosols in gastroduodenal affections (chronic gastrites, colites, intestinal dyspepsias, diabetes mallitus); chronic rhynopharyngites, sinusites, tracheobronchites. The mechanical effect of throat washings is sedative and anti-inflammatory. Water-drinking cures depend on the chemical content of mixt waters. The dose should be carefully prescribed in order to avoid the negative effect of increased sodium and chlorine additions.

The concentrated salt waters of springs and lakes are used for external cures in pools or bath-tubes, heated or naturally hot, or in lakes of which some are heliothermal (e. g. Ursu Lake at Sovata), and for vaginal irrigations. Medical indications: inflammatory, degenerative, abarticular rheumatisms, arthrosing states and affections of the peripheral nervous system, posttraumatic sequelae of the limbs, extra-pulmonary tuberculosis, gynecological affections, endocrine disorders, skin diseases.

Mud cures are recommended for many affections in which the concentrated salt water treatment has good results, that is, ailments of the locomotive apparatus, in particular: inflammatory, degenerative rheumatisms, posttraumatic sequelae, chronic gynecopathies, female sterility, hypothyroidism, psoriasis, exemas, rush. Counterindications: only in the acute forms of these affections, as well as in some disorders of the digestive tract, kidneys or of the cardiovascular apparatus, with arterial hypertension.

A sparing bioclimate has the widest cure indications, because it does not put a strain on the nervous and the endocrine systems, while the overstrained neuro-endocrine functions are brought to a state of repause. It is particularly beneficial in rest and recreation cures, neuroasthenias, and convalescences. One must be cautious when associating it to the other forms of treatment — helio- and hydrotherapy lest accidents induced by hyperinsolation or by hyper- or hypocaloric values should occur. Climatotherapy itself stands out as a major curing modality, offering, among other things, the advantages of negative air ionization, of vegetal and possibly saline aerosols.

Salt therapy practiced in the galleries of former mines is recommended for lung diseases, especially chronic obstructive bronchopulmonary affections, asthma, allergies of the higher airways. Counterindications: lung tuberculosis, heart failure, pulmonary neoplasias, febrile states, etc.

The tourist potential of these areas is subordinated to their medical uses, because the vast majority of visitors come to cure such affections as mentioned above. Some of the resorts lie in an afforested environment, have parks, salt-water strands, hotels, chalets, marked out mountain roads in their surroundings, salt pits, 'salt mountains' (at Slănic), grottos. Unfortunately, many localities, boasting valuable natural cure factors, offer but modest, often improvized facilities. Therefore, they are insufficiently put to account and do not exceed local interest. There exists, however, a number of traditional spas and health resorts that can provide more or less acceptable amenities, but they are exceedingly crowded, particularly in summertime.

Putting these resorts to better uses claims economic studies and investigations into their treatment and tourist offer, to make the most of all their availabilities.

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LA RÉPARTITION DE LA QUANTITÉ DES PRÉCIPITATIONS ATMOSPHÉRIQUES EN FONCTION DE L'ALTITUDE DU RELIEF DANS LES BASSINS DES RIVIÈRES DE LA PARTIE EXTÉRIEURE DES CARPATES ORIENTALES

ION-FLORIN MIHĂILESCU [1], *ELENA PANTAZI* [2]

The distribution of the rainfall amount depending on altitude in the drainage basins of the outer side of the Eastern Carpathians. Based on data from 140 meteorological and rainfall stations related to the observation period of 1896–1984, one analysed the altitudinal distribution of the rainfull amount in the drainage basins of the exterior Eastern Carpathians. By means of the unlinear regression function, which provided the strongest relations to the relief altitude, we produced the vertical profiles of the precipitation quantities with the help of which we emphasized the quantitative differences between basins. The vertical profiles, typical to the aerodynamic shelter areas, express the deep contrast and the pluviometric surplus of the Southern and South-Eastern ones; they also express the more reduced yearly precipitation quanities of the Bistrița River basin compared to the other basins of the exterior Eastern Carpathians.

Mots-clé: précipitations atmosphériques, Carpates Orientales.

Dans le présent ouvrage on analyse la répartition des quantités de précipitations atmosphériques en fonction du relief dans les bassins des rivières de la partie extérieure des Carpates Orientales, sur la base des enregistrements provenant de plus de 140 stations météorologiques et postes pluviométriques et rapportés à la période d'observations 1896 — 1984.

Les profils de la répartition verticale des quantités de précipitations ont été faits pour les 7 bassins des principales rivières des Carpates Orientales : Ialomița, Buzău, Trotuș, Bistrița, Moldova et Suceava. Pour le groupe de bassins des rivières plus petites : Șușița, Putna et Rîmnicul Sărat on a constitué un seul profil.

Comme dans le cas de quelques autres recherches, on a ressenti l'absence de points d'observation dans la zone des hautes montagnes, leur grande majorité étant située dans la région des montagnes moyennes et basses. Au-delà de l'altitude de 1000 m, les points d'observation les plus nombreux se trouvent dans le bassin de la Ialomița où ils représentent environ 50% de son réseau pluviométrique.

Les différenciations de pluviosité entre les bassins ont été mises en évidence par la comparaison du profil vertical de chaque bassin séparément, avec le profil moyen réalisé pour toute la partie extérieure des Carpates Orientales.

Pour pouvoir comparer les profils verticaux des précipitations atmosphériques propres à chaque bassin, on a choisi la fonction de régression non linéaire par laquelle on obtenait la liaison la plus étroite entre les variables mises en corrélation.

Elle est du type : $y = \frac{x}{a + bx + cx^2}$

Ainsi, les rapports de corrélation obtenus pour les courbes calculées pour chaque mois séparément ont oscillé entre 0,82 — 0,97 dans le bassin de la Bistriţa, et entre 0,96 — 0,99 dans le bassin du Trotuş ; en ce qui concerne les courbes saisonnières et annuelles, celles-ci se situent entre 0,84 — 0,97 dans le bassin de la Bistriţa. et entre 0,98 — 0,99 dans le bassin du Trotuş et ceux de la Şuşiţa, de la Putna et du Rîmnicul Sărat.

En général, les profils verticaux appartiennent au type caractéristique des ainsi nommées zones protégées du vent, des montagnes situées aux latitudes tempérées où les précipitations augmentent en fonction de l'altitude, plus fortement dans la partie inférieure des versants.

La dépendance des précipitations de l'altitude, dans les bassins des rivières analysées, se différencie par rapport aux particularités saisonnières du degré de protection créé par la barrière montagneuse des Carpates Orientales s'opposant aux masses d'air humide prédominantes.

En comparant les profils annuels des précipitations on constate un excédent pluviométrique dans le bassin de la Ialomiţa, tant dans la région des montagnes basses que dans celle des montagnes moyennes. De même, si pour le bassin de la Suceava le profil vertical se superpose sur celui moyen, pour les autres bassins on constate un déficit pluviométrique plus prononcé dans la région des montagnes basses dans le bassin du Buzău, et dans celle des montagnes moyennes dans le bassin de la Bistriţa (fig. 1).

En hiver, aux advections propres à la circulation de l'atmosphère, exprimée sur les hautes cimes montagneuses par des vents de direction ouest et nord-ouest, l'effet de fœhnisation produit par les mouvements descendants de l'air qui traverse les Carpates Orientales influence fortement la répartition verticale des précipitations atmosphériques.

À partir du bassin du Trotuş vers le nord, le déficit pluviométrique est constaté sur tout le profil vertical, tandis que pour les bassins se trouvant au sud de celui-ci, la limite supérieure de la zone comportant un excédent pluviométrique contenu dans le profil vertical des précipitations baisse graduellement en ce qui concerne l'altitude, à mesure que le bassin se situe plus au nord.

De cette façon, la zone d'abri aérodynamique est le mieux délimitée dans la partie est des Carpates Orientales où la circulation ouest est perpendiculaire à la chaîne montagneuse.

Ce phénomène est clairement exprimé par la variation de la quantité moyenne de précipitations sur les courbes de niveau de 400 m et de 1200 m que l'on considère comme délimitant à la verticale les montagnes basses. À la base de ces montagnes, la diminution maximale des précipitations atmosphériques se trouve dans les bassins de la Bistriţa, de la Moldova et du Trotuş (fig. 2).

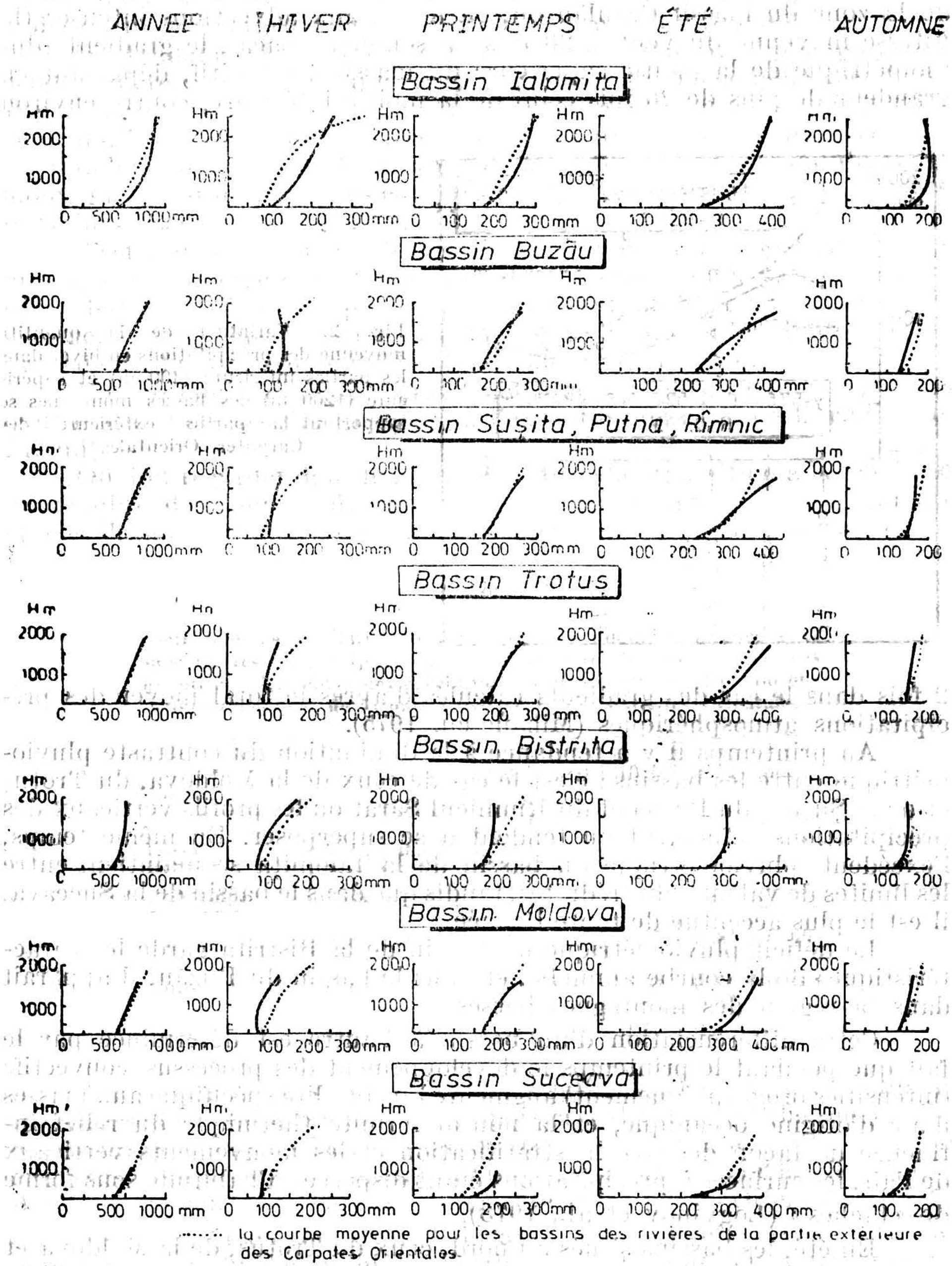

Fig. 1. Profils verticaux des quantités annuelles et saisonnières de précipitations atmosphériques.

Un exemple qui met en évidence l'effet de fœhnisation est celui de la zone du massif Ceahlău où, en hiver, aux advections intenses (la vitesse moyenne du vent = 20 m/s au sommet Toaca), le gradient pluviométrique de la moitié supérieure du massif est positif, dépassant en grandeur de plus de 20 fois celui de la moitié inférieure, contre environ

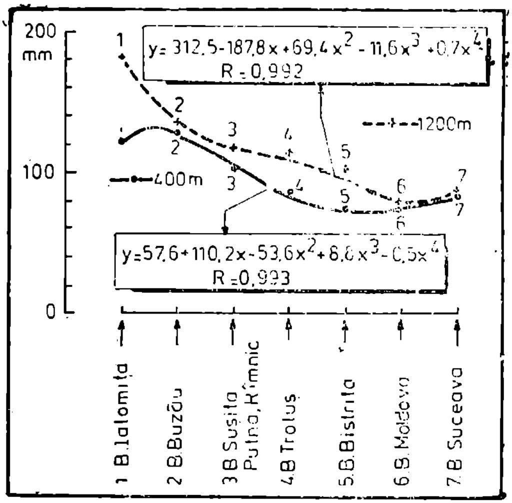

Fig. 2. Variation de la quantité moyenne des précipitations en hiver dans les parties inférieure (400 m) et supérieure (1200 m) des basses montagnes se rapportant à la partie extérieure des Carpates Orientales

2 fois dans le cas des gradients calculés d'après le total moyen des précipitations atmosphériques (Mihăilescu, 1975).

Au printemps il y a tendance à la diminution du contraste pluviométrique entre les bassins ; c'est le cas de ceux de la Moldova, du Trotuş et de la Şuşiţa, du Putna et du Rîmnicul Sărat où les profils verticaux des précipitations coïncident ou tendent à se superposer. En même temps, l'excédent pluviométrique du bassin de la Ialomiţa se maintient entre les limites de valeurs plus réduites, tandis que dans le bassin de la Suceava, il est le plus accentué de toute l'année.

Le déficit pluviométrique du bassin de la Bistriţa garde les caractéristiques de la courbe annuelle, et dans le bassin du Buzău, il apparaît dans la région des montagnes basses.

Cette différenciation d'un bassin à l'autre est déterminée par le fait que pendant le printemps le développement des processus convectifs (intensifiés orographiquement) augmente l'instabilité spécifique aux masses d'air d'origine océanique, et la non-uniformité thermique du relief influence de façon décisive la stratification et les mouvements verticaux de l'air, les surfaces à précipitations étant disposées d'habitude sous forme de « taches » (Logvinov et al., 1973).

