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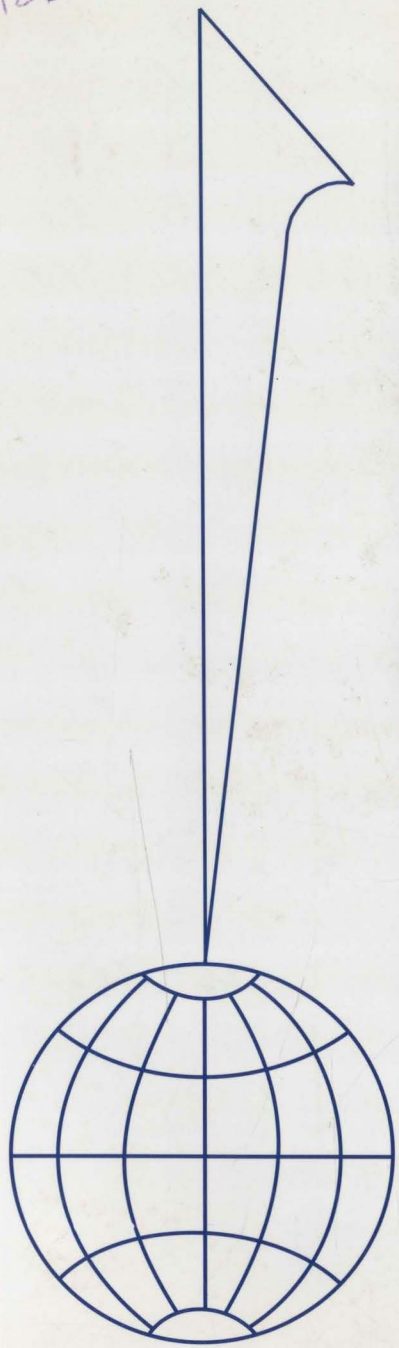

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CONSIDÉRATIONS SUR L'IDENTITÉ ET L'HISTOIRE DES AROUMAINS

*NICOLAE-ŞERBAN TANAŞOCA**

Mots clés: Aroumains, Vlaques, Roumains balkaniques, nation, minorités ethniques.

Some considerations on the identity and the history of the Aromanians. Aromanians (also named Vlachs, Macedoromanians, Koutzovlachs, Tsintsars) are the most important survivors of the ancient Balkan Romanians. Their language is a dialect of the ancient common Romanian. Integrated into the cultural and political lives of the peoples among whom they were living (Greeks, Bulgarians, Serbians, Albanians), Aromanians were gradually assimilated by them. The efforts made by modern Romania in the XIXth–XXth centuries to integrate Aromanians into the Romanian nation were not completely successful. It's quite improbable, despite the attempt of some politicians and intellectuals, to be founded in the future a new latin Aromanian nationality.

De beaucoup plus nombreux que les Meglénoroumains et les Istroroumains, les Aroumains sont aujourd'hui, après la disparition des Roumains du Mont Haemus et des contrées nord-occidentales de la Péninsule Balkanique (la Serbie, la Croatie, le Monténegro, la Bosnie), les survivants les plus importants des anciens Roumains balkaniques[1]. Le nom ethnique *Aromunen,* employé pour la première fois dans la littérature scientifique par le balkanologue allemand Gustav Weigand[2]

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[1] Ouvrages généraux sur les Aroumains et les autres Roumains balkaniques : Institutul român de cercetări din Freiburg, *Bibliografie macedo-română*, Freiburg i.Br., 1984; Th. CAPIDAN, *Meglenoromânii*, I–III, Bucarest, 1925-1928, *Aromânii. Dialectul aromân*, Bucarest, 1932, *Macedoromânii. Etnografie, istorie, limbă*, Bucarest, 1942; Matilda CARAGIU-MARIOŢEANU, *Compendiu de dialectologie română*, Bucarest, 1975; Neagu DJUVARA (coordinateur) et collaborateurs, *Aromânii: istorie, limbă, destin*, Bucarest, 1996; Silviu DRAGOMIR, *Vlahii din nordul Peninsulei Balcanice în Evul Mediu*, Bucarest, 1959; Valeriu RUSU (coordinateur) et collaborateurs, *Tratat de dialectologie românească*, Craiova, 1984; Max Demeter PEYFUSS, *Die aromunische Frage*, Vienne, 1974; Tache PAPAHAGI, *Aromînii. Grai, folklor, etnografie*, Bucureşti, 1932, *Dicţionarul dialectului aromîn, general şi etimologic*, Bucarest, 1963; Sextil PUŞCARIU, *Studii istroromâne*, I–III, Bucarest, 1906-1929. Voir aussi: St. BREZEANU, *Romanitatea orientală în evul mediu*, Bucureşti, 1999; N.SARAMANDU, *Studii aromâne şi meglenoromâne*, Constanţa, 2003; Gh. ZBUCHEA, *O istorie a românilor din Peninsula Balcanică (sec. XVIII–XX)*, Bucarest, 1999; N. Ş. TANAŞOCA, *Apercus of the History of Balkan Romanity*, dans *Politics and Culture in Southeastern Europe*, UNESCO-CEPES, Bucarest, 2001; Anca TANAŞOCA et N.Ş. TANAŞOCA, *Unitate romanică şi diversitate balcanică. Contribuţii la istoria romanităţii balcanice*, Bucarest, 2004. Thede Kall, *Istoria aromânilor*, Tritonic, Bucureşti, 2006. V. aussi, plus bas, fig. 1 et note 18.

[2] Gustav WEIGAND, *Die Aromunen. Ethnographisch-philologisch-historische Untersuchungen über das Volk der sogennanten Makedo-Romanen oder Zinzaren*, I–II, Leipzig, 1894–1895.

et adopté ensuite par les autres érudits européens qui l'ont adapté à leurs langues (roum. *Aromâni*, fr. *Aroumains*, it. *Aromeni*, gr. *Armanoi*, blg. *Aromunite*) n'est qu'un décalque, savant et moderne, du nom *ar(u)mâni/rumâni, rămâni* qu'ils se sont toujours donné eux-mêmes dans leurs patois. Avatar du lat. *Romani*, ce nom ethnique, auquel les Aroumains sont restés jalousement attachés, témoigne, à l'instar de son correspondant dacoroumain *rumâni/ români*, de leur identité romane, voire roumaine, ainsi que de leur détermination à la préserver. Par ailleurs, les étrangers, balkaniques et autres, avaient pris depuis belle lurette l'habitude d'appeler courrament les Aroumains, ainsi que tous les autres Roumains de l'ancienne Dacie et des Balkans, d'un nom dérivé de l'ancien nom ethnique germanique *Wlachen/Walachen* (blg. *Vlasi*, gr. *Vlachoi*, lat. *Blachi, Blaci, Valachi*, rus. *Volochi*, hong. *Olahok*, arab. *Ulakut*, turc. *Eflaq*, fr. *Vlaques*, it. *Valacchi*, angl. *Vlachs*, roum. *vlahi)*. Ce nom, attribué initialement à tous les citoyens de langue latine de l'Empire romain, mais réservé finalement aux seuls Roumains, témoigne, lui aussi, de leur unité ethnique[3]. Il y a, en outre, maints sobriquets plus ou moins péjoratifs dont les Balkaniques s'en sont servis pour désigner les Aroumains, tels les composés grecs *Koutzovlachoi* („Vlaques boiteux") et *Mproutzovlachoi* („Vlaques grossiers") ou le serbe *Tsintsars*, créé, probablement, sous l'impression de la fréquence frappante de l'affriquée *ts* en aroumain. Consacré en quelque sorte par la littérature scientifique et par les documents officiels de l'État roumain qui en font souvent usage à l'époque moderne pour désigner les Aroumains, le nom de *Macédoroumains*, „Roumains de Macédoine" (ainsi que le vulgarisme de fraîche date *machidoni*, „gens originaires de Macédoine") n'est pourtant pas approprié: la patrie primitive des Aroumains n'est pas la Macédoine, quoiqu'ils constituent une composante de poids de cette mosaïque ethnique et devinrent, dans les confrontations entre les États nationaux balkaniques dont elle fut l'objet, un important enjeu politique[4].

Les Aroumains sont concentrés en groupements homogènes, compacts et très anciens en Grèce (Pinde, Thessalie, Épire, Acarnanie, Étolie, Macédoine), Albanie (Épire du nord et plaine de Mouzakia), Bulgarie (Macédoine, Thrace, Rhodopes) et dans l'Ancienne République Yougoslave de Macédoine. Dans la montagne du Pinde et en Thessalie ils étaient à ce point nombreux au Moyen Âge, que les Byzantins donnèrent à cette région le nom de *Grande Vlachie (Megali Vlachia)* et lui concédèrent une certaine autonomie administrative. Dans les temps modernes, on rencontre des Aroumains dans toutes les grandes villes de la Péninsule Balkanique, où ils jouent un rôle de premier plan dans le commerce, les finances et l'industrie. Des colonies aroumaines, gréco-arournaines plutôt, se sont formées, vers la fin du XVIII[e] siècle, en Europe centrale, dans les grandes villes de

[3] Cf. Haralambie MIHĂESCU, *La romanité dans le Sud-Est de l'Europe*, Bucarest, 1993, p. 153–155; A. ARMBRUSTER, *La romanité des Roumains. Histoire d'une idée*, Bucarest, 1977, p. 17–22.

[4] Cf. Matilda CARAGIU-MARIOŢEANU, *Compendiu*, p. 217–218, *Definition einer Volksgruppe, Glotta und Ethnos der Aromunen*, „Österreichische Osthefte", 13, 1971, 2.

L'Empire des Habsbourg (en Autriche, Hongrie, Transylvanie, Banat), où s'étaient refugiés des Aroumains et des Grecs appartenant au richissime patriciat urbain des Balkans, directement affectés par l'anarchie et les revers que les guerres russo-turques et la rébellion d'Ali Pacha de Ioannina contre le Sultan avaient provoqués dans la Péninsule. À cette diaspora aroumaine appartiennent les Mocsony, Gojdu, Sina, Dumba, Şaguna, ennoblis par les Habsbourg en recompense de leur exceptionnel esprit d'entreprise en matière économique et honnorés de l'épithète d'*évergètes* (en grec, „bienfaiteurs") par les nations du Sud-Est de l'Europe (Grecs, Roumains, Slaves, Hongrois) en reconnaissance de leurs largesses au bénéfice du développement culturel de celles-ci. Des colonies aroumaines ont été fondées à partir de la fin du XIX-e siècle en Asie Mineure, Europe occidentale, Australie, ainsi qu'aux États Unis d'Amérique du Nord et au Canada. À l'instar d'autres immigrants balkaniques, beaucoup d'Aroumains se sont établis au cours des siècles, dans les Pays Roumains. Entre 1925 et 1935, la Roumanie a colonisé de quelques 12.000 Aroumains la Dobroudja méridionale (le Quadrilatère), annexée par elle en 1913[5]. Après la perte de ce territoire, repris par la Bulgarie en 1940, l'État roumain a transféré ses colons Aroumains dans les départements de Constanţa, Tulcea, Ialomiţa[6]. Ayant beaucoup souffert à cause de ces dépaysements successifs, ils allaient subir ensuite les persécutions du régime communiste, mais leur dynamisme les a fait recouvrer, après 1989, des positions clés dans la vie économique du pays.

On ne saura jamais déterminer exactement le nombre réel des Aroumains. Dans le passé plus ou moins lointain, pour des raisons de nature politique, les officiels et les historiens des États balkaniques, à quelques exceptions près, ont délibérément dissimulé ou minimisé ce nombre, tandis qu'à leur tour certains chercheurs, hommes politiques et journalistes roumains l'ont démesurément exagéré. Conformément aux statistiques officielles des pays balkaniques, il y aurait eu 11.000 Aroumains en Albanie, en 1930, 19.700 en Grèce, en 1928, 9.085 en Yougoslavie, en 1921, 1.551 en Bulgarie, en 1926, à savoir moins de 50.000 Aroumains dans toute la Péninsule Balkanique des années 1920-1930!

En revanche, du côté roumain, le journaliste Romulus Seişanu évaluait, en 1939, à 80.000–100.000 le nombre des Aroumains d'Albanie et le géographe Marin Popescu-Spineni estimait, en 1941, qu'il y avait au moins 1.000.000 d'Aroumains dans les Balkans. Plus prudents, en 1941, le diplomate Vasile Stoica, qui avait entrepris des enquêtes sur le terrain, évaluait à 276.000 le nombre total des Aroumains (40.000 en Albanie, 70.000 en Yougoslavie, 160.000 en Grèce, 6.000 en Bulgarie), tandis que le diplomate Nicolae Ţimiraş, qui avait visité et étudié sur place, lui aussi, toutes les communautés aroumaines d'Albanie, faisait monter le nombre des Aroumains de ce pays à 31.394[7].

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[5] Vasile Th. MUŞI, *Un deceniu de colonizare în Dobrogea-Nouă*, 1925–1935, Bucarest, 1935; Nicolae CUŞA-Otilia PACEA, *Macedo-aromânii dobrogeni*, Constanţa, 2004.

[6] N. CUŞA, *Aromânii (macedonenii) în România*, Constanţa, 1996.

[7] N.Ş. TANAŞOCA, *Rapoartele diplomatului Nicolae Ţimiraş despre aromânii din Albania*, dans Anca TANAŞOCA et N.Ş. TANAŞOCA, *Unitate romanică şi diversitate balcanică. Contribuţii la istoria romanităţii balcanice*, Bucarest, 2004, p. 255–275.

Voilà, enfin, quelques autres estimations du nombre total des Aroumains faites, au cours des XIX[e] – XX[e] siècles, par certains savants, hommes politiques, voyageurs, agents diplomatiques ou agents secrets dans les Balkans dont l'objectivité ne saurait être mise en doute: 300.000-600.000 (Ami Boué, écrivain et voyageur français, 1840), 600.000 (Ubicini, 1856), 500.000 (L. Hahn, savant allemand, 1854), 500.000 (Kanitz, écrivain et voyageur hongrois, 1868), 600.000 (Rizos Rangabé, écrivain et homme d'État grec, 1856), 800.000 (E. Poujade, écrivain et diplomate français, 1859; E. Picot, romaniste français, 1875), 1.000.000 (Gaston Paris, savant français, 1878), 500.000 (L. Lamouche, militaire français, spécialiste des questions balkaniques, 1895), 164.000 (G.Weigand, 1895), 140.000 (P.Aravantinos, historien grec, 1905), 520.165 (Leon Boga, intellectuel roumain d'origine aroumaine, 1913), 800.000 (von den Goltz Pacha, officier supérieur allemand chargé de la réorganisation de l'armée ottomane, à la veille de la première guerre mondiale), 631.632 (C. Noe, professeur roumain d'origine aroumaine, 1913), 350.000 (Th. Capidan, savant roumain d'origine aroumaine, 1932). En 1948, l'homme d'État grec Evangélos Averoff, Aroumain de naissance, évaluait à 150.000-200.000 le nombre des Aroumains de Grèce, s'empressant toutefois d'ajouter qu'il devrait être doublé, si l'on prenait en considération aussi les Aroumains complètement hellénisés. Selon le Brockhaus Lexikon, en 1966, le nombre total des Aroumains et Meglénoroumains aurait été de 400.000.

De nos jours, les progrés que le processus d'assimilation des Aroumains par les ethnies dominantes des Balkans a enregistrés au fur et à mesure du développement de la civilisation industrielle, homogénéisatrice de toute société, l'inexistence d'une véritable culture d'expression aroumaine écrite, de toute organisation ecclésiale ou politique autonome des Aroumains, ainsi que l'échec éprouvé finalement par la Roumanie dans sa tentative de faire les États balkaniques reconnaître une fois pour toutes leur caractère ethnique roumain ne font qu'aggraver la crise d'identité des Aroumains et rendent de beaucoup plus difficile, sinon tout à fait improbable, l'évaluation exacte de leur nombre[8].

À l'aube du Moyen Âge, la population romane des provinces danubiennes de l'Empire romain dont sont issus également les Roumains balkaniques et ceux de l'ancienne Dacie formait un bloc compact, installé à cheval sur le Danube. Elle comprenait les descendants des anciens autochtones thraco-illyriens romanisés de ces contrées et des colons romains arrivés *ex toto orbe Romano* (Eutrope) pour s'y installer. Son latin, le latin qu'on appelle danubien ou oriental, d'un aspect unitaire dans sa diversité, à des traits et tendances spécifiques, portait l'empreinte de

[8] J'ai puisé toutes ces données statistiques dans le dossier *Românii de peste hotare* de la Commission pour l'étude des problèmes de la Paix du Ministère des Affaires Étrangères de Roumanie, 1945 (des extraits des rapports concernant les Aroumains de ce dossier, rédigés en 1941 par V. PAPACOSTEA et V. STOICA, ont été publiés par Stelian BREZEANU et Gheorghe ZBUCHEA dans la collection de documents *Românii de la sud de Dunăre*, Bucarest, 1997, nos. 146 et 147) ainsi que dans les livres de M.D. PEYFUSS, *Die aromunische Frage* et Matilda CARAGIU-MARIOŢEANU, *Compendiu*, cités plus haut.

l'origine de ses locuteurs. La fragmentation de cette Romania danubienne ou orientale et la dispersion de ses composantes par l'effet des invasions barbares et surtout de l'établissement des Slaves et des Bulgares dans l'Europe sud-orientale, n'eurent lieu qu'après l'aboutissement du processus de formation du peuple roumain et de la langue roumaine commune, dans une période située par les savants entre le VII[e] et le X[e] siècle. La principale preuve en est que tous les quatre dialectes du roumain – le dacoroumain, l'aroumain, le meglénoroumain et l'istroroumain – ont en commun le fonds lexical principal latin, les éléments lexicaux hérités du substrat thrace, les mots empruntés au grec ancien et les plus anciens slavismes dûs aux contacts avec les mêmes tribus sud-slaves.

Pour ce qui est des Aroumains, ils furent probablement détachés de l'unité du peuple roumain après l'invasion et l'établissement des Slaves dans le Sud-Est de l'Europe, mais avant l'arrivée des Hongrois dans cette zone, car, à la différence du dacoroumain, l'aroumain ne présente nulle trace d'une éventuelle influence hongroise. Des traditions historiques médiévales, soigneusement consignées par des auteurs byzantins – Kékauménos au XII-e siècle – et occidentaux – l'Anonyme de Górka au XIV[e] siècle – parlent d'une migration des *Vlaques* de la zone du Danube vers l'Épire, la Thessalie et la Macédoine; les historiens en ont conclu que les Aroumains seraient originaires de l'ancienne Dacie ou même de la Pannonie[9]. Sans pour autant contester un éventuel afflux plus récent de pasteurs roumains originaires des régions septentrionales de la Péninsule Balkanique, Theodor Capidan et Tache Papahagi ont démontré, force arguments linguistiques et ethnographiques à l'appui, que les Aroumains descendent d'un ancien groupe roman local, à des traits particuliers, installé dans la région montagneuse traversée par la Via Egnatia, la principale voie de communication continentale romaine entre Dyrrachium et Constantinople. Au temps de la domination romaine, leurs ancêtres avaient eu probablement mission d'assurer la sécurité de cette artère, une fonction qu'ils remplissaient toujours eux-mêmes aux époques byzantine et ottomane et qui leur a valu certains privilèges, consignés dans les sources diplomatiques. Quoi qu'il en soit, il est sûr et certain que le noyau ethnique des Aroumains est représenté par les *Vlaques* attestés depuis le X[e] siècle dans la région du Pinde et de la Thessalie, nommée déjà, au commencent du XIII[e] siècle, *Grande Vlachie*. Les assertions de certains chercheurs grecs arguant de l'origine hellénique des Aroumains – ils seraient des Grecs romanisés à la suite de leur encadrement dans l'armée impériale – sont dépourvues de fondement scientifique. En effet, on ne trouve en aroumain aucun élément provenant d'un éventuel substrat hellénique ancien, comme il était normal si cette population aurait eu une telle origine. En revanche, on y rencontre des éléments lexicaux appartenant au substrat thrace, ainsi que des slavismes qu'on retrouve aussi en dacoroumain. Les nombreux éléments d'origine grecque qui

[9] KEKAUMÉNOS, *Conseils et récits*, éd. G.G. Litavrin, Moscou, 1972, p. 268–270. Cf. *Fontes Historiae Daco-Romanae*, éd. Al. ELIAN et N.Ş. TANAŞOCA, Bucarest, 1975, p. 39–43. ANONYMI *Descriptio Europae Orientalis*, ed. Olgierd Górka, Cracovie, 1916, p. 12–14.

donnent au parler des Aroumains un certain cachet sont des emprunts datant des époques plus récentes, ils sont le résultat de la symbiose de ces Roumains enclavés en milieu grec avec les Byzantins tout d'abord, avec les Grecs modernes ensuite, auxquels la plupart d'entre eux se sont culturellement et politiquement identifiés, tout en gardant pourtant le sentiment plus ou moins vif de leur spécificité romane[10].

L'origine commune, l'identité structurale de leurs parlers, l'identité des noms ethniques qu'ils se donnent eux-mêmes et dont les autres les désignent, les témoignages et traditions historiques attestant leur unité ethnique avec les autres Roumains prouvent que les Aroumains sont une enclave roumaine dans la Péninsule Balkanique. Sur ce point, l'accord des érudits roumains, balkaniques et occidentaux avaient été depuis toujours unanime. Ce n'est qu'à partir du XIX[e] siècle, „le siècle des nationalités", que les historiens balkaniques, se faisant un devoir de légitimer dans l'esprit de l'idéologie nationale romantique l'existence et l'extension territoriale de leurs États et s'attachant, par conséquent, à en démontrer la parfaite homogénéité ethnique, commencent à dissimuler la présence des Aroumains sur le territoire de ces États et à minimiser le rôle qu'ils avaient joué dans leur histoire. À cette fin, les historiens balkaniques n'hésiteront pas à manipuler arbitrairement les sources pour les faire confirmer leurs préjugés, à contester la romanité des Aroumains et le sens ethnique du nom de *Vlaques*, à présenter ceux-ci comme des immigrants de date récente dans les contrées qu'ils habitent, à dénier l'appartenance des Aroumains au peuple roumain et le caractère de dialecte de la langue roumaine de l'aroumain. De leur côté, certains historiens roumains, dominés eux-aussi par l'esprit du nationalisme romantique, ont eu tendance à perdre de vue les particularités distinctives des Aroumains par rapport aux autres Roumains, supposant qu'ils aient toujours eu le sentiment d'appartenir à la nation roumaine dont ils auraient toujours partagé les aspirations politiques, ce qui n'est pas exact. En réalité, tout en gardant le sentiment de leurs particularités ethniques et linguistiques, les Aroumains s'étaient identifiés politiquement et culturellement, des siècles durant, avec les nations balkaniques au milieu desquels ils vivaient – aux Grecs surtout – et ce n'est qu'au XIX[e] siècle que nombre d'entre eux ont épousé la cause de leur intégration dans la nation roumaine, intégration prônée par les révolutionnaires roumains de 1848, prêchée par les Aroumains établis en Roumanie et posée par le gouvernement de Bucarest en objectif de sa politique balkanique.

L'élevage du petit bétail (moutons, chèvres) a été depuis toujours la principale occupation des Aroumains. De cette occupation en découlent l'industrie laitière, le tissage et autres industries domestiques, le transport caravanier, le commerce. Selon le stratège byzantin Kékauménos, au XI[e] siècle, les Aroumains, installés déjà en riches propriétaires immobiliers dans la ville de Larissa, jouaient

[10] Sur la parenté de l'aroumain avec le roumain et sa place parmi les langues romanes, v. Matilda CARAGIU-MARIOŢEANU, *À propos de la latinité de l'aroumain*, Revue Roumaine de Linguistique, **XXXIII**, 1988, *4*, p. 237–250.

un rôle important dans la vie économique et politique de la Thessalie et au dire du poète byzantin Théodore Ptochoprodrome, au XII[e] siècle, le fromage et les tissus *vlaques* étaient hautement appréciés sur le marché constantinopolitain[11]. Aux XVII[e] – XVIII[e] siècles, à une époque où l'Empire ottoman était devenu un partenaire d'affaires permanent des États chrétiens et un facteur de l'équilibre politique européen, les Aroumains devinrent à leur tour les principaux agents balkaniques du commerce entre l'Occident et l'Orient. C'est à ce temps-là que maints anciens villages des pasteurs aroumains – Moschopolis, Aminciu-Metsovon, Vlacho-Kleisoura, Călarli-Kallarites, Sirako etc. (Fig. 1) – se muent en véritables bourgs balkaniques. Quelques-uns de ces centres économiques étaient également des centres culturels réputés dans tout le monde chrétien orthodoxe: des personnalités remarquables de l'Église orientale devaient leur formation intellectuelle à la Nouvelle Académie de Moschopolis, Grande École de langue grecque, comme l'étaient d'ailleurs les Académies Princières de Bucarest et de Iassy et des livres à large diffusion ont été imprimés dans la typographie de cette ville[12]. Montagnards formant des communautés patriarchales d'une structure originale, fermées aux étrangers, les Aroumains bénéficiaient de privilèges fiscaux et administratifs concédés, à tour de rôle, par l'Empire byzantin, par les États slaves des Balkans, ainsi que par l'Empire ottoman: en échange de leurs services militaires, ils étaient exempts de certains impôts et jouissaient du droit d'autoadministration, ayant leurs propres chefs. Ils étaient unanimement appréciés en tant que vaillants soldats.

Les villages aroumains du Pinde – *ta Vlachochoria* – sont devenus autant de centres d'initiative combattante et de résistance pendant la révolution anti-ottomane des Grecs, en 1821, ainsi qu'au temps de la lutte pour la libération de la Macédoine et son union avec le Royaume hellénique. L'historiographie grecque ne tarit pas d'éloges sur la bravure et le dévouement à la cause hellénique et chrétienne des chefs militaires vlaques (*armatoles, klephtes* et *capitains*), des lettrés et des hommes d'État grecs d'origine aroumaine, tel le fameux Ioannis Collettis, premier ministre du roi Otton et père de la Grande Idée (*Megali Idea*), à savoir du projet visant la reconquête de Constantinople par les Grecs et la restauration de l'Empire byzantin dans une variante passablement modernisée[13]. Les Aroumains ont, par ailleurs, largement contribué à moderniser la société et l'économie dans tous les pays des Balkans au XIX[e] siècle: à côté des Grecs, ils ont été, par exemple, selon Dušan Popović, le facteur décisif du développement du capitalisme et de la bourgeoisie en Serbie[14].

[11] KÉKAUMÉNOS, *Conseils et récits*, éd. Litavrin, p. 256 (*Fontes Historiae Daco-Romanae*, III, p. 30–31); THÉODORE PTOCHOPRODROME, dans *Fontes Historiae Daco-Romanae*, III, p. 186–189.

[12] Valeriu PAPAHAGI, *Aromânii moscopoleni şi comerţul veneţian în secolele al XVII-lea şi al XVIII-lea*, Bucarest, 1935;Victor PAPACOSTEA, *Theodor Anastasie Cavalioti: Trei manuscrise inedite*, Bucarest. 1932; M.D. PEYFUSS, *Die Druckerei von Moschopolis:1731–1769*, Vienne, 1989.

[13] N. MERTZOS, Armanoi – oi Blachoi, Thessalonique, s.a., évoque toutes les personnalités d'origine aroumaine qui se sont illustrées dans la vie intelectuelle et politique de la Grèce.

[14] Dušan POPOVIĆ, *O Cincarima*, Belgrade, 1937.

Fig. 1 – Les régions de l'Europe sud-orientale habitées par les Aroumains à la fin du XX^{e} siècle (Source : Thede KAHL, Ethnizität und räumliche Verteilung der Aromunen in Südosteuropa, Institut für Geographie der Westfälischen Wilhelms-Universität Münster, 1999 („Münstersche Geographische Arbeiten", Heft 43), Karte 1 (dressée par l'auteur à base de nombreuses sources cartographiques et de ses propres investigations sur le terrain).

Leur mode de vie pastoral traditionnel, d'aspect patriarcal, supposant un certain isolationnisme ethnique et, jusqu'aux XIX^{e} – XX^{e} siècles, la plus stricte endogamie, aida, certes, les Aroumains à préserver leur identité romane, mais l'expression culturelle de cette identité resta rudimentaire, ne dépassant guère le niveau du langage familier, de l'ethnographie et du folklore. Pour s'exprimer au niveau de la culture écrite, pour mieux s'integrer dans les communautés urbaines et participer à la vie d'État et d'Église, pour remplir les fonctions qu'ils avaient assumées dans le commerce balkanique, les Aroumains devaient forcément adopter comme instrument de communication les langues officielles de culture et de civilisation utilisées dans les Balkans: le grec byzantin ou le slavon, au Moyen Âge, les langues nationales d'État – le néogrec, le serbo-croate, le bulgare, l'albanais, le turc – à l'époque moderne, le bilinguisme – voire le plurilinguisme – étant de rigueur pour quiconque aspirait à s'élever à une situation sociale éminente. C'ést par celà même que commence leur déromanisation, fatalement liée à leur ascension sociale et à leur progrès culturel. Il nous faut dire que, sans jamais renoncer à utiliser leur dialecte dans la vie quotidienne et de famille, la plupart des Aroumains, attachés aux Grecs par des affinités spirituelles profondes et par des relations historiques ininterrompues, ont montré une préférence marquée pour la langue et la culture grecque, s'avérant même les meilleurs propagateurs de l'hellénisme dans le Sud-Est de l'Europe. Aux temps modernes, leur hellénisation fut rapide et massive, leur nationalisme hellénique, parfois, farouche. En même temps, leur ubiquité dans la Péninsule Balkanique, les contacts avec tous les peuples et toutes les cultures des Balkans, le bilinguisme et le plurilinguisme ont fait des Aroumains les promoteurs de choix d'une identité transnationale balkanique. De par la nature même de leurs occupations principales, l'élevage et le commerce, qui comportaient nécessairement la libre circulation et la liberté d'entreprise, les Aroumains furent, enfin, dans les Balkans, les promoteurs par excellence du libéralisme. On ne connait guère des Aroumains convertis à l'islamisme[15].

Dans les dernières décennies du XVIII^{e} siècle, deux clercs aroumains, Théodore Anastase Cavalioti et Daniel le Moschopolitain, se mettent à coucher par écrit l'aroumain, ainsi que d'autres langues balkaniques, au moyen de l'alphabet grec, afin de faciliter à leurs congénères et disciples non-grecs, l'étude de la langue grécque, la langue de culture de tout l'Orient chrétien. Cependant, si Daniel exhortait les lecteurs de son *Eisagogike Didaskalia* (Enseignement introductif), comprenant un *Lexikon tetraglosson* (Vocabulaire grec-aroumain-albanais-bulgare), d'abandonner leurs langues barbares, d'apprendre la langue grecque, „mère de la sagesse" et de devenir eux-mêmes des Rhomées (Byzantins), Théodore Anastase Cavalioti, auteur, lui-aussi, d'une *Protopeiria,* manuel de grec destiné aux enfants

[15] Cf. N. Ş. TANAŞOCA, *Les Aroumains et la conscience identitaire balkanique*, Bulletin de l'Association Internationale d'Études du Sud-Est Européen, 32–34, 2002–2004, Bucarest, 2004, p. 117–124.

aroumains et albanais, comprenant un vocabulaire trilingue grec-aroumain-albanais, avait, paraît-il, tendance à encourager le développement d'une culture aroumaine écrite. C'est pourquoi Thèodore Anastase Cavalioti est considéré comme le pionnier de la renaissance nationale des Aroumains[16]. Fortement influencés par la philosophie des Lumières et par l'idéologie des intellectuels roumains gréco-catholiques appartenant à l'École transylvaine, quelques clercs aroumains membres des colonies aroumaines de l'Empire des Habsbourg – Constantin Ucuta, Gheorghe Roja, Michael Boiagi – vont élaborer plus tard des abécédaires, des manuels de grammaire, des dictionnaires, des esquisses d'histoire nationale, destinés à inculquer aux Aroumains le sentiment de leur identité ethnique roumaine. Ils sont les premiers à coucher par écrit l'aroumain au moyen de l'alphabet latin et à plaider pour la création d'une seule langue littéraire, commune à tous les Roumains. Craignant l'abandon par les Aroumains de la cause nationale hellénique ainsi que leur éventuelle union avec l'Église de Rome, la Patriarchie de Constantinople et la fine fleur des intellectuels grecs ont sévèrement condamnée ces actions. Le mouvement national des Aroumains prendra un nouvel essor dans la seconde moitié du XIX^{e} siècle, par l'initiative, cette fois-ci, des révolutionnaires roumains de 1848 – Nicolae Bălcescu, Ion Câmpineanu, Ion Ghica, Ion Ionescu de la Brad, Christian Tell, C.A.Rosetti, Ion C. Brătianu, Anastase Panu, Dimitrie Bolintineanu (les deux derniers étaient eux-mêmes d'origine aroumaine) – devenus tous, après l'Union des Principautés roumaines, des personnalités politiques de première importance dans le nouvel État roumain. Le Comité Macédoroumain de Bucarest (1860), devenu quelques années plus tard la Société de Culture Macédoroumaine (1879), en tant qu'organisation représentative des Aroumains, l'État roumain, comme puissance protectrice de ceux-ci, quelques intellectuels roumains d'origine aroumaine – le professeur Ioan Caragiani de l'Université de Iaşi, membre fondateur de l'Académie Roumaine, le Père Averkie (Anastase Iaciu Buda), moine athonite, Apostol Margarit, instituteur aroumain et futur Inspecteur général des écoles roumaines des Balkans – ont contribué à mettre en fonction un ample réseau d'écoles et d'églises roumaines dans la Péninsule. Financées et administrées par l'État roumain, avec le consentement de l'Empire ottoman, ces écoles et églises étaient destinées à empêcher la déromanisation des Aroumains, à affermir et à developper leur identité ethnique, à les rendre conscients de leur appartenance au peuple roumain, en les faisant apprendre la langue littéraire et la culture roumaine, bref, à les réintegrer dans la nation roumaine. Les efforts faits par la Roumanie pour obtenir le droit de créer un évêché des Aroumains dans les Balkans n'ont jamais abouti, à cause de l'opposition tenace de la Patriarchie oecuménique; cédant devant les insistances de l'État roumain, en 1905, l'Empire ottoman octroya toutefois, par une loi spéciale

[16] Pericle PAPAHAGI, *Scriitori aromâni în secolul al XVIII*, Bucarest, 1909; Victor PAPACOSTEA, *Povestea unei cărţi: Protopiria lui Cavalioti*, dans le volume *Omagiu lui C. Kiriţescu*, Bucarest, 1937, p. 665–674.

Photo 1 – Tous les villages des Aroumains sont situés sur les versants. Avdela n'en fait pas exception (1927, d'après Tache Papahagi, *Images d'ethnographie roumaine*, tome premier, Bucarest, 1928).

Photo 2 – Le village de Magarova, situé au pied du Mont Pilistera, près de Bitolia (d'après *Fotografia aromână par les frères I. et M. Manakia*, 1906).

Photo 3 – Le village de Perivole, situé sur un versant du Mont Ou
(d'après *Fotografia aromână par les frères I. et M. Manakia*, 1906).

Photo 4 – Vue d'une part de la bourgade de Clisura, à l'air d'une petite ville
(d'après Tache Papahagi, *Images d'ethnographie roumaine*, tome premier, Bucarest, 1928).