En été, les bassins situés au nord, ceux du Trotuş, de la Moldova et de la Suceava se caractérisent par l'excédent pluviométrique ; il en est de même pour le bassin de la Ialomiţa, mais ici il est plus réduit par rapport aux autres saisons. L'excédent pluviométrique apparaît aussi à la courbure des Carpates, mais dans la région des montagnes moyennes, tandis que dans le bassin du Buzău, dans la région des montagnes basses, le déficit de précipitations est le plus accentué de toute l'année.

La tendance à l'intensification orographique des précipitations pendant l'été, sur les versants Est, représente un phenomène spécifique aux Carpates, étant dû à l'intensification des averses convectives par les versants, à la circulation montagne-vallée et aux mouvements verticaux de grandeur moyenne de l'air, ainsi qu'à l'influence thermique du relief montagneux sur les processus convectifs qui se développent sur des espaces restreints (Logvinov et al., 1973).

C'est sous ce même angle que l'on doit voir aussi le déficit pluviométrique qui se crée dans les bassins des rivières des Carpates de Courbure, déficit attribué aux processus de fœhnisation de la saison hivernale lorsque, en fait, dans la région des montagnes basses du bassin du Buzău, l'excédent pluviométrique est le plus prononcé de l'année.

En automne, le déficit pluviométrique est plus ou moins présent dans le cadre des bassins analysés, à l'exception de celui de la rivière de Ialomiţa.

On doit regarder dans le même sens aussi la répartition à la verticale du nombre des jours à différentes quantités de précipitations, qui est en corrélation directe avec les quantités de précipitations (tableau 1).

Tableau 1

Coefficients de corrélation linéaire entre les quantités annuelles et saisonnières de précipitations et le nombre des jours avec des quantités différentes de précipitations provenant des 27 stations météorologiques de la partie extérieure des Carpates Orientales

Saison \ mm ⩾	0,1	1,0	2,0	5,0	10,0	20,0	30,0
Hiver	0,82	0,91	0,32	0,96	0,88	0,77	0,61
Printemps	0,71	0,84	0,77	0,96	0,88	0,64	0,66
Été	0,73	0,84	0,79	0,95	0,97	0,85	0,66
Automne	0,64	0,66	0,63	0,87	0,81	0,69	0,63
Année	0,74	0,89	0,86	0,98	0,95	0,78	0,62

Les diagrammes concernant la variation mensuelle des quantités moyennes de précipitations par rapport à l'altitude de chaque bassin, construits à l'aide de la fonction de régression non linéaire mentionnée ci-dessus, complètent les conclusions présentées portant sur la distribution des précipitations dans la partie extérieure des Carpates Orientales (fig. 3).

De cette façon, en hiver, l'élévation des isohyètes avec l'altitude, caractéristique du déficit pluviométrique, est la plus puissante dans les bassins du Trotuş et de la Bistriţa.

Dans le bassin de la Bistriţa, il y a des « inversions » dans la répartition des isohyètes avec l'altitude, en novembre et en décembre, comme effet des processus de fœhnisation.

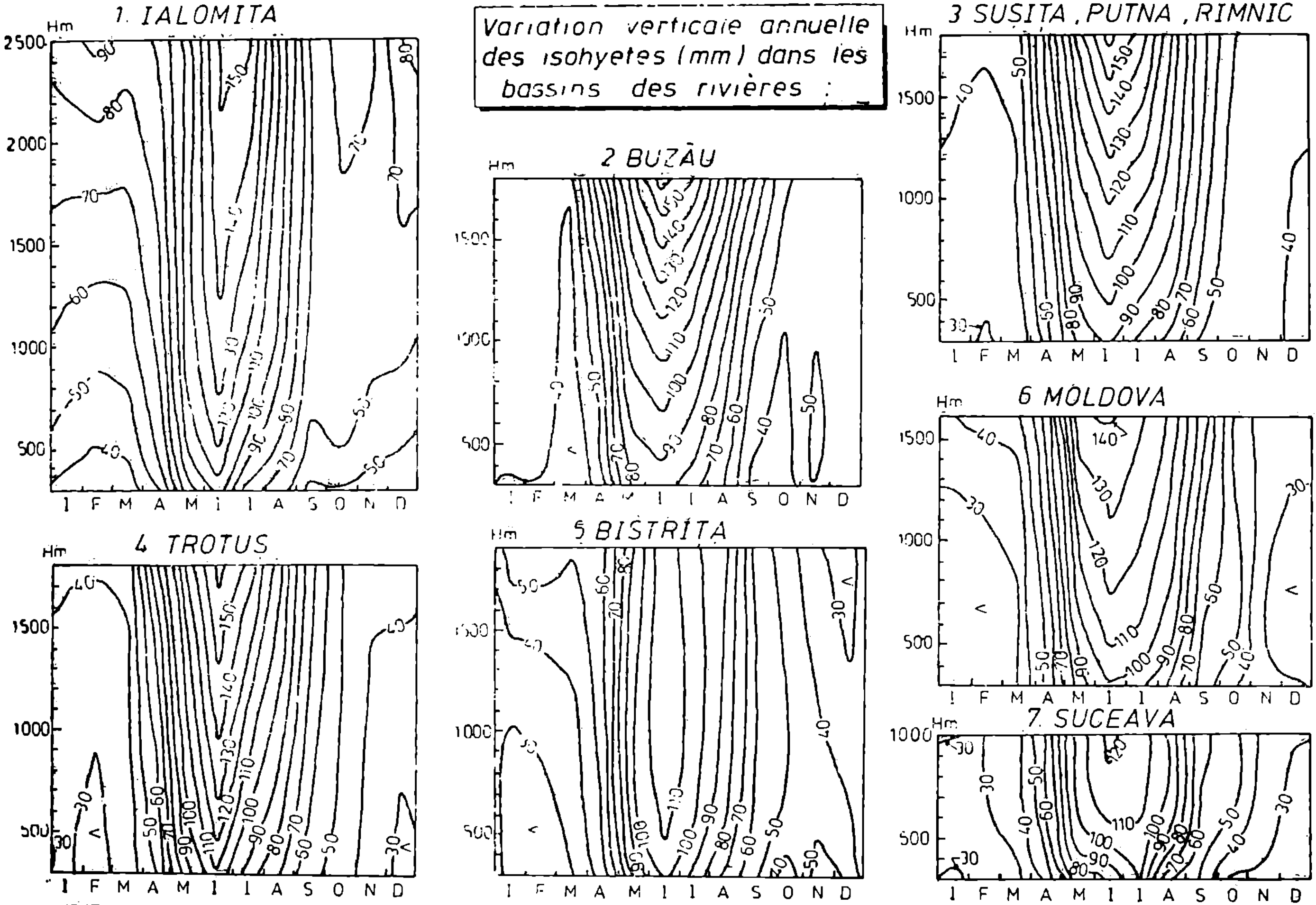

Fig. 3. Variation verticale annuelle des isohyètes (mm) dans les bassins des rivières.

Dans les autres saisons, le déficit pluviométrique mensuel le plus prononcé est enregistré également dans le bassin de la Bistriţa, suivi de celui du Buzău où l'élévation des isohyètes avec l'altitude est cependant prononcée aux mois de printemps et d'été.

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RAILWAY PASSENGER SERVICES IN ROMANIA 1948 — 1990 : A PRELIMINARY SURVEY

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Les services ferroviaires de passagers en Roumanie 1948—1990 : une approche préliminaire. On considère que les transports ferroviaires ont joué un rôle essentiel dans la modernisation de la Roumanie. Après la Seconde Guerre Mondiale, en dépit du rythme plus accéléré de développement des transports routiers, les chemins de fer ont continué à jouer un rôle de premier ordre dans le transport interne et international de passagers et de marchandises. On propose une première évaluation des progrès accumulés dans les transports ferroviaires, notamment des passagers, aussi bien extensivement qu'intensivement. Quoique la longueur du réseau ferroviaire se fût accrue, durant cette période, de 490 km, seulement, les accroissements signalés sont dus surtout à la modernisation du réseau existant (32,2% en est électrifié, 25,9% — doublé). Le parcours moyen d'un passager sur les chemins de fer roumains est évalué à 67,9 km par rapport à 25,9 km sur le réseau routier. En utilisant les horaires des trains de la période 1948—1990, utilisés en Roumanie, on détermine les modifications de trajet effectuées à travers les années, en vue de l'optimisation du trajet, la fréquence du trafic par catégories de train, le racourcissement du temps de parcours surtout pour les trains internationaux, etc.

Key words: railway passenger services, 20th century, Romania

The railway has played an essential part in the modernisation of Romania (Cebuc & Mocanu, 1976). But since the Second World War the railway has continued to play the primary role in the transport of passengers and freight; whereas in Western Europe its importance has been much reduced (Botez et al., 1977). Between 1951 and 1989 railway freight traffic has grown by 6.9 percent per annum, compared with 14.5 percent for road traffic and the tonnage carried by road is now well in excess of the level for rail transport (Table 1). But the railway still moves a greater volume of freight in terms of tonne-kilometers because each tonne carried on the railway is transported 261.9 km compared with only 12.7 on the roads. In the case of passenger traffic the average annual growth on the roads (22.2 percent) is much greater than on the railway (9.3 percent) and the number of passengers carried by road now exceeds the number using rail. But again the much longer average rail journey (67.9 kms. compared with 25.9 by road) means that rail still occupies the first position in passenger-kilometer terms (Pop, 1984).

This increase in traffic must be seen in the context of modernisation of the railway system as regards motive power and rolling stock; stations and depots as well as track and signalling (Soran, 1953). Only 0.5 percent of the network was electrified in 1950 but since 1970 (when the proportion was 4.5 percent) there has been rapid progress to score 21.3 percent in 1980 and 32.2 in 1989. Many lines have been doubled : a total of 2,000 kms. in 1975 rising to 2,949 in 1989. But there has also been a considerable *expansion of the network* (Figure 1). There has been a net growth of 490 kms.

Table 1

Freight and passenger transport in Romania (1950–1989).

		1950	1970	1985	1989
FREIGHT TRANSPORT					
Total freight carried (million t):	rail	35.07	171.31	283.40	306.30
	road	11.80	840.48	2187.22	2416.06
	other [a]	2.29	19.03	65.47	103.96
Tonne — kilometers (billion)	rail	7.60	48.04	74.21	81.13
	road	0.25	12.88	27.87	30.02
	other [a]	1.67	40.71	110.68	150.77
Average distance of haul (kms)	rail	216.7	280.5	261.9	264.6
	road	20.8	15.3	12.7	12.4
	other [a]	730.6	2319.4	1690.5	1536.2
PASSENGER TRANSPORT					
Total passengers carried (million):	rail	116.55	262.09	460.34	481.03
	road	11.29	170.15	837.29	878.55
	other [b]	0.65	2.37	4.35	5.15
Passenger — kilometers (billion):	rail	8.16	13.53	31.08	35.40
	road	0.39	3.57	21.68	23.08
	other [b]	0.13	0.47	3.48	3.91
Average distance of journey (kms):	rail	70.0	51.6	67.5	73.7
	road	34.3	21.0	25.9	26.3
	other [b]	193.8	199.2	788.7	759.2

air, river, pipeline and sea transport.
air, river and sea transport.
Source: *Anuarul statistic al R. S. România 1986, and Romania 1990.*

4.5 percent from 10,853 kilometers in 1950 to 11,012 in 1970 and 11,343 in 1989. The preference for road transport over short distances has certainly discouraged new construction on the scale contemplated in the 1930s (Turnock, 1979). But immediately after the Second World War a number of new main line projects were completed (most significantly the lines linking Bucharest with Craiova (via Videle) and Tecuci (via Urziceni); but also Bumbești—Livezeni, Homorod—Șercaia and Salva—Vișeu) (Rădoi, 1954). The branches to Capul Midia and Snagov also appeared at this time (Turnock, 1987). Since then several link lines (Brad—Deva, Suceava—Păltinoasa and Vîlcele—Bujoreni Vîlcea) have been completed to shorten distances and improve alignment (Peahă, 1965). And in addition a crop of branch lines have been built to tap mineral deposits (particularly in the lignite fields of Oltenia) and connect towns without a railway service (Iacob & Ianoș, 1981). During the 1980s several Moldavian towns benefitted from this programme : Siret and Tîrgu Neamț (plus the links to Săveni and Darabani and between Hîrlău and Botoșani under construction) (Crețu, 1985 ; Opriș, 1987). Today only a few towns in Romania are more than five kilometers from a railway station (excepting the Danube riverside towns of Hîrşova, Isaccea, Măcin, Moldova Nouă and Sulina); though a branch from Gîlgău to Tîrgu Lăpuş has been proposed (Iacob, 1987). However there are still great regional variations in the density of the railway system which must be appreciated in a historical context (Karolyi, 1973). The number of routes across the Carpathians is still restricted and this results in circuitous journeys from Braşov to cities such as Bacău, Galaţi and Iaşi (Turnock, 1981). There appears to be further scope for construction in this area (Banister, 1981).

On the other hand there have been some railway closures, although the total route length is small. The closures fall mainly into three categories : lines cut by the frontier established after the First World War; short branch lines which can be replaced by bus services (Baia Sprie, Buziaş Băi, Capul Midia, Cisnădie, Dobreşti, Firiza, Fundu Moldovei, Lunca Dunării, Ocnele Mari, Odobeşti, Pîncota, Proviţa, Smîrdan, Techirghiol, Telega and Uioara); and railways in cities where new rail-road interchanges have been provided and some railway lines closed to improve circulation on the roads of traffic (Braşov, Bucharest and Reşiţa) (Petrescu, 1965). There have also been some closures affecting narrow gauge lines : the Odobeşti—Burca, Satu Mare—Ardud—Şomcuta Mare, Sighetu Marmaţiei—Coştiui/Ocna Şugatag, Sighişoara—Agnita and Sovata—Praid lines have lost their passenger services (Turnock, 1990). In addition the Sarmizegetusa—Bouţari rack section of the Caransebeş—Subcetate line has closed because of the problems of maintaining the equipment while the old route between Homorod and Şercaia has been abandoned. Furthermore the transit facilities between Timişoara and Baziaş and between Satu Mare and Sighetu Marmaţiei have been discontinued. Many more closures on narrow gauge lines could be reported if the forestry lines (CFF) were also to be taken into consideration (Turnock, 1991).