Photo 5 – Le départ des troupeaux de moutons dans les régions habités par les Aroumains à la fin du XIX^{e} siècle (d'après *Priveşte: Fraţii Manakia,* Ioana Popescu, 2001; Fonds photo Manakia, Musée du Village Roumain, Bucarest).

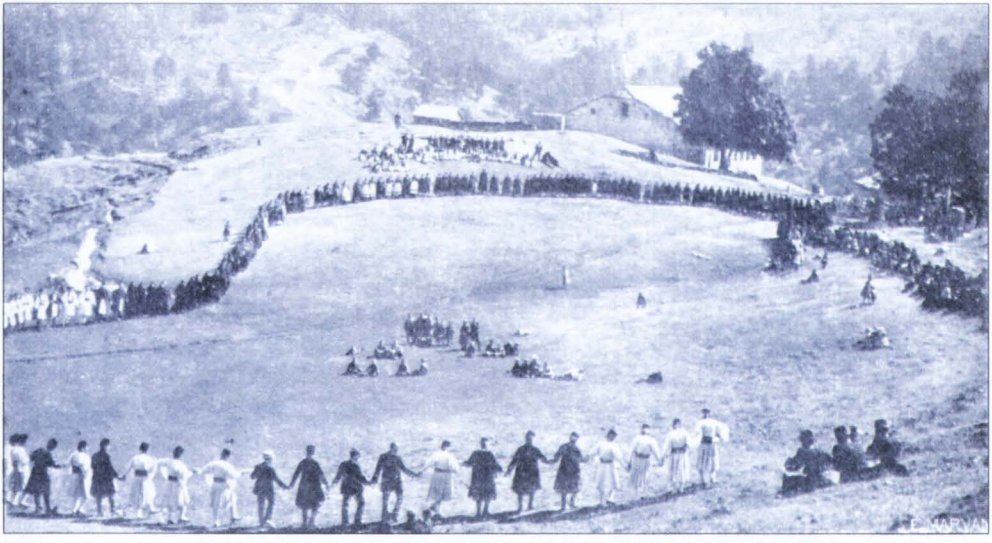

Photo 6 – Aux jours de grandes fêtes locales à Avdela, on se met à danser des rondes (*coruri*) déployées, formées de centaines de personnes (d'après Tache Papahagi, *Images d'ethnographie roumaine*, tome premier, Bucarest, 1928).

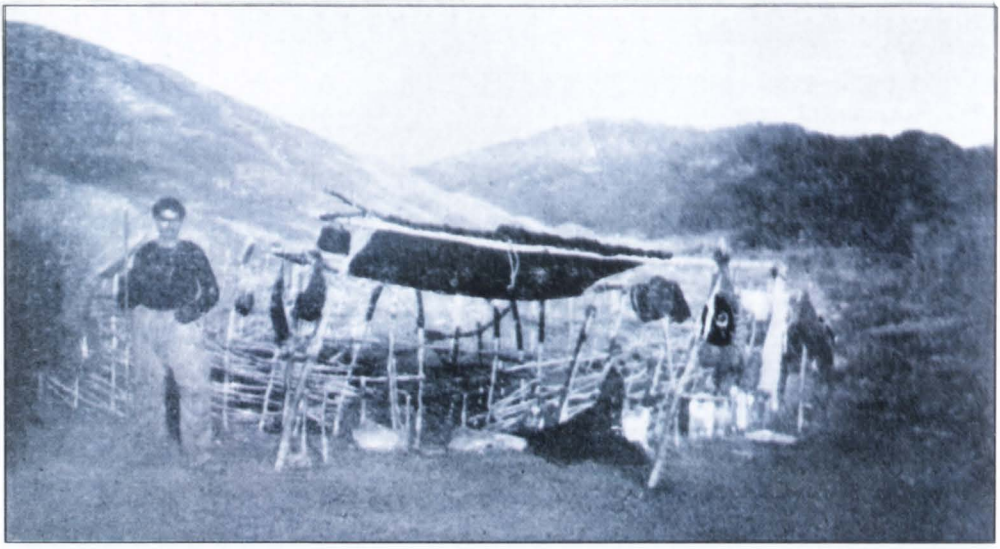

Photo 7 – Bergerie provisoire sur le plateau appelé Muriel, près du village Aménciu (1927) (d'après Tache Papahagi, *Images d'ethnographie roumaine*, tome premier, Bucarest, 1928).

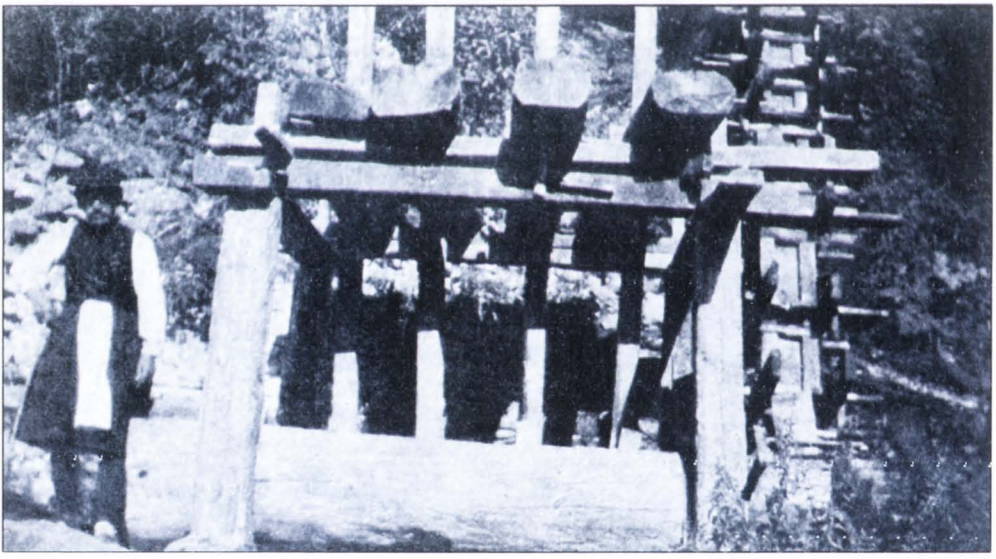

Photo 8 – Moulin à foulon (*bătal'e*) près de Băiasa (1927) (d'après Tache Papahagi, *Images d'ethnographie roumaine*, tome premier, Bucarest, 1928).

(*iradé*), aux Aroumains le droit de constituer leur propres communautés, en tant que groupe national (*millet*) distinct, reconaissant leur caractère ethnique roumain et les autorisant à utiliser le roumain dans leurs écoles et dans leurs églises[17].

Contrairement aux promesses formelles, consignées dans les annexes du Traité de paix de Bucarest (1913), par lesquelles ils s'engageaient à garantir le libre développement de l'identité ethnique roumaine des Aroumains sous la protection de la Roumanie, les États nationaux des Balkans successeurs de l'Empire ottoman ont repris, le lendemain des guerres balkaniques, leur politique d'assimilation des Aroumains, tâchant d'empêcher par tous les moyens le bon fonctionnement des écoles et des églises roumaines de la Péninsule. La Grèce fut le seul pays balkanique qui toléra l'existence ininterrompue sur son territoire, dans l'époque d'entre les deux guerres mondiales, des écoles et des églises roumaines pour les Aroumains, administrées par l'État roumain. Les diplômes de ces écoles n'étaient pourtant reconnus ni par la Grèce, ni par les autres États balkaniques. Par conséquent, les établissements scolaires roumains devinrent, en fait, autant d'offices d'émigration des Aroumains vers la Roumanie. La tentative irresponsable d'un petit groupe extrémiste aroumain, partisan de l'Axe, de créer, dans le Pinde, au temps de l'occupation de la Grèce et sous l'égide des occupants italiens et allemands, une principauté vlaque autonome aggrava radicalement les tensions entre Aroumains aux sentiments nationaux roumains, d'un côté, Grecs et Aroumains à sentiments nationaux helléniques, de l'autre. La cause du libre développement de l'identité aroumaine s'en trouva compromise. Après la seconde guerre mondiale, le gouvernement communiste de Roumanie déclina tout intérêt pour les Aroumains, fit fermer les écoles et les églises que l'État roumain avait entretenues dans les Balkans et liquida, par des accords diplomatiques en bonne et due forme, leur patrimoine immobilier.

On constate de nos jours, un peut partout dans le monde, un regain d'intérêt pour les Aroumains de la part des milieux scientifiques et de l'opinion publique. Sans pour autant renoncer à certains préjugés traditionnels contre eux, les savants et les politiques des Balkans s'avèrent enclins à reconnaître non seulement la présence des Aroumains, mais aussi l'importance de leur rôle dans la vie contemporaine et dans l'histoire de tous les pays de la Péninsule et les études dont ils font l'objet témoignent d'un incontestable souci d'objectivité[18]. Par sa recommmandation de 1997, qui reprend un ancien document de l'O.N.U, le Conseil de l'Europe a officiellement invité les pays dans lesquels vivent actuellement des Aroumains à faire des efforts pour préserver leur identité culturelle et leur parler. Cette recommandation européenne, rédigée de manière

[17] M.D.PEYFUSS, *Die aromunische Frage*, Vienne, 1974.

[18] Voir par exemple: Asterios I. KOUKOUDIS, *Meletes gia tous Vlachous*, Thessalonique, I–IV, 2000–2001; Ivanićka Georgieva (coordinateur) et collaborateurs, *Armănite v Bălgarija*, Sofia, 1998; Kopi KYCYKU, *Arumunët e Shqipërisë në kontekst ballkanik*, Bucarest, 1999; T.J. WINNIFRITH, *The Vlachs: The History of a Balkan People*, Londres, 1987.

quelque peu ambigüe, semble suggérer, sans le dire expressément, que les Aroumains ne seraient pas des Roumains balkaniques, mais une ethnie romane distincte, que leur parler ne serait pas un dialecte archaïque, peu évolué, du roumain primitif, mais une nouvelle langue néo-latine. Il ne s'agit nullement d'une nouvelle hypothèse scientifique, mais tout simplement d'une trouvaille politique: se faisant un devoir de sauvegarder, au nom de la doctrine des droits de l'homme, l'identité évidemment romane des Aroumains, les hautes instances européennes s'efforcent d'éviter, par ce biais, l'éventuelle reprise des anciens conflits entre la Roumanie et les autres pays balkaniques que la reconnaissance internationale de leur caractère ethnique roumain pourrait provoquer.

Une nation ne s'improvise pas. Dépourvus de la chance d'avoir eu une organisation politique et ecclésiastique autonome durable, n'ayant en perspective, à défaut des circonstances géopolitiques requises, aucune possibilité de créer une formation étatique viable, dépourvus d'une culture nationale écrite, dispersés en groupements minoritaires parmi les autres nations balkaniques, ne disposant pas du soutien que seule une puissance politique réellement intéressée au développement de leur individualité ethnique pouvait leur apportait, il est difficile de croire que les Aroumains arriveront jamais à constituer une nouvelle nation romane. Pleines de bonnes intentions, les instances européennes ne réussiront, au mieux, qu'ajourner la complète déromanisation des Aroumains, tout en stimulant, au moins, le développement des études scientifiques les concernant. Issus de tout autres aspirations, les agissements de ceux qui s'évertuent, à l'encontre de la tradition nationale et de l'option de leurs prédécesseurs, d'instituer une minorité ethnique aroumaine en Roumanie, invoquant de manière abusive à l'appui de leur particularisme obtus l'autorité des institutions européennes, tournent en ridicule le tragique de la destinée historique de ces Roumains en voie de disparition[19].

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[19] Voir, en revanche, les observations justes et sensés sur l'identité et le sort des Aroumains, dues à Matilda CARAGIU-MARIOŢEANU, *Un dodecalog al aromânilor. 12 adevăruri incontestabile, istorice şi actuale, asupra aromânilor şi asupra limbii lor*, Constanţa, 1996.

LES PAYS ROUMAINS ET LEURS HABITANTS DANS L'ŒUVRE D'ÉLISÉE RECLUS (1830–1905)

*ALEXANDRU UNGUREANU**

Mots clés: Élisée Reclus, roumains, Roumanie, Nouvelle Géographie Universelle.

The Romanian Countries and their inhabitants in Élisée Reclus (1830–1905). In 1875, simultaneously with the foundation of the Romanian Geographical Society in Bucharest, the first volume of *Nouvelle Géographie Universelle*, an oustanding work by the Great French geographer Élisée Reclus (1830–1905), was being published in Paris. The coincidence of the two events marked the beginning of the classical period in the development of Geography in the West, and also the cultural emancipation of the young Romanian state. For all the incipient stage of Southeast European geographical research, volumes I, III and V provide information and interesting considerations on the Romanian Countries and on the Romanians themselves. On the basis of a comparative study of topographic and geological maps, as well as of statistical data, Reclus succeeded, due to his remarkable intuition, to fill many of the geographical blanks in the knowledge of Romania's territory and reach scientific conclusions often valuable til the present days.

Le fait que la même année, 1875, quand on organisait à Bucarest la Société Géographique Roumaine, paraissait à Paris le premier volume de la monumentale *Nouvelle Géographie Universelle,* due à Élisée Reclus, n'est pas une simple coïncidence – l'œuvre de Reclus marque, d'un côté, le début de l'époque de gloire de la géographie moderne occidentale, et de l'autre – l'organisation, encouragée et stimulée par le modèle européen, d'une des premières sociétés scientifiques roumaines, signe de l' intérêt accru porté à l'Europe de Sud-Est par les géographes des pays plus avancés. Cet intérêt est souligné aussi par la présence de notre très jeune état dans ce premier tome de la magistrale œuvre reclusienne, à côté des pays voisins du sud, dans ce que l'on considérait le berceau de la civilisation – l'Europe Méridionale.

La géographie soviétique a essayé de présenter Élisée Reclus comme celui qui a introduit les idées du marxisme dans la géographie française, surtout partant de l'activité politique, parallèle aux préoccupations scientifiques du savant, opposant de celui qui allait devenir Napoléon III, attitude qui lui imposa l'exil (1851–1857), adhérent, à partir de 1869, à la première Internationale, participant à

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la Commune de Paris (1871), arrêté et puis de nouveau exilé, conséquence de cette participation (1871–1879), auteur, enfin, d'une brochure se référant à l'anarchisme – *L'évolution, la révolution et l'idéal anarchique* (1897).

Mais, un parcours attentif de l'œuvre du grand savant, né il y a plus de 175 ans, nous mène à une toute autre impression générale, mettant en évidence une tendance générale vers la modération et un indiscutable *esprit conciliant* , tous les deux provenant, sans doute, tant du milieu familial clérical protestant, où était encore vivant le souvenir d'une dure oppression, que des études à la Faculté Protestante de Montauban et à l'Université de Berlin, cette dernière étant bien connue à ce temps-là en Europe pour son atmosphère libérale. D'ailleurs, même pendant sa participation à la Commune, Élisée Reclus a été l'auteur du manifeste bien connu du 25 avril 1871, dans lequel il soutenait l'idée d'une entente nationale pour le sauvetage d'une patrie vaincue sur le plan extérieur et émiettée sur le plan intérieur.

Dans ses ouvrages fondamentaux, *Nouvelle Géographie Universelle* (1875–1890), *La Terre* (1867–1868) et *L'Homme et la Terre* (1905), Élisée Reclus s'exprime le plus souvent comme un digne successeur du *rationnalisme et de l'universalisme* d'Alexander von Humboldt, qu'il cite assez souvent, héritant de celui-ci, évidemment, l'attention particulière accordée à la *dynamique permanente du paysage géographique*, tant du point de vue physique que de celui humain (« la mobilité de tout ce qui nous entoure est infinie et pourtant ... nous devons essayer de décrire à la fois le milieu primitif et le milieu changeant » – N. G. U. , t. I, p. 2), *à l'élaboration d'une géographie causale – explicative* (combattant, dans ce sens, « la géographie conventionnelle », informative) et *à l'établissement d'une corrélation permanente de l'espace avec le temps* (« étudiant l'espace, nous devons tenir compte d'un élément de la même valeur – le temps »).

Probablement du même Alexander von Humboldt a repris Reclus aussi la *conception systémique* avant-la-lettre de celui-ci, conception qu'on rencontre quasiment à chaque pas, tant dans les analyses régionales du savant français que dans les formulations générales, du genre « la dépendence mutuelle de tous les phénomènes terrestres » (« La Terre », t. I, p.575), qui mènent directement à l'idée, indiscutable pour l'auteur, d'une géographie unitaire. Les corrélations de nature systémique lui semblent les plus évidentes, comme, par exemple, celles de nature morpho-phyto-climatique, dans le cadre desquelles, d'après le modèle de Humboldt, parmi de nombreux exemples, Reclus présente l'étagement spécifique de la Valachie, avec ses cinq paliers, assez correctement délimités (a. la forêt de conifères et de bouleau, b. la forêt de hêtre et de châtaignier, c. la forêt de chênes et d'érable, partiellement remplacée par les vignobles, d. la steppe et e. la plaine alluviale marécageuse du Danube, avec des forêts de peupliers et de saules).

Il est très difficile de juger si *l'humanisme* qui empreigne toute l'œuvre reclusienne est seulement un résultat de son éducation protestante–libérale ou, peut-être est-il aussi une conséquence de l'ancienne tradition démocratique de la majorité de l'intellectualité française, pour laquelle l'idée du *libre arbitre* a joué le

rôle d'élément central. L'humanisme de Reclus, malgré sa nuance légèrement utopique, le rend, d'un côté, quelquefois extrêmement actuel et, d'un autre, lui permet des prévisions de géographie politique qui se sont avérées réalistes dans une bonne proportion. Dans ce sens, il combat systématiquement les antagonismes, les passions et les haines instinctives entre les races et les peuples et s'indigne, à juste titre, de l'égocentrisme impérial (avec l'exemple classique des chinois qui s'appellent eux-mêmes « les fils du ciel » et habitants de l'Empire de la « Fleur du Milieu »).

L'avenir, dans la conception de Reclus, conçu d'une manière qui aurait pu être aussi celle d'un auteur d'aujourdhui, c'est un avenir fondé sur le métissage de plus en plus accentué des races, la mondialisation, la généralisation des échanges et la réalisation d'un équilibre comme celui qui s'établit entre les vases communicants (« la civilisation aura son centre partout et sa circonférence nulle part »), prenant fin ainsi l'ère du primat d'Europe.

Pourtant, il n'était pas possible que l'élève de Carl Ritter à Berlin (filiation qui, pour certains opposants du marxisme, serait la plus importante) n'ait pas suivi, dans une certaine mesure, son magistre, surtout sous l'aspect de l'image très bien connue de la Terre créé comme une *maison d'éducation pour l'homme et de la nature comme camarade et guide de l'humanité* (« tous les phénomènes de la vie planétaire ont un sens dans les yeux des géographes historiques et les aident à expliquer, au moins partiellement, le caractère et la vie primaire des nations » (N. G. U., t.I, p.7), ou, dans un autre chapitre – « les géographes historiques montrent les voies qui devraient être suivies nécessairement par les hommes dans le flux et le reflux des migrations et des guerres »). Dans cette idée, la civilisation européenne ne serait pas le résultat « de la vertu propre des races qui vivent en Europe » mais des conditions de sol, de climat, de forme et de position du continent. Sous la même influence de Ritter a été conçu aussi, probablement, le plan de la « Nouvelle Géographie Universelle, œuvre qui commence avec la Méditerranée, foyer des civilisations classiques européennes.

Combinant le rationalisme avec le déterminisme et avec l'étique sociale libérale, Élisée Reclus arrive, jusqu'à la fin, à des formules très proches de celles des possibilistes qui l'ont suivi et c'est pourquoi nous pouvons nous poser la question si ce ne fut pas lui celui qu'il faudrait considérer comme l'initiateur de l'école possibiliste française et non pas Paul Vidal de la Blache, surtout si nous nous rappelons l'enthousiasme explosif avec lequel ce dernier a salué l'apparition des deux premiers volumes de la « Nouvelle Géographie Universelle ». Dans une époque quand la notion de géographie humaine, sous laquelle allait agir bientôt l'école de la géographie classique française, n'avait pas encore été créé, É. Reclus était parfaitement conscient de la nécessité de contourer cette composante fondamentale de la géographie unitaire qu'il appelait *géographie historique et statistique*, appellation qui souligne la nécessité d'une bonne connaissance de la dynamique humaine et des mécanismes économiques. La notion–clef utilisée par le possibilisme pour expliquer la capacité de l'humanité de donner une réponse aux

contraintes de la nature, celle de niveau de culture, est déjà présente chez Reclus, dans une forme très proche, celle d'état de culture (« nous ne devons oublier jamais que la forme générale des continents et des mers, comme toutes les particularités de la Terre, sont dans l'histoire de l'humanité une valeur essentiellement changeante, d'après l'état de culture auquel sont arrivées les nations «).

É. Reclus préfigure aussi la géographie possibiliste par l'attention accordée à la *région géographique*, préoccupation par laquelle l'école de géographie humaine française s'est délimitée de l'anthropogéographie allemande. Le plus souvent, Reclus a opté pour la région homogène, conçue à partir d'une certaine unité physique, comme dans le cas des Carpates, où il fait la démonstration du caractère artificiel de la frontière politique qui divisait alors cette chaîne de montagnes ; il y a, pourtant, des situations pour lesquelles il accepte des espaces organisés gravitationnellement, autour d'un pôle bien positionné.

Comme, le siècle antérieur, Montesquieu, celui qui relevait la possibilité de l'amélioration de l' «esprit général» d'une nation, É. Reclus considérait aussi que « les hommes, par le travail, peuvent gagner la priorité devant le milieu qui les entoure » (l'utilisation du terme de *milieu* appartenant à Reclus) et que « dans la mesure dans laquelle les nations gagnent plus de force et de volonté, la forme et la hauteur des montagnes, l'épaisseur des plateaux, la sinuosité du littoral, la disposition des îles et des archipels, comm l'étendue des mers, perdent graduellement de leur importance relative dans l'histoire nationale », l'homme modifiant le milieu dans son profit, bien qu'il supporte aussi l'influence du milieu. D'ailleurs, dans les études géographiques régionales est impressionnante l'attention que l'auteur accorde aux structures sociales et à leur spécificité dans divers espaces ethniques – dans certains des chapitres de la « Nouvelle Géographie Universelle » Reclus faisait déjà une véritable géographie sociale, par exemple dans le chapitre consacré à l'agriculture de Russie, agriculture caractérisée par une extraordinaire symbiose entre les structures communautaires archaïques et les structures féodales; dans l'analyse de l'*économie de la Roumanie* aussi, Reclus souligne son retard et son primitivisme structural, déterminé par la domination de la grande propriété fonciaire, saluant, par conséquent, la réforme agraire du prince regnant Alexandru I. Cuza et considérant comme généralement positifs les effets d'un certain intéressement mutuel de la paysannerie.

Élisée Reclus a été, dans une mesure beaucoup plus grande par rapport à son maître, Ritter, un géographe de terrain, qui a connu d'une manière directe les particularités physiques et humaines d'une grande partie des états et des contrées présentées – France, Italie, Suisse, Belgique, Allemagne, Angleterre, Irlande, Amérique du Nord, Amérique Centrale, nord de l'Amérique du Sud etc. Pour les zones qu'il n'a pas pu connaître directement, le procédé de base a été celui de l'analyse et de la superposition des cartes, avec une attention particulière accordée aux corrélations entre la carte topographique et la carte géologique, dans la mesure dans laquelle celles-ci existaient, la carte « expliquant le sens intime des phénomènes de la nature et de l'évolution historique ».

L'analyse des cartes et leur corroboration avec la situation des zones mieux connues ont permis à Reclus d'arriver à une intuition correcte de certaines réalités de la géographie physique qui ont été confirmées par les études de terrain qui ont suivi. C'est ainsi qu'il a saisi *le parallélisme des Carpates* et d'autres chaînes de montagnes avec « les rivages des mers existantes ou sèches, aussi qu'avec les abîmes des océans, comme une des conditions nécessaires à leur naissance », préfigurant ainsi l'idée de l'orogenèse par subduction, parue beaucoup plus tard. En ce qui concerne le *Delta du Danube*, Reclus a compris le rôle du cordon littoral initial, Letea – Caraorman, ainsi que la manière de laquelle celui-ci a été brisé par le fleuve et dépassé par les deltas secondaires plus jeunes. Le géographe français a remarqué l'existance des *Subcarpates de Moldavie*, bien que, pour l'instant, sans nom, mais appelés « des chaînes basses, parallèles avec les grandes montagnes, avec la direction NO–SE, séparés par la Moldova et la Bistriţa ». Il a observé aussi la déviation de plus en plus puissante vers l'est des rivières de Valachie, dans la mesure de leur rapprochement du Bas Danube, avec l'abandon, sur leur droite, de leurs anciens cônes, comprenant, bien avant Vâlsan, le rôle d'ancien cours de l'Ialomiţa joué par la rivière Mostiştea. Correctement saisie est aussi l'origine lacustre de certaines dépressions internes des montagnes situées sur le cours supérieur de l'Olt (présentées comme des cas facilement reconnaissables de dépressions d'origine lacustre, dans « la Terre », avec une carte très suggestive), ainsi que la formation successive des défilés qui les lient.

E. Reclus a utilisé, évidemment, l'information indirecte aussi (moins certaines interprétations), reprise des travaux d'autres chercheurs – géologues, géographes, historiens, économistes, ingénieurs, agents diplomatiques ou simples voyageurs. Cette information étant inégale comme valeur et couvrant d'une manière très discontinue l'espace analysé, le géographe français a essayé toujours de l'utiliser avec beaucoup de prudence, en extrayant systématiquement la conclusion, qui s'est avéré de nouveau correcte, qu'à l'avenir une géographie universelle ne pourra plus être élaborée que par la collaboration d'un grand nombre de chercheurs, de toutes les régions du globe. La « Nouvelle Géographie Universelle » reste ainsi la dernière grande géographie régionale qui a été, dans sa substance, l'œuvre d'une seule personne.

En ce qui concerne les Pays Roumains, tenant compte de la division d'alors de notre territoire entre la Roumanie autonome et les empires voisins (Autriche-Hongrie, Russie et Turquie), ainsi que des difficultés matérielles supportées par l'auteur pendant l'élaboration des premiers volumes (comme exilé, en Italie et en Suisse), nous devons reconnaître qu' É. Reclus a fait un effort appréciable pour s'informer, auquel il fut substantiellement soutenu aussi par ses connaissances linguistiques (d'allemand, d'anglais etc.). À côté des sources françaises employées (A.Vaillant, Fr. Damé, V. Duruy, F. Desjardins, G. Lejean, A. de Gérando etc.), É. Reclus a utilisé aussi de nombreux ouvrages géologiques, géographiques, historiques et ethnographiques austro-allemands (von Roessler, Kunitz, Paul et

Tietze, Pojepny, Ditz, Schwicker), germano-russes (Kohl, Schmidt), anglais (Hattley, Boner, Patterson, etc.) et, bien que moins, roumains (C. Bolliac). Malheureusment, Reclus n'a pas eu connaissance non seulement des travaux des géologues roumains, à commencer avec ceux de Gr. Cobâlcescu et Gr. Ştefănescu, mais même de beaucoup de ceux des géologues autrichiens, comme K J. Andrae, E. A. Bielz, Th. Fuchs e. a .

Souvent l'intuition, fondée sur le travail de terrain, et l'instrument principal de contrôle, la carte, ont évité au geographe français les erreurs dues à l'information indirecte, mais, dans les domaines de la géologie et de la géographie physique, le niveau général de la connaissance directe était lui même encore très modeste et la couverture bibliographique laissait encore de larges taches blanches. C'est pourquoi, à côté d'une remarquable connaissance des grandes lignes de la structure géologique et de la morphologie de certaines contrées (les Carpates Occidentales, les Carpates Méridionales, présentées sous le nom d'Alpes de Transylvanie, la Dobroudja du Nord, le Delta du Danube), d'autres régions sont connues d'une manière beacoup plus vague (par exemple, les Carpates Orientales, appelées les Grandes Carpates, où l'on ne connaît même pas l'origine volcanique des Montagnes de Harghita) et, en fin, il y a aussi des régions presque inconnues (par exemple, le Plateau Moldave, à l'exception de la vallée épigénétique du Dnestr, plateau considéré comme un simple prolongement de la « Plaine Sarmatienne »). Parmi les formes de relief spécifiques au territoire roumain, É. Reclus présente d'une façon préférentielle le relief plus jeune, formé par l'accumulation fluvio-lacustre et fluvio-marine; le relief structural-pétrographique (à quelques exceptions près, comme celle des Detunate, des Carpates Occidentales, ou des formes de relief qui encadrent le défilé du Danube), moins connu à l'époque, aussi que le relief de nivelage cyclique, dont on ne parlait pas encore au niveau mondial, ne reçoivent que peu d'attention. En ce qui concerne l'évolution de certaines vallées de la Plaine de la Tisa (par exemple la vallée de la Crasna, avec ses changements de trajet) et de celles qui traversent les Carpates, É Reclus accepte l'hypothèse des débordements et, par ailleurs, y ajoute quelques compléments originaux, comme celui de l'évolution du défilé du Danube par la retraite en amont d'une gigantesque cascade, du genre de celle du Niagara, idée qui n'est pas à être totalement à écarter, même au niveau des connaissances actuelles.

Beaucoup plus riches et plus utiles sont, pourtant, les chapitres consacrés aux problemes humains de la Roumanie et des autres contrées peuplées par des roumains.

D'abord, en ce qui concerne *l'origine du peuple roumain*, le géographe français se prononce, d'une manière répétée et sans équivoque, pour la théorie de sa genèse à partir des autochtones géto-daces, latinisés sous l'emprise de l'Empire Romain. La prudence et l'attitude diplomatique par rapport aux grandes puissances de ces temps-là, ainsi que l'influence de von Roessler et de Hunfalvi, l'ont poussé pourtant à présenter, en ce qui concerne le problème de la continuité des roumains,

des thèses contradictoires, acceptant d'un côté l'idée erronée d'un retour tardif des roumains en Transylvanie, mais, d'un autre, montrant qu'il y a des indices documentaires, bien antérieurs au XV-e siècle, démontrant la présence des roumains dans cette province, le fait qu'une population nombreuse a pu se reconstituer sur la base d'un petit nombre d'autochtones qui n'ont pas quitté la région et que les rois de Hongrie ont dû apporter une série de colonistes (« saxons » etc.) pour remplacer la population préexistante, décimée à l'occasion de l'occupation de la Transylvanie.

Généralement, l'attitude de Reclus face aux *Roumains de la Roumanie* de ces temps-là et face aux aroumains est favorable, même un peu exagérée en ce qui concerne la présentation des attributs nationaux (la capacité de conserver la tradition et la langue, une culture, maintenue dans un état latent, plus avancée que celle des migrateurs etc.). Les plus belles paroles sont réservées aux aroumains (nommés zinzars, probablement d'après Lejean), dont les attributs seraient la fierté pour leur origine romaine, l'habileté dans la pratique des métiers manuels, la multilatéralité, l'intelligence, la très haute capacité commerciale, la tendance permanente de gagner leur pain par le travail etc.

Malheureusement, en ce qui concerne *les Roumains de la Transylvanie, du Banat, du nord-est de la Serbie et de la Dobroudja*, l'auteur français reprend certaines attitudes malveillantes d'autres auteurs, les présentant comme une nation envahissante, expansionniste, qui, à commencer avec la fin du Moyen Âge, aurait élargi son aire de répartition, sur le compte des serbes, des bulgares, des turcs, des allemands, des hongrois etc. ; les roumains de ces contrées sont crédités avec une exceptionnelle capacité assimilatrice, surtout par le fait de ne pas posséder un penchant pour apprendre une autre langue et par un rôle supposé dominant des femmes roumaines dans les mariages mixtes. Les roumains de l'ancienne Autriche-Hongrie (évalués à environ 2 896 000 personnes) sont comparés en permanence avec les nations favorisées pendant des siècles et, évidemment, un grand nombre de ces comparaisons leur étaient défavorables – on leur reproche l'ignorance (en 1873 on publiait seulement 9 journaux et revues en roumain, dont un seul journal en Bukovine, face aux 679 publications en allemand et 188 en hongrois, le nombre des étudiants roumains était beaucoup plus petit que celui des étudiants allemands), l'indifférence supposée pour les terrains obtenus par la réforme agraire, qu'ils auraient laissés tomber facilement dans les mains des usuriers juifs, leur apparente absence de l'histoire avant 1848 (bien qu'on rappelle aussi la révolte de Horea), la violence manifestée dans les rapports avec les familles des grands propriétaires etc., mais, d'un autre côté, on ne néglige pas la politique officielle de magyarisation.

On parle le moins des quelques 750.000 Roumains de la Bessarabie de ce temps-là et des autres contrées de l'Empire Russe.

Le fait qu'en réalité, on ne pouvait pas parler, ni même de loin, d'une augmentation du poids de la population roumaine et aroumaine des régions qui se trouvaient sous une domination étrangère est démontré aussi par les cartes et les

données statistiques de la même « Nouvelle Géographie Universelle ». Les cartes ethniques de la population de la Serbie et de tout le territoire habité dans une certaine proportion par les roumains, publiées par Reclus, à côté des sources statistiques anciennes et actuelles, démontrent le fait que, raréfiée aujourd'hui d'une manière considérable, la population roumaine était autrefois massive dans le nord-est de la Serbie, le nord-ouest de la Bulgarie et les régions situées à l'est du Dnestr,. D'après ce qui nous montre le géographe français, vers 1870, habitaient dans le nord-est de la Serbie environ 160 000 roumains, dans la Turquie Européenne de ces temps-là – à peu près 275 000 aroumains et roumains, en Grèce – 4 000–8 000 aroumains et en Istrie – 5 000 istro-roumains. Si les roumains, les aroumains et les istro-roumains qui vivaient au sud du Danube n'auraient pas été soumis à l'assimilation par les grecs, les serbes, les bulgares etc., alors, appliquant à la population de 1875 la valeur du bilan naturel moyen de la Péninsule Balkanique, on arriverait, pour le présent, à une population roumaine et aroumaine, au sud du Danube, d'environ 1 000 000 d'habitants, alors que, aujourd'hui, dans la statistique grecque et bulgare, celle-ci ne fait même plus sentir sa présence. En ce qui concerne la Transylvanie, le caractère supposé expansionniste des roumains est contredit de nouveau par les chiffres concernant la dynamique de la structure ethnique de la population ; il est vrai que de 1761 à 1877 (d'après Benkö), la population roumaine d'ici a augmenté de 133,0 %, mais, dans le même temps la population hongroise s'est accrue encore plus vite – de 138,5 %, et les juifs, qui en 1761 étaient si peu nombreux qu'ils n'étaient pas enregistrés, étaient arrivés à 17 000 personnes.

Néanmoins, en deux situations, Reclus même reconnait la réduction proportionnelle de la population roumaine. La première est celle des aroumains, dont la grécisation graduelle est mise au compte de la pression culturelle de la population majoritaire dans les régions de plaine, du culte orthodoxe, officié en grec, et de l'isolement. La deuxième et celle des roumains de Bucovine, où le phénomène de ukrainisation a été favorisé par l'occupation autrichienne, dans la capitale de Bucovine, Cernăuți, le poids des roumains se réduisant à seulement 17, 7 %, alors que dans les villages environnants, la population était encore, dans ce temps-là, entièrement roumaine.

Les considérations de nature économique et édilitaire sont, dans leur ensemble, assez critiques aussi, mais, dans notre opinion, celles-ci sont plus justifiées que celles de nature ethnique. On déplore la faible mise en valeur des ressources minérales des Carpates (même si l'auteur surévaluait la richesse en ressources naturelles de cette chaîne de montagnes), l'état édilitaire déplorable d'un grand nombre de villes (surtout de Bessarabie), ainsi que des villages de la Plaine Roumaine. Mais, il y a ici aussi des appréciations fondées sur des évaluations statistiques fausses – c'est le cas de l'appréciation d'une très faible mise en valeur des terrains en Valachie et en Moldavie où, en 1874 il y aurait eu pas moins de 3.800.000 ha de terrains complètement inutilisés, chiffre provenant probablement de la confusion avec la superficie des forêts.

En même temps, comme tout adepte de la modernité, le géographe français exprime le très grand espoir, peut-être même exagéré, qu-il mettait en perspective dans le développement des voies de communication, premièrement des voies ferrées et de la navigation sur le Danube et la Mer Noire, dont l'organisation et la dynamique sont présentées avec des détails intéressants (l'existence, alors, de deux flottes fluviales sur le Danube, une en amont et une deuxième en aval des Portes de Fer, la construction, dans la Dobroudja, du premier chemin de fer de tout l'Empire Turc de ce temps etc.).

La même confiance sans limites faite à l'importance des transports et l'utilisation de la méthode comparative, probablement un autre aspect de l'influence de la manière rédactionnelle de Ritter, ont conduit É. Reclus de mettre l'une à côté de l'autre La Valachie et la Lombardie et de voir dans la Transylvanie une nouvelle Suisse de l'avenir (« quand le mur des Carpathes sera en fin perforé dans toutes les directions et lorsque la Péninsule Turque sera par son commerce et son industrie une partie intégrante de la vraie Europe...la Transylvanie changera sa position relative au reste du Monde...deviendra un des centres de l'Europe commerciale « – N. G. E., t. III, p.369).

Enfin, sur le plan de la géographie politique, É. Reclus s'avère être un meilleur évaluateur des perspectives, par rapport au plan économique. C'est ainsi qu'il considérait que « fondé sur le droit de la guerre...l'édifice européen est nécessairement instable, essayant de confondre dans la même nation oppresseurs et opprimés, que sépare le souvenir des combats sanglants et des massacres. La volonté des populations allait, plus ou moins tard, détruire l'œuvre artificielle des guerres et des diplomaties, la carte politique de l'Europe devrait être fatalement remaniée et le vrai équilibre devrait être établi seulement lorsque tous les peuples d'Europe pourront décider leur destinées. » Il faut reconnaître que l'évolution ultérieure de la réalité historique a suivi cette voie, prévue par Reclus, et nous croyons qu'elle gardera cette orientation .

En ce qui concerne les roumains, le géographe français attirait l'attention sur la discordance frappante entre « l'espace roumain, qui forme un cercle presque parfait, autour des Carpates, et le pays autonome, qui comprend seulement la moitié de cet espace » aussi que sur le désir des roumains « que leur patrie entière se trouve renée dans un seul corps politique », dont le centre naturel devrait être cherché dans le sud de la Transylvanie.

Plus que ça, dans une nouvelle organisation politique de l'Europe de l'avenir, Élisée Reclus arrivait à prêcher une solution des problèmes ethno-politiques par la constitution d'un genre de Fédération Danubienne de peuples égaux en droits, dont le noyau ne pourrait être un autre que la Roumanie. C'est une idée qui dérive de la constatation d'une frappante homogénéité ethnique de la Roumanie d'avant la première guerre mondiale, contrastant avec la mosaïque balkanique. Il n'est pas nécessaire d'analyser ici les motifs pour lesquels cette idéaliste prévision n'a pas

pu se transformer en réalité, mais il n'est pas moins vrai que la Roumanie recomplétée s'est réalisée, au moins pour un certain temps.

Malgré les imperfections explicables des riches textes reclusiens concernant les contrées roumaines, nous ne pouvons pas maintenant, après 130 ans, que de nous réjouir de l'occasion de remémorer l'activité méritoire d'un géographe qui a fait davantage que ses contemporains pour déterminer, avec assez d'objectivité, la place et le rôle des roumains dans le concert des peuples.

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LA FRONTIÈRE, RUPTURE ET ESPACE VECU. PROJECTIONS EN ROUMANIE ET EN HONGRIE

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Mots clés: Frontière(s), Représentations spatiales, Appropriations, Recompositions, Elek, Jimbolia, Nădlac.

Borderline, disruption and living space. The case of Romania and Hungary. The border is both a line of cohesion and of differentiation for the population living close to it. Although a line delimiting two spaces, its presence, part of a distinct whole, structures the territory, yet without creating clear-cut disruptions. In terms of one's attachment to various groups having a dynamic of their own, the border is perceived either as standing for disruption or for linkage. The same when it comes to activities, and situations, the way of life in border areas being distinctively different from that in other parts of the county; as spatial object, the border contributes to defining people's living space. The transitional space can therefore be interpreted as an aggregate of borderline domains whose nature and dimensions evolve in terms of relationships between individuals and spaces; the cross-border area is a dynamic space. The present approach views the border not as an element of disrupture, but as a space marker, influencing the spatial and territorial rearrangements taking place in Europe.

Il est différentes manières d'aborder la frontière. Une récurrence est toutefois observable dans les questionnements relatifs à cet objet, concernant la mesure de ses contenus politiques. De même existent de multiples possibles quant à la lecture des enjeux locaux de développement. Doit-on privilégier des bilans économiques ? Doit-on s'attacher à l'étude des rapports sociaux ? Tout questionnement doit être relativisé. Il nous est possible de lire la frontière comme un objet complexe, tant outil de séparation que vecteur d'inclusion, à l'échelle européenne. La frontière interagit dans l'espace avec d'autres objets, pour former des cadres de vie : des ensembles perçus et vécus par les individus en société.

Ces mêmes sociétés humaines, à leur tour, composent avec leur environnement et entre elles, se singularisant (regroupements spécifiques) et s'unissant portées par des volontés communes, des projets citoyens. Ne seraient-ce alors les

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sociétés qui, à des degrés divers, font usage de la frontière : cette dernière devenant par ce biais un déterminant plus ou moindre de l'espace social ? La lecture des constructions sociales et des vécus des groupes frontaliers s'impose en ce cas comme un élément d'analyse et d'interprétation des influences de la frontière sur le développement local et régional.

La frontière devient d'autant un outil de graduation, car d'expression, des rapports à l'espace et aux autres groupes (justifiant en cela le choix d'une représentation chorématique des effets de frontières). Cette spécificité peut être appréhendée par l'entretien : auprès des individus représentatifs d'une société locale, de ceux qui, par leurs discours et actions, influencent les perceptions de la frontière en un champ clos constitué de la ville ou de le commune. Ainsi, privilégiant le contact avec des entrepreneurs, des élus, des représentants d'associations culturelles ou des hommes d'églises, il est possible de rendre compte des idéaux et des vécus locaux.

En domaine frontalier, une telle approche est à mettre en perspective avec une lecture, plus large, des volontés politiques (multiscalaires) d'actions sur et au-delà de la frontière. En somme, est ici prise en compte la nature artificielle de la frontière. Cette dernière est création humaine ; son contenu et ses influences sont définis tant par les volontés politiques que par les actions, au quotidien, de ceux qui vivent la frontière. Positionnement méthodologique autant qu'ambition, ce regard porté sur les sociétés humaines participe pleinement de la volonté de compréhension et d'interprétation des rapports à la frontière.

LA FRONTIÈRE COMME RUPTURE PERMANENTE : UN RAPPORT À L'AUTRE CONTRAINT ?

La définition de la frontière connaît de profonds changements dans l'actuelle Europe centrale. L'un, brutal parce qu'en partie inattendu, naît du déclin et de la chute des régimes communistes. Les rapports interétatiques sont redéfinis suite à cette fracturation politique, à l'échelle régionale autant que continentale. Dans les discours du moins, la nature des frontières évolue : aux frontières plus qu'ailleurs peut-être, se lirait la difficulté de composer avec les résultantes structurelles et conservatrices[1] des années de totalitarisme et d'enfermement croissant ? Ce qui préfigure d'un « retour à l'Europe » n'exclut pas, mais au contraire renforce, le poids de l'Etat en ses frontières (M. Foucher, 1993, p. 12).

Plus lent et d'évolution à ce jour encore incomplète, un autre de ces changements repose sur les politiques cohésives de l'Union européenne, dont les contours normatifs et territoriaux demandent à être définis. L'objectif de

[1] Ainsi la notion de « protochronisme », comme réécriture et interprétation de l'Histoire à des fins idéologiques, telle que la dénonce l'historienne de la Roumanie Catherine Durandin, en référence à un article rédigé en 1974 par le critique littéraire Edgar Papu : « Le protochronisme roumain », dont « l'idée centrale est de nier les influences extérieures dans la formation de la culture roumaine, notamment les influences occidentales. » (C. Durandin, 1995, p. 459).

constitution d'une entité supranationale s'exprime dernièrement par l'élargissement de l'Europe communautaire à dix nouveaux Etats, desquels une majorité connut le communisme. La frontière devient en ce contexte le vecteur unique de deux dynamiques régionales divergentes : elle est à la fois facteur d'expansion et d'occlusion (D. Bechev, 2004).

L'idée de rupture couramment associée au tracé vaut toujours mais s'efface. En ce sens, elle n'introduit plus qu'à une différenciation entre des Etats perçus comme des acteurs historiques dont le jeu politique définit tantôt des volontés de cohésion, tantôt des oppositions. Ses effets de rupture se maintiennent aux yeux des populations l'avoisinant en raison seulement des contrôles et des disparités de niveaux de vie, de cultures et, déterminant pour l'avenir, de statuts des Etats concernés dans l'Europe communautaire; car pour autant, le dépassement de la frontière est rendu possible.

La construction européenne, ajoutée à l'amélioration des relations bilatérales, encourage un franchissement de la frontière pour les activités économiques, les loisirs, le travail. Le tracé devient une ligne dont la porosité partielle (interfaces douanières ouvertes) agit en tant que discriminant du développement régional et local. Des départements, des communes ou des individus se saisissent des opportunités naissant de cette évolution des frontières. Ces dernières ne seraient-elles alors que des déterminants de l'espace géographique qui, au même titre que la proximité d'une grande ville ou certaines ressources naturelles, influencent le développement d'une commune ou d'une région ? Induiraient-elles en somme des dynamiques locales liées à des présences subies ?

D'importantes différenciations de rythmes de développement sont lisibles entre des communes, ou des entreprises, aux potentiels de départ équivalents. Il est nécessaire de reconnaître qu'un facteur non déterminé joue dans ces dynamiques de singularisations spatiales: l'expression de la capacité à tirer profit d'une situation ou, en d'autres cas, de certains évènements (E. Bioteau, 2002). Les frontières agiraient-elle ainsi, au contraire, telles des éléments de nature meuble, que les perceptions de chacun contribuent à définir ? De là, peut-on percevoir dans les frontières les supports de constructions spatiales spécifiques ?

NĂDLAC, UNE FRONTIÈRE AUX EFFETS DE DISSOCIATION

Frontalière de la Hongrie, la ville de Nădlac figure par son poste douanier l'une des principales portes d'entrée de Roumanie. Le trafic routier annuel va sans cesse augmentant depuis 1989 et la libéralisation des marchés et des échanges. Cette proximité d'une frontière «ouverte» assure à la ville une renommée nationale, voire internationale. Elle offre aussi des retombées économiques substantielles; les dotations en parc hôtelier, services de restauration et d'entretien de véhicules, stations d'alimentation en carburants sont *de visu* supérieures à la moyenne

étatique[2]. Elle est la ville « pont » entre les régions industriels du sud-ouest de la Roumanie et l'occident européen.

Jusqu'aux dernières années de la décennie 1990, cette situation profite à Nădlac dans ses relations régionales, à l'échelle de l'extrême ouest du département (judeţ) d'Arad. Le rapide développement économique des villes d'Arad et de Timişoara permet une accentuation des échanges, tandis qu'un seul point de franchissement de la frontière s'offre aux transporteurs routiers. Le trafic est tel que certains transporteurs se voient contraints de se rendre au poste de Borş, depuis le sud du Timiş, dans un souci de gain de temps (Fig. 1)[3]. Ce qui agit comme contrainte au vu des habitants de la majorité du territoire roumain est perçu depuis Nadlac comme atout. La Hongrie ne figure alors qu'un espace de passage ou, pour les habitants de la bordure frontalière, un espace d'achats aux dimensions restreintes à l'extrême périphérie orientale de son territoire[4]. Hors des échanges commerciaux, s'accentuent, de plus, les rencontres transnationales. Des groupes folkloriques et des rencontres entre citoyens de chaque Etat ont lieu régulièrement.

Dans ce contexte d'accentuation de la connaissance mutuelle de l'Autre et d'accroissement constant des échanges de nouveaux points de franchissement de la frontière (par voie routière[5]) sont créés. D'abord ouverts au seul transit automobile, ils permettent peu à peu à leur tour le passage de véhicules de tonnages plus importants ; de nouveaux points de franchissement de la frontière sont à l'étude, afin de garantir une couverture quasi-totale de la frontière hongroise. Si le rôle et la représentativité de Nădlac dans le trafic transnational sont confirmés, la ville ne dispose plus à ce jour du seul et unique point de passage. Les entrepreneurs comme les individus ont désormais le choix entre plusieurs variantes et, déjà, le trafic routier émis par le département (judeţ) Timiş tend à se concentrer sur le poste douanier de Cenad[6]. Cette dynamique s'exprime plus fortement encore en département (judeţ) Arad, où les créations et réhabilitations de postes douaniers s'opèrent à proximité de la ville de Nădlac, notamment dans le village de Turnu (commune de Pecica). Un questionnement se profile quant à la réactivité des autorités locales et des habitants de Nădlac face à l'apparition de ces nouvelles concurrences spatiales. L'éludant volontairement, nous concentrons notre regard sur les conséquences de cette évolution.

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[2] Faits confirmés par les responsables de la Chambre de Commerce, d'Industrie et d'Agriculture (C.C.I.A.) Arad et les techniciens de l'Agence de Développement d'Arad (Adar) au cours d'entretiens menés en février 2004.

[3] Entretien du 07.05.2003, avec un transporteur routier de Jimbolia (Timis).

[4] Nombreux sont ceux qui, en Roumanie, depuis les communes et villes frontalières, profitaient (et profitent encore) de la proximité de la Hongrie pour réaliser de petits échanges (import/export) en tirant profit des différentiels de prix des produits de consommation courante. Les déplacements cependant n'excèdent pas les 30 à 40 Km au plus (distance séparant Nădlac de Szeged), voire se limitent à un aller-retour à Budapest, marché mieux achalandé.

[5] Ainsi, à proximité de Nădlac, existe un poste de passage frontalier ferroviaire à Curtici, antérieur à 1989 et par la suite amélioré.

[6] Ouvert au trafic « tous véhicules » le 1er avril 2004.

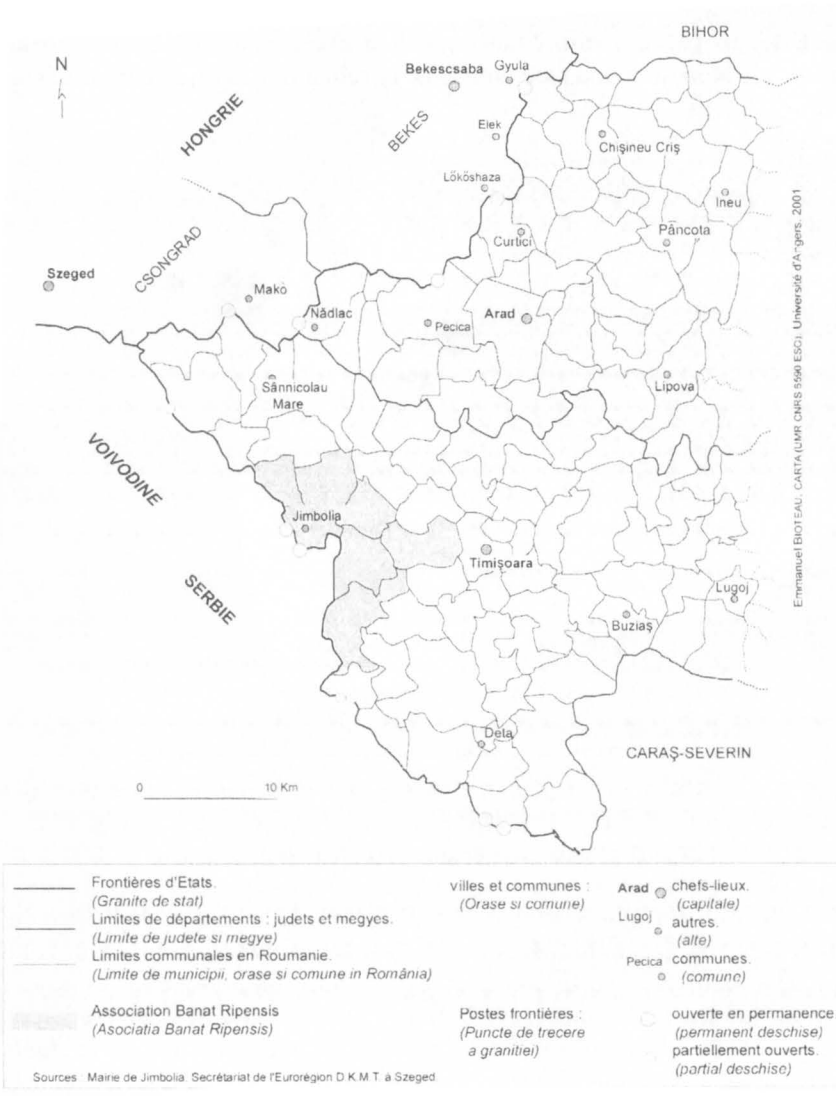

Fig. 1 – Eléments de localisation.

Depuis Nădlac, la frontière politique se double d'une frontière physique par le cours du Mureş qui, son franchissement rendu impossible faute de ponts, rompt avant la ville d'Arad toute relation en direction du Sud et du département (judeţ) Timiş (Fig. 2). Suite à la redéfinition de la frontière entre Roumanie et Hongrie[7], la ville figure un cul-de-sac ; elle est close entre rivière Mureş et tracé frontalier. Ce contexte géopolitique fut à la fois peu ou prou favorable en fonction des choix gouvernementaux et de l'évolution économique des deux Etats ; à celui-ci se

[7] Suite aux règlements du 1er conflit mondial, conclus lors du Traité de Trianon, le 04.06.1920.

surimpose depuis peu une dimension supplémentaire, de fermeture. Paradoxalement, l'ouverture du poste douanier de Turnu et la réhabilitation de ceux situés au nord d'Arad contribuent à limiter l'influence de Nădlac.

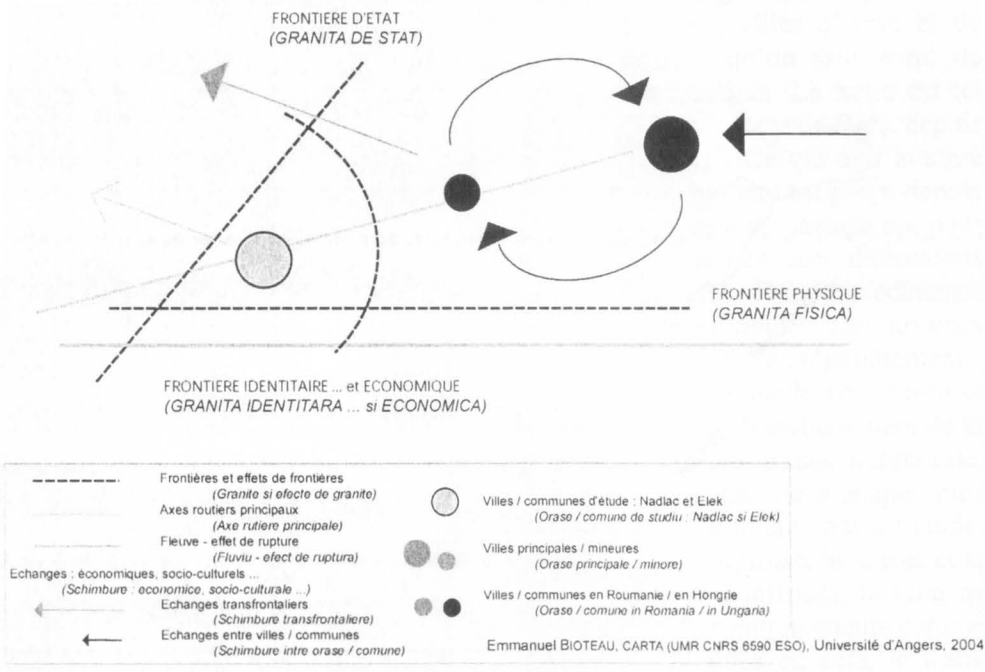

Fig. 2 – Nădlac, une frontière aux effets de dissociation.

La ville devient moins attractive, tant du fait de la hausse de l'offre de points de franchissement de la frontière que de la quasi saturation du trafic routier sur l'axe la desservant. Son poste douanier reste le plus important dans un rayon d'une centaine de kilomètres ; mais chaque autre douane nouvellement créée permet la création *in situ* d'unités industrielles. Neuves et adaptées aux besoins actuels d'une économie essentiellement vouée à l'export, ces dernières dynamisent les communes les avoisinant. Des zones franches sont notamment constituées en ce sens [8]. Or, Nădlac ne dispose pas de ce statut privilégié. Qui plus est, sa démographie décroissante et son faible peuplement, au regard de certaines communes à l'entour[9], entravent les volontés d'investissements lourds sur son territoire. De surcroît, si la douane opère comme attribut d'ouverture d'un point de

[8] Notamment la zone franche (zone économique libre) de Curtici, s'appuyant sur la proximité de la douane ferroviaire.

[9] Pecica, au statut de commune et non de ville, est plus peuplée que Nădlac ; les deux bourgs sont distants d'une vingtaine de kilomètres. Dans le même ordre d'idées, les villes frontalières de la Hongrie, en département (judeţ) Arad, telles Curtici ou encore Chişineu Criş, sont plus peuplées que Nădlac.

vue économique, elle est aussi déstabilisatrice en interne. Ainsi, la proximité de la Hongrie pousse de nombreux résidents, citoyens roumains de toutes souches nationales, à chercher au-delà de la frontière un emploi garantissant de revenus supérieurs à ceux offerts en Roumanie. A ces facteurs, enfin, se surimpose la distance de Nădlac vis-à-vis du pôle économique et démographique majeur que constitue la ville d'Arad. Par comparaison, celle-ci est susceptible de fournir un marché et la main d'œuvre nécessaires au bon développement des industries des communes et villes frontalières situées en son voisinage (Pecica, Curtici). Une rupture économique se tisse donc entre Nădlac et son espace proche, malgré une situation *a priori* avantageuse.

A regarder de plus près, cette dissension interne, naissant des activités, se double d'une forte singularisation ethnoculturelle. Le peuplement de Nadlac est à majorité slovaque. La ville doit donc combiner ses difficultés conjoncturelles avec une image la différenciant dans l'espace régional et national (E. Bioteau, 2004). De plus, le gouvernement slovaque accordant certaines commodités (bourses d'études, cartes de travail) aux ressortissants roumains de souche slovaque, une part non négligeable[10] des jeunes slovaques de Nădlac quitte la ville, privilégiant un emploi à l'extérieur du territoire roumain grâce à un appui identitaire cette fois. Hors, le lien premier dans l'espace régional est celui entre Roumanie et Hongrie. Dans un contexte où la plupart des communes et villes environnantes entretiennent des liens privilégiés avec la Hongrie ou des communes de l'occident européen, via jumelages, Nădlac se trouve, à un degré mineur mais réel, pénalisée par la nature de ses rapports à l'extérieur.

De sorte, de par l'identité locale et l'attrait de l'extérieur pour les jeunes, une dissociation interne s'opère à Nadlac qui se détache alors doublement de son environnement spatial. La frontière première perçue par la population est celle distinguant la ville de ses voisines orientales, roumaines. Tandis que la frontière hongroise ne constitue qu'une étape en direction de Slovaquie ; cette dernière, elle, figure un espace de référence pour une partie de la population et, surtout, est identifiée comme telle, à l'extérieur de Nădlac. Distance, intérêts économiques et identité locale se combinent pour tisser une frontière interne. Perçue et vécue par les habitants de l'ouest du département (județ) d'Arad, elle distingue Nădlac dans l'espace régional. S'exprimant du point de vue de l'emploi et de l'innovation locale, puisque la ville n'accueille pas d'infrastructures nouvelles, cet état de fait tend à induire une rupture. Puisque à ce jour rien n'indique que le processus observé soit inéluctable, nous lisons ces observations comme les indicateurs d'une dissociation. A Nădlac pourtant, il ne semble pas que les processus de défense d'une identité locale soient exclusifs. En revanche, se pose au final la question du rôle des autorités locales et de certains acteurs locaux ou régionaux dans

[10] Au cours de nos entretiens (menés en février 2004 pour les derniers), nos interlocuteurs évoquaient un ratio de un demi à un tiers des jeunes de souches slovaque émigrés en Slovaquie, parmi lesquels les plus diplômés.

l'établissement et le maintien de telles perceptions. En ce sens, la défense de spécificités locales ne contribue-t-elle pas, dans un tel contexte de recompositions territoriales et sociales, à isoler un peu plus la ville de son voisinage ?

ELEK, UNE FRONTIÈRE AUX EFFETS D'EXCLUSION

La commune hongroise d'Elek présente, quant à elle, un aspect totalement différent de celui de Nădlac. Elle ne dispose ni de poste frontière avec la Roumanie, ni d'axe routier important la desservant. La plupart des actifs locaux sont employés dans l'agriculture ou dans les industries des villes voisines de Gyula et Bekescsába. Elek ne peut être considérée comme une commune dynamique de l'est de la Hongrie, et ce à tous points de vues. Elle peine notamment à stabiliser sa population, confrontée à un vieillissement croissant de ses résidants du fait des départs des jeunes en direction des villes voisines et de la chute de la natalité (les deux étant plus ou moins liés). Enfin, tandis que Nădlac se singularisait par son peuplement slovaque en Roumanie, celui d'Elek est, lui, majoritairement hongrois. Ainsi, si des résidants de souche nationale roumaine sont recensés, nombre d'entre eux sont, de l'avis même de leurs représentants[11], fondus dans la société hongroise, au point de ne plus maîtriser ni langue, ni coutumes de leurs référents nationaux.

La municipalité d'Elek entrevoit peu de possibilités de mises en valeur de cet identitaire roumain local, qui plus est dans un contexte de forte différenciation économique entre les deux Etats. Au contraire même, l'avenir pour la commune semble tenir en un ancrage plus important en périphérie des deux pôles urbains et industriels voisins. Sa situation le long d'une frontière infranchissable la prive d'activités intenses; ce qui paradoxalement garantit d'un attrait touristique (sans pour autant disposer d'infrastructures) et, surtout, permet d'envisager un développement de l'habitat périurbain. Si une évolution en ce sens est encore peu visible, des prémices s'en font sentir avec l'établissement de nombreux retraités en provenance des villes voisines (la vie à la campagne reste moins coûteuse) et la création de pensionnats spécialisés dans l'accueil de personnes grabataires[12].

Ce bref bilan est en soi peu original. En aucun instant, par aucune donnée spécifique, Elek ne paraît être animée d'une dynamique frontalière. Au contraire, de par ses formes et son évolution, elle se rapproche de toute commune rurale confrontée aux difficultés de l'économie agricole, qui plus est en situation quasi périurbaine. L'évocation de la frontière ne fait pas même état d'un manque ou d'un besoin. Lors de nos entretiens, les réponses à ce sujet restaient évasives et

[11] Entretiens du 25.02.2004, avec un représentant de la Chambre de Commerce de Hongrie, Délégation pour les Relations avec la Roumanie, à Bekescsaba, et du 26.02.2004, avec un représentant de la Maison Culturelle d'Elek ; tous deux sont de souche roumaine.

[12] L'ensemble des informations contenues dans ce paragraphe sont issues des entretiens réalisés le 26.02.2004, auprès de représentants de la municipalité et de la Maison Culturelle d'Elek. Des données annexes sont disponibles en bibliographie (E. R. COLȚA, 1999).

décrivaient une ouverture de la frontière souhaitable, pour d'évidentes raisons économiques de proximité : reconstituer, élargir, un voisinage interrompu. Mais la commune ne peut espérer disposer d'un poste douanier avant quelques années, du fait de la proximité de deux postes fonctionnels et attractifs (Fig. 3). Seule est évoquée la possibilité d'une ouverture de route en direction du doublon roumain de la commune[13]. Cette commune voisine, avec laquelle un jumelage est en cours, a, elle aussi, eu à souffrir du tracé de la frontière ; elle conserve un statut de commune rurale, peu dynamique, excentrée des principaux axes routiers de l'ouest roumain.

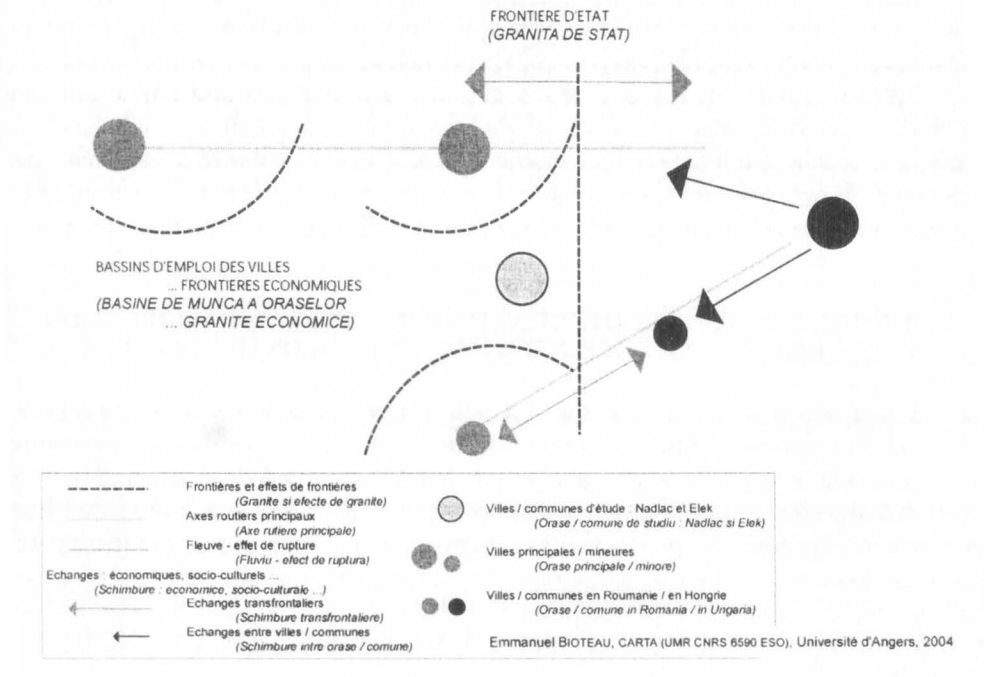

Fig. 3 – Elek, une frontière aux effets d'exclusion.

Une frontière ouverte à hauteur d'Elek ne semblerait dès lors pas en mesure de soutenir le développement de la commune. Pourtant, avant l'établissement du tracé frontalier, soit 85 ans auparavant, Elek constituait un petit pôle rural dominant dans son espace proche ses communes voisines, actuellement hongroises ou roumaines. La frontière a donc eu pour Elek un effet de rupture se traduisant aujourd'hui par une perte de statut (toutefois partielle). Le bourg rural dynamique devient périphérique de trois pôles contigus : Bekescsàba, à l'intérieur du territoire étatique, ville chef-lieu de département (megye) et Gyula et Lőkőshaza, ville et commune dotées de postes frontières. Le développement industriel s'effectue en ces pôles et autour d'eux. Elek s'en trouve dissociée ; elle ne peut tirer profit de ce

[13] Grăniceri, en département (județ) Arad.

développement que dans la mesure où elle parvient à se raccrocher aux besoins de ces mêmes pôles (la zone de polarisation de Lokoshàza reste toutefois peu dynamique), par la mise en place d'infrastructures d'accueil spécifiques (pour personnes d'âge avancé).

La frontière a donc pour Elek un effet d'exclusion, la plaçant hors des espaces d'innovation car éloignée des équipements moteurs que sont les postes de passage de la frontière. Qui plus est, une frontière ouverte ne garantirait pas pour la commune d'un développement plus conséquent : l'espace environnant, dans et hors des frontières, a évolué. Le processus d'exclusion est donc double en sorte. Elek nous montre ainsi au final l'image, presque classique, d'un cas de figure où la frontière créée une rupture difficilement surmontable.

Entre Roumanie et Hongrie cependant, une spécificité s'impose peut-être, au regard d'autres frontières européennes : les tracés sont finalement récents, mais leur extrême fermeture durant la seconde moitié du XX^{ème} siècle a contribué à accélérer les processus de désagrégation des liens antérieurs. Se pose dès lors la question de la reconstitution de ces liens, quant à la nature des procédés de leur rétablissement.

LA FRONTIÈRE COMME LIMITE DE NATURE FLUCTUANTE : INTRODUCTION D'UN FILTRE DU DÉVELOPPEMENT LOCAL ET RÉGIONAL À JIMBOLIA

La frontière à Jimbolia est sensiblement différente de celle observée à Elek. Là aussi, la frontière induit une rupture. Cette rupture est cependant ici de nature politique, suite à la décision d'embargo sur l'ex-Yougoslavie de la décennie 1990. Poste frontière ferroviaire et routier, Jimbolia tirait profit de la proximité de l'Etat yougoslave. De tous temps des petits échanges étaient effectués, garantissant un supplément de revenus à une partie de la population locale ayant su, et pu, se saisir de cette opportunité. De sorte, la fermeture forcée du tracé déstabilisa l'économie locale. Plus encore, elle menaçait d'un déséquilibre social interne, les difficultés économiques exacerbant les tensions entre groupes se réclamant de souches nationales distinctes.

Dans ce contexte d'isolement et de dégradation des conditions de vie, la ville voit une partie de sa population émigrer, en direction de l'étranger ou des pôles d'emplois voisins de Timişoara, Arad et Sânnicolau Mare. Ce phénomène vient renforcer un processus entamé dès 1990 avec le départ de la population de souche allemande en direction d'Autriche ou d'Allemagne, et de quelques jeunes Magyars pour la Hongrie. Singulièrement, ces départs vont permettre la constitution de liens entre la ville de Jimbolia (certains de ses habitants) et l'extérieur transfrontalier de l'occident européen. Alors que, jusqu'à cet instant (embargo), la ville pensait son développement dans une exploitation de la frontière yougoslave, elle dispose désormais d'appuis sensibles[14] en d'autres espaces. Ce basculement est renforcé

[14] Nous usons de ce terme afin de souligner le caractère identitaire et personnel de ces liens : chacun décidant de ces liens et les entretenant en son for intérieur.

par l'installation en ville d'entreprises à capitalisations mixtes allemande ou hongroise (ces dernières en nombre réduit cependant). Toutes se sont établies à Jimbolia du fait de la connaissance d'individus locaux ou issus de la ville. Surtout, leurs besoins en main d'œuvre assurent des emplois, aux plus jeunes notamment : la population peut ainsi se stabiliser.