While the network has been extended it is clear that much more intensive use has been made of it. In 1950 each kilometer of railway handled 0.70 million tonnes of freight and 0.75 million passengers but in 1985 the figures were 25.15 and 2.76, showing a growth of 35.9 and 3.7 times respectively. Modernisation of traction (especially electrification) has been crucial in this respect, along with the doubling of track on many of the main lines. The purpose of this paper is to examine the changes in the passenger train workings, using a selection of CFR timetables. The earliest post-war timetable available to the author is for 1948 and the most recent deals with 1990 — 1991. It has been possible to split this period into two halves through study of the 1969—1970 timetable as well. Both periods have witnessed a substantial growth of rail traffic but the modernisation policies have been slightly different. During the first period emphasis was placed on the perfection of steam traction, with some dieselisation (Rădoi, 1964). By contrast the last two decades have seen widespread electrification and the elimination of steam traction (apart from some shunting work) (Herbst-Rădoi, 1972).

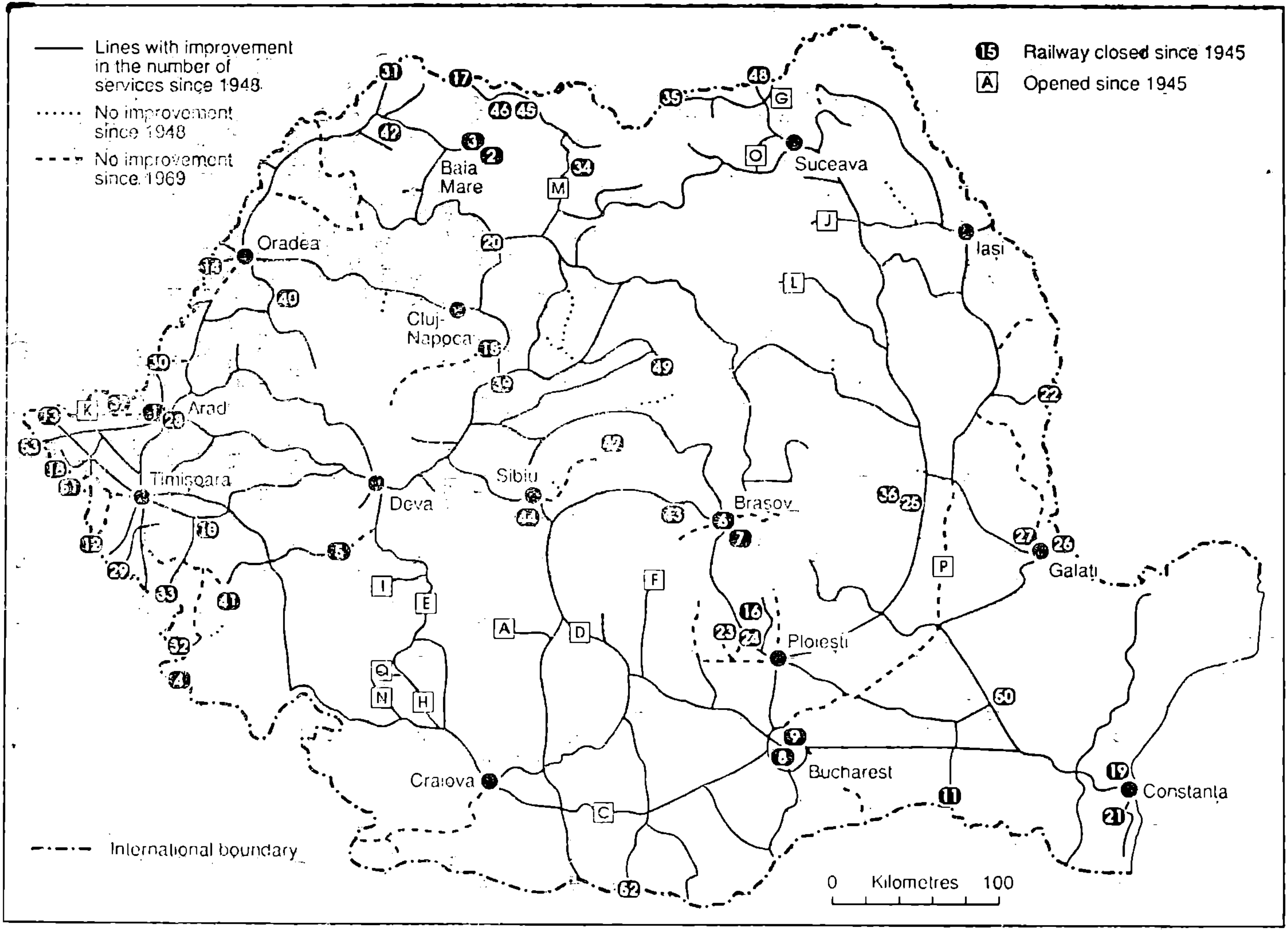
Lines with improvement in the number of services since 1948
No improvement since 1948
No improvement since 1969
Railway closed since 1945
Opened since 1945
International boundary
Oradea
Baia Mare
Suceava
Iasi
Cluj-Napoca
Arad
Timisoara
Deva
Sibiu
Brasov
Galati
Ploiesti
Bucharest
Craiova
Constanta
0 Kilometres 100

Fig. 1

Fig. 1. — The Romanian railway network.
Railways closed to passenger services (some closures of linest of the frontier may pre-date 1945): *1*, Arad—Pîncota; *2*, Baia Mare—Baia Sprie; *3*, Baia Mare—Firiza; *4*, Baziaş—Frontier; *5*, Boutari—Sarmizegetusa; *6*, Braşov—Braşovul Vechi; *7*, Braşov—Satulung; *8*, Bucharest: Obor—Gara de Nord/Titan; *9*, Bucharest: Progresul—Filaret/Gara de Nord; *10*, Buziaş—Buziaş Băi; *11*, Călăraşi—Port; *12*, Cărpiniş—Frontier; *13*, Cenad—Frontier; *14*, Cheresig—Frontier; *15*, Cîmpia Turzii—Turda; *16*, Cîmpina—Telega; *17*, Cîmpulung pe Tisa—Frontier; *18*, Comloşu Mare—Frontier; *19*, Constanţa/Dorobanţu—Capul Midia (a); *20*, Dej—Dej Ocna; *21*, Eforie—Techirghiol; *22*, Fălciu—Frontier; *23*, Filipeştii de Pădure—Proviţa; *24*, Floreşti—Filipeştii de Pădure; *25*, Focşani—Odobeşti; *26*, Galaţi—Frontier; *27*, Galaţi—Smirdan; *28*, Ghioroc—Radna; *29*, Giera—Frontier; *30*, Grăniceri—Frontier; *31*, Halmeu—Frontier; *32*, Iam—Frontier; *33*, Jamu Mare—Frontier; *34*,*Moisei—Telciu; *35*, Nisipitu—Ulmi; *36*,*Odobeşti—Burca; *37*, Pecica—Frontier; *38*, Pojorîta—Fundu Moldovei; *39*, Războieni—Uioara; *40*, Rogoz—Dobreşti; *41*, Reşiţa—Reşiţa Uzină; *42*,*Satu Mare—Ardud—Şomcuta Mare; *43*, Şercaia—Valea Homorod (b); *44*, Sibiu—Cisnădie; *45*, *Sighetu Marmaţiei—Coştiui; *46*, *Sighetu Marmaţiei—Ocna Şugatag; *47*, *Sighişoara—Agnita; *48*, Siret—Frontier; *49*, *Sovata—Praid; *50*, Ţăndărei—Lunca Dunării; *51*, Teremia—Frontier; *52*, Turnu Măgurele—Port; *53*, Valcani—Frontier.
*Narrow gauge
a, Line built after 1945
b, Replaced by track following a new alignment.
Railways opened since 1945:
A, Băbeni—Alunu; *B*, Brad—Deva; *C*, Bucharest—Roşiori de Vede—Craiova; *D*, Bujoreni Vîlcea—Vîlcele; *E*, Bumbeşti—Livezeni; *F*, Cîmpulung—Argeşel; *G*, Dorneşti—Siret; *H*, Filiaşi—Rogojel—Tîrgu Jiu; *I*, Lupeni—Bărbăteni; *J*, Paşcani—Tîrgu Neamţ; *K*, Pecica—Nădlac; *L*, Piatra Neamţ—Bicaz; *M*, Salva—Vişeu; *N*, Strehaia—Motru; *O*, Suceava—Păltinoasa; *P*, Tecuci—Făurei; *Q*, Turceni—Drăgoteşti.

EXPRESS TRAINS

Express trains ("accelerat" and "rapid") (Fig. 2) have greatly increased, particularly with respect to trains from Bucharest to the provinces. In 1948 there were three trains daily from Bucharest to Timişoara (two via Piteşti and one via Videle) and two trains daily to Arad, Constanţa, Galaţi (one via Buzău and the other via Urziceni), Iaşi, Oradea and Suceava/Vatra Dornei. One train daily ran to five other destinations : Băile Herculane, Braşov, Cluj (via Piatra Olt and Sibiu), Satu Mare (via Ciceu) and Sibiu (via Piatra Olt). In addition one connection daily was provided at Braşov for Sibiu and Tîrgu Mureş. Cumulatively therefore Cluj and Sibiu as well as Timişoara had three links with Bucharest, Craiova, Focşani, Mărăşeşti, Orşova and Turnu Severin had four, Buzău and Piteşti five, Braşov and Cîmpina six and Ploieşti eleven.

In 1969 the former pattern was still quite recognisable but services on certain lines had increased : Constanţa had seven trains (most continuing to Mangalia) including the summer trains and international workings ; while Timişoara had six and Iaşi five (including trains working into Yugoslavia and the former Soviet Union respectively). The improved service to Timişoara meant that no special service to Băile Herculane was needed. Four trains reached Arad (with one connection for Brad) and also Oradea (one continuing to Satu Mare) while there were three to Baia Mare via Ciceu (again one continuing to Satu Mare) with one related working from Beclean to Sighetu Marmaţiei (replacing the stopping train from Satu Mare routed through Halmeu and the former Soviet Union) and another from Deda to Tîrgu Mureş. There were three trains to Suceava with con-

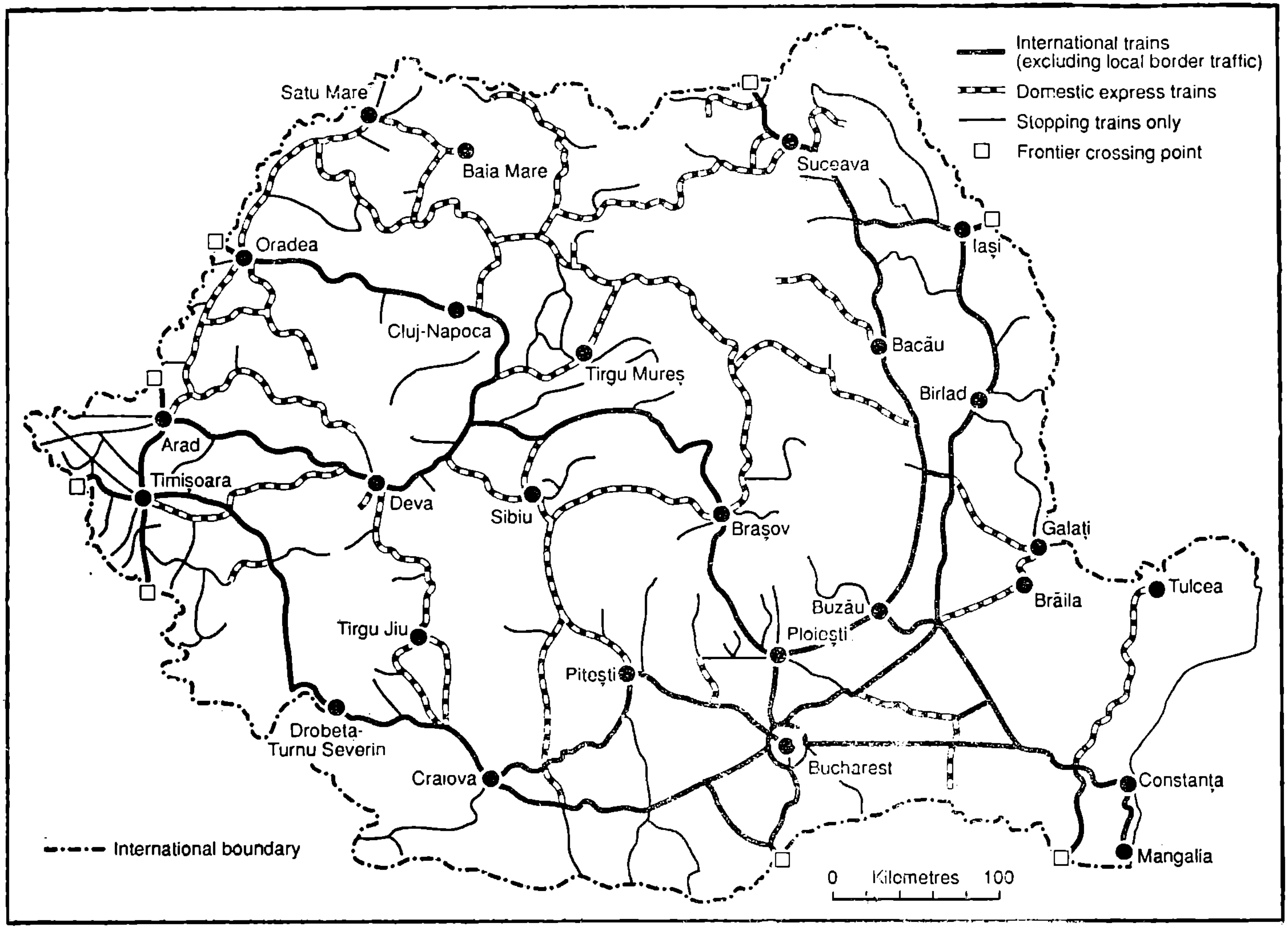

Fig. 2. — Routes for international, express and stopping trains,

nections to Piatra Neamţ and Vatra Dornei and a further train passed through Suceava from Bulgaria (via Negru Vodă and Tecuci). There was still one daily train from Bucharest to Cluj via Piatra Olt and Sibiu and another to Sibiu only. The latter was routed via Videle and Caracal, reflecting increased use of the direct line (a point which also emerges in the case of the Timişoara workings, because four used the direct line to Craiova while only one continued on the old route through Piteşti). New routes to emerge included the path through Făgăraş, Sibiu and Sebeş for three of the four Arad trains (following the opening of new alignment between Homorod and Şercaia), the access to Timişoara through Deva, Ilia and Buziaş and the route through Tîrgu Jiu and Petroşani for one one train daily between Bucharest and Deva.