Dans ce contexte toujours, l'élection d'un maire de souche magyare permet de renforcer les liens, par jumelage, avec une commune hongroise [15]. De l'expérience hongroise est retiré le modèle de constitution de microrégions. Ces dernières ont l'avantage d'offrir, sur le papier, une population et, donc, une offre de main d'œuvre plus importants. De même, elles permettent une mise en commun des ressources, fait essentiel dans l'optique de dépôts de candidatures aux fonds structurels européens : dans un contexte où la fermeture de la frontière entrave tout projet transfrontalier (susceptible d'être plus aisément éligible), l'argument de stratégies communes est d'autant plus porteur. Ainsi se forme rapidement autour de Jimbolia et sur le squelette de l'ancien raion du même nom, l'association régionale Banat Ripensis[16]. Sur cette base ont pu être emportés déjà deux financements de projets européens. Sur cette base, toujours, la venue d'un établissement industriel de capitalisation étrangère, garantissant plus de 3.000 emplois, a pu être envisagée ; les tractations ont été interrompues, mais Jimbolia était la ville la moins peuplée parmi les quatre visitées par cette société.

Quel bilan tirer de ces observations ? La municipalité, comme les entrepreneurs et la majeure partie de la population de Jimbolia[17], a, en quelques années, inversé son regard sur les frontières. La fermeture de l'espace de référence a contribué à un renforcement des liens (préalablement potentiels) avec la Hongrie et l'Allemagne. De fait, la ville s'inscrit aujourd'hui dans un double espace frontalier, en deux domaines. L'un garantit d'activités industrielles, d'emplois et de relations d'import/export. Pour une partie de la population locale, il figure aussi l'espace de liaison en direction de l'espace de référence d'un identitaire de groupe. Cette même frontière hongroise, qui plus est, se rapproche, structurellement parlant, suite à l'ouverture du poste frontière de Cenad. Dans le même temps, la réouverture de la frontière avec l'actuelle Union de Serbie-Monténégro permet de réactiver des liens seulement interrompus mais non effacés. Les commerçants locaux profitent des différentiels de coûts et de salaires.

De sorte, la fermeture de la frontière ex-yougoslave a ici été bénéfique. Elle a permis à la ville de se saisir de nouvelles opportunités de développement (même si force est de reconnaître que la venue d'entreprises étrangères n'est pas conditionnée par la fermeture de frontière en question). Au final, la population se mobilise sous

[15] Jimbolia dispose ainsi de jumelages avec la commune hongroise de Pusztamerges, et avec la ville serbo-monténégrine de Kikinda.

[16] Cette dernière regroupe les six communes constituant l'ancien raion de Jimbolia : Cărpiniş, Cenei, Comloşu Mare, Lenauheim, Uivar et Jimbolia, ainsi que la commune de Săcălaz, limitrophe de Timişoara.

[17] Séries d'entretiens menés durant quatre années, de 2001 à 2004 dans la ville de Jimbolia, auprès des groupes d'individus susnommés.

la contrainte. Nous n'avons pas évoqué ici le rôle de quelques individualités dans ce processus de mobilisation ; toutefois, à degrés divers, chaque habitant prend conscience que la ville doit jouer de son double positionnement : sur la frontière serbo-monténégrine et à courte distance de la Hongrie (figure 1). L'espace frontalier vécu s'étend et n'est plus limité à un simple rapport de voisinage. De ce point de vue, le renforcement des liens avec l'Allemagne, via l'implantation d'établissements industriels, contribue à élargir le champ des possibles. La frontière peut de ce fait être lue comme un filtre, un catalyseur, du développement.

NECESSAIRES PRISES EN COMPTE DES SOCIÉTÉS CIVILES ET DE LA PARTICIPATION DES POPULATIONS

A la lecture d'exemples tirés de la construction européenne transparaît la nécessité d'une sensibilisation de la population aux initiatives transfrontalières (G. Lepesant, 1997) ou de développement régional (M.-J. Jolivet, P. Lena, 2000) : la garantie de succès des politiques repose sur une interaction constante entre les autorités décisionnelles et les citoyens. La prise en compte de la participation des populations au développement local se justifie donc dans une démarche d'étude de la frontière. Cela rejoint en somme le constat que toute initiative qui ignorerait l'Homme, en tant qu'individu socialisé et spatialisé, serait à terme condamnée, ce que souligne l'expérience sociologique (S. Schnapper, 1998, p. 498).

Dans la condition où la frontière agit en tant que borne de l'espace économique et politique, elle influence le développement régional et local. Mais elle se lit aussi comme marqueur de l'espace social et, ainsi, par elle, s'expriment et se différencient perceptions et vécus des citoyens habitant l'espace frontalier. Ces deux dimensions de la frontière se combinent et, en aucun cas, ne se révèlent antinomiques. Seulement, la population perçoit et use différemment de la (des) frontière(s), en fonction des potentiels de développement locaux. Ces mêmes potentiels sont en partie définis par des constructions identitaires adjacentes qui, à leur tour, dépendent à degrés divers de la proximité de la frontière, ce qu'illustre l'observation aux marges occidentales du territoire roumain.

Des questionnements sont ainsi formulés quant à la contribution des représentants de la société civile aux actions menées dans cet objectif (D. Branea, 2001). De ce point de vue, il subsiste « une série de barrières dans la réalisation de tels désirs, parmi lesquelles les plus importantes sont d'ordre législatif » [18]. Ajoutons que, de la recomposition de la société roumaine, émergent des regroupements identitaires (E. Bioteau, 2002) qui, bien que par essence non exclusifs, contribuent à fragmenter cette dernière en groupes d'intérêts parfois divergents[19].

[18] Enquête (transmission via support Internet) auprès de la Préfecture du Timiş; réponse du 05.05.2004 à la question : « la société civile vous paraît-elle actuellement en mesure de s'approprier et de dynamiser les échanges transfrontaliers ? » (E. Bioteau, avril/mai 2004).

[19] Qui plus est dans l'ouest de la Roumanie, et particulièrement dans le Banat, où subsiste un héritage culturel multiforme et où se renouvelle la pluriconfessionnalité.

Ces constats confirment, entre autres, les doutes émis quant à l'existence d'une société civile, au sens d'entités collectives structurant les rapports entre individus et participant à l'organisation et aux décisions publiques.

Or, les exemples développés ci avant soulignent sinon militent dans le sens d'une nécessité de participation des populations locales dans le développement de leur commune, ou de leur ville. Le cas d'Elek est une illustration d'une commune disposant de peu d'atouts et tâchant de les mettre en valeur afin de contourner l'obstacle frontalier. Composant avec un cadre géographique contraignant, les autorités municipales ne parviennent toutefois pas à inverser le caractère périphérique de leur situation. En ce cas, la frontière agit réellement comme rupture, en tant que contrainte subie. Nădlac, en revanche, montre que la non mobilisation de la population autour de la problématique du développement local pénalise à terme la commune (si une mobilisation a lieu, elle repose sur la préservation d'une identité locale singulière). De fait, toute stratégie de développement qui, à l'instar de Nadlac, repose sur un rapport à l'Autre contraint, car confirmant et renforçant un isolement déjà induit par des facteurs conjoncturels, présente le risque d'accroître les difficultés locales. La frontière, bien qu'ouverte, et bien que garantissant d'une situation en partie favorable, devient un obstacle. Ici, dans une certaine mesure, un défaut de mobilisation et de participation de la société civile entrave le développement; qui plus est dans un contexte de concurrence allant croissant.

Cette prise en compte des nouvelles concurrences spatiales devient primordiale dans un contexte mouvant de recomposition sociale et spatiale, et de transition des économies. Ainsi, au regard de l'exemple fourni par la ville de Jimbolia, nous remarquons que certaines contraintes induites par les frontières peuvent être dépassées ; elles ne le sont que dans la condition où, justement, élites locales et simples résidents, entreprises et associations, participent à une réflexion commune sur le devenir du site. Dans ce cas précis, la fermeture d'une frontière agit comme moteur de redéfinition de l'identitaire local et de réorientation des perspectives de développement. A terme, cela permet de tirer profit de deux domaines frontaliers, et promeut une assise intercommunale et transnationale des activités et des supports structurels de ces dernières. Dans l'objectif de construction d'entités territoriales transfrontalières, il paraît donc nécessaire d'inclure, de rendre actives, les populations ; cela ne semble être possible que par le biais des sociétés civiles naissantes.

UNE IMAGE AUTRE DE LA FRONTIÈRE À L'AUNE DES CONSTRUCTIONS TRANSFRONTALIÈRES ?

Les relations frontalières se sont renouvelées au centre de l'Europe tant dans leurs formes que dans leurs contenus ; elles s'institutionnalisent, via la création d'eurorégions. En Roumanie notamment, depuis le début de la décennie 1990, les considérations et usages des frontières sont constamment redéfinis. Cette évolution participe du processus de mutation politique auquel doit se plier l'Etat roumain, en

poursuite de ses objectifs de développement économique et social et d'intégration européenne.

Sujet à controverses[20], l'état des relations avec la Hongrie s'est peu à peu normalisé (P. Dunay, 1997). La volonté d'amélioration de l'ouverture de la frontière ainsi que l'émergence de stratégies communes de développement sont mis en exergue (A. Ilieş, I. Horga, 2000). Les relations entre les deux Etats font aujourd'hui office de modèle demandant à être appliqué ailleurs[21]. Dans ce contexte, il est bien entendu que les efforts de cohésion portent avant tout sur les espaces frontaliers : aux discours du politique doivent répondre un équilibrage économique et de multiples expériences d'interactions sociales et culturelles. Dès lors, de seul objet de rupture, la frontière devient un tout diacritique. Elle reste une séparation entre deux Etats soit, mais devient aussi, et de plus en plus, un outil de distinction entre diverses constructions sociales, à échelle communale et/ou régionale, à l'intérieur comme à l'extérieur des territoires étatiques.

La frontière ne participe plus dès lors d'un simple rapport intérieur/extérieur, mais combine avec d'autres objets spatiaux et divers facteurs sociaux pour former un cadre contextuel d'actions et d'initiatives. Son tracé fermé limitait les espaces de vie, en domaine frontalier. Son ouverture croissante exacerbe les concurrences spatiales. A chacun de se l'approprier et d'en faire usage, au risque d'enfermements, contraints ou volontaires. A l'aune des constructions transfrontalières au centre de l'Europe, parvenir à saisir ce qui construit et/ou déconstruit les liens sociaux le long des frontières nous parait donc essentiel.

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[20] Se reporter à la bibliographie (S. Rosière, 1998, J. Schultz, 1992, V.V. Mihăilescu, 1993).

[21] Ainsi, ne nous projetant que dans l'ouest roumain, les rapports avec l'Ukraine ou l'actuelle Fédération de Serbie et Monténégro requièrent, eux, d'être clarifiés (E. Lhomel, 2000).

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LE RYTHME DES FRONTIÈRES[1]

OCTAVIAN GROZA[*]

Mots clés: frontières, Etats, régions, Union Européenne.

Borderlines and their impact on space organisation. An essential role in shaping the organisation of the European territory has been played by states and regions. From a network-type organisation, the European territory evolved towards a political-related type and eventually to a type of organisation centred on natural states with intangible borderlines. This evolution was mirrored by the European-type diffusion of modernity, from the centre (Lotharingean Europe) towards the periphery of the Continent to the effect of a twofold territorial organisation: concentrical at the Continental level and a display of parallel strips at the national level. The paper outlines the construction of the European Union from a geographical perspective (project, principle and modalities of territorial construction).

Poser le problème des frontières politiques c'est poser le problème de la nature et de la légitimité du contenu qu'elles enveloppent, c'est-à-dire des Etats modernes. Dans ce champ d'analyse, la géographie ne peut pas se substituer aux sciences politiques mais elle peut compléter leurs approches avec une dimension essentielle pour la compréhension des dynamiques à l'ouvre: la dimension spatiale.

Depuis 2000, la devise de l'Union Européenne est « Unie dans la diversité ». Cette devise couvre une réalité relativement banale: l'Europe est un continent petit (7% des terres et 12% de la population de la planète) mais extrêmement fragmenté dans ses composantes naturelles et surtout sociales. La volonté de créer une certaine unité de l'espace européen suppose un projet, un principe et des moyens. Le projet c'est l'Union Européenne, mais quel est le principe et quels sont les moyens nécessaires à son accomplissement et surtout quels sont les obstacles les plus forts qui risquent d'entraver la construction de cette unité ? On reviendra sur le principe et sur les moyens; pour l'instant on risque une affirmation un peu provocatrice: les obstacles sont constitués par les Etats européens eux-mêmes et par leur expression spatiale la plus évidente – les frontières.

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1. ÉTATS ET FRONTIÈRES, LÉS CLES DE L'ARYTHMIE DE L'ESPACE EUROPÉEN

Si on peut considérer que des esquisses d'identité de groupe (identité nationale ?) et les organisations politiques les encadrant sont apparues très tôt en Europe (Duroselle, 1990; Lévy, 1997), l'Etat moderne est une invention relativement récente. L'Etat a besoin d'une condition fondamentale: un territoire bien délimité par des frontières imposées aux voisins. Les organisations politiques du Moyen Âge fonctionnaient plutôt grâce à des réseaux commerciaux, supportées par des réseaux urbains puissants – l'exemple de la Hanse est symptomatique. L'Europe des réseaux n'était pas compatible avec l'organisation étatique ayant le contrôle absolu dans chaque point de l'espace et le pouvoir des seigneurs ou des rois diminuait au fur et à mesure qu'on s'éloignait de leurs sièges. Il n'y avait que l'Eglise qui avait un pouvoir constant sur tout l'espace où elle était présente. La possibilité des mesurages géodésiques exactes n'est apparue que vers la fin de la Renaissance; on peut dire que la cartographie est à l'origine de l'Etat moderne; ce n'est qu'après avoir tracé des limites précises que l'entité spatiale dotée d'un système de pouvoir a pu s'organiser administrativement, avec tout ce que cela implique. L'exemple des républiques italiennes, devenues les premiers *Etats-territoire*, et dotées d'un appareil diplomatique auprès les cours de l'Europe dès la moitié du XVe siècle, a été très vite suivi mais ce n'est qu'après la paix de Westphalie (1648) que le principe de souveraineté a consacré le concept moderne de territoire et donc de frontière.

Les Etats post-westphaliens n'étaient pourtant que des contenants administratifs, vides d'idéologie ou plutôt contenant la même idéologie du pouvoir et du contrôle: la religion mise à part, ils étaient relativement indifférents vis-à-vis de leur contenu ethnique ou linguistique. Le droit divin des rois et des empereurs transgressait facilement les frontières des souverainetés décrétées par des pouvoirs terrestres... d'où une recomposition incessante des marges et des frontières. Ce n'est qu'après la Révolution française et la cristallisation de l'*Etat-nation* que les frontières deviennent sacrées au nom des idéologies nationales. La souveraineté commence à s'exercer entre des nations et pas entre des entités administratives; la frontière devient une présence au moins aussi forte dans les esprits que dans l'espace. Ces inventions politiques incessantes ont changé maintes fois la nature du pouvoir étatique et par la suite ont interdit toute stabilité territoriale sur de longues durées.

Géopolitiquement, l'Europe est un espace récent: seulement 23,8% des frontières européennes ont été établies avant le XIXe siècle. Environ 22% des frontières actuelles datent du XIXe siècle et le siècle suivant a encore remanié 24,3% entre 1910 et 1924 et 29,9% entre 1945 et 1949. Qui plus est, la plupart des frontières présentes du continent n'a pas été tracée par des négociations directes entre des voisins: plus des 50% des lignes de frontière de l'Europe résultent des décisions internationales et 19% des décisions unilatérales, notamment dans l'espace européen de l'ex-URSS (Foucher, 1998; Thébault, 2006). Ce résultat instable de l'architecture politique des territoires européens est le résultat de la confrontation de quelques pôles historiques (Fig. 1), qui ont généré des royaumes, des empires et des

Etats-Nation dont les ambitions expansionnistes ont eu comme terrain d'action un espace continental relativement réduit et densément peuplé par des sociétés très différenciées. Au gré des flux et des reflux de ces centres de pouvoir, l'Europe est devenue au fil du temps une sorte de piano difforme, avec des cordes enchevêtrées (Fig. 2) dont la musique grotesque s'est faite entendre très fort pendant les deux conflits mondiaux. Trop petits ou trop ambitieux, les Etats de l'Europe se sont toujours révélés impuissants à durablement régler leurs contentieux et leurs affaires ont été maintes fois « résolues » par des interventions extérieures, fait évident à la fin des deux guerres mondiales.

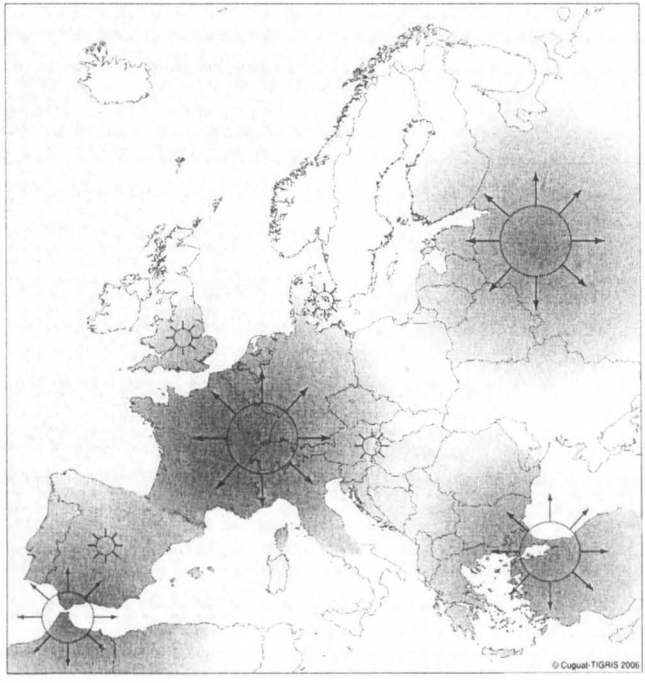

Fig. 1 – Pôles historiques en concurrence dans la construction territoriale de l'Europe (Source: TIGRIS – Iaşi, 2006).

Les solutions wilsoniennes par exemple, fondées sur le droit divin des peuples et essayées après la première conflagration mondiale, se sont révélées non appropriées et n'ont pas empêché la deuxième guerre. La période d'après le deuxième conflit mondial a vu apparaître le principe d'*intangibilité des frontières*. Promu par Moscou, afin de rendre impossible les revendications territoriales latentes entre les Etats du camp communiste, il ne devient effectif – et mondial – qu'après la Conférence sur la Sécurité et la Coopération en Europe, qui a eu lieu en 1975 à Helsinki, avec la participation de 33 pays européens, des Etats Unis et du Canada. Apparemment fort et capable d'assurer la paix pour longtemps, ce principe a un talon d'Achille, mis en évidence de façon très puissante après la chute des

régimes totalitaires de l'Est. En effet, hormis l'idée de stabilité des frontières, il impose la primauté de la frontière d'Etat sur les frontières culturelles telles les clivages ethniques, linguistiques ou religieux. Corroboré avec *le principe de souveraineté,* il accorde le pouvoir complet de l'Etat sur ses citoyens, au-delà de toute différenciation par race ou nationalité mais seulement à l'intérieur de ses frontières, ce qui implique le fait que l'Etat n'a le droit à aucune emprise sur ses ressortissants habitants les pays voisins. Ce point faible a été cruellement révélé par le déchirement de la Yougoslavie et par des tensions aigues entre les Etats candidats à l'Union Européenne. Encore une fois les Etats européens ont fait faillite à leur devoir, confondant l'intangibilité des frontières avec leur immuabilité.

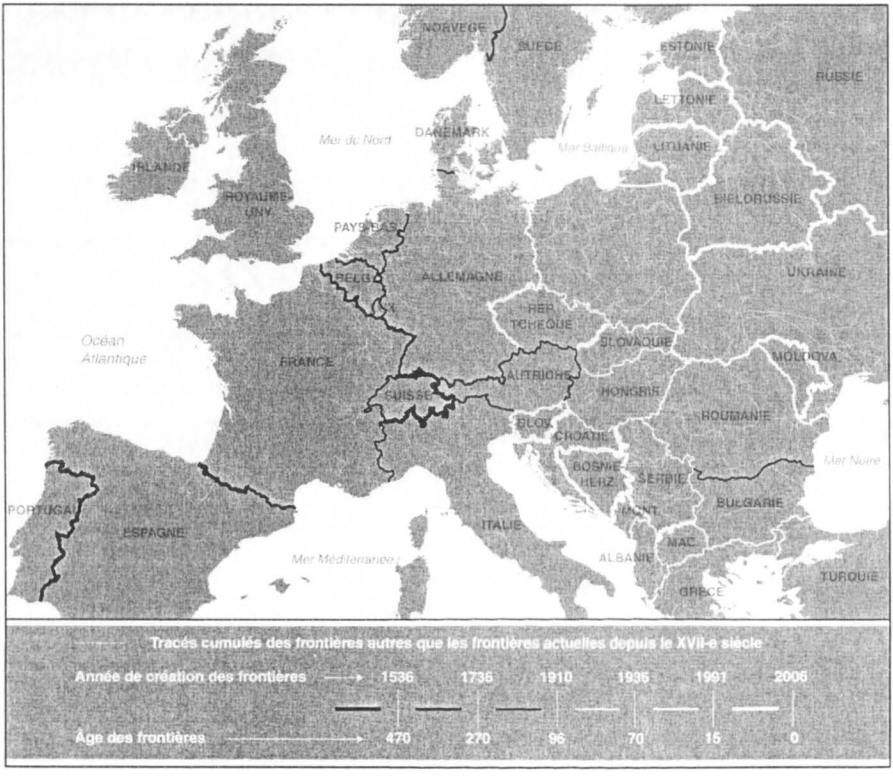

Fig. 2 – Diffusion ouest – est de l'Etat – nation
(Source: M. Foucher, 1998 ; V. Thébault, 2006).

Sur l'ensemble du territoire européen, la conséquence spatiale principale de la confrontation des pôles historiques et de l'apparition ultérieure des Etats modernes et de leurs frontières se traduit dans une organisation de type centre-périphérie. Le centre, organisé sur l'axe de « l'Europe lotharingienne », a toujours été un espace d'invention et a su garder son avance politique, culturelle, technologique et sociale. Avant la mise en place des frontières *nationales*, au fil des siècles, la diffusion des inventions s'est

faite *par le bas*, sur les routes de la guerre, de la culture et du commerce, par l'intermédiaire des milliers de connexions individuelles, suivant les goûts, les intérêts, les orgueils et les moyens des individus et des groupes. Gouvernée par les temps longs et soumise aux filtres de la distance, cette diffusion par contagion a créé des gradients dont les intensités diminuaient de façon continue vers les périphéries lointaines de l'entre-deux (Rey, 2001) où se faisaient ressentir des influences venues d'autres horizons. Le phénomène peut très bien être mis en évidence dans le cadre de l'Europe Centre-orientale (Rey, 1996), Ukraine comprise...

L'apparition des frontières nationales, dont les contenus héritaient dans la plupart des cas des fragments d'Etats-territoire et des structures territoriales organisées par des gradients historiques, a créé des obstacles redoutables devant la diffusion par le bas et a ouvert largement les portes à une diffusion hiérarchique et sélective, par le haut, des inventions du centre. L'étranglement des canaux traditionnels de diffusion a presque figé l'organisation profonde des territoires, les bandes longitudinales créées par les gradients historiques témoignant d'une inertie spatiale évidente, dont le poids s'avère considérable même dans le cadre des dynamiques actuelles (Fig. 3).

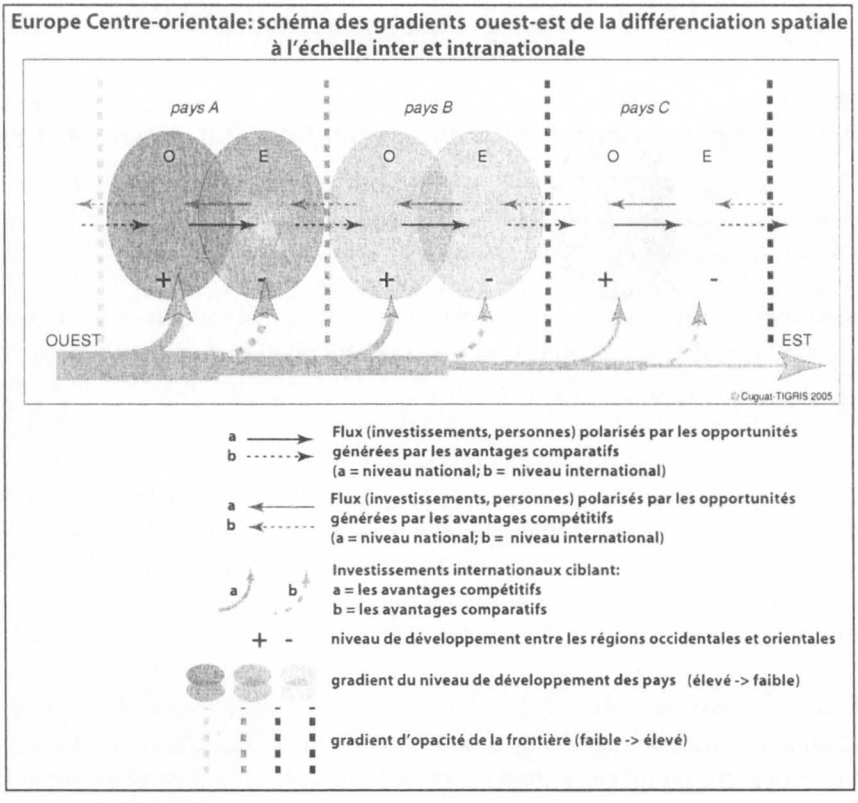

Fig. 3 – Exemple de l'organisation centre-périphérie de l'Europe (Source: TIGRIS-Iaşi, projet ESPON 3.4.1.).

Source de déséquilibres spatiaux, ces gradients dont les intensités diminuent de l'ouest vers l'est et qui témoignent des degrés divers de percolation de *la modernité de type ouest-européen*, ont créé des difficultés évidentes de gestion territoriale. Soucieux de gagner le jeu de la démocratie (à l'Ouest) ou essayant de mettre en œuvre les idéologies égalitaristes (à l'Est), les Etats se sont dotés de politiques d'aménagement du territoire et ont procédé à des actions gigantesques censées diminuer ces décalages infranationaux. Les résultats n'ont pas été à la hauteur des moyens: bien que le niveau général de développement ait considérablement augmenté, les déséquilibres sont restés en place, avec une conséquence inattendue: dans la majorité des cas les décalages entre les régions situées d'un côté et de l'autre des frontières des pays voisins sont devenus encore plus marqués. A l'échelle de l'Europe et à l'échelle nationale, les Etats et les frontières se sont vus ainsi en posture de générer une véritable arythmie spatiale, par les discontinuités systématiquement produites.

2. LES ETATS ET L'UNION EUROPÉENNE : RESISTANCES DES SOUVERAINETÉS NATIONALES

Durant la période des communautés (la CECA – Communauté Européenne du Charbon et de l'Acier, l'EURATOM – Communauté Européenne de l'Energie Atomique et CEE – Communauté Economique Européenne), qui s'étale entre le Traité de Rome (1957) et le Traité de Maastricht (1993), la construction d'un marché commun et d'un espace économique s'est déroulée sans confrontations capables de mettre en péril le projet d'une Europe unie. L'Europe des six, puis l'Europe des neuf, puis l'Europe des douze ont été autant des niveaux de construction réussie qui ont entretenu un espoir que la direction était bonne.

Il y a eu pourtant un signe puissant qui avait montré très tôt que la distance entre *Communauté* et *Union* est très grande et cela parce qu'en chemin il y avait beaucoup de... frontières. Suite à la proposition faite en 1950 par la France, en mai 1952 les pays membres essayent de mettre en route la CED – Communauté Européenne de la Défense, projet abandonné deux années plus tard, suite au refus de l'Assemblée nationale... française. Cet échec a mis en lumière la jalousie de l'Etat-nation quant à ses prérogatives régaliennes (il aurait perdu les attributs qui touchaient à la défense et à la politique extérieure) et aussi le poids des peurs enfermées entre les frontières des nations. Il a montré encore une fois l'incapacité des Etats à trouver les voies de l'entente, laissant de nouveau l'étranger se mêler des affaires de sécurité (l'OTAN). Pourtant ce moment délicat a constitué aussi un moment qui a prouvé la capacité d'invention du « centre »: à la place de la CED a été mise en route l'UEO – l'Union de l'Europe Occidentale, organisme censé renforcer la coopération politique et surtout militaire entre les pays membres. S'il y

a aujourd'hui de bonnes prémices pour la constitution d'une force armée européenne, cela est dû à l'UEO. L'épisode est seulement un des jalons qui ont construit lentement le sentiment que *le principe fondamental* d'une Europe unie peut être trouvé.

Mais les Etats ont du mal à renoncer à l'idée de souveraineté nationale et donc au contrôle strict des frontières. Si les frontières commerciales ont été vite enlevées et le marché commun est devenu très tôt une réalité européenne, les frontières politiques – enveloppes de toutes sortes de nationalismes- résistent très bien. L'idée de la libre circulation des personnes, véritable symbole de la disparition des frontières, a eu du mal à s'imposer et encore plus de mal à devenir réalité. Le premier pas a été fait en 1985 dans une petite commune luxembourgeoise, Schengen, où cinq pays (la France, la RFA, la Belgique, les Pays Bas et le Luxembourg) ont signé un accord concernant l'abandon progressif des contrôles frontaliers pour les ressortissants de la CEE. Complété par la Convention de Dublin en 1990, l'accord n'entre en vigueur qu'en 1995, mais les autres Etats finissent d'adhérer à peine en 1998, et là encore avec les exceptions notables du Royaume Uni et de l'Irlande.

La création de l'Union Européenne par le Traité de Maastricht (1992-1993) a pourtant des ambitions qui dépassent nettement l'idée d'espace économique: c'est un espace politique qui est ciblé dorénavant. Toutefois, la réserve manifestée par les Etats quant à la perte de leurs attributs essentiels, qui en dernière instance leur assure la légitimité, reste le chaînon faible du processus. Dans le cadre de la CEE, les compétences de décision étaient partagées et presque jamais à la défaveur des Etats. La Communauté avait quelques *compétences exclusives* mais consenties par les pays et/ou en position assez périphérique (la politique commerciale, la politique concernant certaines ressources de la mer) et *partageait* avec les Etats quelques domaines « neutres » ou d'un intérêt commun évident (la politique concernant l'environnement, la politique sociale...). Les Etats se gardaient la part du lion, leurs *compétences réservées* concernant les domaines clé: la défense, la politique extérieure, la politique du système sanitaire ou la fiscalité. Le principe de *subsidiarité* ne règle que très partiellement le problème. Le projet d'Union Européenne se propose de changer les choses, car sa construction repose sur un trépied composé de *la communauté économique* (qui peine pour construire la zone euro), de *la coopération poussée en matière de police et de justice* (prévue pour l'instant seulement comme une structure intergouvernementale) avec notamment la *PESC – Politique Etrangère et de Sécurité Commune*, sujet très sensible car touchant une des prérogatives vitales des Etats modernes.

Deux des objectifs annoncés par le Traité de Maastricht « menacent » vraiment les fondations étatiques et donc les frontières: la promotion d'une *identité*

et d'une *citoyenneté* européennes. L'un et l'autre de ces deux éléments posent problème. La citoyenneté européenne ne peut pas être traité comme simple formalité administrative, car chaque citoyen aura des droits électoraux partout dans l'espace de l'Union et sera représenté (et défendu) dans l'espace international par des institutions européennes (pour l'instant par l'appareil diplomatique des douze Etats fondateurs de l'UE, car le « non » français à la Constitution a reconduit le statut de *sans papiers* de l'Union Européenne). Le système de la double citoyenneté (européenne et nationale) sera-t-elle une solution ?

Avec l'identité les choses se compliquent encore plus. Y a-t-il une identité européenne ? En septembre 1973 les neuf pays de la Communauté ont produit un texte concernant l'identité européenne mais ce ne fut qu'un phénomène de conjoncture, un certain désir de se définir par rapport aux Etats Unis. Jusqu'au Traité de Maastricht on ne pouvait trouver dans aucun texte officiel européen la moindre allusion à la *culture*, pourtant élément essentiel dans la construction des identités. Même Maastricht n'a fait que révéler encore une fois la chasse gardée des Etats – *l'identité nationale*. Concernant la culture, le Traité ne prévoit qu'une coopération en termes vagues, car plusieurs Etats ont refusé avec violence tout essai d'homogénéisation des politiques culturelles. Ce n'est pas étonnant alors de constater que le processus d'adhésion à l'Union des nouveaux membres n'a pas pu acquérir des dimensions symboliques dans l'esprit des populations concernées[2]. Ce n'est pas sans intérêt de préciser aussi que le refus allemand d'une politique culturelle commune a eu pour cause la pression des *Länder*, car on a là un bon exemple de voir l'autre volet de la construction de l'Union – les régions.

En bonne ou en moins bonne position économique, les régions de l'Europe s'affirment de plus en plus comme acteurs majeurs – économiques mais aussi politiques – sur la scène internationale. Suite à la lenteur de la mise en place d'une politique européenne d'aménagement territorial (*v. encadré*), et aux phénomènes de décentralisation administrative à l'intérieur des Etats, des groupes de pression ont commencé à agir auprès les instances européennes. Parmi les plus actives on note l'ARFE – l'Assemblée des Régions Frontalières Européennes, qui fonctionne depuis 1971 sur la base de la convention-cadre sur la coopération transfrontalière (Charte de Madrid), avec plus de 160 régions affiliées et l'ARE – l'Assemblée des Régions d'Europe, qui, depuis 1985 compte plus de 255 des régions provenant de 30 pays différents.

[2] Cf. Michel Foucher, conférence dans le cadre du colloque *Frontières... européanisation, mondialisation*, organisé le 7 novembre 2006 par le centre Géophile de l'ENS-LSH, Lyon.

Brève histoire de la construction des politiques d'aménagement du territoire européen

1961 – La conférence permanente des pouvoirs locaux et régionaux de l'Europe (CPLRE) du Conseil de l'Europe sur la nécessité d'une politique commune d'aménagement

1970 – à Bonn le Conseil organise la première Conférence des ministres responsables de l'aménagement du territoire (CEMAT); résultats:

1983 – à Torremolinos est adoptée la Charte européenne de l'aménagement du territoire

1988 – à Lausanne est présenté le Schéma européen du développement du territoire

1989 – à Nantes commencent les débats communautaires sur l'aménagement du territoire

1990 – lancement des programmes INTERREG à financement communautaire

1999 – à Potsdam est adopté le **Schéma de développement de l'espace communautaire** et **l'ESDP (European Spatial Development Perspective),** qui cible « une meilleure coopération entre les politiques sectorielles à impact signifiant, entre les Etats-membres, entre leurs régions et leurs villes" (ESDP, p.11) ».