In 1990 a further substantial increase in services was evident with heavier traffic on the main routes along with the opening up for more secondary routes to express trains. Thus Tîrgovişte on the Titu—Pietroşiţa branch which had previously enjoyed stopping trains direct from Bucharest was now served by one express train per day and Vaşcău could now be reached by an express train from Arad as well as Timişoara. The opening of the new line from Vîlcele to Bujoreni Vîlcea provided for a further service to Arad via Piteşti and Sibiu. Another trend was the promotion of through coaches to whole trains. Thus Botoşani which had previously received through coaches from Bucharest, detached from a train to Suceava, now had its own train from the capital. Carei which had a through coach from Bucharest through Ciceu and Zalău now had a full train (routed through Cluj) which continued to Satu Mare. Finally some additional localities obtained through coach working from Bucharest: Bistriţa and Rodna for example. And on some occasions sets of through coaches were marshalled together to form portions of express trains. Thus the train routed to Simeria through Petroşani was made up of portions for Cluj and Deva; while a train routed to Războieni through Braşov and Sighişoara comprised portions going forward to Cluj and Tîrgu Mureş. It is also evident that timings improved between 1969 and 1990, though not to the same extent as between 1948 and 1969.

Several themes are worth highlighting. First there is an increasing range of express passenger services related to the emergence of the county centres since the administrative reform of 1968. Towns like Bistriţa, Botoşani, Slobozia and Zalău experienced a large growth of population (and an especially large growth in employment in industry and services) which increased the demand for rail services. All the new administrative centres that lay aside from the principal routes (already well provided for) gained some special improvements in services. However Alexandria, the centre of Teleorman county, is still without an "accelerat" service from Bucharest, the only such centre to lack this facility. However the town is relatively small and it does have some good connections by stopping train from main line trains running between Bucharest and Craiova which stop at Roşiori de Vede and there are stopping trains to Alexandria which originate in Bucharest. Furthermore Alexandria has an excellent road link with the capital: 85 kilometers compared with 134 by rail. Reşiţa, the centre of Caraş—Severin county, also has a poor service with through coaches only (detached from Timişoara trains at Caransebeş to complete the journey as part of a stopping train). But Reşiţa does have the advantage of an air service from Bucharest to Caransebeş.

However there are still a number of destinations which attracted express or through coach workings in 1948 which lost the facility by 1969 and have not so far regained it. Some towns have experienced a relative decline in provision and now depend on stopping train connections with express services. For example Dorohoi (with a through coach from Bucharest in 1948) which has lost ground to both Suceava and Botoşani. Rădăuţi suffered a similar demotion with the loss of its connecting "accelerat" train but the situation has been restored with the provision of an "accelerat" from Bucharest to Putna (which lies beyond Rădăuţi) in the 1990 timetable. The holiday resorts also provide some interesting detail. While the principal watering places (such as Băile Herculane, Călimăneşti and Vatra Dornei) are situated on the major through routes and automatically enjoy a good service, there are others which require special provision. Sovata enjoyed a through coach connection with Bucharest in 1948 but this facility has now disappeared, partly because of the circuitous nature of the rail journey via Blaj : buses provide much more direct access. Likewise Tîrgu Ocna has lost its through coaches (from both Bucharest and Iaşi), although in this case there are other services on the Adjud—Ciceu line which provide compensation. On the other hand the post-war growth of Sîngeorz Băi has resulted in a through coach service from Bucharest to Rodna.

On the matter of *timings* it is evident that on some routes improvements have been modest by national standards. Between 1948 and 1969 acceleration on some routes were minimal due to the previous use of high speed railcars on "auto rapid" services (daily to from Bucharest to Băile Herculane, Cluj, Constanţa, Galaţi and Iaşi); also on connections from Braşov to Sibiu and Tîrgu Mureş). These vehicles were all withdrawn from express working by 1969 and replaced by diesel locomotive-hauled trains which accomplished only a modest improvement in journey time. Again between 1969 and 1990 some routes experienced a deterioration in the speed of the fastest train. This is due to the availability of a restricted "rapid" service in 1969 with attractive schedules which could not be maintained in the context of increasing congestion on the network, especially on the very congested route from Bucharest to Braşov and other cities in Transylvania. Some international trains were also affected in this way. In other cases a change in route has upset the schedule. In 1969 the best train serving Petroşani took only 6.37 hours (i. e. 6 hours 37 minutes), a massive improvement on the time of 13.48 in 1948 when the direct line from Filiaşi and Tîrgu Jiu was not complete and when access was possible only via Simeria. However in 1990 when Petroşani had its own service from Bucharest, the choice of the longer route through Piteşti made for a journey time of 8.12 : still a big improvement on 1948.

Some comment is also necessary on the opening of new main lines because on the whole these have so far attracted only limited use by express passenger trains. Exceptions are provided most clearly by the new all-Romanian route to Sighetu Marmaţiei via Salva and Vişeu, replacing the transit facility between Halmeu and Cîmpulung pe Tisa. Also there is the direct line from Bucharest to Craiova which has gradually drawn traffic away from the old route through Pitești. The new route is substantially shorter (209 kilometers compared with 250) and now has the additional advantage of electrification. The realignment between Homorod and Șercaia has enabled some express trains to work between Brașov and Deva via Făgăraș and Sibiu rather than the longer route through Sighișoara and Mediaș. But the saving is relatively modest in the context of the Bucharest—Arad journey (598 kilometers against 630) and has been eroded by the electrification of the longer route which had regained some of its earlier prominence in 1990. On the other hand the Vîlcele—Bujoreni Vîlcea link will attract only one "accelerat" train (though it reduces the distance between Bucharest and Sibiu to 265 kilometers compared with the routes through Brașov (315 kilometers), Caracal (375) and Pitești (392). Also the direct connection between Deva and Brad has failed to attract any express facility and even connections by stopping train are extremely poor : yet the distance from Bucharest to Brad is reduced from 797 kilometers (via Sighișoara and Arad) to 513. The early post-war construction between Bucharest, Urziceni, Făurei and Tecuci has also failed to draw traffic away from the heavily-populated axis through Ploiești and Buzău. The saving in distance on the Bucharest—Iași route is minimal (398 kilometers via Urziceni compared with 405 via Mărășești) and it is not used at all now (apart from one stopping train between the two cities), although one express train was routed this way in 1969. Expresses from Bucharest to Galați also used the route as far as Făurei but there is more traffic on the longer route through Ploiești (259 kilometers compared with 230) and the quickest train to Galați in 1990 took the longer route.

Express services between provincial cities bear out the generalisations already made. In 1948 an "accelerat" service connected Timișoara with Iași, although the journey involved separate trains to Cluj which did not connect (and thereby necessitated a total journey time exceeding 27 hours). In 1969 a single through train accomplished the journey in 15.41 hours ; while links were available between Timișoara and Baia Mare and (with good connections) between Suceava and both Brașov and Galați. In 1990 further services were available including additional links between Iași and Timișoara : one which parallelled the 1948 route to Cluj and then continued through Simeria (with a section for Hunedoara) and Buziaș ; another which combined with a section from Galați at Adjud and crossed Transylvania via Ciceu and Deda to join the previously-mentoned route at Războieni. In 1990 Galați was linked with Călărași and Contanța (the sections dividing at Fetești) and Brașov had new services to Galați and Iași. These trains have greatly strengthened connections beween the east and west of the country and respond to increased demand arising from the migration of young Moldavian workers to western regions where a relatively low rate of natural increase has resulted in labour shortages. A further new service, between Sighetu Marmației and Timișoara, is helpful in connection with the migration of country people from Maramureș who work in agriculture and forestry in Transylvania for the same reasons. The new trains also provide an albeit limited express service on sections of the network where the local services are relativelyparse andthey help to provide more options for fast longdistance travel. Although it is unlikely that anybody will travel from Iaşi to Timişoara via Ciceu, even by "accelerat" when there is the quicker and shorter journey available through Cluj and Oradea, the comparison between the 1990 "accelerat" of 17.21 hours and the stopping train times of 40.50 hours in 1948 and 35.50 in 1969 indicate the level of improvement in connectivity in some provincial districts. And the saving in time is complemented with matters of comfort regarding seat reservations and avoidance of changes of train under what can be very crowded conditions.

The most outstanding changes have occurred in respect of summer season trains from the Black Sea coast. While trains between Mangalia, Constanţa and Bucharest have increased there has been a development of services bypassing Bucharest. The "auto rapid" service of 1948 from Constanţa to Sinaia via Urziceni has disappeared but it was replaced by several through coach workings from Mangalia to Moldavia, attached to the "Varna" international train at Medgidia and operated over the route Feteşti—Făurei—Tecuci. In 1990 however a substantial programme of special trains was operating and the majority were routed through Feteşti—Făurei—Buzău, proceeding northwards to Moldavia or westwards to Transylvania via Ploieşti. The growth in capacity is another measure of the transfer of population from the countryside to the towns and, with it, the rise in the amount of salaried work which can provide for family vacations at the seaside.

STOPPING TRAINS

Stopping trains have increased in number although not to the same extent as the express services. Two approaches may be considered. The first looks at all those lines which were not involved in express passenger workings in any of the three years in question and notes the number of trains provided, the journey time and the average speed. In a few cases the provision has remained unchanged between 1948 and 1990 : Oraviţa—Anina, Sibiu—Vurpăr, Sighişoara—Odorhei, Tîrgu Mureş—Lechinţa/Mihesu de Cîmpie. And likewise there are a handful of cases where there has actually been a reduction : Blaj—Praid, Bucharest—Snagov, Comăneşti—Moineşti, I. L. Caragiale—Moreni and Podu Iloaiei—Hîrlău. These are either short lines (some narrow-gauge) overshadowed by bus services which offer a more frequent service combined with shorter and faster journeys (especially in the case of some narrow gauge lines with speeds of around 10 kms/h in 1948 and still only about 20 in 1990). The overwhelming trend has been towards more trains and faster speeds : in 1948 only 24 of the 97 services examined exceeded three trains per day (and only two exceeded six : Bucharest—Snagov with 22 and Cîmpia Turzii—Turda with eight) but in 1990 there were 68 lines out of 86 with more than three trains and 22 with more than six (including four in double figures : Sărăţel—Bistriţa with 15, Sărăţel—Măgheruş Şieu with 11 and both Şibot—Cugir and Tîrgovişte—Pietroşiţa with 10). It should be noted that if all services are combined then certain sections of track have a generous cumulative service. Thus in 1948 there were 11 trains daily between Bucharest and Ploieşti : 10 for Bucharest—Titu (nine continuing to Goleşti) and Arad—Sîntana; eight for Craiova—Piatra Olt, Galaţi—Brăila and Timişoara—Jebel; and seven for Arad—Timişoara, Bacău—Piatra Neamţ and Iaşi—Podul Iloaiei. Only 33 lines in 1948 were provided with stopping trains running at an average speed of 30 kms/h or better and only one exceeded 40 (Craiova—Calafat with 44 kms/h) but in 1990 66 lines offered trains running at an average speed of 30 kms/h or better, although only 18 exceeded 40 kms/h.

The second approach looks at the range of stopping train services provided for Bucharest and seven leading provincial cities: Braşov, Cluj, Constanţa, Craiova, Galaţi, Iaşi and Timişoara. Once again it is clear that the number of trains has increased althrough some longdistance services (Bucharest to Arad, Iaşi and Timişoara) have been reduced to compensate for increased availability of express services concentrating on the urban centres. Some new services have appeared between 1969 and 1990 through the adoption of revised terminal points along main lines that always enjoyed through services. The outstanding trend has been the improved provision of trains over intermediate distances. Through trains are now available on several routes where changes were previously needed. Bucharest is now linked directly with Alexandria, Sibiu (via Piteşti), Tîrgovişte and Tulcea; while trains from Cluj to Beclean, Năsăud and Salva make a change at Dej less necessary. But Iaşi scored more significant improvements. It was previously necessary to change at Paşcani for stations to Bacău, Bicaz and Putna, all served by through trains in 1990: also Tîrgu Neamţ at the terminus of a new branch line. Meanwhile Braşov's links with the eastern parts of the country have improved with through trains to Iaşi and Mangalia (eliminating the need to change in Ploieşti). Train speeds have shown a general improvements: 78 of the 88 routes examined in 1948 involved average speeds below 40 kms/h for the best train (88.6 percent) whereas in 1990 the figure was 56 out of 139 (40.3 percent). On 33 lines the average speed was below 30 kms/h in 1948 (37.5 percent) but only three in 1990 (2.2).

INTERNATIONAL SERVICES

These have also undergone considerable change (Table 2). First there has been a great increase in the number of trains crossing the frontier. In 1984 there were only four shown in the timetable (apart from the services running in transit to Baziaş and Sighetu Marmaţiei): one each at Curtici, Episcopia Bihor, Jimbolia and Negru Vodă. Trains for Paris crossing at Curtici and Episcopia Bihor included formations for Szczecin and Prague respectively. In 1969 there were 22 trains, rising to 50 in 1990 (including trains running in summer only). Second there have been many changes in trains and routes. Only the Sofia train has used the same path in all three years covered by the survey (and even this service has been affected by the Danube bridge which replaced the ferry). The "Bucureşti" Express to Zagreb and Rijeka was advertised in 1948 and 1969 (when it was summer only between Zagreb and Rijeka) but disappeared from the timetable in 1990 when connections for Zagreb were given through Belgrade. The Zagreb train was still running via Piteşti in

1969, whereas the Belgrade train had switched to the direct line through Videle. The two trains to Western Europe were still running to Basel ("Wiener Walzer") and Paris ("Orient") in 1990 but the former was combined with the re-routed "Carpaţi" as far as Szolnok, whereas it was operating independently in 1969; moreover in 1948 the Basel train was extended to Paris as the Arlberg—Orient Express. There have also been changes to the route through Romania; both were routed through Mediaş and Arad in 1948 but switched to Sibiu and Arad in 1969 (presumably because of the new alignment through the Perşani Mountains); only to return to the Mediaş route in 1990.

The Balt-Orient Express still reaches Berlin via Budapest and Prague, as it also did in 1969, but there is a second train ("Pannonia"), running between Sofia and Berlin, which did not exist in 1969. However in 1948 Berlin had no through service (Prague was the limit) for the then "Balt-Orient Express" ran through Moravia and Silesia to reach Szczecin, with a connection to Warsaw at Bohumin. In 1969 Warsaw was served by the "Carpaţi" express taking the route through Lvov in the Ukraina. But in 1990 this train was re-routed through Miskolc, Košice and Kraków, a longer route to the extent of more than 300 kilometers but more useful for the cities of southern Poland and eastern Slovakia. There were no trains advertised to Moscow in 1948 but the "Danubius" (Sofia—Moscow) appeared in 1969 following the route Urziceni—Bîrlad (420 kms) along with a Bucharest—Moscow service reaching Iaşi via Ploieşti and Bîrlad (a slightly longer route of 426 kms); this latter train was known as the "Romania" express in 1990. However in 1990 both trains were routed to Ungheni through Ploieşti and Paşcani (483 kms). 1990 also saw the appearance of a third Moscow train, the "Sofia" express which used the Vicşani frontier crossing as opposed to Ungheni for the other two. Local frontier traffic has seen a big increase. In 1969 there was one local train each day between Medgidia and Kardam and between Timişoara and Vršac; and two trains between Salonta—Kotegyen and Satu Mare—Debrecen. In 1990 the Vršac service was no longer listed but the Kardam service had increased to two trains daily and new workings were shown on the routes Carei—Nagyecsed; Curtici—Bekescsaba, Iaşi—Chişinău, Oradea—Puspőkladany and Timişoara—Kikinda (two trains daily in all cases except Carei—Nagyecsed which had three).

Journey times have been generally shortened between 1948 and 1990 but it is noticeable that there have been few improvements since 1969 partly because some trains have been diverted on to longer routes. The Prague journey of 36.30 hours in 1948 came down to 25.10 in 1969 but the 1990 time was virtually identical at 25.09 (while the "Pannonia" was marginally faster at 25.03). A very big change followed the completion of the Friendship Bridge across the Danube between Giurgiu and Ruse in 1954. In 1948 the only service to Sofia took 19.48 hours but in 1969 the Danubius Express (Moscow—Sofia) made the journey in 9.30 hours. Trains to Varna could run via Giurgiu/Ruse whereas previously the Negru Voda/Kardam crossing was used. The only train by this route took 22.25 hours in 1948 compared with 10.33 via Giurgiu in 1969 (although the distance by the latter was greater: 500 kilometers compared with 405 via Negru Vodă, a route still used for local traffic and also for summer holiday trains to Varna which avoid Bucharest). No trains run beyond Sofia although the Danubius Express included a through coach from Moscow to Istanbul in 1969 operating one day per week. In 1990 this facility was provided all the year round on the "Sofia" express while the "Danubius" included through coaches from Moscow to Athens (also Bucharest to Athens on the "Pannonia"). In 1969 the "Wiener Walzer" included a through coach Bucharest—Köln daily in summer only; and in 1990 there were through coaches from Bucharest to Leipzig ("Balt-Orient") and Sofia to Wrocław ("Carpaţi").

Several summer holiday trains appeared in 1969 : "Bulgaria" (Moscow—Sofia/Varna); "Mamaia" (Budapest/Prague/Warsaw—Mangalia); "Nord-Orient" (Budapest/Prague/Warsaw—Varna via Bucharest); and "Varna" (Warsaw—Constanţa as well as Kraków/Warsaw to Varna). The latter used the route through the former Soviet Union and proceeded to Bulgaria via Mărăşeşti, Tecuci, Feteşti and Negru Vodă. The 1990 programme was much more substantial however. The "Bulgaria" operated a Sankt Peterburg—Sofia service (running all the year round from Kiev to Sofia) and the "Mamaia" still connected Prague (but not Warsaw) with Mangalia while the "Varna" from Warsaw/Kraków was re-routed through Košice and Miskolc like the "Carpaţi" already noted. The "Nord-Orient" no longer featured but extra capacity between the northern countries of Eastern Europe and the Balkan resorts were provided by several new trains : "Nesebar" (Warsaw and Budapest to Burgas, Varna and Istanbul); "Nord-Sud" (Warsaw and Szczecin/Wrocław to Burgas), "Tracia" (Leipzig and Prague to Varna); "Transdanubium" (Prague to Burgas); „Vitosha" (Dresden and Bratislava to Sofia). Additional workings to the Russia also featured : "Marea Neagră" between Moscow and Varna and two un-named trains, one between Moscow and Burgas/Plovdiv and the other from Leningrad, Vilnius and Minsk to Sofia.

Some interesting routing features emerged for these trains. While the Moscow—Burgas train went through Chişinău, Ungheni and Iaşi all the other Russian trains entered through Cernăuţi and Suceava. Within Romania all the trains used the Siret corridor from Paşcani to Buzău, the Burgas/Varna traffic then switching to Făurei, Feteşti and the Negru Vodă/Kardam frontier crossing. In the case of the Moscow—Burgas/Varna train this meant a journey of 560 kilometers on Romanian territory (Iaşi—Nicolina to Negru Vodă) compared with 452 on the direct line through Bîrlad which has not, however, been modernised to the same degree as the railway along the Siret. The other summer trains used the main line through Bucharest Braşov, Mediaş, Cluj and Oradea (sometimes avoiding Gara de Nord in Bucharest with a stop at Chitila) but "Nesebar" and "Transdanubium" were routed through Videle and Craiova to Arad and Curtici, the former via Tîrgu Jiu and Petroşani and the latter by way of Turnu Severin and Timişoara. Trains to Burgas and Varna used the Negru Vodă/Kardam frontier crossing (with the exception of "Nord-Sud", passing through Giurgiu and Chitila) and avoided Bucharest by taking the Feteşti—Buzău—Ploieşti route. It is a reflection of the differences in capacity on the various main lines that this route of 320 kilometers between Negru Vodă and Ploieşti is preferred to the 287 kilometer route through Urziceni. The "Mamaia" express also took this route although in 1969 it had run through Bucharest. By contrast in 1990 the "Varna" express was routed from Negru Vodă into Bucharest in connection with through coaches from Bucharest to Miskolc and Varna. This train provided the only through service from Bucharest to Varna and the 1990 time of 9.28 hours in 1990 may be compared with the 22.25 time already referred to for 1948.

CONCLUSION

There has been a substantial growth of traffic, both domestic and international. Some new lines have been provided but the growth has been provided for largely through the modernisation of the existing system. Routes have been changed to allow improved circulation within Romania, given the very great increase in demand for long journeys, and also to channel trains wherever possible along the electrified lines. New trains are needed to cater for changing demands and the growth of the holiday trains to the Black Sea coast is the outstanding development. The changing climate of international relations will require changes, although these will be conditioned by the competition from road and air services. In this respect it is interesting to see that the 1991 railway timetable (not available in time for use in connection with the analyses on which this paper in based) includes a greatly-improved pattern of services between Romania and Hungary. By contrast the direct links with Western Europe had almost disappeared: the "Dacia" Express runs all-year to Vienna, supplemented seasonally with the "Kalman" to Munich.

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OBJECTIVES AND SEQUENCING OF SCHOOL GEOGRAPHY

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Les objectifs et l'échelonnement du contenu de la géographie scolaire. L'échelonnement des contenus, d'après le modèle général donné, suppose trois étapes dans l'apprentissage de la géographie: une étape d'orientation (8—10 ans), une étape d'extension (11—14 ans) et une étape de développement (après 14 ans), chacune avec des objectifs des contenus spécifiques, détaillés par âge et classes.

Key words: school geography

Sequencing and contents structure of school geography implies the design of an objective model (pattern) that optimizes the relationship between pupils' education generally and the training values of geography as a study object. There exists the opinion, generally expressed, that the instructive possibilities of geography are much wider and especially up-to-date on the background of contemporary world development.

(1) AIMS OF EDUCATION THROUGH GEOGRAPHY

The main scope of instruction through geography is to efficiently contribute to the shaping of the child's personality. The problem is to establish the areas and the specific possibilities of school geography in the training influences as a whole. Part of them have been synthetized, in an accessible form, in the project of the international chart on education through geography; this was published by prof. H. Haubrich in the IGU Bulletin (IGU, Newsletter, 22,1991) and is well known and appreciated.

In the folowing we show the general objectives of education through geography, which have also a deep signification for the structure of the curriculum.

These major objectives should be:

— shaping of a global, integrating and spatial thinking (that is a "geographical thinking");

— understanding of the global, objective reality and of the in terdependent character of phenomena;

— seizing the priority of the relationship man-earth in the evolution of contemporary world;

— acquiring and use of the own system of communication, the cartographic system;

— the individual and collective conviction of the priority of understanding collaboration and international cooperation in a changing world;

— seizing the fundamental necessity of preserving the environment;

— perception of the diversity of local geography ;
— the respect for other regions, countries, peoples, as parts of the natural and cultural patrimony of mankind.

These objectives render of course the specific aspects induced by geography. The general objectives of training are accomplished by a series of contents (mathematics, physics, foreign language, etc). School activities, extra-school activities, multimedia influences which eventually have the ideal of accomplishing an endowed, educated, independent man, in a changing world. From this point of view geography has a multitude of new fields.

There are three main ideas that result from these objectives :— First, the priority of the relationship man-earth which is an aspect of geography nature, of the specific object of study (the relationship between society and its life medium) ; this dual character of geography as a science of relations between nature and society, with historical origins (Aristotel, Strabo, Varenius, Humboldt, E. de Martonne), up to our days shows the thoroughly objective character of this reality. That is why, considering the instruction through geography, seizing this connection is in itself a necessity of geography as a science.

—Second, by its own method, the cartographic method, geography allows the building of a system (language) of its own for observing, analysing description and introduction of the objective reality ; the synthesis of this system is the map ; but we speak of all types of maps necessary to modern man (general maps, climatic, economical maps, etc.).

— Third, all the objectives of school geography (but also of other objects of study, such as physics, chemistry, biology, technological studies, etc.) aim to a fundamental concern of contemporary world : knowing, preserving and rational utilization of the environment.

We could say that the problem of the environment is now the fundamental problem of mankind which implies an adequate instruction. These general objectives have, now, an essential role in designing contents and their sequencing.

(2) REFERENCE CRITERIA, FACTORS AND METHODOLOGY OF SEQUENCING SCHOOL GEOGRAPHY

We shall briefly indicate the factors which compete in the optimum organisation of contents. Some of them, by their importance, become criteria of sequencing the contents.

— As we could previously see, an essential element (factor) is formed by the *objectives and general scopes* of school geography. These general objectives can be detailed on several levels, such as : objectives on cycles (several classes) on classes (that is on a school year), specific objectives (of medium generality) and behavioural objectives. The method of building a complete picture of objectives is the following : deductively specifying objectives (from the general ones to the behavioural one), then, inductively (starting from the present instruction, based on present handbooks). These two pictures do not coincide. Here is the fun, damental pedagogical problem : we must retain only the objectives which-properly tested, must be accomplished in a satisfactory amount by a number of pupils. From the research on a specific sample of pupils at the bud of the school activity we came to the conclusion that an unsatisfactory amount of objectives has been reached (under 50%), that is a relatively reduced school efficiency. For pupils with higher performances the amount of 85 — 90% is frequently reached. The solution is to keep and exercise only the objectives that can be reached by a significant amount of pupils. The relatively low efficiency is explained, in this case, by shortcomings of the training process, and not of the contents or objectives.

For shaping and sequencing the contents there is a specially interesting aspect : *the implied contents* (of a lesson, theme, chapter, etc.) *is justified as such* (and have their usefulness) only if, after its accomplishment we can notice a gain in the pupil's behaviour, or in other words, if the pupil *has accomplished the instructive objectives set forth.* From this point of view, it is obvious that a contents "in itself" cannot be supposed.

An essential criterion in sequencing the contents is the specification of stages and *moments of intelectual development of pupils* (or in other words the psychopedagogical peculiarities of each class and age). This is, otherwise, the most difficult criterion to describe, because of the lack of a comprehensive pattern, generally available for intelectual development. In shaping the contents, there are some significant aspects from this point of view (according to the stages described by J. Piaget).

— The period between 7 and 12 years (the stage of concrete operations), when the children must be given a direct contents (reality or images of reality) and not by intermediary (relations about reality or too abstract elements).

— The period between 11 and 14 years (the stage of shaped operations) when we pass from the direct objective reality to a mediated reality (symbols, sentences about reality); this implies the development of suppositional deductive, thinking, of projective, inner and abstract thinking. The task is at this level, that the contents *have a more abstract structure* and lead to speeding up the intellectual development of pupils.

— After the age of 14 years, the system of the fundamental operations of thinking is already built; at the beginning of the stage (14 — 15 years) reflection anticipates reality and then (15 — 16 years) there is a "reconciliation" and the mutual interaction between reflection and reality. From these points of view there is a constant need for *an utterly theoretical course, followed by another course* mainly on application and concrete reality.

A basic criterion for the structure and sequencing of the contents (which we consider as a "principle") is to provide, in the first part of school period, a psychological structure (adequate to pupils) and in the second part, a logical one (adequate to science and isomorphic to its logics). In this way, in the first part (at small ages) the contents must be shaped "on reality" (not to sum up reality), and in the second part (at higher ages) "on science", between them with a period of transmission (by means of the local geography of continents) from reality to science.

This principle, of the relationship between logical and psychological in training, developed by Kneller, has been presented in more details another time I.G.U. Congress, Moscow, 1976). We consider it as the fundamental principle of structuring and sequencing contents.

(3) THE SKETCH OF A PATTERN FOR SEQUENCING THE CONTENTS

The sequencing of contents is diversified in different countries. There is a theoretical work become classical (N. J. Graves, 1979) and a collective work of the Commission on Geographical Education within I.G.U. (ed. N. J. Graves, 1978). The present pattern may be applied to a continued education of 11 years. For a shorter education period (10 years), it must be properly adjusted.

This pattern has several stages, that is :

— An orientation stage (up to 10 years) ; its aim is to give the children a first direction in surrounding reality. The contents must be direct (or mediated by pictures) and its perception must be total. The knowledge may be sequenced in two years under the form of an integrated object "The knowledge of the environment".

— An extension stage (11 – 14 years) ; its aim is to enlarge the field of the studied phenomena, to pass from "reality" to "object", to create a system of notions.

The contents must have an internal organic structure, which correlates physical and economic elements, general and local elements, to extend the causal analysis of phenomena, to provide an international large education.

The structure (on 4 years) may have the following courses, in their sequence :

— *Introduction in geography*, with a stress on *notions, terminology, language*, shaped on geospheres.

— Geography of continents (in two successive years), with general, local elements, representative countries ; for our country the optimum sequence should be the following : Africa (general, local, some representative countries), then America, Australia, Antarctica, Asia (one year) followed by Europe and C.I.S. (the following year) ; we find it necessary to study all the European countries of the continent in view of an integrated Europe.

— Homeland Geography (in a classical structure, one year).

— A period of development (after 14 years), concentrated on the structure and concerns of science, with a theoretical formative integrative character.

Its aim is to improve the knowledge at higher level and to train pupils in scientific research methods of reality.

The contents must render the structure of science, its concerns, to be deeply formative, theoretical, interdisciplinary, integrating and to have several explanations to concrete research.