Accusés d'avoir des intérêts obscurs au profit de l'un ou de l'autre des Etats de l'Union Européenne[3], ces *lobbies* œuvrent pour une autonomie accrue des régions et militent pour l'implication sérieuse de l'Union dans le développement régional. Compte tenu du fait que parmi les objectifs du Traité de Maastricht figure celui de la réduction des disparités territoriales (pour augmenter le degré de cohésion économique et sociale de ses membres) et du fait que la région s'impose comme élément primordial de l'architecture territoriale de l'Europe, il est évident que le volet régional de la politique européenne devient un instrument important pour assouplir la position des Etats quant à la politique d'aménagement. Pris dans l'étau constitué par les exigences de la construction de l'Union et par la nécessité de déléguer des responsabilités vers les régions, l'Etat européen se voit affaibli par rapports aux normes classiques de la modernité mais en même temps il est obligé de se réformer et de se repenser. Pour l'instant il réussit plutôt bien et, d'obstacle à l'Union, il en devient le moteur principal. Le mécanisme n'a rien d'alchimique...

[3] V. par exemple Pierre Hillard (http://www.diploweb.com/forum/hillard2.htm)

3. L'UNION EUROPÉENNE, SON PRINCIPE ET SES MOYENS : UN REGARD GÉOGRAPHIQUE

Il ne faut pas (ou il ne faut *plus*) chercher les frontières de l'Europe en relation avec l'Union Européenne. L'Europe est un continent dont les limites peuvent intéresser au plus les géographes, pour les besoins de leurs cours magistraux ou de leurs querelles académiques. L'Union Européenne est une association volontaire *d'Etats*, à vocation intégrative, dont les frontières peuvent très bien avoir une géométrie variable (d'ailleurs le projet de Constitution stipulait, pour les Etats-membres, la possibilité de quitter l'Union, ce qui n'est pas le cas à présent). Le principe initial de la communauté européenne était celui de compatibilité entre les membres. Une fois le critère accompli, l'adhésion se révélait simple. Dans ces conditions, le rideau de fer faisait figure de frontière claire, bien que des Etats s'y juxtaposant (Autriche, Finlande, Suède) n'osaient pas déposer leur candidature d'adhésion. La dégringolade du monde communiste a rendu cette frontière très embarrassante pour les stratèges de la construction européenne. L'embarras provenait du fait que personne ne mettait vraiment en cause le statut *européen* des pays de l'Europe Centre-orientale et que dans l'acte fondateur de la communauté il était dit que *tout état européen* peut devenir membre. Pourtant, *l'incompatibilité* entre les Etats de l'Union et ces nouveaux prétendants à la légitimité européenne était plus qu'évidente. Pour la première fois dans l'histoire de l'Union il n'était pas question de juxtaposer des *semblables* mais des *semblables différents*... Il n'était plus question d'une simple *adhésion*.

Parce que les textes fondateurs ne contenaient aucune précision sur les critères susceptibles de « mesurer » le caractère européen[4] ou l'identité européenne d'un nouveau candidat, l'Union s'est vue obligée de regarder dans son propre passé afin de trouver une solution. Le résultat a été surprenant: durant ses 33 années d'évolution, elle avait accumulé un bagage richissime d'expérience, positive ou négative, unique au monde, concernant les processus *d'intégration*. Synthétisée et épurée, cette expérience constituait une sorte de manuel de bonne conduite pour les membres et pour les éventuels candidats. Ce manuel, connu très vite sous le nom d'*acquis communautaire*, et composé de plus de 80 000 pages d'actes juridiques et de principes de droit, groupées en 31 chapitres, pouvait très bien servir comme filtre ou comme *unité de mesure* de l'*européanité* du candidat. Ce filtre n'est pas un produit culturel hérité de l'histoire ancienne; il n'est pas taillé selon les normes d'une européanité chargée de toutes les idéologies, les craintes et les peurs ancestrales. Il reflète des normes d'une européanité récente, construite au quotidien, dans le cadre d'un projet commun qui a fait les preuves de sa viabilité.

[4] Pourtant la candidature du Maroc, déposée en 1987, a été rejetée car le pays n'était pas... européen.

Qui plus est, ce n'est pas un produit fini: il est une structure évolutive et les éventuels candidats devenus membres étaient appelés à continuer l'œuvre. Ce filtre n'est pas une sorte de lit de Procuste –cadre rigide et imposé- mais une invitation et un défi en même temps, adressé à des nations et à des Etats qui, en le relevant, devront se confronter à eux-mêmes.

A partir de là il est inutile de chercher les limites de l'Union car devient européen celui qui le veut et... le peut. Le Conseil européen de Copenhague de juin 1993 a énoncé trois critères qui doivent être accomplis par tout Etat désireux d'intégrer l'Union Européenne: posséder une économie de marché viable, des institutions démocratiques et stables, et surtout manifester *la capacité d'intégrer complètement l'acquis communautaire*. Si d'autres espaces sur d'autres continents peuvent avoir l'économie et les institutions conformes aux exigences européennes, l'acquis est un trésor propre à l'Europe et l'accepter et le mettre en pratique c'est s'européaniser. Il était évident que postuler dans ce contexte pour le statut de membre n'était pas seulement une *adhésion*; le Conseil européen de Luxembourg de décembre 1997 a décidé de rendre explicite sa volonté de faire valoir l'acquis communautaire et a appelé *élargissement* toute extension future de l'Union. L'acquis communautaire fait donc figure de modèle à suivre et intégrer l'Union signifie intégrer les procédures, les normes et les valeurs construites depuis le Traité de Rome. *Sur ce principe nouveau d'européanité, le centre recommence à rayonner par ses innovations et de plus en plus dans un espace où les frontières commencent à perdre leur arythmie,* à perdre de leurs fonctions de discontinuités spatiales. Le terme d'élargissement couvre donc un phénomène géographique, de diffusion spatiale d'un modèle innovant, processus qui combine de façon équilibré et simultanée les canaux officiels (importation par le haut des institutions et des procédures) et les canaux officieux, de la diffusion par le bas, au niveau des individus et des microgroupes, la seule capable de construire une identité européenne. Et c'est pour la première fois dans l'histoire que ces deux dynamiques sont encadrées par une organisation politique, l'Union Européenne, qui se donne les moyens pour le faire.

La diffusion « par le haut » est financée par les fonds de pré adhésion (SAPARD, PHARE, ISPA), par les divers programmes communautaires (INTERREG, EQUAL, URBAN, LEADER) et par les fonds structurels postadhésion. La diffusion par le bas est financée indirectement, notamment à travers les politiques communes d'aménagement territorial, où les villes et les voies de transport sont au premier plan. L'Europe est en train d'inventer une organisation politique flexible et hybride, qui combine les traits classiques de l'Etat moderne avec la logique prémoderne des réseaux et celle postmoderne de la gouvernance et des territoires nomades.

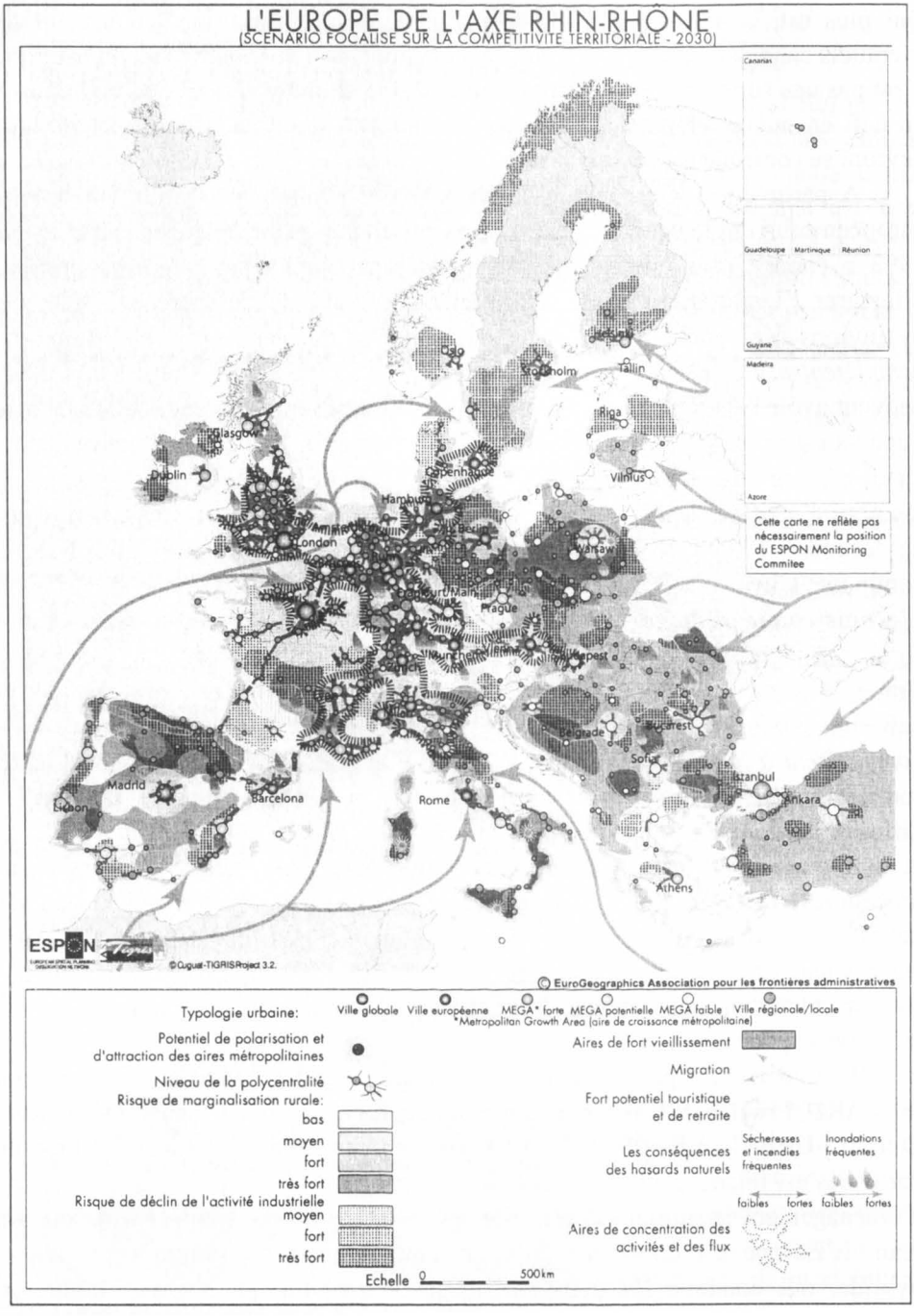

Fig. 4 – Le scénario de l'Europe compétitive de l'an 2030 (Source: TIGRIS-Iaşi, projet ESPON 3.2.).

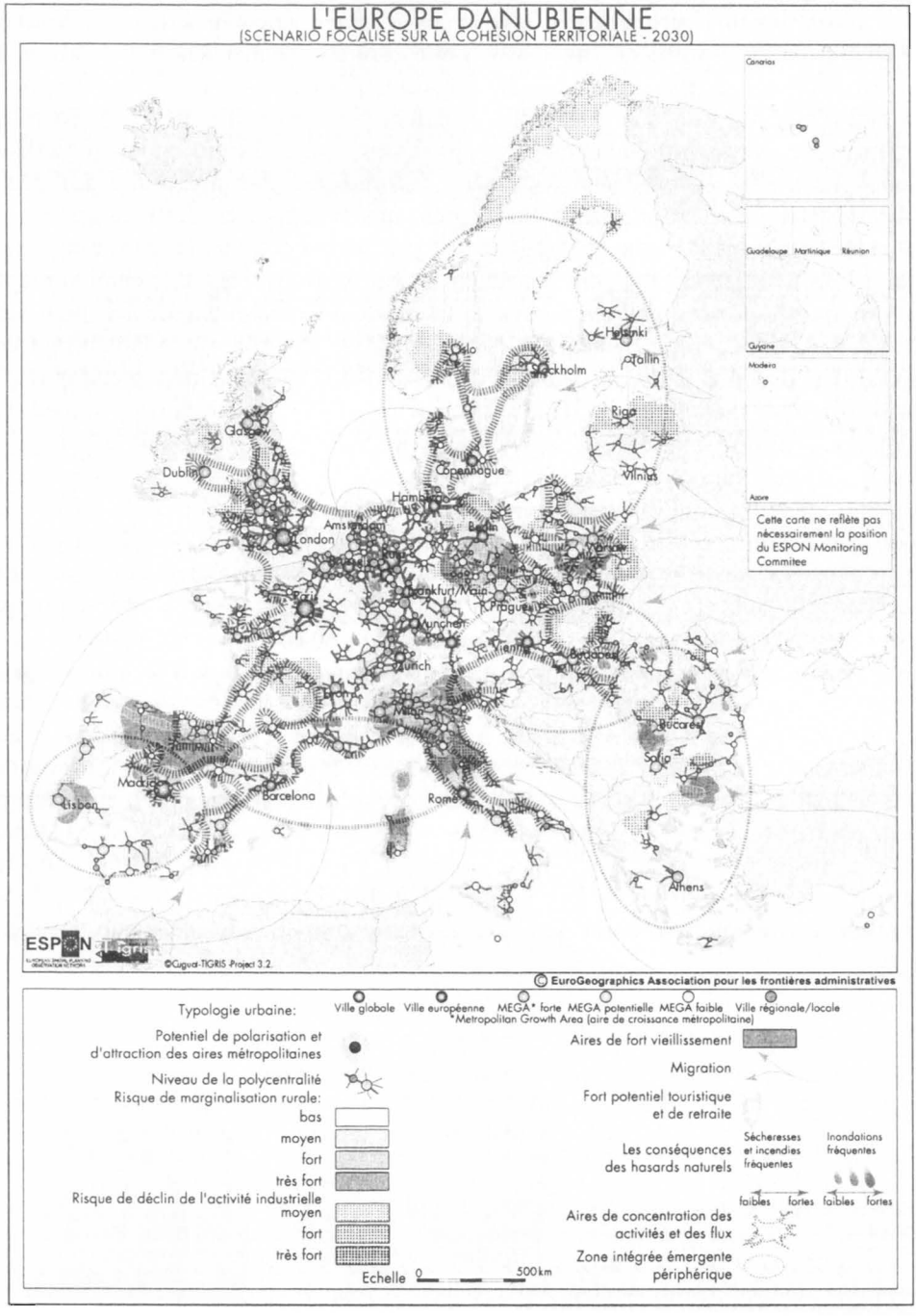

Fig. 5 – Le scénario de l'Europe cohésive de l'an 2030
(Source: TIGRIS-Iaşi, projet ESPON 3.2.).

Mais l'Union Européenne n'évolue pas sur une planète déserte et sa destinée dépend aussi de la force et l'habileté qu'elle aura à s'adapter aux exigences de la mondialisation. La tentation – et la nécessité d'ailleurs - sont pressantes pour qu'elle se mesure aux forces des pôles mondiaux très puissants (ALENA, Extrême Orient). En 2000, à Lisbonne, le sommet des chefs d'État, puis en 2002 à Barcelone le Conseil européen ont lancé une stratégie de compétitivité destinée à faire de l'UE le premier pôle technologique mondial, tout en perfectionnant « le modèle social » européen, en augmentant le taux d'activité et en limitant les exclusions ; peu réaliste (l'échéance pour les objectifs était 2012 !) cette stratégie est toujours défendue par les forces et les *lobbies* néolibéraux de l'Union. Ces orientations ont été retouchées à l'occasion du Conseil européen de Göteborg (juin 2001), finalisé par la mise en route d'une stratégie de développement durable, destiné à concilier les trois volets principaux de la construction européenne: économie, société et environnement. Cette stratégie est fondée sur un triptyque d'actions (élaboration coordonnée des politiques communes de développement durable ; gestion équilibrée des ressources naturelles et limitation des effets des aléas dus au changement climatique ; respect du protocole de Kyoto). Les figures 4 et 5, réalisées par le centre de recherches TIGRIS de Iaşi dans le cadre du contrat européen de recherches ESPON 3.2 illustrent la situation de 2030 selon que l'Europe suivra l'un ou l'autre des stratégies établies à Lisbonne et à Göteborg.

Ces deux stratégies ne s'excluent pas réciproquement ; il y a toujours moyens de trouver une voie de compromis, qui puisse tenir compte des conjonctures mais sans perdre de vue l'objectif majeur. La seule condition est de ne plus laisser aux frontières et aux Etats le soin de rythmer le territoire – cela doit être l'affaire des citoyens. L'Etat « est devenu trop petit pour résoudre les grandes problèmes et trop petit pour en résoudre les petits problèmes » (Lundmark, Malmberg, 2000). L'Union Européenne semble avoir bien compris la leçon. La frontière comme limite absolue ne fait plus partie de ses stratégies – la politique de voisinage en est la preuve. Pourvu que le monde soit préparé à accepter cette nouvelle invention européenne.

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GEOGRAPHICAL CONSIDERATIONS REGARDING THE ROMANIAN HIGHER EDUCATION

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Key words: concentration, diffusion, territorial analysis, higher education institutions, Romania.

Considérations géographiques sur l'enseignement supérieur roumain. Le système national d'enseignement supérieur roumain était représenté au début de l'année universitaire 2004–2005 par 117 institutions, dont 57 d'etat et 60 privées. Dans le cadre de toutes ces institutions, approximativement 600.000 étudiants suivaient leurs cours, ce qui signifie une moyenne au niveau national de presque 3000 étudiants pour 100.000 habitants. Le réseau national a été pendant la période antérieure à 1990 dans un processus continu de restructuration et adaptation à un marché déficitaire. L'apparition des nouvelles universités d'etat (pendant les années 1991–1994) et l'accréditation de certaines institutions privées d'enseignement supérieur (29) a diversifié l'offre éducationnelle au niveau territorial et structurel, en lui offrant une grande stabilité. L'analyse territoriale de la répartition des universités et de ses filiales, ainsi que du nombre d'étudiants démontre l'existence d'un décalage entre Bucarest et toutes les autres régions du pays, mais aussi entre les régions du Centre et de l'Ouest du pays d'un coté, et celles du Sud et de l'Est de l'autre coté. La genèse des universités privées démontre leur forte liaison avec les universités d'etat, liaison mise en lumière par l'utilisation pour une longue période de temps des professeurs provenant des universités d'etat, ainsi que d'une grande partie de l'infrastructure. Toutefois, on remarque une significative corrélation entre la grandeur des villes et l'existence de certaines universités, fait qui confirme l'idée que l'apparition d'une université suppose une masse critique de population. Même si le processus de décentralisation des services universitaires a commencé, la capitale s'impose pourtant encore par un très grand nombre d'universités (d'etat et privées), mais aussi par le nombre d'étudiants scolarisés. Le passage de l'enseignement supérieur roumain à la structure par cycles apportera des changements fonctionnels importants dans le réseau national des institutions du domaine.

INTRODUCTION

After a period of arranging, which meant the opening of the educational market for other actors, budgetary or from the private field, the Romanian higher education had an evolution more and more focused on satisfying the request at

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national level. An important role within this complex process of re-arranging was held by the adoption of a legislation which, on the one hand, was able to cultivate quality within the education process, and on the other hand could establish very clearly the status of the actors from the educational market. In this respect, three laws were congruent: The Law regarding the authorising and the accrediting within the higher education (1993), The Law of Education (1995) and The Law regarding the status of the teachers and professors (1997). The further changes of these Laws allowed the recording of some certain qualitative elements (the financing, the promotion on superior positions, university scientific research). At the same time, there was a diminution of some standards, compared to those initially foreseen, as it was the case of accrediting the new private higher education institutions.

At the beginning of the third millennium, one could notice that the Romanian higher education records mutations which get it closer and closer to the European education system. Romania's joining the Declaration of Bologna (1999), regarding the fundamentals of higher education restructuring at continental level, and sustaining this process in all the future meetings, represents a political decision which will positively influence the national educational market. Moreover, the passing to the cycle structure (university degree, master's degree, doctor's degree) will lead to compatibility between the Romanian and European educational systems, making the access of the graduated students to the European labour market easier. In this respect, an important role will be held by the achieving of a European register of the agencies specialized in ensuring the quality within higher education, and which will ensure a framework for a unitary approach regarding the quality evaluation process in this field. The structural mutations taking place at international and national level can't diminish the relation between the university and the space where the university inserts. Therefore an analysis of territorial distribution of the university offer is necessary, its structure and the existent territorial discrepancies as well. This analysis becomes extremely useful for stating some suitable policies in the field, for ensuring equal chances of access to the tertiary education for all the country's people. The new communication techniques and the unlimited access to information change learning into a process in which there isn't always necessary a direct dialogue between professor and student, but an indirect one, too. At the same time, the dynamic of the labour market gives learning a permanent character all over its life.

The present study is mainly based on data provided by the National Statistics Institute, and also by the Ministry of Education and Research. The main ideas are centred upon the relation between the state education and the private education, between their dynamic and structure, divided on centres and areas of development, on individualization of correlations between some characteristic elements and the elements belonging to the university field.

THE HIGHER EDUCATION SERVICES CONCENTRATION

The national network of higher education institutions was counting, at the beginning of the university year 2004/2005, 117 entities, namely universities, institutes, academies or national schools, all of them ensuring educational services in all fields (Fig. 1). From among these, 77 were accredited and 40 were functioning under temporary authorization regime. 600,000 students were studying within these institutions, both in the state education system (approximately ¾) and in the private education system.

These institutions are placed in 60 localities, thus meaning a favourable indicator (350,000 inhabitants for a centre providing university services) at national level, taking into consideration the critical population mass necessary for the functioning of a university. In fact, only in 33 localities there were more than 1,000 students. Moreover, from among 60 centres, 18 were having less than 300 students. Taking into account these differences, we can estimate that the territorial impact is not achieved by means of a large number of university locations, but especially by means of the concentration degree of students within some of the big urban centres.

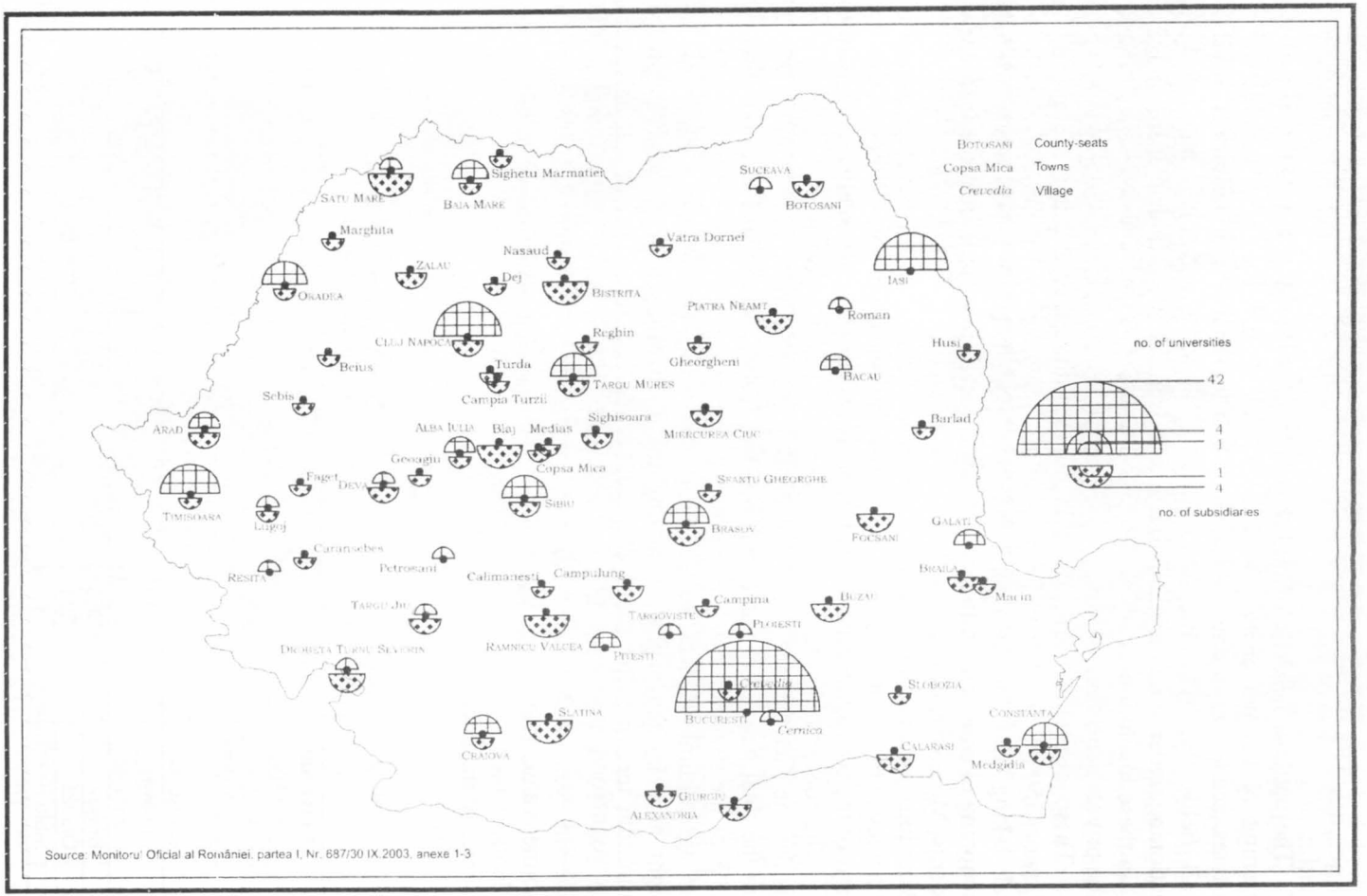
The concentration level of the higher education services is very strong, if we consider the fact that the first 9 university centres of the country totalize 77,4% from the total number of students at national level. The capital itself concentrates 32,3% of the students registered in the whole country, from all the fields: starting from agricultural sciences, to art, theatre and film. The analysis in time of the weight held by the capital, regarding the total number of students, shows a diminution tendency; regarding the relative value, from 37.7% in the university year 1989/1990, this went up to a weight of 36,13% in 1989/1999, and in the university year 2004/2005 it slightly surpassed 32% (Table 1). However, in absolute value, there is a constant and consistent increase of the number of students, which has marked a volume of almost 3.4 times, between the two extremes of the interval presented above, which signifies 147,000 students.

Table 1

The weights dynamic of the university centres with more than 20,000 students from the total number of students at the national level (%)

Nr. crt.	University centre	Number of students (2004/2005)	1989/1990	1998/1999	2004/2005
1.	Bucharest	210,139	37.7	36.1	32.3
2.	Cluj Napoca	61,134	10.8	10.2	9.4
3.	Iaşi	60,273	14.8	9.9	9.3
4.	Timişoara	43,511	11.7	8.0	6.7
5.	Craiova	29,418	5.4	4.6	4.5
6.	Constanţa	28,048	0.4	3.1	4.3
7.	Braşov	26,372	4.4	4.1	4.1
8.	Oradea	22,126	0.5	3.0	3.4
9.	Sibiu	21,954	1.0	2.6	3.4

Source: The Ministry of Education and Research, processed data.



Source: Monitorul Oficial al României, partea I, Nr. 687/30.IX.2003, anexe 1-3

Fig. 1 – Distribution of universities and their subsidiaries in Romania, 2003.

The diminution tendency of the traditional centres weight maintains and increases, due to the coming out of new university centres with regional role, situated in areas with high human potential. This refers to historical regions, like Dobrogea and Crişana, and other areas situated at the crossroads of some historical regions (Arad area, the south of Moldavia, Maramureş, etc.), too. This explains the fulminating increase of students' number within the regional centres of Constanţa and Oradea. Regarding the traditional centres, although there is an important increase in absolute value, the relative value records a decrease, due to the weight of the new university centres.

Two university centres follow, with a very high impact potential, having in view that each of them concentrates almost 1/10 from the total number of students, at national level. This refers to the cities of Cluj-Napoca and Iaşi, which surpass 60,000 students each, having a large number of higher education institutions, both state and private universities. Thus, the university centre Cluj-Napoca comprises both universities with complex profile (The "Babeş-Bolyai" University, state and the „Bogdan Vodă" University, private), and other universities with specialized profile (The Technical University, The University of Medicine and Pharmacy, The University of Agricultural and Forestry Sciences, The University of Arts, The University of Music). There is a similar situation for Iaşi, but here the private education holds more universities which are already accredited: the „Petre Andrei" University, the „Apolonia" University (specialized on dental medicine).

Concerning the dynamic of these university centres, we'll notice that during the university year 1989/1990, Iaşi held a much larger number of students than Cluj-Napoca, having approximately 15% from the total number of students in Romania at that time. The university centre Cluj-Napoca held only almost 11%, and among the two there is a consistent difference: approximately 6,500 students. The post-totalitarian evolution brings the city of Transylvania its force of first regional city, having in view the associated spatial extension, much larger than in the case of Iaşi. The latter's development within the interval analyzed above was of 3,45 times, compared to 2.47 times, for the „capital" of Moldavia. It is obvious that the latter, at least from the point of view of number of students, behaves like a regional city.

On the next position there is Timişoara, which held the third place within the national hierarchy of the university centres before 1990, when it held almost 12% of the total number of students. The increase of the number of students within around 15 years was very high (2.26 times), but it wasn't explosive, like in Cluj-Napoca's case. Timişoara has got four state universities (from among which a complex one and three specialized), and three private universities as well, from among which two are accredited.

To a certain distance, taking into account the weight within the total number of students at national level, there are other three university centres, with more than

25,000 students: Craiova, Constanţa and Braşov. The three of them are part of the same category of regional cities, having in view their territorial role and their weight within the national economy. While the university centres Craiova and Braşov were situated on the fifth and sixth places within the period previous to 1990, Constanţa developed afterwards, because at that time it had less than 700 students. This town's evolution as a university centre was actually explosive. Thus, within the analyzed period, the number of students increased forty times, reaching today a weight of 4.3% from the total number of students at national level, from an initial weight of 0.4%. The setting up of the "Ovidius" University was essential, the other universities with a profile connected to the complex harbour function recording approximately constant values regarding the number of students. Besides the state universities, an accredited private university functions here, as well as branches of other private universities accredited in Bucharest.

The university centres Craiova and Braşov have developed in approximately equal rhythms, within both of them functioning private universities beside state universities, from among which only "Gheorghe Barițiu" University from Braşov is accredited. In Craiova, there are two state universities, out of which one is mixed and the other is specialized in the field of medicine and pharmacy. The disparity between these university centres, and the ones which have got over 40,000 students diminished considerably. For example, while the university centre of Craiova held, in the year 1989/1990, about 1/3 of the students of Iaşi centre and less than half of the number of students of Timişoara, in the year 2004/2005, the university centre Iaşi held a double number, and Timişoara had more students with only about 30%.

Within the hierarchy of the university centres with more than 20,000 students, Oradea and Sibiu detach, too, but with a difference – their dynamic was quite distinct. Oradea recorded a very rapid rhythm of extension, the number of students increasing 27 times during the analyzed interval, taking into account that it started from 825 students and today it surpasses 22,000 students. This fact reflects in the university profile, too, which is of a great complexity (from engineering, medicine, agriculture, etc., to arts and music). Simultaneously, the university centre Sibiu started from a superior number of students (about 1,700) and developed in the same direction of complexity increasing. Within the same interval, the increase was of almost 13 times, so that today there are almost 22,000 students. In Sibiu, there is an accredited private university.

The territorial distribution of these major university centres provides the image of a relatively balanced space, compared to large historical provinces, as well as to large geographical units. These centres are placed either on top of the regional hierarchies (Iaşi, Cluj-Napoca, Timişoara, Craiova, Constanţa), or at the immediate inferior level (Braşov, Oradea, Sibiu). Their territorial role was more or less affected by the spatial parasitization by means of the setting up of other

university centres, after 1990, from among which some had a very fast evolution, affecting the basins of traditional recruitment of students.

THE DIFFUSION OF HIGHER EDUCATION SERVICES

The diffusion of university services may be analyzed by means of the increase, on steps, of the number of localities having higher education institutions or branches of the universities from different traditional centres. This diffusion process was generated, on the one hand, by the de-centralizing policy, obvious after 1990, and on the other hand, by the legal coming out of some private institutions within the university field. As a result, in the university year 1990/1991, seven centres with activities of higher education came out. These were part of the category of large or medium-sized towns, with a certain territorial prestige, such as Arad, Brăila, Alba Iulia, Satu Mare, Bistriţa, Râmnicu Vâlcea, but also from the category of some medium-small-sized towns (Cugir), with branches specialized in the engineering field.

In the following four years, other ten localities with such kind of institutions came out, usually county residences (Buzău, Târgovişte, Târgu Jiu, Drobeta Turnu Severin, Botoşani, Deva), or towns which had a certain cultural role, along the time (Blaj, Lugoj, Vălenii de Munte or even Caracal – the latter two will disappear starting with the university year 1996/1997). After 1992, some of these institutions change, by means of a government decision, into universities, thus coming out the universities "Valahia" from Târgovişte, "Constantin Brâncuşi" from Târgu Jiu. By means of the same procedure, other institutions from towns which developed higher education activities immediately after the fall of the totalitarian regime become universities ("1 Decembrie" from Alba Iulia, "Aurel Vlaicu" from Arad) or other institutions which functioned as sub-engineers institutes before 1990 (The University of Bacău, The University of Baia Mare, The University "Petru Maior" from Târgu Mureş etc).

Between 1997/2001, there is a multiplying of the localities with higher education activities, so that, covering four years, other twenty-five centres come out. These are mostly part of the category of medium-sized towns, but of small-sized towns, too, or even rural localities. From among the medium-sized towns, we mention eight county residences (Focşani, Sfântu Gheorghe, Călăraşi, Piatra Neamţ, Zalău, Miercurea Ciuc, Slobozia and Giurgiu), eight medium-sized towns (Bârlad, Odorheiu Secuiesc, Sighetu Marmaţiei, Câmpulung, Gheorgheni, Aiud, Târgu Secuiesc). The small-sized towns are situated in certain areas of Transylvania (Năsăud, Topliţa), of Crişana (Beiuş, Marghita) or of Banat Băile Herculane, Făget), and the rural settlements are situated in the south of the country (Amara, Crevedia, Cernica).

This strong affecting of the traditional network of centres with higher education activities had its fundamentals in the multiplying of private higher education

institutions, but also in the development of some branches of the state universities, meaning the approach of the university services offer to the areas with a specific request. Thus, there came out numerous branches of the "Babeş-Bolyai" University, of the Academy of Economic Studies from Bucharest, of the University of Oradea, but especially of some private universities, situated in Bucharest, Arad and Iaşi. The branches of the state universities and the explosive increase of their number of students relied on the introduction, starting with 1998/1999, of the fee-based state education.

Beginning with the university year 2001/2002, up to the end of the period we analyzed, there is a diminution of the number of higher education institutions, inclusively the disappearing of some centres like Vatra Dornei, Făget, Geoagiu or Slobozia. An important part of the thirty-three institutions on the verge of closing up, starting with the university year 2002/2003, were situated in Bucharest or in the traditional university centres (Bucureşti, Iaşi, Timişoara, Braşov, Oradea, etc.).

THE COMPARATIVE ANALYSIS OF THE HIGHER EDUCATION CENTRES PER DEVELOPMENT REGIONS

The development regions represent a proper framework for a serious analysis of the university services distribution, as well as of the way these centres cover the needs of a region. A rapid look upon the university centres distribution before 1990s brings out some quite important lacks which are still present within the actual dynamic of the territorial aspects connected to the higher education.

Most of the development regions possessed, in that period, two or three university centres. The exceptions were represented by the West region, which possessed four university centres, and the South-West region, with only one university centre. It is obvious that such a distribution was insufficient, as a gross average would have been of over 1.3 million inhabitants/centre.