The study of geography at this level may contain :

— a course of "Physical and environmental geography" (which includes in an integrating concept the whole of knowledge and special practices concerning the knowledge, protection and organization of the enviroment) ;

— a course of "General economic geography"
— a course of "Homeland Geography" (local and general geography).

This structure is detailed in a series of sequences, chapters, themes, logically arranged in relation to the initial objectives.

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THE ESTIMATION OF TOURISTIC POTENTIAL BY GEOGRAPHICAL ELEMENTS *

SORIN ROATĂ

Die Würdigung des touristischen Potentials durch geographischen Elemente. Das Werk schlägt eine originale Weise für die Würdigung des touristischen Potentials vor. Es geht auf einige objektiven Geographie Elemente zurück: Visuellfeld, Abhang, Vegetation, die Qualität der Route, die Naturformen, die anthropische Elemente, die meteorologische Elemente. Die Werte aus Tabellen sind die Vorschläge von Konvention, die sich in Formeln appliziert. Diese erleichtert die Verwendung der modernen Berechnungsmitteln für die Würkigung des touristischen Potentials in fixen Punkten, auf Teile der Route, oder auf ganzen Routen. Der graphische Ausdrück ist sehr interessiert und attraktiv und hat eine grosse und praktische Bedeutung: Skizzen, Karten (die 2. Abbildung), Diagramme (die 3. Abbildung).

Key words: touristic potential, attractiveness, estimative quantification, Romania

The estimation of touristic potential is a very important present-day problem in Romania, especially in mountain regions, which remained in a secondary plan, according to investitions and touristic arrangements. Trying to amplify a study on touristic potential, on the qualities of the geographical landscapes and the possibilities of quantification of their components[1], we propose here a model of estimation that could be applied to all categories of mountain routes, in precised (fixed) points, on certain parts of the routes or on entire routes.

The tourism, as a human activity, appeared and developed under the influence of many factors, which could be grouped into two main categories (objectives and subjectives), being stimulated by a physical and a psychical confort. The degree of variability of the subjective factors is, practically, infinite, from the individual level to the group level, determining an impossibility of their quantification. But the quality of the objective factors could be measured or valued and quantified, if the estimation is applied to a person/homogenous group with physical train, emotional capacities, culture, equipment, etc., of an *average value*.

Here is a short analysis of the principal objective geographical factors that contribute to the specific physical and psychological convenience of the mountain touristic activity (the content of the tables are proposals for a *convention*, based on some certain criteria, presented below).

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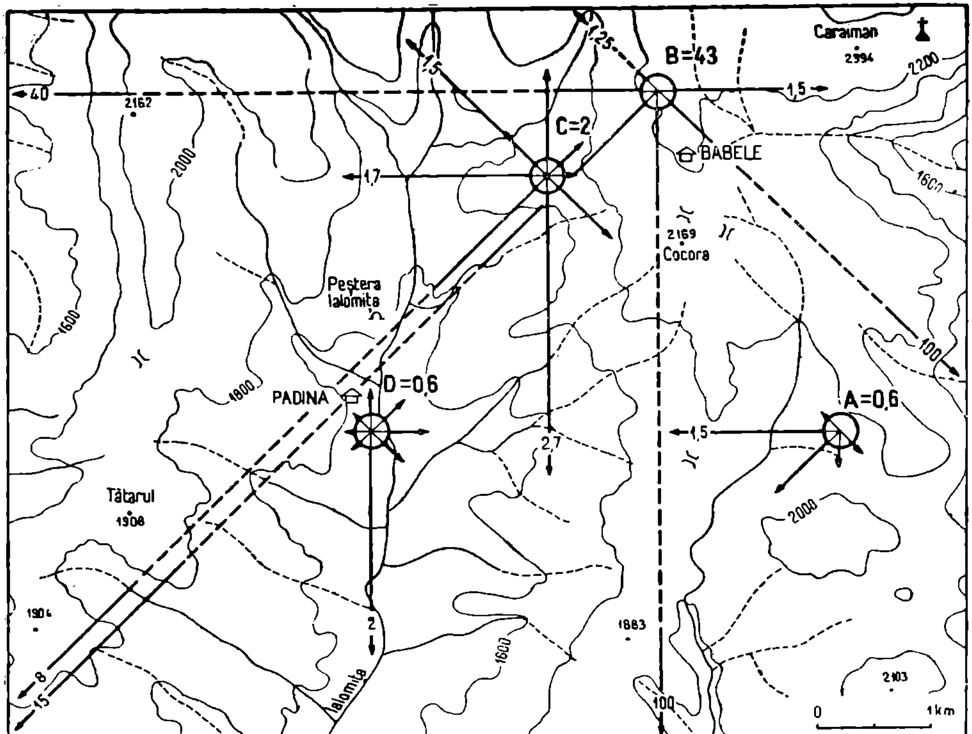
* Paper presented at the VIIth Symposium "Man and theMountain", Voineasa, 1991, June.

[1] "Some approaches to the touristic potential of the karst areas of the Southern Carpathians and the Mehedinţi Plateau", paper presented at the VIth Symposium "Man and the Mountain", Voineasa, 1990, June.

Estimation of the Visual Field (Cv). The emotions created by the geographic landscape is one of the most important genetic elements of the touristic activity. This reality is more evident for the mountain landscapes, where the peoples are going to *look around* and *to admire*. So, the attraction of a place situated nearby the talveg of a deep valley, is not comparable to that of a point located on a mountain peak, with a wide view and profoundness of many kilometers.

The visual field is an element that could be measured on the topographic map in every point, both as the angle value (we recommend the method of arches of circle of 45°) and as the potential profoundness (the rays of circle will be prolonged up to the intersection, with the contour line with the same altitude as the point of observation than will be measured and totalized, for the average calculation, like in Fig. 1 and



POINT	LOCATION	ALTIT.	PROFOUNDNESS N	NE	E	SE	S	SW	W	NW	TOTAL	Cv
A	Cab Piatra Arsă	1950	0	0	0	0,25	0,30	0,75	1,50	0,20	3,00	1
B	Vf Baba Mare	2250	0	0	1,50	100	100	15	40	1,25	257,75	8
C	Piciorul Babelor	1888	0,90	0,50	0,40	0,90	2,70	8	1,70	1,50	16,60	4
D	Lunca Ialomiţei la Padina	1500	0,90	0,37	0,50	0,45	2	0,20	0,20	0,20	4,82	2

Fig. 1 — The calculation of the Visual Field (Cv) on maps.

formula 1).

$$Cv = \frac{L_{r1} + L_{r2} + L_{r3} + \ldots + L_{r8}}{8} \quad (1)$$

where : — L_{r1}, L_{r2}, L_{r3}, L_{r8} — the measured length of the circle's rays
— 8 —the number of considered circle's rays

In some certain situations (mountain peaks) the circle's rays length seems to be infinite, but this is an apparent problem. On a way, the planetary curvation, on another way the human eyes' possibilities and the meteorological conditions are limiting the dimensions of the circle's rays. The practice shows that only in uncommon situations the deep of the visual field is more than 100 km, so we propose this dimension as a maximum one.

The value of the visual field (Cv) is influenced by vegetation, by the presence of some anthropic elements (buildings, etc.), and by the meteorological conditions at the moment of observation. Table 1 was proposed on the visual confort growing criterion in function of the distance reduction.

Slopes' estimation (P). The inclination of the topographic surface is a determining element on the confort of tourists during their walk. Usually, the confort is declining proportionally with the growing of the slope angle, up to the disconfort at a very inclined slopes.

This report of a contrary proportionality is available both for climbing or descending actions, also depending on the quality of the way. It is often expressed in sexagesimal degrees (table 2). This could be done on the topographic maps, on relief sections or in the field. The element (P) is defining, at the same time, the different parts of the routes. In fixed points of observation, the value of slope angle will be zero.

Table 1

The proposed values for the Visual Field (Cv)

Average of profoundness	Pts.
100	10
50.00—99.99	9
25.00—49.99	8
12.50—24.99	7
6.25—12.49	6
3.12—6.24	5
1.06—3.11	4
0.80—1.05	3
0.40—0.79	2
0.20—0.39	1
less than 0.20	0

Table 2

The proposed values for Slope's angle (P)

Angle (°)	Pts.
0—4	10
5—9	9
10—14	8
15—19	7
20—24	6
25—29	5
30—34	4
35—39	3
40—44	2
more than 45	1

Table 3

The proposed values for Vegetation (V)

Angle (°)	Pts.
360	10
315—359	9
270—314	8
225—269	7
180—224	6
135—179	5
90—134	4
60—89	3
40—59	2
20—39	1
s than 20	

Vegetation (V). By the type, length and density, the vegetal associations have a direct influence on the visual field. So, in conditions of a herbaceous association (mountain or alpine grass-plot) the visual field is at top, in forestry conditions can't be more than 20 — 30 m. In detail, there are differences in connection with the types of the forests, the density of trees, the diameter of trunks, etc. Realising this interdependence, we consider that the influence of vegetation on the visual field must be a percent raportation of element (V) to element (Cv), as in table 3. The criterion of the proposed values was the restriction introduced by vegetation on the visual field, easy to estimate in the field (similarly with the estimation of nebulosness in meteorology).

Natural Forms (N). If the effect produced by every natural form is difficult to be estimated, a classification of such components of the geographical environement could be made on their dimensions, spectaculosity, originality, etc. (table 4). The presence of such forms could raise the attraction of some landscapes in fixed points or parts of the routes, or they could be not present and have to be missed in equation.

$$N = \frac{N_1 + N_2 + N_3 + \ldots + N}{n} \qquad (2)$$

where : N_1, N_2, N_3, N — the value of each natural form
n — the number of considered elements

Table 4

Proposed values for Natural Forms (N)

Types of forms	Points
Karstic depressions (dolines, uvalas, etc.), rivers, springs	1
Geologic phenomena (fossils, points with veins, etc.), mineral springs	2
Cave entrances, grottos, niches	3
Steeps, overhang steeps less than 50 m high	4
Waterfalls, cataracts less than 10 m high	5
Steeps, overhang steeps more than 50 m high	6
Waterfalls more than 10 m high	7
Natural lakes	8
Glacial ridges, ridges and spectacular peaks	9
Stones looking strange, natural bridges and arches	10

Anthropic Elements (A). More and more frequently, the anthropic changes have a negative role in the estimation of landscape. Sometimes the anthropic changes could be positive (dam lakes, buildings, with aesthetic architecture, well projected ways, etc.), but generally, the anthropic action is a negative one, both in moral and material dimensions. So, we proposed table 5 and formula (3) :

$$A = \frac{A_1 + A_2 + A_3 + \ldots + A_n}{n} \qquad (3)$$

where : A_1, A_2, A_3, A_n — the value of each anthropic element
n — the number of considered elements

The anthropic elements (A) have mostly 10 points (for the pathways only), or 7 points (for ways and high-ways exclusive).

Table 5

The proposed values for Anthropic Elements (A)

Types of elements	Points
Quarries, waste dumps	0
New clearings of forest	1
Dams and dykes (including that in construction)	2
Cable railways, endless bands, ropeways	3
Cities	4
Buildings with implications in landscape (huts, cabins, forestry and touristic chalets, other buildings)	5
Compact villages	6
Railways, forestry rails, forestry, industrial and touristic ways	7
Dispersed villages, historical traces	8
Small pastoral buildings (sheepfolds, shelters, etc.)	9
Path-ways, cart-tracks, elements of architecture, pop technics and folk usages	10

The quality of the way (T). This have a plenty contribution to the touristic potential of a route. Between a smoothed path-way and a bouldered-way there is a great difference of confort, although the value of slope (P) is the same. Main complications are present in snowy seasons, in connection with the mechanic properties of snow, antecedence of some traces, etc. This element having a great variability, the quantification is difficult. So, we propose to use it in detailed studies only, as in table 6. The values will be reported to the length of every part of the route and then will be made an average. The main criterion is the physical and moral impact on the tourists' mind, and could be estimated in the field only.

$$T = \frac{T_1}{L_1} + \frac{T_2}{L_2} + \frac{T_3}{L_3} + \dots + \frac{T_n}{L_n} \qquad (4)$$

where : T_1, T_2, T_3, T_n — the quality of the way in every part of it
L_1, L_2, L_3, L_n — the length of each part of the route

Table 6

The proposed values for the quality of the way (T) in not snowy seasons

Type of way	Points
Dangerous path-way on a ridge	0
Narrow path-way on the slope (belt)	1
Path-way in a forest with felled trees, path-ways modelled by drains	2
Path-way paved with mobile gravel (scree)	3
Eroded cart track	4
Paved way	5
Path-way with rare boulders	6
Asphalt way	7
Levelled cart track	8
Smoothed path-way	9
Path-way with grass	10

By practice, the comparison between two routes in the same massif or in two different massifs is limited by the changes of the slopes. In fixed points (P_f), the slopes could be neglected and the element (N) could be used when necessary. The equation becomes as in formula 5(a and b) and could be illustrated as in Fig. 2 (necessary mediation):

$$P_f = \frac{Cv + V + N + A}{4} \quad (5a) \qquad P_f = \frac{Cv + N + V + A + T}{5} \quad (5b)$$

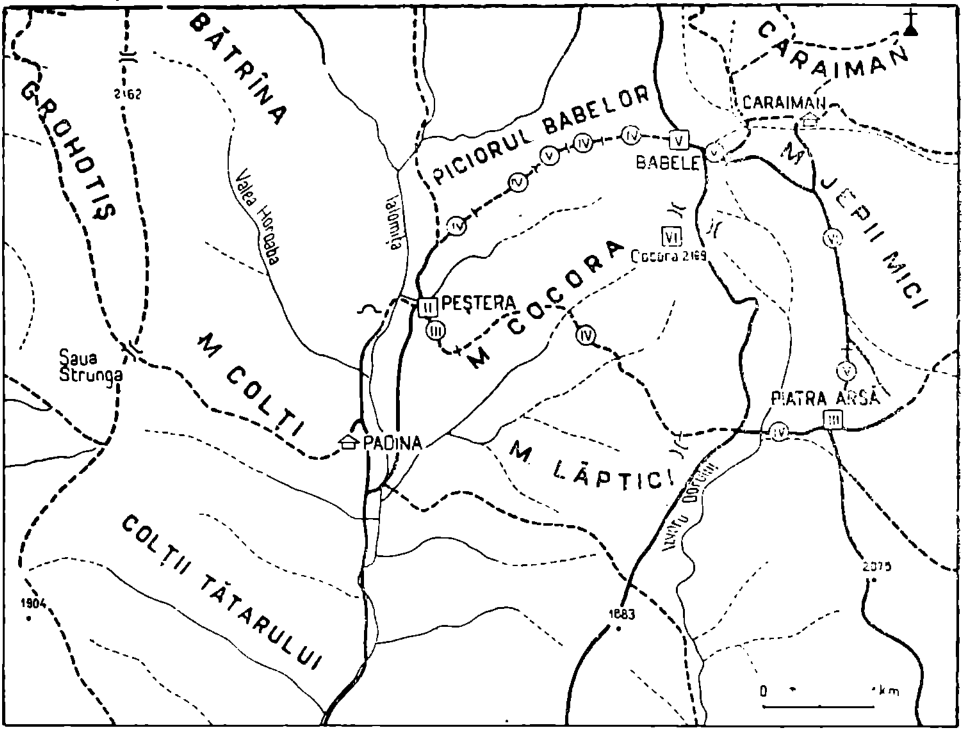


Fig. 2. – The map of touristic potential on parts of routes of some touristic routes in the Bucegi Mountains (Southern Carpathians).