The evolutions which followed after 1990 show, at least statistically, an improvement of this situation. Thus, the maximum limit, as an absolute value per university centre, records the highest value in the North-East region (623,970 inhabitants/centre). It is to be noticed that the number of centres with higher education activities multiplied faster in the West, North-West regions and in the centre than in the other regions. Thus, the former regions hold at least 10 such centres, whereas the regions from the east- and south-Carpathian area hold only 5–6 centres, on an average (excepting the South region, with 9 centres).

The multitude of centres and especially their development at infrastructure level made the number of students per development regions are extremely differentiated. Excepting the capital and the South region, we can notice a number of students which oscillates around 70-75,000 students per each region. The number is slightly surpassed in the case of the North-West region, where there are approximately 91,000 students. The big exceptions, as mentioned above, are

represented by Bucharest and the South region, which in fact, from the point of view of the higher education, make up the same territorial structure.

The most interesting information is provided by the number of students per 100,000 inhabitants. This represents an indicator which is used at UNESCO and at the European Union level, in all comparative analyses. If we consider this number at Romania's level (around 3,000 students/100,000 inhabitants), we can notice that, from this point of view, we get close or even surpass some states from the European Union (Greece, Hungary etc). Given this average, on development regions, the variations are extremely big, and they should be taken into account within the university infrastructure development process (Table 2).

Table 2

The variation of the number of students per 100,000 inhabitants, per development regions. (2004/2005)

Development region	Total number of students	Number of centres with university activities	Number of students/100,000 inhabitants	Theoretical number of inhabitants, belonging to a centre with university activities
North-East	77,266	6	2,063	623,970
South-East	47,507	5	1,662	571,737
South	39,519	9	1,177	373,155
South-West	43,819	5	1,881	465,868
West	72,420	10	3,720	194,665
North-West	90,919	10	3,312	274,492
Centre	68,746	14	2,701	181,805
Bucharest-Ilfov	210,139	1	9,524	2.206,479
ROMANIA	650,355	60	2,992	362,226
South-Bucharest*	249,658	10	4,486	556,487

*For a more accurate assessment of the phenomenon, the South-region must be considered within a larger spatial area, including the region Bucharest-Ilfov.

Source: *Processed data.*

The first thing to be mentioned is that under the average at national level there are all the extra-Carpathian regions, except the Bucharest-Ilfov Region, which surpasses this average with more than three times, and the Centre area.

The second thing to be mentioned is that the greatest discrepancy is represented by the capital, which has an extremely complex and very developed educational offer, thus allowing the registration of more than 200,000 students. The central position of Bucharest, compared to the South, South-West, South-East and even Centre regions, leads to the idea that Bucharest's offer covers a part of the request within these spatial entities as well. However, the role played by the capital for the South region is obvious, therefore in the above table a special row was inserted in order to show the few indicators at the South and Bucharest-Ilfov region, gathered.

A third thing to be mentioned is that the West region seems to be over-sized, regarding the infrastructure in the field of higher education, consistently surpassing the national average. Having in view the fact that university services per centres are not intended exclusively to the population of that region, we must admit there are preferences for a certain centre from another region and that the spatial dynamic of the clients within the field isn't always predictable. However, it is obvious that the regional proximity of the suppliers of tertiary education creates advantages for the potential students within that region.

Therefore, the large mass of students within a region prefers, from economic reasons, the centres which are situated closer. For this reason, the chances are not equal for the potential clients from the North-East region, compared to the West region. The former option for one of the closest centres from outside the region leads us to the idea this centre could be Bucharest. But this means very high supplementary costs, taking into account the life's price in the capital, and the long distances as well (for example, between Botosani and Bucharest). The situation is reversed in the West region, where each component county has got at least one university centre, usually with a diversified offer.

The Region Centre is also situated under the national average. An important part of the request is satisfied by the educational offer of the North-West region and especially by the university centre Cluj-Napoca. This interaction between the two regions compensates the surpassing of the national average in the case of the North-West region, with a number slightly under the national average in the region Centre.

The students' number differentiated dynamic per regions. The analysis of the evolution of the number of students per regions shows a relatively evident difference between them, taking into account, on the one hand, the existence of some traditional centres, inclusively private centres. At the national level, it could be noticed an increase of the number of students, between 1990 and 2004, of over 3 times, and in the university year 2004/2005 there were recorded over 650,000 students (Table 3).

Table 3

The increase of the number of students during the interval 1990/2004, per development regions.

Region	Number of students in the university years:				Relative increase (%) 1990/2004
	1990/1991	1995/1996	2000/2001	2004/2005	
North-East	29,721	43,448	64,946	77,266	260.0
South-East	10,828	17,240	39,296	47,507	438.7
South	5,222	11,417	31,709	39,519	756.8
South-West	10,525	18,682	35,397	43,819	416.3
West	25,723	37,032	61,463	72,420	281.5
North-West	22,838	46,130	74,420	90,919	398.1
Centre	12,553	25,848	53,045	68,746	547.6
Bucharest-Ilfov	75,400	136,344	172,876	210,139	278.7
Total	192,810	336,141	538,152	650,335	337.3

***Source**: The Ministry of Education and Research*

Both at national and regional level one can notice that between 1995/2000 there was an important increase regarding the total number of students. This "positive breach" was due to the passing, starting with the year 1998/1999, to the fee-based regime within the state universities, to which there added the excessive multiplying of the licence specializations and of the branches number, both within the private higher education (thus, there are to be noticed the universities: "Spiru Haret" from Bucharest and "Vasile Goldiş" from Arad, and within the state higher education (The "Babeş-Bolyai" University from Cluj-Napoca).

The smallest increase within the analyzed interval was recorded in the North-East Region, represented by the same important university centres which existed during 1990/1991 as well: Iaşi, Suceava and Bacău. Other towns, like Botoşani, Vaslui, Piatra Neamţ or Huşi, are only small branches with a few hundreds of students. Despite the fact that, at the level of the year 1990, this region concentrated the highest number of students, after Bucharest, in 2004 it was behind the North-West Region, at a considerable distance.

An increase which was lower than 3 times can be noticed in the case of Bucharest region, which continues to concentrate about 1/3 from the total number of students at national level, and in the case of the West Region, with a very high number of students in 1990 and with a relatively reduced population, compared to the other regions of the country. Whether the relative diminution is justified in the case of these regions, due to the excessive degree of university services concentration, in case of the North-East region, this quite slow increase may be due to the lower wages, compared to the other regions of the country and the more reduced number of the students which are studying within private universities, inclusively within state universities, in a fee-based regime. In this respect, we must underline that the North-East Region is the poorest in the country, with a Gross Domestic Product per inhabitant lower than 2,000$ (1980, 7$ in 2003), much under the average per country (2,738$/inhabitant).

A very important increase is recorded in the regions from the southern part of the country, especially in the South Region. In this region there were recorded, in 1990, only 5,222 students, and in the year 2004 they reached almost 40,000 of students, meaning an increase of about 7.6 times. The explanation of such a phenomenon is due to the pressure of some small university centres (Piteşti) and specialized (Ploieşti), to become, for their sub-regions, real attraction poles within the higher education field. This is why in the following years these two centres diversified their educational offer. Whether the university centre Piteşti was inclined to an increased diversification, Ploieşti was known as a centre of the technical education, specialized in training specialists within the oil field. The diminution of the request on the internal market and the loss of the external services market in this field determined a diversification of the higher education in Ploieşti, which today produces specialists in many fields: philological, economic, judicial sciences, etc.

Besides the two existing university centres from the socialist period, starting with 1992 there came out the "Valahia" University from Târgovişte, which gradually recorded an increased number of students, with a more and more complex profile:

from engineering sciences to socio-humanistic sciences. Besides these three university centres, with a well outlined area of students' attraction at the given counties level (Argeş, Prahova and Dâmboviţa), but with students coming from the entire southern part of the country as well, during the interval after 1990 there came out branches of the different universities, private and state, in centres like: Giurgiu, Câmpulung, Alexandria, Călăraşi, Amara. All these changes originally led to this increase of the number of students, although the university centre Bucharest provides much more diversified educational services. Its selective attraction is also imposed by the very high life costs from the capital, compared to a countryside town. This element was essential within the viability of these university centres or branches, developed in the very reception basin, aforetime exclusive for the university centre Bucharest.

On the next place, having in view the value of relative increase, there is the Region Centre, where the number of students in the year 2004 was 5.5 times larger than in the year 1990. This extremely rapid evolution was the result of many changes within the dynamic of the already existent university centres (Braşov, Târgu Mureş and Sibiu), of the coming out of some new state and private universities. Besides the "Transilvania" University from Braşov, which diversified its study fields, including fields from the technical domain to medicine, music and theatre, the "Lucian Blaga" University from Sibiu had the same development trajectory, and the same fields are practically found here. In the university centre Târgu Mureş, besides the older universities of medicine and theatrical and cinematographic art, after 1992 the "Petru Maior" University came out, with a more and more complex profile. In the same year there came out the "1 Decembrie 1918" University, in Alba Iulia, which is now being in a multiplying process regarding the study fields.

The network of educational offers was rounded with some branches of the state universities from the region (Mediaş, as a branch of the University from Sibiu, and Topliţa, as a branch of the University from Braşov) or from the outside (the "Babeş-Bolyai" University has got two branches: Sighişoara and Gheorgheni).

The private higher education is represented within this region by three accredited universities (the "George Barițiu" University from Braşov, the Romanian-German University from Sibiu and the "Dimitrie Cantemir" University from Târgu Mureş) and by many other authorized private institutions, from among which the most representative one is the "Sapienţia" from Miercurea Ciuc.

The dynamic of the students' number within the studied interval underlines the existence of 3 regions which marked an increase of approximately 4 times (South-East, South-West and North-West). These are totally different from the point of view of a territorial structure and of an evolution way. Both the South-East and South-West Regions are based upon two state university centres each. Whether the first region developed starting from the centres Galaţi and Constanţa, which existed before 1990, but with certain specificity (the first one is specialized in naval engineering, and the second in merchant and military marine), the second had as a main centre the University of Craiova. Out of this University, in 1999, the University of Medicine and Pharmacy from Craiova detached, and a part of the professors had an important role in the setting up of the "Constantin Brâncuşi" University from Târgu Jiu. As a matter of

fact, this is the second university centre of the region. Well developed branches of the University of Craiova and the University of Bucharest are at Drobeta Turnu Severin, and at Râmnicu Vâlcea and Călimănești as well.

In opposition with such kind of achievements, exclusive in the case of the South-East Region (with only two university centres) and extensive in the case of the South-West Region, the North-West Region knows a mixed development, combining the acceleration of the process of the university centres which functioned within the socialist period with a multiplying of these universities branches. Thus, branches of the state universities function in centres like: Bistrița, Zalău, Sighetu Marmației, Marghita, Beiuș, Turda, etc. Moreover, we must notice the spectacular evolution of the university centre Oradea, which reached, from 825 students in 1989, a number of 22,000 students in 2004.

The private higher education is represented by two accredited universities ("Bogdan Vodă" from Cluj-Napoca and "Emanuel" from Oradea) and many private universities ("Avram Iancu" from Cluj-Napoca, "Vatra" from Baia Mare, "Academia Comercială" from Satu Mare, etc.) or branches of some private universities from Bucharest (The Christian University "Dimitrie Cantemir") or from Arad (the "Vasile Goldiș" University).

On the whole, regarding the comparative dynamics of the number of students per development regions, one can notice a tendency of diminution of the differences between Bucharest region and the other regions. Thus, during the university year 1990/1991, the Bucharest-Ilfov Region surpassed more than 6 times four regions, whereas during the year 2004/2005 the value was surpassed in only one region (Table 4).

Table 4

The comparative report between the number of students from the Bucharest Region and the other regions during the university years 1990/1991 and 2004/2005.

The report between regions	**University year 1990/1991**	**University year 2004/2005**
Bucharest/ North-East Region	2.5 times	2.7 times
Bucharest/ South-East Region	7.0 times	4.5 times
Bucharest/ South Region	14.4 times	5.2 times
Bucharest/ South-West Region	7.2 times	5.0 times
Bucharest/West Region	2.9 times	3.0 times
Bucharest/North-West Region	3.3 times	2.2 times
Bucharest/Centre Region	6.0 times	3.2 times

***Source**: Calculated data*

As shown in the above table, the tendencies of approach and diminution of the process of hypertrophy of the regional university services is obvious. A slight increase of the disparity appears in the case of the North-East region, compared to which Bucharest region increased its initial disparity. In this situation, although the number of students significantly increased in the North-West Region, too, the increase rhythm was inferior to that recorded by Bucharest. It is also remarkable

the diminution of this disparity between Bucharest and the South Region, due to the contribution of the three intra-regional university centres: Piteşti, Târgovişte and Ploieşti. As a result, this disparity reduced three times, still remaining significant.

Geographical differences of the training potential. The university centres and the branches of the universities record a different potential training, depending on the predominant profile, the existing tradition within the higher education field, the weight of the private education etc. The training potential is decisive within the education process quality, as well as within the increase of a university centre's attractiveness. The evaluation of the training potential is based upon many criteria and indicators, which must be correlated to the real possibility of getting them. For their assessment, we must consider that three important elements are sufficient: the professors, the available space and its equipment. The professors represent the university's "treasure", and if we have indicators to also certify its quality, then we have an essential element for determining the training potential. When evaluating the space where the educational activities are taking place, we used the number of seminar rooms and of the laboratories. For the equipment level, we considered the number of computers and the percentage of their connection to the INTERNET.

Synthetically, within the analyze for showing the main types of higher education centres by training potential there were used the following indicators: the average number of the students from a university (taking into account the existence of more universities in some university centres), the number of students per educational staff, the number of students per professor, the professors' weight within the didactic personnel and the number of students per computer.

By means of the "cluster" analysis the main types were taken, following the two kinds of higher education state and private. Depending on the resemblance of the indicators value, there were obtained, in both situations, five significant categories:

A. In case of the **state higher education** (Fig. 2), the main categories are characterized as follows:

a) The category of the university centres with **very high training potential** includes big universities, with an average of almost 8,500 students. The values of the indicators are the most favourable for the education process: big universities, the number of students per educational staff and per professor is the most favourable for the education process unfolding and the professors' weight within the educational staff is the highest. These reflect the existence of some premises capable to raise the level of students' preparing. The highest values are characteristic to the capital and to some centres of some of the big historical provinces. To these university centres Braşov is added, enjoying its position at the edge of the historical province, enhanced by its traditional industrial potential. These characteristics allowed the development of the state higher education up to the level of the recognized centres. The infrastructure of the state higher education in these towns is based upon a big university, with a tradition ("Al.I. Cuza" in Iaşi, "Babeş-Bolyai" in Cluj-Napoca, etc.), a technical university, a medicine university to which other specialized universities are added.

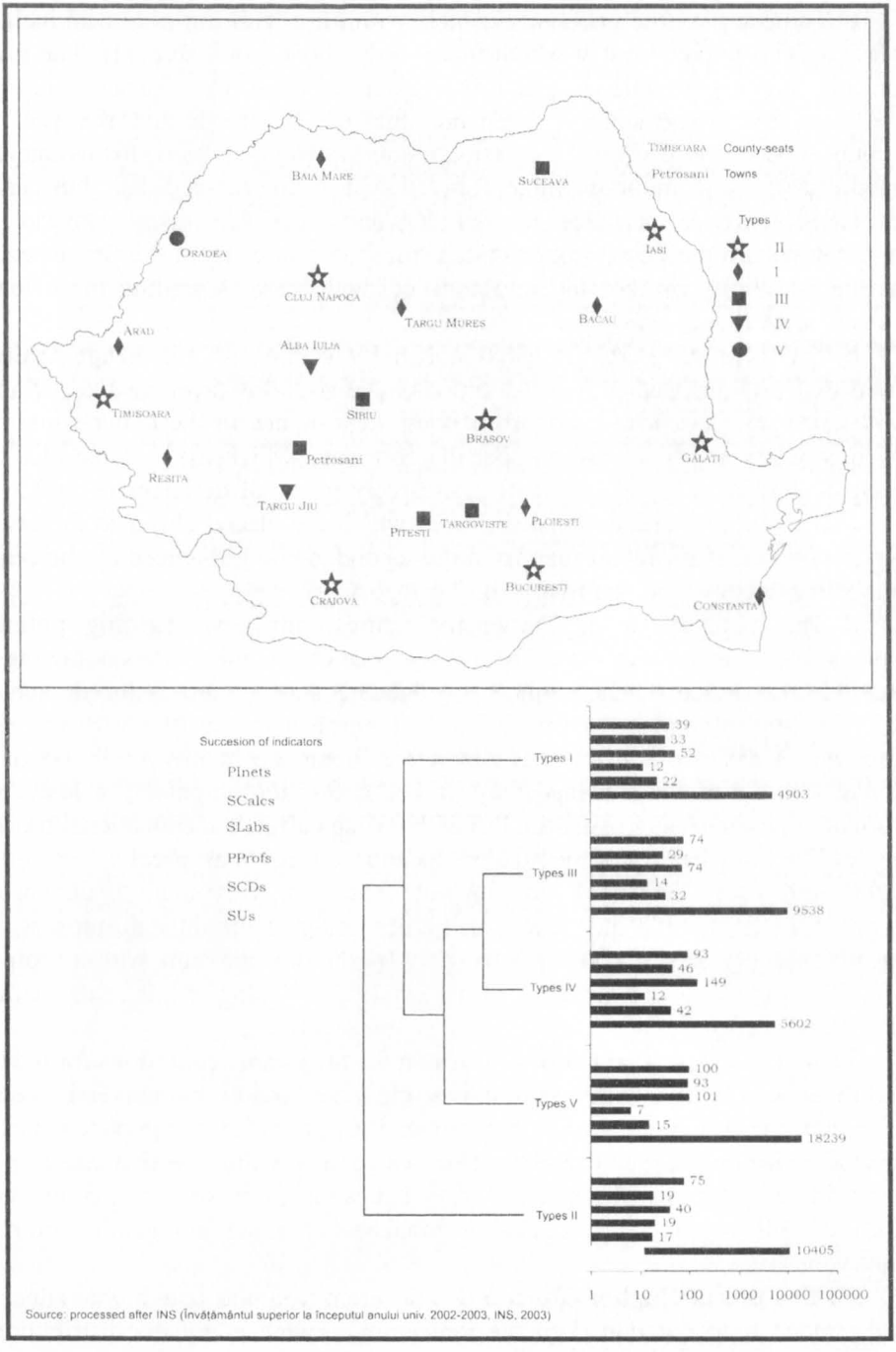


Fig. 2 – Typology of Romania's university centres and their instruction potential, Public Universities, Academic Year 2002–2003.

b) The category the university centres with **high training potential** includes 7 centres, with universities in which there study about 8,600 students. The towns from this category are characterized by average values of the indicators, close to those from the first category. They are different by the higher stress of the educational personnel. Different university centres like Craiova belong to this category; Craiova has got an important mixed university and one of medicine, but centres with universities once specialized as well ("Oil and Gases" University from Ploieşti). These centres are placed at best distances from the centres from the first category, thus the possibility of "coming into conflict" with these, regarding the potential students' attraction.

c) The next category groups 6 university centres with **average training potential**. The higher education institutions have got a low average size, of about 4,600 students. The specific feature of these centres lies in the better equipment with computers and the small number of professors, which leads to the idea of a deficit of performable didactic staff, inclusively potential deficiencies within the educational process. The university centres which are placed closer to the centres from the first category rather than from the second, being influenced by the centres from both categories, belong to this third category.

d) The category of the university centres with **low training potential** includes four university centres. The average size of the universities is the biggest (over 11,000 students), the number of didactic staff is too reduced, and the equipment with computers is precarious. All these point out the very increased effort of the didactic staff, which can reflect upon the quality of the students' training. Moreover, the students' very limited access to computers, inclusively to information, by means of using the INTERNET, can affect the educational process.

e) The last category of the higher education centres is **atypical** and includes a single centre Blaj. The Theological Institute from Blaj, very small as dimensions, has the most favourable indicators for the unfolding of the didactic process. The education quality seems to be affected only by the didactic staff with a professor status. Their absence was the cause of the separate enclosing of this centre within a particular category.

In conclusion, can be noticed that the most favourable conditions for the high level didactic activity (within state universities) are hold by the university centres with a long tradition university, big universities and with a complex education (university, technical, medical, etc.). The five centres within the first category can be considered the basis of the state higher education from Romania, compared to which the other university centres or branches of some universities from the country evolve.

B. The private higher education is different from the state higher education by the much bigger variation of the indicators, as well as by the distribution of university centres (Fig. 3). From the analysis of the private university centres, using the same cluster method, there still resulted five categories.

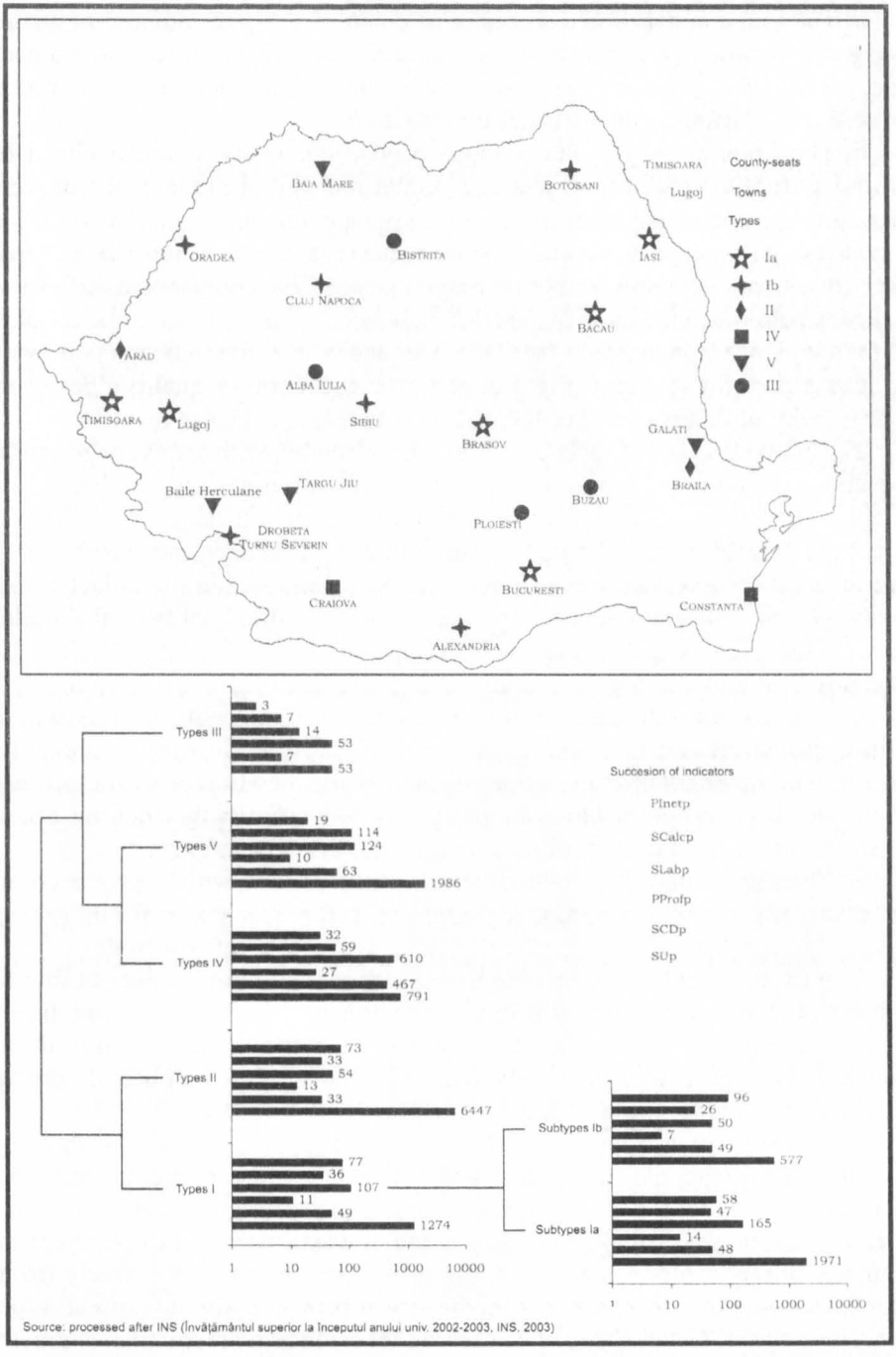


Fig. 3 – Typology of Romania's university centres and their instruction potential, Private Universities, Academic Year 2002–2003.

a) The first category includes only one centre, Buzău, already on the verge of **closing up**. Formally, this centre seemed to have favourable indicators, except the one regarding the computers. In fact, this centre wasn't authorized to function temporarily according to the legislation in force.

b) The second category including 8 private university centres, with a **high training potential**, records an average of the number of student per university under 2,000 people. The values of the indicators are among the most favourable to the educational process of quality. If we can speak about a network of private higher education, then these centres represent its basis. The comparative analysis with the centres considered the basis of the state higher education leads us to the conclusion that the two corresponded only partially. The analysis of the indicators shows that in Bucharest and in the west of the country the education of quality doesn't deny the possibility of the existence of the private education, at a close level.

c) The next category includes 7 university centres with an **average training potential**, and the average size of the universities surpasses the number of 2,600 students. The values of the indicators which characterize these centres differ a lot from those from the second category: the number of students per professor is of more than 780 people, and the weight of the professors within the didactic staff is of only 8%, etc. All these have a negative impact upon the quality of the students' training. This category includes towns with important state universities (Iaşi, Braşov), and centres without a university tradition (Băile Herculane, Lugoj) as well.

d) The last but one category includes only two university centres with **low training potential** and with universities which record an average of about 1,500 students. The numbers of students per didactic staff, the absence of the professors and the insufficient equipment with computers reflect upon the training potential and create little favourable conditions for a qualitative education.

e) The last category includes five university centres which have a common particularity: they don't have proper didactic staff and proper spaces for the education process. As a result, their training potential can only be **very unfavourable**.

The localizing of the private higher education institutions point out that these are concentrated in the capital and in some regional "cities". At the same time, we must notice that the private education training potential is much behind the state education. The absence of proper didactic staff and the low number of computers may affect the quality of the education process.

As a result of the analyses which were made, it is obviously shown that Bucharest, Cluj-Napoca and Timişoara have many alike particularities. Iasi is placed near these, but it is different regarding the private higher education, which is extremely developed. This particularity of the university centre Iasi results from an unbalance of the territorial repartition of the state universities, inclusively from the limited access of the inhabitants of the historical province Moldavia to all types of university services. Generalizing, it can be said these towns represent main elements of the national network of universities. It is interesting that Bucharest surpasses all other towns in absolute values (the most striking difference is noticed in the case of

private higher education), but by the relative values, it belongs to the same category. In the case of many university centres, the differentiation state-private is obvious, due to the different level of the training potential. On the whole, these differences are somehow covered by the reciprocal completion of the state and private universities, attenuating the drawbacks (especially of the private universities).

STRUCTURAL-SPATIAL RELATIONS IN THE FIELD OF HIGHER EDUCATION

One of the important objectives of each geographical study within this field is that of trying to determine the extent in which the network of higher education centres is interdependent and coherent from the structural and spatial points of view. At the same time, it is important to underline whether the critical population mass, necessary for the coming out of a university, is one of the structure elements of the national universities network.

For this, it was made the correlated analysis, within which it was taken into account the diversity of the education, expressed by means of the number of universities/faculties, and the effect of agglomeration with its two sides: the relationship between the property form and the relationship between the centre size and the number of the town population (Table 5). Due to the fact that the samples distribution is log-normal, within the equation of the regression line, the data are expressed as logarithms of real values (x and y). It is also to be mentioned that, for the analysis of the relations by the property form there were taken into consideration only those centres which record the values of the independent variable and the values of the dependent variable as well.

Table 5

The statistical parameters of the indicators which characterize the structural relations within higher education in Romania

Variables	The correlation coefficient (r)	The significance degree (r^2)	The equation of the regression line
Facult	0.789	0.623	$\lg y = 0{,}72 \lg x + 0{,}04$
Fstud	0.744	0.554	$\lg y = 0{,}62 \lg x + 0{,}95$
Univ	0.860	0.740	$\lg y = 1{,}02 \lg x + 0{,}01$
Ustud	0.628	0.395	$\lg y = 1{,}03 \lg x - 0{,}96$
PFS	0.784	0.651	$\lg y = 1{,}47 \lg x - 4{,}01$
PUS	0.629	0.395	$\lg y = 1{,}22 \lg x - 2{,}52$

Note:

Facult: independent variable (x) – the number of the faculties within state universities; dependent variable (y) – the number of the faculties within private universities.

Fstud: independent variable (x) – the number of students registered within state faculties; dependent variable (y) – the number of students registered within private faculties.

PFS: independent variable (x) – the number of town population; dependent variable (y) – the number of students registered within these towns.

For these first correlations the data per university centres and branches are analyzed.

Univ: independent variable (x) – the number of state universities; dependent variable (y) – the number of private universities.
Ustud: independent variable (x) – the number of students registered within state universities; dependent variable (y) – the number of students within private universities.
PUS: independent variable (x) – the number of town population; dependent variable (y) – the number of students registered within these towns.
For these last three correlations, data are analyzed only per university centres. The data regarding the branches are included within the university centres to which they belong.

The variables which take into consideration all study centres repartition (respectively universities and their branches) reflect the real situation of the educational offer distribution, but also of the places where the process of higher education takes place. These directly show the localizing of the university services, without taking into account the administrative status of the education system. The data referring only to the territorial repartition generalize the spatial characteristic of the education process, emphasizing the importance of the university centres, compared to their branches.

The correct analysis of the parameters of regression equations shows that the localizing of private universities is somehow more related to the number of state universities within a centre, while the repartition of the faculties demonstrates tendencies of more independence. The thoroughness of the first assertion is demonstrated by the fact that 75% of the private universities depend on the state universities presence and number. In case of faculties, only 62% of the private faculties follow the state faculties, showing that private universities branches are situated in many territorial niches than state universities. On the whole, it results that we face a good correlation in both cases, this reflecting the quite tight connection between variables.

When referring to the size of the university centres (except the branches), the correlation between these, by the property forms, is somehow weaker. Regarded from the faculties' angle, the correlation is much more powerful; thus, only in 40% of cases the private universities size can be explained by means of the size of the state universities.

The relationship between the number of students and the number of town population is relatively powerful in case that both university centres and the universities branches were analyzed, resulting the fact that in 65% of the cases the number of students who study effectively in a town depends on the town size. The coming out of new university centres, inclusively in medium or even small-sized towns, makes the size of the university centres depend on the size of the towns, only in proportion of 40%.

Having as a background these more or less powerful influences, some characteristics of the universities localizing process result. State and private universities try to place their headquarters together, in order to profit from the agglomeration process. This leads to the increase of competition within the university centres, but creates the real opportunity for private universities to use the

professors and even the infrastructure of the state universities (the central university libraries, the hostels, the seminar rooms, the lecture rooms and even the specialized laboratories). At the same time, avoiding competition, state universities try to bring the study basis, respectively the branches closer to the client (potential student).

This localizing is achieved by taking into account the relation state/private in proportion of 55%. In this situation, competition decreases due to the fact that the placement strategy is more flexible. It is based upon the complementarity's principle within the respective study centre. Despite a relative branches "blossoming", sometimes appearing under camouflage, as territorial centres for the open education, the most important part of the activities takes place near the universities headquarters.

As already shown, the universities headquarters are placed in larger towns, with a proper size to provide didactic activities. On the other hand, the branches are placed in smaller towns, being more sensible to the variation of town population number. This explains why the correlation between towns population is weaker in the case of universities and stronger when taking into account the population of the towns where the branches are placed.

Regarding the process of spatial de-centralization of the universities, we can notice some differentiations between state and private universities. Firstly, state universities had two types of challenges to which they had to respond: on the one hand, the financing system, and on the other hand the private universities more and more powerful competition, and especially of the strong private universities. The state education sub-financing conditions led to the modifying of the Education Law no. 84/1995, in the sense of giving the state universities the right to school tuition fees students, over the number of places financed from the state budget. This measure affected the students' recruitment basins for private universities, which recorded, in some cases, a decrease of the number of students or led them to a policy of diminishing the schooling fees.

As the attraction of the tuition fees students from the big urban centres, which are university centres with a tradition has some limits, many of the state universities took a policy of getting the educational offer close to the potential students (Fig. 4).

In this case, the most evident policy of de-centralizing and attracting funds from such sources was held by the "Babeş-Bloyai" University, which set up, after 1998, branches in numerous county residences from Transylvania (Bistriţa, Zalău) or in small and medium-sized towns (Gheorgheni, Sighetu Marmaţiei, Sighişoara, Năsăud, Turda, Dej). At a lower level, the same phenomenon can be noticed in the case of the University of Bucharest, the University of Oradea or the "Lucian Blaga" University from Sibiu. Whether this de-localizing is made within the same historical province or within spaces with direct accessibility, then it can be beneficial, too, but when it happens at long distances, it appears unexplainable (for example, the branch from Husi of the "Lucian Blaga" University from Sibiu).

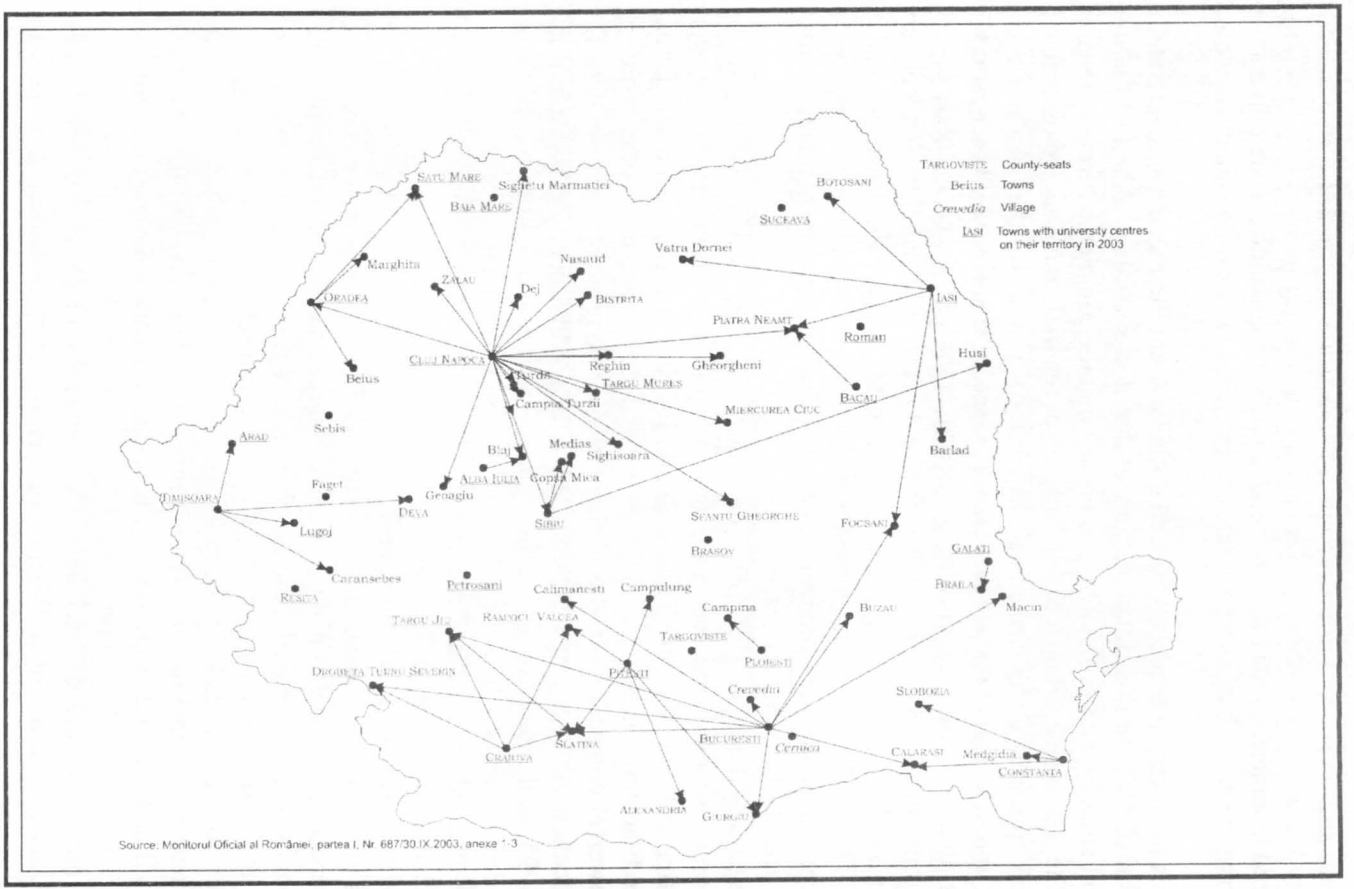


Fig. 4 – Spatial links between universities and their subsidiaries in Romania, Public Universities, Academic Year 2002–2003.

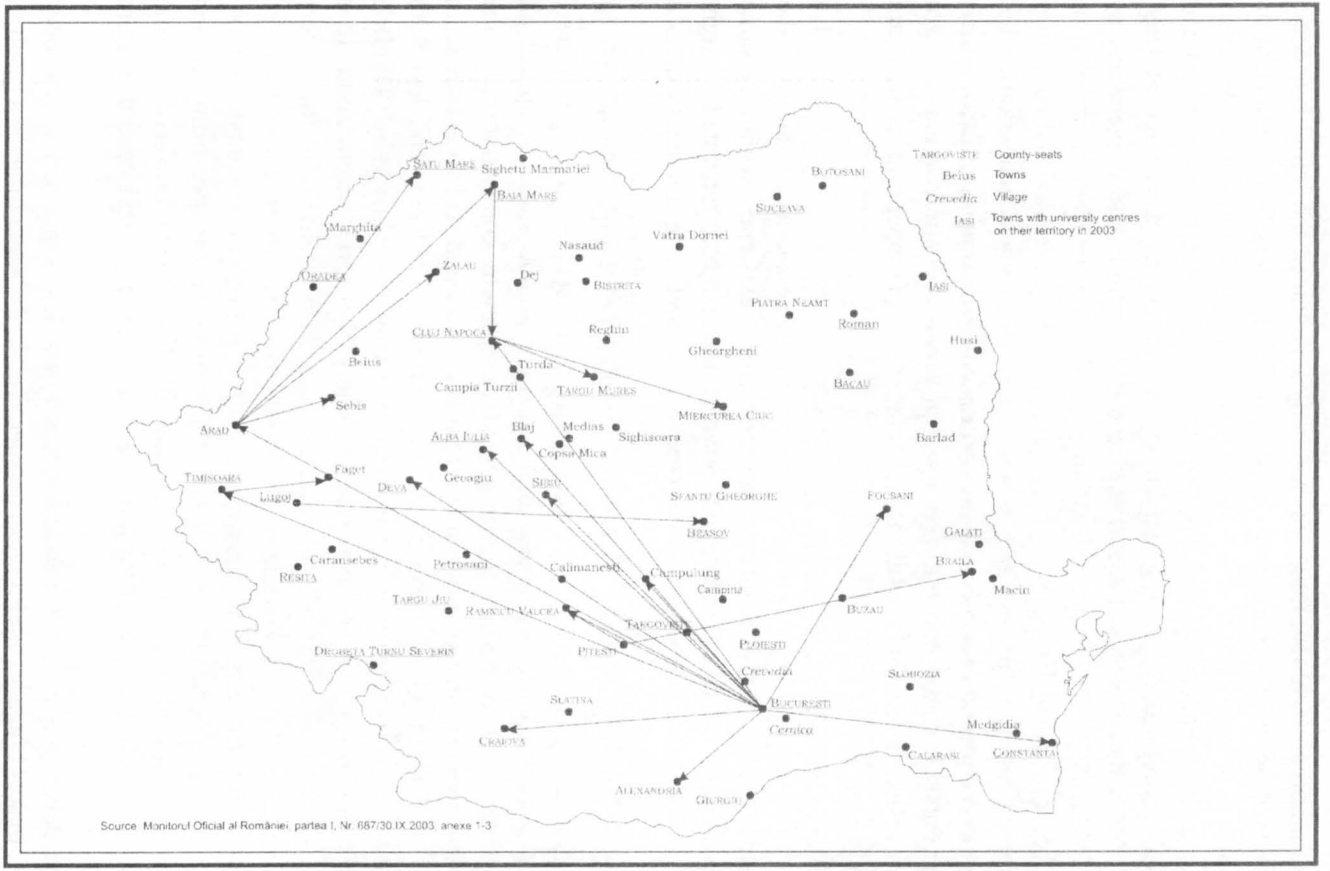


Fig. 5 – Spatial links between universities and their subsidiaries in Romania, Private Universities, Academic Year 2002–2003.

The traditional technical universities mostly maintained the initial branches, which they held before 1990, too (the "Politehnica" University from Timişoara or the Technical University from Cluj-Napoca). In other situations, these detached and made up independent universities (Reşiţa). Under territorial aspect, private universities were localized in big university centres, taking advantage at least initially of the existence of a didactic staff available within state universities, as well as of education spaces, unused within pre-university education, but also in smaller urban centres or without university tradition, where there existed education spaces, rented at low prices and where local authorities encouraged this phenomenon. As a result of some close up and fusion by absorption processes, their number diminished, so that today the strongest private universities, which have got chances to resist national competition, and international competition as well, are placed within big universities towns.

After the accrediting of the 20 private universities, it could be noticed a phenomenon of students' orientation mainly towards these and a diminution of the students who preferred only authorized universities. The existence, within the same university centre, of more accredited private universities, generated a tight competition between these, but also between private and state universities. As a result, the approaching of the educational offer to the potential students made up a priority for some of the private universities. Having in view the big number of branches and "territorial centres" for the education at distance, the "Spiru Haret" University from Bucharest detaches, totalizing over 30,000 students, spread all over the country. This highly contributes to the present configuration of the relationships between private universities from Bucharest and their branches from the territory (Fig. 5). Other universities with territorial branches, and less with other types of university pseudo-locations are the Christian University "Dimitrie Cantemir" from Bucharest and the "Vasile Goldiş" University from Arad. It is surprising the non-existence of such tendencies of de-centralizing in the eastern half of the country, and especially in Moldavia. The lower income of the population within these regions may not constitute a favourable element for de-localizing the higher education activities within private universities from Iasi and from other regions as well. It can be noticed that private universities from Bucharest were mainly oriented towards the central-southern and central western part of Transylvania.

The development of the new education types, and especially of the open education, makes branches multiply, in perspective. At the same time, as a result of competition, the process of fusion of state and private universities and of private universities between them will lead to concentrating the universities headquarters in certain centres.

CONCLUSIONS

The Romanian higher education recorded a spectacular development between 1990–2004, which allowed the leap from a very low value (about 840 students) at continental level of the students number per 100,000 inhabitants, to a value which situates Romania, today, within the superior medium echelon (about 3,000 students/ 100,000 inhabitants).

The spectacular development was due, on the one hand, to the increase of the places financed from the budget (with approximately 80,000 inhabitants), but especially to the development of private higher education, and after 1998 it was due to the state universities facility to school tuition fees students. This last category's contribution is of about 150,000 students, who add to the 135,000 students schooled within private universities. An important role within the decentralizing process of the university education had the coming out of the universities and the others' development, previously set up, but having an insignificant number of students (the universities of Oradea and Constanța). Although the students' average value per 100,000 inhabitants is relatively high, it records numerous differences at regional level. From among these, the disparity between the intra and extra-Carpathian regions imposes, where the value is less than half of the national average. These big discrepancies could be explained by the capital's hypertrophy, which, by its educational offer induces a massive void within all extra-Carpathian regions, except the North-East region. However, an objective analysis obviously shows the absence of a coherent policy of spatial optimization of university services, an extremely difficult access, with very high costs, of the potential students from the extra-Carpathian regions to these services, concentrated in a reduced number of higher education centres. On the whole, it must be noticed that in Romania the localizing of universities depends on the size of the towns where they are situated, which can be beneficial for universities and population, who take direct benefit from this reality. The localizing of the universities in big cities (inclusively the dependence of universities on them) leads us to the idea of a localizing model of French type (before de-centralizing) or rather of Russian type. In contrast with these models there are the German and British types of university localizing within smaller towns or situated around a big city. The explanation can also consist in the fact that the French type, but especially the Russian type of organizing public and state life is characterized by authoritarian central traits, and the Romanian type would be just a continuation of the organizing previous to the year 1990. At the same time, this situation can be only a coincidence and it is about the inertial force of tradition, which imposed the big urban centres of Romania on the position of first rank university centres.

A second characteristic of the Romanian higher education lies in the domination of the state higher education (over 3/4 from the total number of students). The private education, being very young, only partly imposed itself on the educational market. Both in absolute and relative values, state universities surpass private universities and they cannot be directly compared.

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LA RÉPARTITION DES TERROIRS VITICOLES EN ROUMANIE

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Mots clés: *viticulture, oenologie roumaine, zones et régions viti-vinicoles.*

The distribution of the vineyards in Romania. After a historical summary of the previous regionalisations, the authors classify the viticultural plantations (respectively the wineyards with their centers and realms) in 8 viticultural regions, composing the 3 big viticultural zones in Romania: the Intracarpathian, the Pericarpathian and the Danube-Pontic (according to the included map). Such a classification, based on the geographical criterium, allows a more intimate correlation between the natural environment offer and the human capitalization on an ampelographic (wine types) and oenologic (wines and different subproducts) line.

La Roumanie est reconnue comme un ancien et important cultivateur de vigne, ses vins étant appréciés et valorisés aussi bien sur le marché intérieur qu'extérieur. La superficie occupée par les plantations viticoles, au niveau de l'an 2002, était de 242.700 hectares. En 2005, le patrimoine viticole de la Roumanie, qui inclut également les surfaces qui ont été défrichées et vont être replantées, s'élèvent à 254. 400 ha, ce qui représente 1% du territoire du pays et 1,7% de la superficie agricole.

Du point de vue de l'efficacité économique, il faut préciser que le secteur viti-vinicole participe avec 7,6% environ à la valeur de la production végétale, respectivement 4,1% de la valeur de la production agricole totale du pays. Le vin arrive en troisième position dans le cadre des produits agricoles exportés, et plus d'un million de travailleurs gagnent leur pain dans ce secteur économique.

Bien que la superficie viticole se soit rétrécie ces dernières années, la Roumanie continue à figurer parmi les premiers pays viti-vinicoles du monde, où elle occupe la neuvième place. En Europe, elle se situe à la cinquième place comme superficie et la sixième place comme production de vin, présentant les caractéristiques suivantes: 5,4% de la superficie viticole, 3,1% de la production de raisins à vin et 2,9% de la production de vin du continent européen.

La production de vin a été, en 2002, de 5,46 millions hectolitres, dont 3,11 millions hl de vins obtenus de variétés nobles (*Vitis vinifera*) et 2,35 millions hl de variétés interspécifiques (cépages résistants) et hybrides directement productifs. Cette quantité de vin, tout comme les autres produits et sousproduits viti-vinicoles

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sont suffisants pour assurer une consomation interne pondérée, un excédent pouvant même être exporté.

De la superficie totale occupée par des cépages pour raisins à vin, 73,6% sont occupés par des cépages à vins blancs et 26,4% par des cépages à vins rouges. Par conséquent, la principale direction de production est constituée par les vins blancs, suivis par les vins rouges; on produit également des vins mousseux, des vins distillés, des jus de raisins, etc.

*

L'ancienneté et l'ampleur du développement de la viticulture en Roumanie s'explique, tout d'abord, par l'offre du milieu naturel, respectivement la prétabilité de toutes les composantes écologiques à cette plante soustropicale, qui s'adapte très facilement dans les zones tempérées, si l'on satisfait ses prétentions biogénétiques d'espèce héliophile xéro-mézophyte. A l'exception de la zone de montagne, le territoire de la Roumanie répond à ces exigences, surtout si, là et où il le faut, on assure sa protection contre des phénomènes météoriques négatifs, des maladies et des insectes nuisibles.

Evidemment, l'offre écologique aurait pu rester une simple provocation sans effet si les conditions historico-sociales n'avaient pas été réunies, dont l'intuition et la tradition populaires, la nécessité économique de consommation et de commerce, les législations avantageuses promues par les dignitaires laïques et ecclésiaux, sous la coupe et avec le concours des scientifiques. C'est ainsi que l'on a créé cette harmonie bénéfique entre nature-tradition-science-technologie, qui a permis l'extension et la modernisation continue de la viticulture et de l'oenologie roumaines.

Le cadre naturel écologique favorable à l'épanouissement de la vigne est directement ou indirectement influencé par certains facteurs géographiques, tels le **substrat lithologique** et **pédologique** comme principal fournisseur d'éléments nutritifs, le **relief** par l'altitude, la déclivité et l'exposition à la radiation solaire, les **eaux** de surface et de profondeur par leur volume et leur composition, la **végétation** comme source de matière organique pour le sol et moyen de protection antiérosion et, plus spécialement, le **climat**, avec ses mézoclimats et ses microclimats (topoclimats). A côté de la géographie physique, respectivement la nature avec son offre potentielle, la géographie humaine et économique est également impliquée, car l'**homme**, par son travail et son esprit, est celui qui met en valeur ce potentiel. Les deux entités complémentaires peuvent être exploitées dans une perspective géographique et viti-vinicole au niveau le plus général, théorique et applicatif par ce que le titre de cet article indique, à savoir "la répartition géographique zonale et par régions de la viticulture en Roumanie".

*

La répartition régionale de la viticulture dans l'espace roumain a été longtemps dépendante de l'empirisme des masses de viticulteurs praticiens et producteurs

individuels qui, très souvent, ont ignoré les lois et les dispositions, notamment celles qui interdisaient la culture des hybrides directements productifs. Même l'action de délimitation des zones viticoles des années 1936–1939 ne poursuivait pas tant l'extension de la culture de la vigne et la répartition des cépages par régions, que le rétrécissement des plantations viticoles et la localisation de celles-ci sur des terrains impropres à d'autres cultures (R. Odobeşteanu, 1937).

Ainsi donc, la disposition viticole régionale, dans l'acception de l'harmonisation de la vigne avec la nature, est nouvelle, correspondant à la dernière moitié du vingtième siècle, et nous la devons à quelques viticulteurs réputés, dont I.C. Teodorescu (1942), G. Constantinescu (1958, 1978), T. Martin (1968), Şt. Teodorescu (1987), M. Oşlobeanu et al. (1991), Victoria Cotea et V.V. Cotea (1996), C. Târdea et L. Dejeu (1996), mais aussi à quelques géographes de renom, tels N. Al. Rădulescu et al. (1968), I. Velcea (1968), Niculina Baranovski (1961, 1972), V. Tufescu (1974), Sorina Vlad (1977, 1984) et d'autres qui, même s'ils ont abordé la question unilatéralement ou indirectement, ont contribué à la réalisation d'un fond de données qui permettent une répartition zonale plus complexe de la viticulture roumaine.

On peut considérer qu'une telle solution, du moins jusqu'à présent, est illustrée par la récente parution, en 2000, aux Editions de l'Académie Roumaine, d'une ample monographie géo-viti-vinicole, **Les vignobles et les vins de Roumanie** (604 pages), élaborée par un collectif pluridisciplinaire formé de V.D. Cotea, N. Barbu, C. Grigorescu et V.V. Cotea, coordonné par les deux premiers. Ce volume a utilisé une riche bibliographie de référence dans les multiples domaines impliqués dans la problématique viti-vinicole du pays et, d'abord, les connaissances et l'expérience de ses auteurs. La réalisation de l'unité par la corrélation interdisciplinaire de la diversité constitue le principal atout de cette collaboration. En découle l'avantage essentiel de ce livre: la présentation intégrante de la triade nature-cépage-vin pour chacune des unités viti-vinicoles de la Roumanie, quel que soit le niveau taxinomique hiérarchique, ce qui lui a valu de nombreuses appréciations sur le plan national, ainsi que le prix de l'Office International de la Vigne et du Vin (organisation intergouvernementale qui siège à Paris) pour l'an 2001.

L'organisation du texte a été faite sur la base de la répartition par zones et régions viti-vinicoles territoriales et non en fonction du critère typologique (des aires isolées), comme on le faisait auparavant. Le critère territorial géographique s'est imposé par le fait que, à l'exception de la zone montane impropre à la culture de la vigne, l'on rencontre des plantations viticoles dispersées, de diverses dimensions, avec différents cépages et propriétaires, éparpillement sur le fond duquel apparaissent des aires plus concentrées, du type des vignobles et / ou des centres viticoles, insuffisamment délimités spatialement et statués législativement. En vertu de ce critère, à dominante géographique, mais à forte justification viti-vinicole, on a distingué les **zones** viticoles qui suivent, à l'intérieur desquelles on a

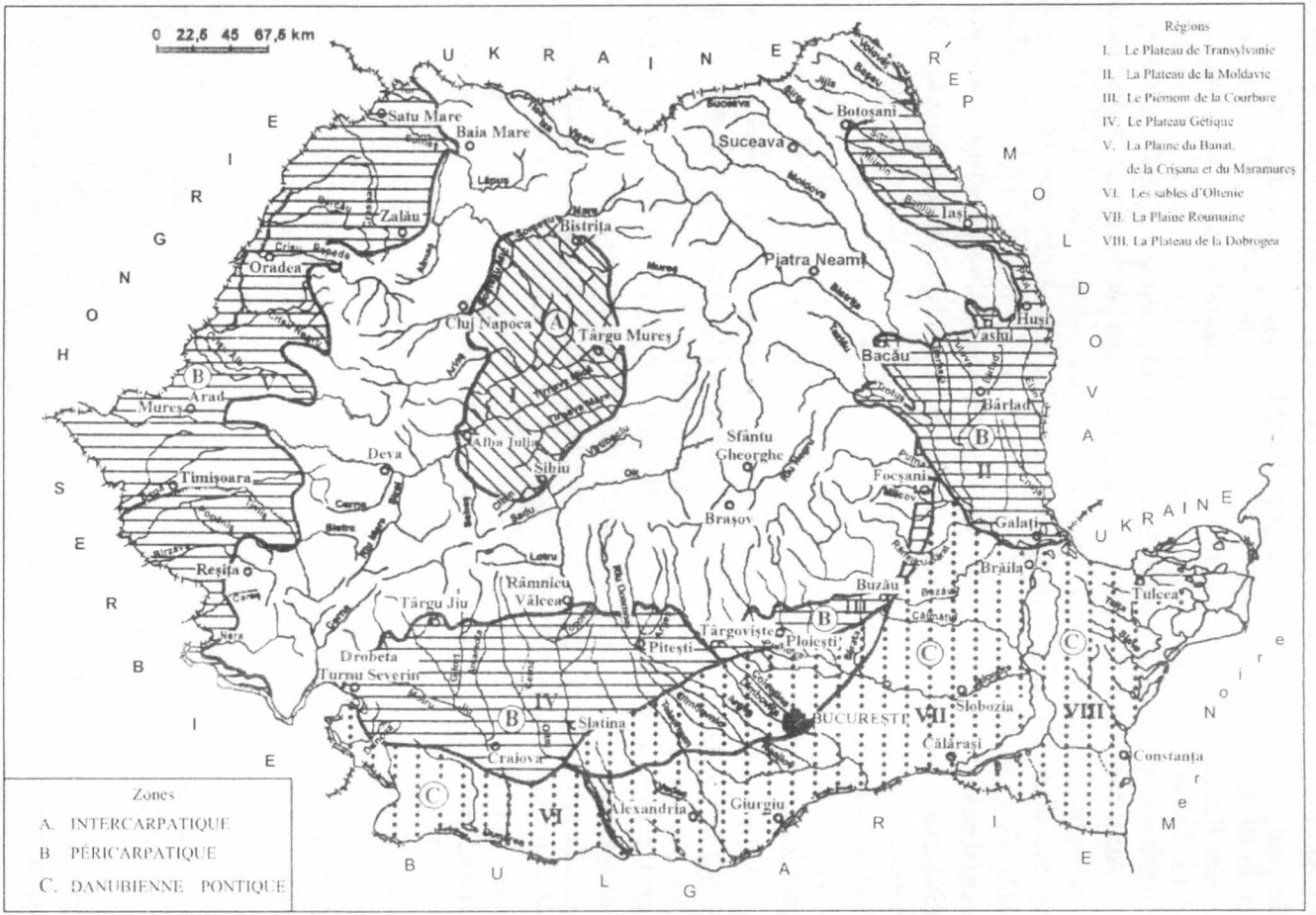

Fig. 1 – La régionalisation de la viticulture en Roumanie.

délimité (par ordre taxinomique sous-hiérarchique) des **régions** viticoles et des **vignobles**, avec leurs **centres**[1] et leurs contrées[2], succintement présentés ci-dessous.

A. LA ZONE VITICOLE INTRACARPATIQUE

I. La région viticole du Plateau de la Transylvanie (avec les vignobles: Târnave, Alba, Sebeş, Apold, Aiud, Lechinţa).

B. LA ZONE VITICOLE PERICARPATIQUE

II. La région viticole du Plateau de la Moldavie (vignobles: Cotnari, Iaşi, Huşi, Dealurile Fălciului, Colinele Tutovei, Zeletin, Dealu Bujorului, Nicoreşti, Iveşti, Covurlui).

III. La région viticole du Piémont de la Courbure des Carpates (vignobles: Panciu, Odobeşti, Coteşti, Dealurile Buzăului, Dealu Mare).

IV. La région viticole du Plateau Gétique (vignobles: Stefăneşti-Argeş, Sâmbureşti, Drăgăşani, Dealurile Craiovei, Drâncei, Severinului).

V. La région viticole des collines et des plaines du Banat (le vignoble du Banat).

VI. La région viticole des collines et des plaines de la Crisana et du Maramures (vignobles: Miniş-Maderat, Diosig, Valea lui Mihai, Silvania).

C. LA ZONE VITICOLE DANUBIANO-PONTIQUE

VII. La région viticole des sables du sud de l'Olténie (vignobles: Dacilor, Calafat, Sadova-Corabia).

VIII. La région viticole des terrasses du Danube (le vignoble Greaca).

IX. La région viticole des centres indépendants de la Plaine Roumaine (centres viticoles: Drăgăneşti-Olt, Furculeşti, Mavrodin, Urziceni, Sudiţi, Ruşetu, Cireşu, Însurăţei, Jirlău, Rîmnicelu).

X. La région viticole du Plateau de la Dobroudja (vignobles: Sarica-Niculiţel, Istria-Babadag, Murfatlar, Ostrov).

Pour chacun des vignobles mentionnés (le vignoble étant considérée comme unité étalon dans la taxonomie nationale et mondiale), on a maintenu, afin de faciliter des études comparatives, le même schéma descriptif: historique, position géographique, milieu naturel (substrat lithologique, relief, eaux, climat, végétation, sols), cépages de vignes et vins.

[1] *centre viticole* = unité territoriale indépendante ou, habituellement, subordonnée à un vignoble; il est caractérisé par des conditions écologiques particulières, des cépages viticoles et des sortiments vinicoles distincts.

[2] *contrée viticole* = unité territoriale élémentaire dans l'espace d'un centre viticole, la plus homogène du point de vue écologique et avec une certaine spécificité des produits viti-vinicoles. En Roumanie, le terme "contrée" comporte des acceptions différentes: orographiques, phytogéographiques, agricoles, y compris viticoles.

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Après la parution du livre, l'élaboration d'une variante plus brève, traduite en plusieurs langues de circulation internationale, dans le but de promouvoir l'image de la viticulture roumaine a l'étranger s'est imposée et nous en avons profité pour faire quelques rectifications au schéma viticole initial. Nous avons souhaité corriger ainsi les délimitations héritées des diverses répartitions antérieures, qui forcent la réalité géographique et, partant, celle viti-vinicole. Deux de ces rectifications sont importantes: a) les régions V et VI de l'Ouest du pays devraient être envisagées ensemble, sous l'appellation de "la région viticole Banat-Crisana-Maramures", unification justifiée par l'existence du même substrat litho-pédo-géomorphologique et des mêmes caractéristiques bioclimatiques, spécifiques aux collines et aux plaines de l'Ouest; b) les régions viticoles VIII et IX du Sud-Est du pays se prêtent à l'unification en une seule région, celle "de la Plaine Roumaine", à cause de l'identité du substrat loessique, de la quasi-horizontalité du relief, du biopédoclimat spécifique au continentalisme est-européen et à l'insolation sud-européenne.

Par conséquent, ces quelques modifications conduisent à la structure taxinomique actuelle, qui comprend 3 zones et 8 régions viticoles (voir la carte) qui englobent les 39 vignobles avec leurs centres viticoles (au nombre de 137), auxquels s'ajoutent les 34 centres indépendants.

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L'opération de répartition et de régionalisation géographique de la viticulture roumaine permet la formulation d'une généralisation à caractère de lois, pour une bonne part déjà connues ou au moins envisagées, concernant la distribution de la vigne sur le territoire du pays et ses rapports à l'environnement.

1. Si l'on exclut la zone montagneuse (de plus de 500–600 m altitude) et l'extrémité nord du Plateau de la Moldavie, 65% de la surface de la Roumanie est apte pour la culture de la vigne.

2. Sur les trois zones géo-viticoles: Intracarpatique, Péricarpatique et Danubiano-Pontique, celle des collines et des plateaux péricarpatiques est la plus étendue et présente les meilleures aptitudes pour la viticulture. C'est la zone avec les superficies viticoles les plus étendues, avec la plus grande production pour l'unité de surface et avec les vins les plus renommés.

3. Tous les facteurs du milieu ont contribué (par leurs traits individuels et leur complémentarité) à la réalisation d'une ambiance éco-viticole d'exception, reflétée dans la qualité des produits, surtout des vins, tellement appréciés sur le plan local, régional, national et international. Mais, le facteur qui s'impose souverainement est le **climat**, dans toutes ses composantes et, notamment, par son potentiel héliothermique, qui satisfait les exigences de cette plante héliophile. Les autres facteurs sont subordonnés de manière positive ou négative, élévant ou baissant la

note de bonification du climat, ou créant la possibilité de l'adaptation des différents cépages aux variations de celui-là.

4. Le fait que la production viti-vinicole dépend, premièrement, du climat (plus particulièrement de la radiation solaire, de la somme des heures de brillance du soleil et de la somme des degrés thermiques dans la période active) explique les étroites relations qui existent entre la qualité et la quantité de la production, d'une part, et la quantité de la production avec la variation zonal-latitudinale et altitudinale du climat général, de l'autre, y compris les nuances régionales et locales (mézoclimatiques et microclimatiques). De ce point de vue, l'excellent travail ***L'Oenoclimat de la Roumanie*** (1987), signé par le prestigieux collectif formé par Şt. Teodorescu, A. Popa et Gh. Sandu, ainsi que d'autres sources d'information, sélectionnées et soumises à la généralisation géographique, ont conduit à l'élaboration des considérations qui suivent:

a) Dans les régions tempérées à nuance boréale, respectivement les plus fraîches et les plus humides des latitudes les plus nordiques du pays (plus de 46–47) et des altitudes collinaires de 300-500 m, on produit presque exclusivement des vins blancs, de table pour la plupart. Dans certaines contrées viticoles, dans des bassins ou des niches abritées et bien ensoleillées, on obtient également des vins de qualité supérieure, notamment secs ou demisecs, parfois demidoux et doux, à appellation d'origine contrôlée (AOC). Ce sont, en général, des vins fins, savoureux, discrètement acidulés, qui vieillissent bien, réalisés spécialement avec ou à base de Feteasca blanche, tels ceux de Halmeu-Seini (Maramureş), Sighetul et Şimleul Silvaniei (les collines de Silvania), Lechinţa, Dej, Teaca, Sibiu (le Plateau de la Transylvanie), Polovragi, Jiblea-Călimăneşti, Curtea de Argeş, Cricov, etc. (les Sous-Carpates).

Les conditions éco-viticoles générales ne sont pas trop généreuses: des sols à prédominance acide et à bilan hydrique annuel excédentaire, un climat avec des Tm = 8–9°C, des Pm = 600–800 mm, un potentiel hélio-thermique faible à modéré, mais avec des topoclimats suffisants, dont les paramètres deviennent favorables à la maturation complète des raisins et des accumulations de composantes qui influent de manière bénéfique sur la qualité.

b) Dans les régions typiquement modérées ou continentales des latitudes médianes du pays (plus fréquemment entre 45° et 47° latitude nordique) et avec des altitudes collinaires et des plaines hautes (150–300 m), on rencontre les vignobles les plus nombreux (70% environ), les plus grands et les plus renommés de Roumanie, avec les vins blancs les plus médaillés, secondés ou pas par les vins rouges. Ce sont des vins équilibrés sur le plan compositionnel et produits dans une palette qualitative extrêmement variée, y compris de vins de table, mais avec une nette prédominance des vins de qualité, depuis les secs-demisecs aux demidoux et doux, très souvent avec appellation d'origine contrôlée (AOC) et même avec des niveaux de qualité (AOCC).

En ce sens, les meilleurs sont les vins des vignobles de la Plaine de la Moldavie (Cotnari, Iaşi, Huşi, Nicoreşti), ceux du Piémont de la Courbure (Panciu,

Odobeşti, Coteşti, Dealu Mare), ceux du Plateau Gétique (Stefăneşti-Argeş, Drăgăşani, Craiova), ceux des Collines et des Plaines du Banat-Crisana (Teremia, Buziaş, Miniş-Maderat), ceux du Plateau de la Transylvanie (Târnave, Alb, Aiud, Sebeş), ceux de la Dobroudja du Nord (Niculiţel) et Centrale (Murfatlar). Parmi ceux-ci, d'une réputation tout à fait particulière jouissent les vins: Grasse et Feteasca blanche de Cotnari, Feteasca noire de Uricani-Iaşi, Busuioaca de Bohotin-Iaşi, Zghihara de Huşi, Galbena de Odobeşti, Pinot gris et Chardonnay de Murfatlar, Sauvignon de Valea Călugarească, Tamâioasa roumaine de Pietroasa, Feteasca noire et Cabernet Sauvignon de Tohani, Cabernet Sauvignon de Sâmbureşti, Cadarca de Banat, Mustoasa de Maderat, Feteasca royale de Târnave, Muscat Ottonel de Crăciunel et de Jidvei, Traminer d'Alba et d'autres, c'est-à-dire ces vins uniques, qui expriment en un tout la vocation native du vignoble, la nature biologique du cépage, la tradition et la technologie spécifique.

Une telle richesse de cépages et de variétés vinicoles s'explique par la grande diversité du milieu naturel, sur fond de substrat lithopédologique neutre à faiblement acide et d'un relief à dominante collinaire, sous l'empire d'un climat caractérisé plus fréquemment par des Tm = 9-10°C, des Pm = 500-600 mm et un potentiel héliothermique élevé, climat qui favorise la complète maturation des raisins, l'installation dans les années d'exception d'une lie noble, la concentration en grains des sucres, des arômes et d'autres composantes de valeur qui complètent les qualités sensorielles des vins.

c) Les régions tempérées plus chaudes, de nuance subtropicle, des zones du Sud de la Roumanie (le plus souvent au-dessous du parallèle 45° latitude nordique et à des altitudes inférieures à 100–150 m) se caractérisent par la prédominance des vins rouges et des quantités de raisins de table qui satisfont non seulement la consommation interne (comme dans le cas des zones sus-mentionnées), mais produisent aussi d'importants surplus destinés aux marchés extérieurs. Certes, subordonnés aux vins rouges, on trouve également des vins blancs ou rosés. Du point de vue qualitatif, dominent les vins de consommation courante mais, dans les années qui remplissent les conditions de haute favorabilité bioclimatique et dans les conditions d'une technologie adéquate, on obtient aussi des vins AOC, dont quelques-uns jouissent d'une réputation bien méritée, tels Babeasca noire de Nicoreşti, Feteasca noire de Dealu Bujorului, Merlot d'Istria-Babadag, Cabernet Sauvignon de Medgidia, Noir dense d'Oreviţa-Severin, Cadarca de Recaş, etc.

Ce qui est typique pour les produits de cette troisième zone, c'est la résultante de l'adaptation des cépages de vigne au substrat pédologique, généralement fertile du point de vue géochimique, mais avec une faible réaction acide et un bilan hydrique annuel légèrement excessif à l'ouest (luvisols bruns-rougeâtre), à réaction neutre à faiblement alcaline et bilan hydrique déficitaire à l'est (sols tchernozémiques), à côté de psamosols sur les sables du sud de l'Olténie. Egalement décisif reste, cependant, le climat chaud (Tm = 10,5–11,5°C), avec le potentiel héliothermique le plus élevé du pays. L'ambiance litho-pédo-climatique et donc les produits viti-vinicoles sus-mentionnés sont caractéristiques pour le sud de la **Plaine du Banat**,

pour le sud et le sud-est de la **Plaine Roumaine**, l'extrémité sud du **Plateau de la Moldavie**, les parties centrales et sudiques de la **Dobroudja**.

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La répartition zonale géographique viti-oenologique d'en haut est une réalité parfaitement justifiée du point de vue naturel à ces niveaux supérieurs, même si elle a été conçue comme résultante d'une opération d'abstractisation, de généralisation inhérente à des espaces aussi étendus et non homogènes, donc de sacrifice de nombreux détails. Egalement justifiée est l'apparente contradiction entre la répartition viticole à prédominance concentrique, à peu près conforme à la disposition concentrique des unités géographiques majeures imposées par le relief, et la distribution zonale oenologique à dominante latitudinale imposée par le climat, contradiction apparente, vu que les deux types de répartition interfèrent aussi bien spatialement que sur le plan productif, viti-vinicole.

Aux niveaux inférieurs, concrets, de la hiérarchisation, respectivement les vignobles, les centres et les contrées viticoles, où le degré d'homogénéisation des conditions naturelles est nettement élevé, on constate une grande diversité de cépages, qui "suffoquent" partiellement ceux traditionnels, adaptés au milieu et porteurs de vins qui sont entrés dans la légende. Nous ne sommes pas contre les tentatives scientifiques d'introduire ou de créer de nouveaux cépages mais, dans bon nombre de cas, on s'y est pris de manière chaotique, à cause du désir de certains viticulteurs de s'enorgueillir du plus grand nombre de cépages sur leur territoire. On est ainsi arrivé à de véritables mosaïques qui ignorent le milieu, qui forcent le code génétique spécifique du cépage, défient la législation en vigueur et, surtout, compromettent les appellations d'origine établies par la tradition et l'expérience, comme exprimant les rapports optimum entre le potentiel écologique, ampélographique et oenologique. Ce processus non souhaitable est également amplifié par des producteurs individuels qui, insuffisamment éclairés, préfèrent planter des hybrides directement productifs (moins prétentieux par rapport au milieu, faciles à entretenir, résistants aux maladies et aux insectes nuisibles). Il faudrait des interventions plus fermes au niveau de l'état ou du secteur pour l'adaptation aux exigences actuelles du marché et, surtout, pour le respect des lois, des dispositions et des recommandations dans cet important domaine de l'économie nationale, y compris dans le sens d'arrêter la tendance à remplacer les vignobles par d'autres cultures.