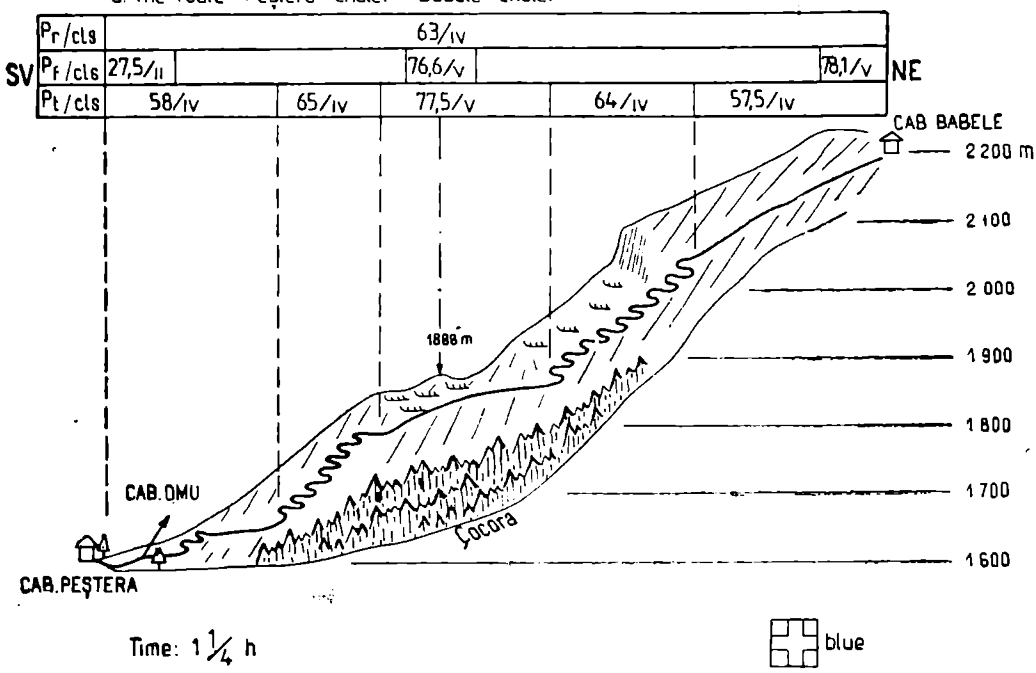
The equation is more complete for the parts of the routes (P_t) and diagrams of variation of the touristic potential could be made (Fig. 3):

$$P_t = \frac{Cv + P + V + N + A}{5} \quad (6a) \qquad P_t = \frac{Cv + P + V + N + A + T}{6} \quad (6b)$$

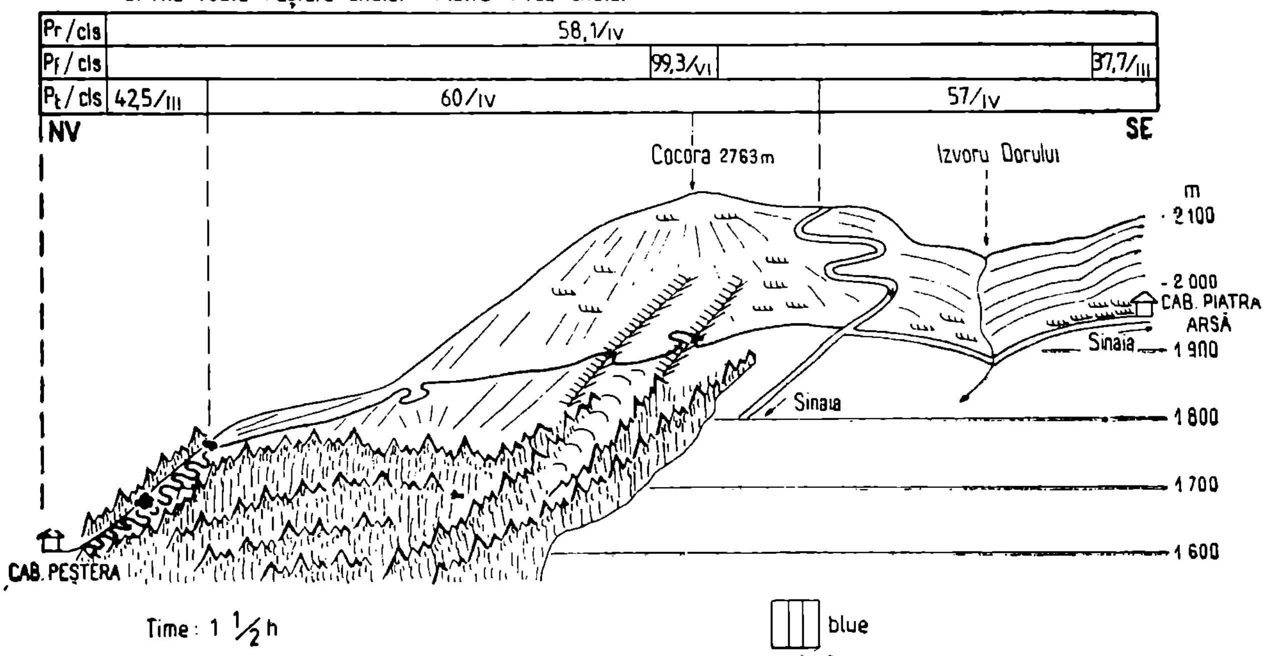
The index of potential for the whole route will be a mediation between the total value of the parts and fixed points that were considered and then will be expressed in percents:

$$P_r = \frac{(P_{f1} + P_{f2} + P_{f3} + \ldots + P_{fn_1}) + (P_{t1} + P_{t2} + P_{t3} + \ldots + P_{tn_2})}{(n_1 + n_2)} \% \qquad (7)$$

a. The route Peștera Chalet - Babele Chalet



b. The route Peștera Chalet — Piatra Arsă Chalet



c. The route Piatra Arsă Chalet — Babele Chalet

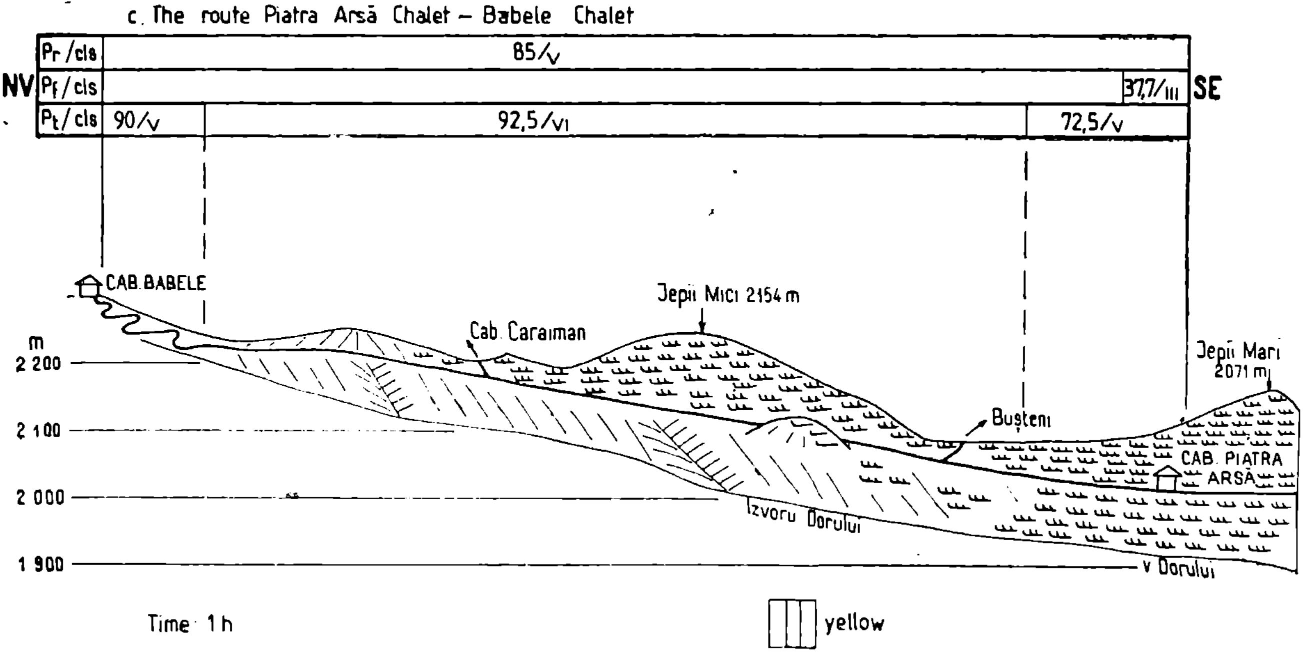


Fig. 3. — The diagrams of the touristic potential of some touristic routes in the Bucegi Mountains (Southern Carpathians).

where : $P_{f1}, P_{f2}, P_{f3}, P_{fn1}$ — the value of index in fixed points
$P_{t1}, P_{t2}, P_{t3}, P_{tn2}$ — the value of index for parts of the route

n1 — the number of fixed points that were considered
n2 — the number of parts of the route that were considered

The index of touristic potential (P_f, P_t, P_r) will range between 1 and 10. To be more usual, we propose here six classes of potential (table 7) :

Table 7

Classes of potential in fixed points, parts of the routes or entire routes

Total value of potential	Class
under 1.00	I
1.01– 3.00	II
3.01– 5.00	III
5.01– 7.00	IV
7.01– 9.00	V
9.01–10.00	VI

For the detailed studies one could introduce the meteorologic elements (M), that must be appreciated *in a certain place and at a certain moment.* The values proposed are in table 8. So, the equation is :

$$P_f = \frac{Cv + V + N + A}{4M} \qquad (8a)$$

$$P_f = \frac{Cv + V + N + A + T}{5M} \qquad (8b)$$

The presence of (M) at denominator is an objective necessity because the value of the touristic potential in a certain point on a bad weather could be nearby zero (e. g. a very dense fog and rain).

The introduction of this potential index of landscape have not a theoretical value only, but many practical uses. It comes to support the activity of field specialists in mountain regions (geologists, geographers, biologists, foresters, etc.) but the main benefit is for touristic activity.

Table 8

The proposed values for meteorological elements (M)

Temperature	Points	Precipitations	Points
(–15)–(–5)	3	Rain	4
(–5)– 5	1	Snow	3
5–15	0	Cloudy	2
15–25	1	Variable sky	1
25–35	3	Clear sky	0
Wind	**Points**	**Visibility**	**Points**
Very hard	4	Dense fog	10
Hard	3	Haze	5
Moderate	2	Mist	3
Mild	1	Partly clear	1
No wind	0	Clear	0

The mountain guides, as well as the tourists themselves, could plan their excursions on scientific bases, also as equipment, as optimum load, as effort and as emotions. Also it could be used by economists and managers in their studies for the next investitions. This system could solve many theoretical and practical problems in tourism and could be extended to all types of relief, types of tourism in space and time, with the help of a computer. The expressive and attractive possibilities of graphics (maps, diagrams, graphs) is a supplementary argument for accepting our proposals.

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DER AUSDRUCK „MEERAUGE" WIDERSPIEGELT IN DER HERKUNFT DES TOPONYMS *ZĂNOAGĂ*

VASILE PÂRVU

The phrase "ochi de mare" reflected in the origin of the toponym *Zănoagă*. The toponym *Zănoaga* has in the Southern Carpathians the meaning: "1. a circular depression rounded by steep slopes in the high mountains; corrie; 2. green clearing or hill's slope available for farming; 3. whirlpool of deep water along a water course, below a dam". Its etymology according to Iorgu Iordan (1963) and to *The Explanatory Dictionary of the Romanian Language* (DEX) (1975) is the Sl. *za+noga* "at the foot (of the mountain or hill)". We try to prove that this etymology is not correct. In Paring and Retezat Mountains are many cirque lakes named *Zănoaga*. We believe that the toponym *Zănoaga* comes from the Germ. *Seenauge* (= Meerauge) which is a translation made by the Transylvanian Saxons, of the Romanian phrase "ochi de mare", meaning "cirque lake". That phrase is known also in another languages: Germ. *Meerauge*, Pol. *morskie oko*, Czech *morské oko*, Hung. *tengerszem*. In the Tatra Mountains are 58 cirque lakes named *Morskie Oko*.

Schlüsselwörter : Gletscherseen, Gletscherkessel, Limnonym, Ortsnamenkunde, Südkarpaten.

Gletscherkessel kennzeichnende Formen für Gletscher — sind in der europäischen Fachliteratur unter folgenden Begriffen bekannt: *Kar* (Deutschland), *corrie* (Sehottland), *cwmb* (Wales), *botn* (Skandinavien), *oule* (Pyrenäen)[1].

In den rumänischen Karpaten gibt es eine ganze Reihe von Synonymen für diesen Begriff : *căldări*, *găuri*, *groape*, *scoabe*, *hîrtoape*, *cățunuri*, *găvane*, oder *zănoage* [2] (im Falle einer länglichen Form), *tigăi* und *tărtării* [3].

Gletscherseen *(lac de cirque, cirpue lake)* werden durch die Lexeme *Karsee* (Deutschland), *corrie lake*, *tarn* [4] (Schottland) bezeichnet. In unseren Gebirgen nennt sie der Volksmund *iezere*, *zănoage*, *tăuri*, *jghiomfuri*.

Die vorliegende Arbeit nimmt sich vor, die Bedeutung und Herkunft des Gattungsnamen *zănoaga* zu erschliessen. In der Fachliteratur bezeichnet man mit dem oben erwähnten Wort" ein tiefes, vom Winde geschütztes Tal, zwischen zwei Bergen [5]". Im Semenic — Gebirge hat es die Bedeu-

[1] Emm. de Martonne (1907), *Cercetări asupra evoluției morfologice a Alpilor Transilvaniei (Carpații Meridionali)*, im Band *Lucrări geografice despre România*, sub îngrijirea V. Tufescu, Gh. Niculescu, Ș. Dragomirescu, Bd. I, Edit. Academiei, 1981, S. 224.

[2] *Geografia României*, I, *Geografia fizică*, 1983, Edit. Academiei, S. 138.

[3] G. Giuglea, in dem Band *Cuvinte românești și romanice*, Edit. Științifică și Enciclopedică, București, 1983, S. 311.

[4] H. Baulig, *Vocabulaire franco-anglo-allemand de géomorphologie*, Paris, 1956, S. 282.

[5] *Geografia de la A la Z. Dicționar de termeni geografici*. Coordonator Gr. Posea, Edit. Științifică și Enciclopedică, București, 1986, S. 322.

tung von „Gebirgsquellen oder-bächen" [6]. Der *DEX* [7] gibt folgende Bedeutungen für *zănoaga* : 1. „Tal mit felsigen Abhängen in Hochgebirge; Gletscherkessel. 2. Waldlichtung oder Wiese am Fusse eines Berges, für die Landwirtschaft geeignet. 3. Wasserauge am Laufe eines Flußes oder an einen Staudamm flussabwärts".

T. Porucic erwähnt den Gattungsnamen *zănoaga* mit der Bedeutung : „großes Loch in einer Gegend mit Gebirgsrelief" [8].

Iorgu Iordan verzeichnet den Begriff mit der Bedeutung : „Vertiefung, windgeschütztes Tal zwischen Bergen, grüne Lichtung " [9].

Die Ortsbezeichung *Zănoaga* ist als Name einiger Berge in den Kreisen Argeş, Buzău und Dîmboviţa anzutreffen. Ein Wald in der Muşceler Gegend trägt denselben Namen. Desgleichen gibt es einige Dőrfer mit dem Namen *Zănoaga* in der Gegend von Caracal, Drăgăneşti-Olt und Ploieşti. Die Bezeichnung *Zănogi* ist in der Olteţ — Gegend belegt und im Kreis Gorj ein Berg mit dem Namen *Zănogu* [10].

In den Geschichtsurkunden der Walachei erscheint das Toponym fünfmal als Name eines Berges und zweimal als Name eines Dorfes [11].

Die älteste Belegung des Ortsnamen stammt aus dem Juli des Jahres 1451 (=6959) in einer Urkunde durch welche der Berg *Zănoaga* in Ţara Loviştei) als unverletzbares Eigentum des Bojaren Dragomir Ruhat und seiner Nachfolger bestätigt wird : „Und der Berg Mănăileasa und Stîna Mare und Zănoaga und Prislop und Între Boile, Arsurile lui Boe" [12].

I. Conea erwähnt ebenfalls für die Ţara Loviştei einen Beleg aus dem Jahre 1867 der sich auf die Urkunde von 1451 bezieht, der bestätigt : ‚Eigentum zwischen *Boilea und Plaiul Mănulesei, gennant auch Leu und ‚Stîna Mare und Zănoaga und Prislopu welcher heißt Petriceaua und Arsurile*" und darauf hinweist daß „alle heutigen Namen der Berge sind, Eigentum der beiden Dörfer" [13] (Găujani und Boişoara, Anm. des Autors).

Die Herkunft der Bezeichnung ist, nach Iorgu Iordan, eine slawische : *za-* + *noga* „am Fuße", und in einer Fußnote fügt der Autor hinzu : „also am Fuße eines Berges oder eines Hügels" [14]. I. A. Candrea [15] vergleicht die Bezeichnung mit dem ruthenischen Wort *zanoga* „zurückgezogener Ort". Im DEX wird das Etymon durch das russische *zanoga* und das ruthenische *zanoha* erklärt.

Diesen Deutungen widerspricht die geographische Begründung die sich auf die tatsächliche Etymologie des Toponyms *Zănoaga* stützt, das ursprünglich die Bedeutung „Gletschersee" trug, und somit ein Limnonym

[6] L. Botoşăneanu, Şt. Negrea, *Drumeţind prin Munţii Banatului*, Edit. CNEFS, 1968, S. 234.
[7] *Dicţionarul explicativ al limbii române*. Edit. Academiei, Bucureşti, 1975, S. 1039.
[8] T. Porucic, *Lexiconul termenilor entopici din limba română*, 1931, S. 33.
[9] Iorgu Iordan, *Toponimia românească*, Edit. Academiei, Bucureşti, 1963, S. 537.
[10] Iorgu Iordan, *op. cit.*, S. 537.
[11] *Documente privind Istoria României*. B. *Ţara Românească. Veacurile XIII—XVI. Indicele numelor de locuri*, Bucureşti, 1956, S. 161.
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[13] I. Conea, *Ţara Loviştei. Studiu de geografie istorică*, im *Buletinul Societăţii Regale Române de Geografie*, Band LIII, 1934, Bucureşti, 1935, S. 141.
[14] Iorgu Iordan, *op. cit.*, S. 537, die Fußnote 5.
[15] I. A. Candrea, Gh. Adamescu, *Dicţionarul Enciclopedic Ilustrat „Cartea Românească"*, Bucureşti, 1931, s.v. *zănoaga*.

(Seenname) und keineswegs ein Oronym (Bergname) ist und auch nicht die geographische Lage eines Ortes im Gebirge bezeichnet, sei er nun am Fuße eines Bergabhangs oder eines Hügels.

Um die Etymologie eines Toponyms mit Bestimmtheit festzulegen muß auch die Herkunft des Namens als solcher (als Ortsbezeichnung) [16] bekannt sein.

Die Toponymie des Paring-Gebirges und des Retezat weist zahlreiche Beispiele von Gletscherseen mit der Benennung *Zănoaga* auf: *Zănoaga Mare*, *Zănoagele Mari* (Paring); *Zănoaga*, *Zănoguţa*, *Zănoguţa Mică* (zwei), *Zănoguţele Galeşului* (drei), *Zănoguţele Stînişoarei* (zwei), *Zănoagele Judelui* (Retezat).

Im Reiseführer *Popas în Retezat* von E. Iliescu (1972) treffen wir unter anderen, im Tourismus gebräulichen Termini, auch den volkstümlichen Ausdruck „ochi de mare" (= Meerauge), der den Gletscherseen von den Hirten des Retezat verliehen worden ist. Desgleichen ist dieser Ausdruck in dem Şureanu — Gebirge anzutreffen und bezeichnet Gletscherseen.

Wir halten dafür, daß dieser Ausdruck den Schlüssel zur Bestimmung der Etymologie des Toponyms *Zănoaga* darstellen kann. In diesem Fall ist es nicht schwer die Herkunft des Gattungsnamen *zănoaga* im deutschen *Seenauge* (= *See — n* [17] *— auge*) zu erkennen, das als Synonym das deutsche *Meerauge* („ochi de mare") hat.

Es scheint, daß im Mittelalter die siebenbürgisch — sächsischen Besitzer der Berge, in denen Gletscherseen vorkommen, den volkstümlichen rumänischen Ausdruck „ochi de mare" mit dem deutschen *Seenauge* übersetzt haben. Ihrerseits haben die rumänischen Hirten diesen Begriff, durch Rückübertragung, wieder übernommen ohne zu wissen daß *sie* die eigentlichen *Namengeber* sind.

Der Ausdruck „ochi de mare" (Meerauge) ist auch in anderen Sprachen anzutreffen: Polnisch *morskie oko*, Tschechisch *morské oko*, Ungarisch *tengerszem*. Solche „Meeraugen" gibt es im gesamten Karpatenraum, vor allem in der Hohen Tatra, wo es sich um kleine Bergseen aus dem Pleistozän handelt [18].

In einem deutschen Lexikon steht über die Karpaten auch Folgendes: „Die wilde Romantik der Tatra wird noch erhöht durch 58 dunkelblaue und grüne, oft bis Juli eisbedeckte, tiefe Seen (sogen. *Meeraugen*), die in einer Höhe von 1400 — 2025 m an steilen Felswänden, von Trümmerhalden umgeben, oder in unwirtlichen Kesseln verborgen liegen" [19].

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[16] I. Conea, *Toponimia şi cercetarea toponimică în cadrul geografiei*, im Band *Îndrumători de cercetări geografice. Cercetări economico-geografice*, Biblioteca geografului, Bd. 7, Bucureşti, 1969, S. 246.

[17] Das „n" ist nicht die Endung des Plurals sondern ein alter Genitiv Singular (wie in Schwane*n*hals, Greise*n*alter), in W. Jung, *Grammatik der Deutschen Sprache*, VEB Bibliographisches Institut, Leipzig, 1984, S. 375.

[18] *Meyers Neues Lexicon*, VEB Bibliographisches Institut, Leipzig, Band 9, 1974, S. 261: Meeraugen „(Kleine Bergsen in den Karpaten während des Pleistozäns von Gletschern ausgeformte, heute wasserfüllte Kare, bes. zahlreiche in den Vysoké Tatry; *Das Gesicht der Erde*, zweite neubearbeitete Auflage, Brockhaus Verlag, Leipzig, 1962, S. 699: „Meeraugen in den Karpaten Bezeichnung für die kleinen Gebirgsseen, bes. im Gebiet der Hohen Tatra".

[19] *Meyers Konversations — Lexicon*, Leipzig, 1890, Band 9, S. 557.

Von diesen Meeraugen der Tatra ist *Rybie Pleso (Morskie Oko).* hervorzuheben, ein „herrlicher See der sich unter dem Rysy — Gipfel ausdehnt, gelegen auf der Höhe von 1 393 m, mit einer Fläche von 33 ha, der ungefähr 30 m tief ist [20]. Ein polnischer See *Czarny Staw*, der auch *Morskie Oko* heißt, befindet sich in einer Höhe von 1584 m [21].

Die Bezeichnung *zănoaga* wiederum bedeutete ursprünglich Meerauge und nachträglich, durch Verlieren der anfänglichen Grundbedeutung, benennt sie auch „Gletscherkessel" und nachher im erweiterten Sinn „jedwelche Bodenvertiefung". Nur aufgrund dieser letzteren Bedeutung kann das Toponym *Zănoaga* als Namen von Dörfern aus der Rumänischen Tiefebene [22] und dem Banat erklärt werden.

Zum Schluß muß unterstrichen werden, daß der Ausdruck „ochi de mare" den Ausgangbegriff darstellt nach dem die Siebenbürger Sachsen den Begriff *Seenauge* gebildet haben. Die ursprüngliche Bedeutung des Toponyms *Zănoaga* ist verlorengegangen, lebt aber im Volksmund als „ochi de mare" heute noch weiter.

Eingegangen am 28. Februar 1990

Lyzeum "Trajanus"
Deva

[20] *Les Hautes Tatras*, Edition „Orbis", Prague, XII, Fochowa, S. 59; cf. *Słownik geograficzno-krajoznawczy Polski*, Warszawa, 1983, S. 441; *Tatry Polskie, Mapa topograficzna*, Maßtab 1: 10.000.

[21] *Les Hautes Tatras*, cf. die Karte „Les environs des Vysoké Tatry", Maßstab 1: 75.000.

[22] Die Ortsnamen *Zănoaga*, Dörfer im Kreis Dolj (Gemeinde Leu), Kreis Olt (Gemeinde Băneasa), Kreis Prahova (Gemeinde Dumbrava) und *Zănogi*, Dorf innerhalb der Gemeinde Cornereva, Kreis Caraş-Severin, — nach I. Iordan, P. Gişteseu, D. I. Oancea, *Indicatorul localităţilor din România*, Editura Academiei, Bucureşti, 1974, S. 275.

VLADIMIR TREBICI, *Populaţia Terrei* (Terra's Population), Editura Ştiinţifică, Bucureşti, 1991, 363 p., 63 figs., 89 tables, bibliogr.

Together with the exceeding of the figure of 5.3 billion inhabitants in 1990, this work completes, for those interested from various fields of activity, the information about a fundamental problem of the present day — the problem of the population — with all its aspects which mankind is facing at the moment.

The work has two big parts. The first one examines the population and the main demographic phenomena with the aim to highlight the great variety of demographic situations in the world, despite the fact that the analysis was based on data supplied by organisms belonging to the UNO referring to a single year, that is 1985—1986 as concerns the number and density of the population and to a single period 1980—1985 as concerns the phenomena regarding fertility and mortality. The author points out the complex contemporary demographic tendencies, tackling under multiple aspects the population of Terra both on continents and on great geographical regions, that is those established by the UNO classification in accordance with the criteria of economic and demographic development materialized in two big groups: developed regions or countries and less developed regions or countries. Thus the reader has the oportunity to learn about these regions/countries from the points of view of the evolution, structure of population by sex and age, mortality and fertility as well as the determinative causation that has lately brought about essential changes especially in developed countries of the world.

The problems in the chapter regarding the international migration during 1980—1985 will be also interesting for the reader. To countries with a tradition in immigration like North American countries, Australia, New Zealand, are added of late the developing countries, big oil producers of the Arabian Peninsula that register high values of the international immigration balance.

At the end of the first part of the book, the author dwells upon the urban and rural population, the rates of urbanization of the regions and countries established by the UNO criteria as well as the urban concentrations of more than 5 million inhabitants in 1985. He makes appreciations regarding the active and unactive population analysing particularly the activity rate of the world population in accordance with sex and age.

In the second part of the book, demographic regional types are established taking into consideration the life expectance at birth and the total fertility rate. The work analyses the parallelism economic dynamics — demographic dynamics and tackles integrately the resources and the population and the ecological consequences of human activity dealt with from the angle of decrease or increase of the population in the future.

By adopting the World Plan of action in the field of population at the World Conference of the Population in Bucharest 1974, political and scientific strategies of the states regarding the demographic problem of mankind were outlined. The principles on which this plan is based are exhaustively analysed by the author, who highlights at the end of his work the major problems of the future of mankind in the new demographic transition begun in the 70's through the unprecedented reduction of natality in the developed regions, as opposed to the force and dynamism of the developing regions which offer encouraging prospects to their economic and demographic evolution. This does not confirm some theories regarding the "demographic implosion" or even catastrophic scenarios backed by some scientists abroad.

It is certain that from the viewpoint of professor Trebici's work we can ascertain that at present mankind has at its disposal great human resources. By means of a judicious coordination of national and international political bodies these resources will grant new dimensions for the settlement of new interstatal relations of equity, of viable and lasting development for the present generations and especially for the future ones.

Through the variety of graphics and synthetic tables of the work, the reader understands better the contemporary problems regarding the world population and the explanation of the cluster analysis as a method of the average linkage between groups method and its aplications included at the end of this work can be used as a working instrument for the establishment of the demographic profile of some groups of countries.

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