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Les conclusions qui découlent des répartitions viti-vinicoles auxquelles on a fait référence sont des réalités vérifiables scientifiquement, ce qui ne veut pas dire qu'elles ne peuvent être ajustées ou complétées. Nous constatons, toutefois, que dans l'approche des rapports entre le milieu géographique, d'une part, avec les

cépages et les vins, de l'autre, il existe encore des aspects insuffisamment élucidés. L'un d'entre eux, point négligeable, est constitué par le sol et son rôle dans l'équation sol-cépage-vin, rôle qui a été traité uniquement du point de vue pédogéographique.

Dans les travaux de spécialité et dans le langage courant viticole ou oenologique, on utilise fréquemment le syntagme *sol-climat* ou *conditions pédoclimatiques*, mettant sur le même plan ou presque la dépendance de la viticulture, et même des propriétés du vin, du sol et du climat. Quant à la dépendance du climat, celle-ci est indiscutable, soit directement, par ses composantes héliothermiques, pluviométriques et aérodynamiques, soit indirectement, par les nuances introduites par le relief, l'hydrographie et la végétation. Le rôle du sol ne peut être équivalent à celui du climat, d'autant plus que le sol et ses caractérisiques sont étroitement conditionnés par le climat et donc difficilement dissociables analytiquement. Cependant, quelque influence que le sol puisse subir de la part du climat, tout comme de la part des autres facteurs du milieu, une fois formé comme entité distincte, il participe à la croissance de la vigne par sa composition (y compris en fournissant des substances nutritives) et par ses propriétés physiques, chimiques, biologiques, etc. Mais toutes les plantes enracinées dans ce sol bénéficient d'une telle participation. Une exigence plus particulière de la vigne quant au sol se réfère à la texture de celui-ci. On sait que la vigne préfère une texture moyenne ou moyenne-grossière (argileuse, argileuse-sablonneuse, sablonneuse, sablonneuse-rocheuse), donc perméable à l'air, l'eau, les racines. Il se développe plus difficilement sur une texture pierreuse, à cause de l'extrême perméabilité à l'eau (la sécheresse édafique) et la difficulté à extraire des éléments nutritifs de ces fragments durs, mais surtout sur une texture à granulométrie extrême, argileuse, qui retient beaucoup d'eau, jusqu'au gonflage dans les périodes humides, empêchant la pénétration de l'air et favorisant l'installation des maladies cryptogammiques, pour que pendant les saisons sèches, il durcisse et se fende, affectant le système radiculaire. Certes, le chimisme extrême du sol est également nocif, de même que l'abondance de calcium, fer, potassium, sodium, souffre, chlore, azote, etc., ou l'excès de sels trop acides ou alcalines, mais ce genre de situations peuvent devenir restrictives pour d'autres plantes de cultures également. A partir de là, certains chercheurs ont des réserves quant à la contribution du sol à la réalisation de produits viti-vinicoles de qualité. Certains d'entre eux, dont M. Popescu-Spineni (1945), affirment même que "les sols les plus ingrats sont excellents pour la vigne". Nous ne pouvons être d'accord avec de telles assertions négativistes. Elles doivent être réconsidérées en ce sens que la vigne n'est pas indifférente ou réfractaire aux sols fertiles (bien que le degré de fertilité soit différemment apprécié d'une plante à une autre) mais que, le plus souvent pour des raisons économiques, elle est poussée vers les terrains inhospitaliers d'autres cultures agricoles, comme par exemple sur les coteaux des

collines ou sur des aires sablonneuses, sablonneuses-pierreuses. Nous estimons qu'une telle mesure est juste, d'abord pour faire place aux cultures céréalières plus exigeantes vis-à-vis du sol, tandis que la vigne met en valeur avec une plus grande efficacité économique les versants plus escarpés et les terrains sablonneux; deuxièmement, parce que la vigne a (tout comme l'arboriculture et la sylviculture), par son enracinement profond, a un rôle stabilisateur, antiérosion (hydrique sur les versants, éolien sur les sables). Ainsi donc, le rôle du sol dans la viticulture ne doit être ni minimisé, ni exagéré. Il est du même ordre que les autres facteurs physico-géographiques (pierre, relief, eaux, végétation), qui diversifient l'influence du climat, unanimement reconnu comme facteur décisif. Un plus pour le sol et qui plaiderait (ne serait-ce qu'empiriquement) en faveur de la formule factoriale sol-climat serait le fait que celle-ci est une expression de tous les facteurs du milieu, y compris le climat, qu'elle représente synthétiquement et de manière corrélative dans les rapports avec la viticulture et ses produits. Pour l'instant, il est difficile de délimiter quantitativement et qualitativement la dépendance ampélographique et oenologique de celle pédologique.

Une preuve en ce sens est également le fait que, malgré nos efforts, nous n'avons pas réussi à établir une causalité indiscutable entre la diversité typologique ou physico-chimique des sols et certains cépages ou vins. Comme ni la littérature nationale, ni celle internationale n'offrent de réponses claires, c'est encore une énigme pourquoi sur le même sol et au même endroit poussent des cépages différents et que l'on obtient aussi bien des vins blancs et rouges, des vins secs et des vins doux, fruités ou pas, etc. On peut en déduire seulement que le principal responsable est le code génétique héréditaire de chaque variété de vigne (obtenue par sélection naturelle, non artificielle), tout au plus filtrée par le climat (surtout par la photosynthèse) et probablement nuancée par les autres facteurs du milieu environnant, dont le sol.

La conclusion serait que, si aux niveaux généraux de répartition zonale, on peut établir des rapports géo-viti-vinicoles clairs, de nombreux détails de ces rapports restent à être déchiffrés par les gens et les technologies de l'avenir.

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RURAL SETTLEMENTS IN ROMANIA. DEVELOPMENT RESTRICTIVE AND STIMULATIVE FACTORS

LILIANA GURAN-NICA[*]

Key words: development restrictive factors, development stimulative factors, rural settlements, Romania.

Facteurs restrictifx et générateurs du développement des établissements ruraux de Roumanie. Facteurs politiques et économiques. Le concept de développement des établissements humains a connu une évolution continuelle par rapport aux réalités du moment donné et au domaine qui l'utilise. D'un approche purement économique on est arrivé, ce dernier temps, à un approche de type complexe, puisque le développement est perçu comme un phénomène durable. Pour le développement durable d'un système c'est le contexte qu'il s'y trouve qui compte. Un contexte qui comprend aussi bien des facteurs générateurs que restrictifs du processus de développement. Leur connaissance, comme éléments déterminants de la direction et du rythme du développement, est essentielle. Les informations obtenues à la suite de l'analyse respective peuvent clarifier la situation actuelle et le potentiel du développement ultérieur du système. Les éléments components du système national sont les facteurs déterminants du développment du sous-système d'établissements ruraux et de celui régional. Leur caractère, restrictif ou générateur de développement des facteurs respectifs, est difficile à déterminer. Ceux-ci se trouvent, à leur tour, dans un processus évolutif, puisqu'ils peuvent passer, à travers le temps, d'une catégorie à l'autre ou cumuler ces deux caractéristiques par rapport au contexte politique et économique régional, européen ou mondial. A travers le concept de développement durable on considère comme facteurs déterminant du développement rural el régional aussi bien les facteurs politiques, économiques et socieaux que ceux naturels. L'étude se propose d'aborder seulement les facteurs politiques et économiques qui ont influencé d'une manière décisive, le développement des établissements ruraux en Roumanie cette dernière décennie.

Development of human settlement is a concept steadily progressing in terms of momentous realities and the domain it is referred to.

The special attention which world states had paid to economic evolution in the past century, made this concept be approached and interpreted primarily from an economic standpoint. So, development is viewed as growth achieved through a succession of processes, as progress attainable in time. The economic theory assumes that development is a stagewise evolutive process in which the first stage is marked by the closed, family-type economy (the producer is identified with the

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consumer); a second stage features by a far more complex urban-type economy; and finally, a third stage, of national economies, characterized by the market system (Greenwald, 1984)[1].

The economic approach to the development concept has dominated also the studies of human settlements so that the geographical component and the complexity of man-environment relations have long been ignored.

The second half of the 20thcentury has produced lots of new concepts e.g. *balanced and harmonious development of the territory and of settlements, multilateral development, ecodevelopment* and most importantly, the comprehensive modern concept of *sustainable development* (Fig. 1).

This manysided concept conceives evolutions as the interaction of four systems: economic, human, environmental and technological. For the model to be operational, it is necessary that sustainability should become the hallmark of all of a system's component parts. In the case of rural settlements, sustainable development must target all their components: energy, agriculture, industry, etc. and obviously the natural ones.

The context within which a system acts at a certain moment, inclusive of the factors that generate, but also restrict, its advancement, are of crucial importance for its sustainable development.

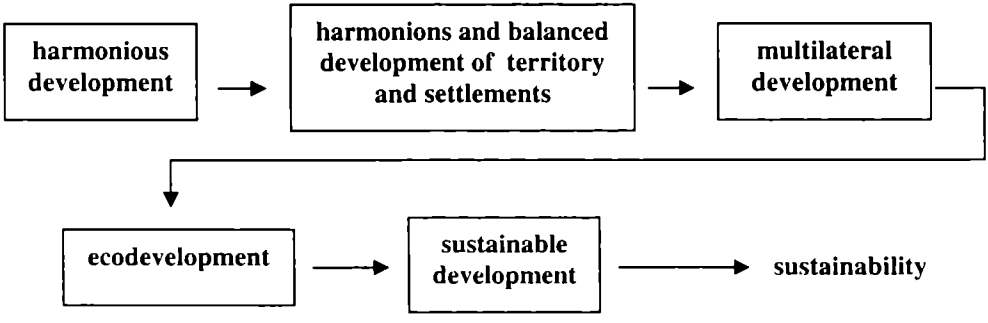

Fig. 1 – Content and evolution of the development concept.

Therefore, a good knowledge of these determinant factors is essential in shaping the direction and rate of development.

The information gathered by studying them could help elucidating the system's present situation and its potential for future development.

Taking the system of rural settlements and the regional system to be sub-systems of the national system, the component elements of the national system would represent the factors determining the development of its sub-systems (Fig. 2). Establishing to what extent these factors are restrictive or stimulative for development is a fairly difficult task, because they themselves are undergoing

[1] Vaselina Urucu (coord.), Revigoration of the Romanian village within complex geographical areas. Case-studies in Buzău County (in Romanian), under Romanian Academy Grant No. 87, 1998.

evolution, passing in time from one category into another or combining in terms of the regional, European or global political and economic context.

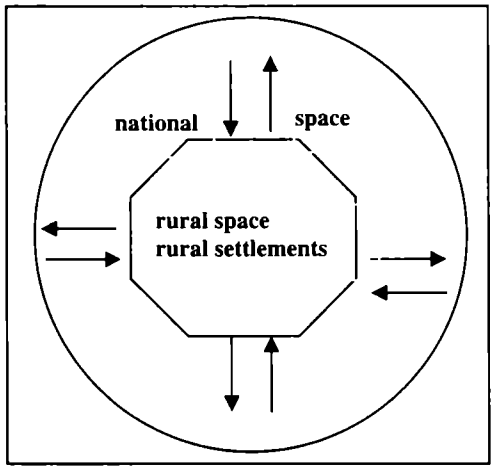

Fig. 2 – Role of development of restrictive and stimulative factors.

In the light of the sustainable development concept, rural and regional progress is determined by political, economic, social and natural factors.

POLITICAL FACTOR

The political factors are part and parcel of the national system, they play an essential role in regional or local evolution at a given moment, and intervene into a system in a permanent and definitory manner. So, in terms of these factors and their actions, the system will follow one line or another. The political can act both as generative and restrictive factor for the national, regional and local develompent plan. One has but to look at the East-European countries' evolution before and after the year 1989 to acknowledge it. The main tool used by the political factor is legislation, by way of which one chooses the direction and path of economic and social evolution, in other words, the parties in power impose their economic policies.

In 1989, Romania, like the other Central and Southeast European countries, experienced the powerful shock of transition to a new political system. As a result, radical changes in the complex national system took place on all levels. Transition from a highly centralised economy to the market system proved to be a long-lasting and very complicated process. The economic and social reform in Romania, and the present situation at all macro-medium and micro-territorial levels show the consequences of the economic and social policies pursued under the legislation of the past eleven years.

The regional and local areas, the rural ones in this case, withnesse sweeping changes when the first laws came into force. Out of the host of normative acts issued after 1989, the Land Law (18/1991) and other privatization laws passed in 1991–1992 (no 36/1991, 58/1991 and 46/1992) had a powerful impact on the rural system, in general and on the local one, in particular.

The provisions of the Law No. 18/1991 secured the resumption of private property over the land[2], a major step forward in the process of privatization. The declared aim was to allot the land to its former owners or to their successors. The former restitutable properties were to be no larger than 0,5-10 ha arable equivalent.

Most of the reappropriated land was taken from collective farms, some of it from the property of town halls and of state farms.

The land reform was to benefit nearly five million people entitled to receiving property certificates for the reappropriated parcels. However, until Aprilie 1998, only 3.9 million (~ 80%) actually received those parcels. The dissolution of the 3,588 collective farms and of the 132 Intercooperative Economic Associations that had formed the comparative sector in agriculture, holding 63% of the total agricultural land (Gavrilescu, 1998) was a means of privatising this sector through decollectivization.

The laws passed in the very next stage were to sustain the process and supplement (Law No. 18/1991), or slove property issue and lay down rules and regulations for the functioning of agricultural-related firms and associations (Law No. 36/1991), for the privatization of trading companies (Law No. 58/1991), stimulate the rights of former owners running joint stock companies, as well as the reorganization and functioning of the former state enterprises as trading companies (Law No. 46/1992). The year 1997 marked a new political stage with impact on the rural space. The amendaments made to the previous legislation were intended to encourage the development of private farms and the creation of a framework for a land market to become operational in Romania. Thus, Law No. 169/1997, rose the number of restituted hectares of agricultural terrain to 50 and of forest land to 30. Law No. 54/1998 ruled that a family estate could englobe up to 200 ha, also stipulating the right of financial transactions between physical persons. Law No. 1/2000 (the Lupu Law) confirmed the upper limit of restitutable estates to 50 ha, but reduced the possession of forestland to 10 hectares.

The results of implementing the above laws, as tools of the political will, were to be felt in the coming years, when a new property structure and the afferent relations would be put in place. The specialist literature[3] mentions the existence of three forms of property in the following proportions: *private property* – 85% of agricultural land as against 14% in 1989, *state property*, steadily shrinking to a mere 5–6% (after Law 1/2000 came into effect), *public property*, representing 15% (Fig. 3). At the same time

[2] Although the collective farm system vouched that land was community property yet the Romanian peasant could not dispose directly of the land that formally belonged to him.

[3] Violeta Florian, M. Popa, V. Pamfil, Marioara Rusu (2000), *Land Fragmentation and Potential Economic and Social Impacts on Rural Society in Romania*, Scientific Association for Rural Development, Bucharest (mss).

the agricultural forms of exploitation kept diversifying as follows: *agricultural companies* with juristic person status (about 3,500, holding 1.4 million hectares in 1999). Their managerial structure resembled greatly that of the former collective farms, except that they no longer received directives from the state; *family associations* (about 6,200, with 869 thousand ha in 1999) have not juristic person status but are registered (table 1); *family exploitations* (individual smallholdings) englobe 4.1 million units (households), with 68% of the total agricultural land. This traditional form of rural activity, despite being also the dominant form of organization, produce but for subsistence, lack of money and inadequate working facilities standing in the way of efficiently; *trading companies* are the direct succesors of the former state farms, but with a modified organization and managerial structure. In 1999, they held some 11% of all the agricultural land, and functioned partly in a centralised regime (***, 2000).

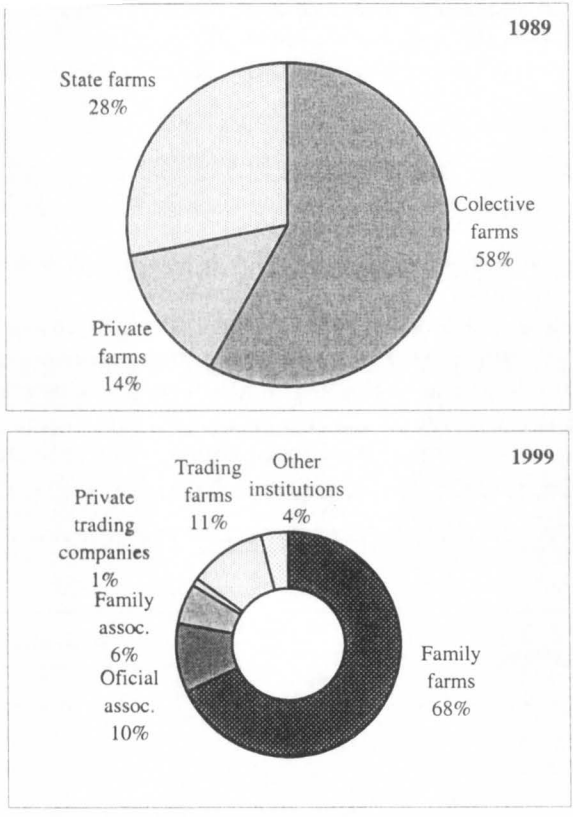

Fig. 3 – Farm structure in Romania, ratio per total agricultural land (source OECD, 2000).

So, having established a new propertly structure to meet present and future evolutions in line with the EU pattern, the above laws are to a certain extent stimulative factors of rural development.

On the orher hand, the current legislation acts also restrictively, favouring rather industrial-type units to the detriment of private or family exploitations. Just because of this legislation, family farms are decapitalised, as seen in deficient fixed assets, poor use of fertilizers, dysfunctions in the exploitation of the irrigation systems and no funds to capitalise.

All these are the consequence of the kind of economic policy pursued by the governing forces, and that has a positive or negative impact on the reform itself. One of the declared aims of the former government's policy was to revitalise the reform in agriculture by creating a favourable economic framework. An important point in their programme was "to extend and strengthen the family exploitation" as the most adequated social structure for agricultural production, capable to solve the crisis in this sector (Gavrilescu, 1998).

Attaining this goal means eliminating technological backwardness, as well as improving and developing the legal framework of privatization and marketing in agriculture. What has been said so far highlights both the difficulties of Romanian agriculture all these years and the development restrictive elements.

ECONOMIC FACTORS

The economic factors capable to generate or restrict rural development at regional and local levels are: development grade, evolution of the national economy and of the agrarian economy, in particular.

A first phase in the process of transition from the centralised system to the market economy featured by recession of varying intensity and scope in the countries of Central and Eastern Europe. Some of these states proved successful in overcoming the critical moment, starting on the path of economic growth; others, continued the downslide to this day. These evolutions are reflected by fluctuations in the inflation rate (Table 2).

Table 1

Structure of agricultural land in private property 1993–1999

Year	Agricultural associations (juristic persons)				Family associations (not juristic person)				Individual farms				Total
	No (thous)	Thous. ha	Average size ha	% of total area	No (thous)	Thous. ha	Average size ha	% of total area	No (thous)	Thous. ha	Average size ha	% of total area	Thous. ha
1993	4.26	1910	448	17.4	13.77	1763	128	16.0	3420	7333	2.14	66.6	11006
1994	3.97	1771	446	15.8	13.74	1537	112	13.7	3578	7905	2.21	70.5	11213
1995	3.97	1773	436	15.2	15.91	1596	100	14.0	3597	8052	2.24	70.7	11381
1996	3.76	1752	466	15.2	15.11	1440	95	12.5	3625	8348	2.30	72.3	11540
1997	3.91	1714	438	14.8	9.49	1000	105	8.6	3973	8897	2.24	76.6	11611
1998	3.58	1558	435	13.3	7.17	950	132	8.1	3946	9182	2.33	78.5	11690
1999	3.57	1429	399	11.5	6.26	869	139	7.0	4119	10083	2.40	81.5	12381

Source: ***, 2000)

Table 2

Rate of inflation in Central and East-European countries

Year/country	1990	1991	1992	1993	1994
Romania	4.5	228	120	300	62
Hungary	28.4	35	20	...	19
Bulgaria	26.3	334	65	...	121
Czechoslovakia	10	58	10-12	...	C.R.[1]
					10
					S.[2]
					13
Poland	586	70	50	...	32
Russia	...	...	140	...	...

After D. Gavrilescu, 1998, p. 14
[1] Czech Republic; 2. Slovakia

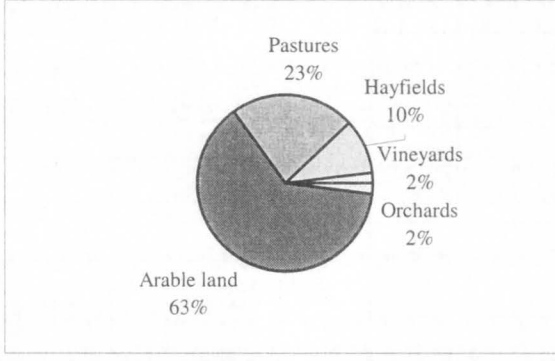

Fig. 4 – Structure of agricultural land.

Romania lists in the second category, due primarily to the "inconsistent polices" pursued by the post-1989 governments, a reality mirrored by the decreasing values of all macro-economic indicators (Tabel 3).

The process is ongoing, with brief speels of increase. As a consequence, the offer-demand ratio kept degrading, triggering the liberalisation of prices, absence of national currency (*leu*) convertibility, which in its turn spiralled inflation.

And agriculture made no exception from the general economic evolution. The effects of the Law No. 18/1991 were: restructuring of the main categories of agricultural land, decrease of production and efficiency and the massive diminution of livestock. Eight years after the Law No. 18 came into force, the land use picture changed dramatically in that pasture lands and hayfileds increased by 13% and 7%, respectively, vineyards by 2%, while arable areas and orchards dropped by 7% and 20%, respectively (***, 2000). The crop structure also recorded sensible changes, e.g. while soya-beans (-71%), wheat (-28%), potatoes (-22%) and vegetables (-8%) diminished greatly, maize and sun-flower crops extended significantly (10% and 16%, respectively). Animal production also dropped in the year 2000 compared to 1989: by 36% in cattle, 60% in swine, 47% in poultry and 44% in sheep (***, 2000).

Tabel 3

Macro-economic indicators

Indicator	Units	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Real GDP evol.	%	-5.8	-5.6	-12.9	-8.8	1.5	3.9	7.1	4.1	-6.6	-5.4	-3.2
GDP in USD	Mld. USD	53.7	38.3	28.9	19.6	26.4	30.1	35.5	35.3	34.9	41.5	33.9
Currency rates (annual mean)	Lei/ USD	14.9	22.4	76.4	308	760	1655	2033	3083	7168	8876	15333
Unemployment rate	%	n.a.	n.a.	3.0	8.2	10.4	10.9	9.5	6.6	8.9	10.3	11.5
Bugetary deficit	% from PIB	7.5	0.3	-1.9	-4.4	-2.6	-4.2	-4.1	-4.9	-3.6	-3.1	-3.0
Current account	% from PIB	5.6	-8.7	-3.5	-8.0	-4.5	-1.4	-5.0	-7.3	-6.1	-7.3	-3.8
Total external debt	Mld. USD	0.0	0.2	2.2	3.5	4.5	5.5	6.7	9.2	10.4	9.7	9.1

Table 4

Park of tractors and agricultural machines in Romania, 1989–1999 (thousand pieces)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Tractors	129	105	131	140	156	162	162	163	164	167	168
in the private sector	n.a.	n.a.	101	102	118	129	129	132	136	139	140
Combines in the private	38	35	35	35	34	35	36	36	34	33	31
sector	n.a.	n.a.	28	28	27	28	30	30	29	28	27
Ploughs	71	63	73	82	94	102	107	113	117	122	123
in the private sector	n.a.	n.a.	57	61	73	84	89	95	100	105	107
Disk harrows	37	34	36	41	48	52	55	59	62	65	67
in the private sector	n.a.	n.a.	27	29	36	42	45	49	53	56	58
Sowers for cereals	18	16	17	18	21	22	24	26	26	28	28
in the private sector	n.a.	n.a.	13	14	17	18	20	22	22	24	24
Sowers for other crops	18	17	17	19	22	24	26	27	28	30	30
in the private sector	n.a.	n.a.	14	14	17	20	22	23	24	26	26

Sources for table 3 and 4: ***, 2000.

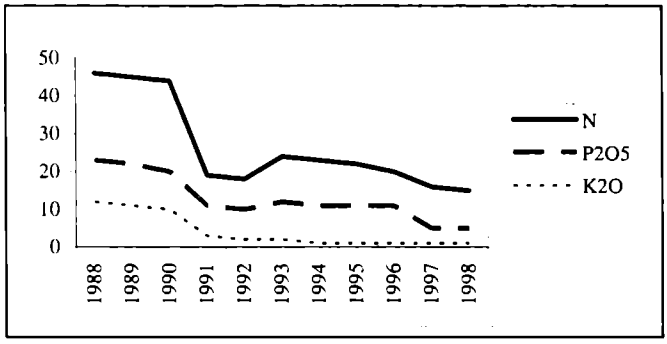

Fig. 5 – Structure of agricultural land.

The nagative effect of the above law is even more obvious when looking at the use of fertilizers (Fig. 5), of licenced seeds, and of pesticides (by 34% lower in 1997 than 1990). The same goes for the fixed assets in this sector. Despite machines and tractors being more numerous due to big internal production lines (Table 4), few farms can afford buying them, the costs being much too high even if a preferential credit system is in place (***, 2000). The first to suffer are the family farms, which continue working with archaic means.

Besides, the spatial distribution of machines and tractors depends on the proportion of mechanisable terrain, the type of vegetal production and, most importantly, on available funds. In view of it, territorial disparities are growing, in terms of the arable area/tractor indicator. While the all-country average was 58 ha/tractor (99 ha/tractor in the private sector), regional values looked as follows: 73 ha/tractor in Brăila; 108 ha/tractor in Tulcea; 31 ha/tractor in Caraş-Severin and 32 ha/tractor in Braşov (Gavrilescu, 1998, p. 37). Space disparities are caused both by natural and economic factors.

Summing up we would say that many of the factors discussed herein proved rather restrictive for the development of rural settlements over the past ten years.

They could turn stimulative provived some positive changes would occur. This desideratum is dependent upon a stable economic and institutional framework capable to boost and complete the economic reform process, thus ending up the transition period.

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THE ROLE OF THE SEDIMENT SOURCES IN THE ROMANIA'S RESERVOIRS SILTING

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Key words: sediment sources, reservoirs, silting process, Romania.

Le rôle des sources de sédiments dans le colmatage des retenues en Roumanie. La Roumanie compte parmi les pays avec les plus grandes réalisations dans le domaine de la construction des barrages. Parmi les 80 pays membres de la Commission Internationale des Grands Barrages (ICOLD), la Roumanie occupe la 19-ème place concernant les grands barrages (246) et la 9-ème en Europe. Les retenues sont caractérisées par des petites capacités, en général sous 200 mill. m^3. Les auteurs se proposent d'offrir une synthèse sur le taux de colmatage par rapport aux conditions morphodynamiques des bassins versants. Le taux total d'érosion est évalué pour tout le territoire de la Roumanie à 125 mill. t/année, dont 45–50 mill. t/année sont transférés dans les rivières. Presque 1550 kg/s de sédiments sont déplacés du territoire de la Roumanie, ce qui signifie un taux du débit solide d'alluvions, en moyenne de 206 t/km^2/an. Il y a des endroits où le debit solide – seulement les sédiments en suspension – aboutit à 2500 t/km^2/an, par exemple les Subcarpates de la Courbure et le Piémont Gétique. Au contraire, dans les Carpates constituées de roches cristallines, ce débit solide atteint à peine 10 t/km^2/an. On a pris en calcul 138 retenues avec un volume initial entre $1 \times 10^6 m^3$ et $1230 \times 10^6 m^3$, retenues pour lesquelles il y a des déterminations sur la période de colmatage. La situation du colmatage des retenues de la Roumanie se présente ainsi: *très grave* pour un nombre de 15 retenues à un volume moyen de 8 mill. m^3, situées dans des régions de grande production spécifique (plus de 500 t/km^2/an), et où le taux de colmatage se situe entre 2 et 10 ans, ensuite *grave* pour un nombre de 30 retenues à un volume sous 35 mill. m^3, et dont le taux de colmatage se trouve entre 10 et 50 ans. Cettes retenues sont amplacées dans des régions à une production moyenne de sédiments de plus de 250 t/km^2/an, beaucoup d'entre elles sont placées dans le système de cascades à petites retenues sur des grandes rivières; finalement, *difficile*, pour 13 retenues, dont le taux de colmatage est de moins de 100 ans dans des régions à une production de 200 t/km^2/an).

INTRODUCTION

The dams and reservoirs created behind them have represented a domain of interest for geomorphology, especially for its dynamic branch, because it has been stated that such anthropic structures cause irreversible changes in the dynamics of

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the fluvial systems. The issue has been debated upon in a series of works and PhD thesis, especially by the research team from"Stejarul" Research Station from Piatra Neamț, but also by researchers from other domains of activity. The arguments brought forward deal especially with the fact that nowadays the large dams of the world with their hydrographic systems have been in most of their part and some of them totally controlled by dams with their reservoirs, with a water volume of 5–6 times the average discharge of all the rivers in the world, estimated at almost 1250 km^3/s (Ichim, Rădoane, 1986).The arrangement of transversal dam work introduced great discontinuities in the transportation of sediments, in the evolution of riverbeds and the adjoining slopes, which in geological time are controlled with a very reduced rate of manifestation by the tectonic movements and the variations of the general base level. As for the development in space and the duration of manifestation of the influence of such anthropic structures, William and Wolman (1984) have estimated on the basis of the analysis of an important number of cases, that on the big rivers course the distance may be of hundred km, and the duration of thousand years degree. Or, as we shall see, such structures are to be found also in Romania having a total volume of almost 13 thousand millions m^3 (1/3 of the entire volume of water carried in one year by the interior rivers. Moreover, they are accompanied by the dislocation important amounts of rocks, by terrigenous materials, which, only between 1950–1990, in the context of hydropower arrangement have totalized 500 mil. m^3 embankment, 771 km of dams, 33 mil. m^3 of surface concrete, 12 mil. m^3 of underground excavations on 669 km drifts.

This work refers only to one of the processes that dam reservoirs undergo once they are placed in a river system – the silting. More precisely, we try to make a synthesis of the knowledge stage of the dam lakes silting in Romania that we want to approach on the basis of the relations with our territory morphodynamics and considering the substantial accumulations of new data. The factual material that we have is structured as follows: a) the construction of dams and the arrangement of dam reservoirs in Romania; b) the problem of sediments sources; c) the silting of dam lakes.

THE CONSTRUCTION OF DAMS AND THE ARRANGEMENT OF DAM RESERVOIRS IN ROMANIA

Romania is known as a country where the tradition of dam construction and of the arrangement of lakes is very old (Dăscălescu, 2000). There are mentioned Saard and Cristurul Pool near Turda, attested even from the XII^{th} century, and the oldest reservoir dating as early as 1780, whose dam, of 23 meters high, after several repairs is still functionable. It is about Tăutu Mare reservoir from Metaliferi Mountains built for the gold mines. Since the XV^{th} century in Romania a big interest has been shown for the arrangement of the rivers with small accretion and water falls. There are documents that certify pools as early as 1448, and in Brașov

area, according to some historical documents, between 1503–1550 there were 28 pools. In another old document, Moldova was described as " rich in pools", some of them probably existing at least from the period of Ştefan cel Mare (the reservoirs Hârlău, Belceşti, Şipote, Dinischean), and other ones arranged later, especially during Alexandru Lăpuşneanu and Vasile Lupu's reigns. Moreover, in Vasile Lupu's period Dracşani Pool was enlarged, and it is still considered to be one of the largest pools in Romania (S = 486 ha, Tv = 5,5 mil. m^3).

The modern and contemporary period marked in Romania an increasing interest in the arrangement of water falls for hydropower purposes. So that, at the end of the XIX^{th} century the first hydroelectric power stations were built on Dâmboviţa, in Bucharest (1890) and on Sadu, near Sibiu (1896), without having too much water accumulation. The ample study about the hydropower reserves, of the brilliant scientist D. Pavel (1933) may be considered the first synthesis on arrangement conditions of dams and on dam reservoirs in Romania. Until 1940, 128 hydropower plants were built but the water accumulations were not so important. Starting from the '60, the rhythm of arranging reservoirs became faster, culminating between 1980–1990, when a number of 78 reservoirs were put into operation.

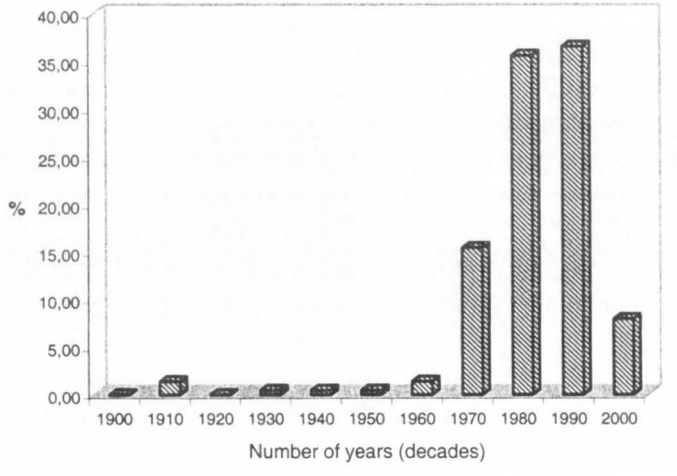

Fig. 1 – The rhythm of dams construction in Romania in the XX^{th} century (data offered by the Romanian Committee of the Big Dams, 2000).

After this period a severe decline of dam constructions was registered, between 1991–2000, when only 17 dams from those which had already been started were finished. Otherwise, this dynamics is also graphically illustrated (fig. 1), which indicate the rhythm of dam construction in Romania in the XX^{th} century, after the official data published by the Romanian Committee for the Big Dams

(2000. At present, the data indicate that Romania is among the countries with the greatest achievements in the world regarding dams, which allowed also technology export (Algiers, Iran, Turkey). Among the 80 countries members of the International Committee of the Big Dams, Romania occupies the 19th place concerning the number of "big dams" (considered over 15 m height) and the 9th place in Europe. The total number of the big dams is therefore 246, among which almost half are dams under 40 m height. The highest dam is Gura Apelor, on Râul Mare, in Retezat Mountains and it is 168 m. We can add to these another 1500 dams, under 15 m height, the reservoirs having capacities under 1 million m^3.

As a conclusion, we can estimate that the anthropic intervention through the arranging of dams and reservoirs, in the river systems of Romania's territory, is significant and justifies the concern of the geomorphologists to know the relations between the dynamics of the landscape and the behaviour of these anthropic structures.

THE SEDIMENT SOURCES

The position in a temperate-continental climate and the presence of the Carpathians is defining for the distribution and the system of the geomorphologic process, generating sediments and which expresses, finally, the morphodynamic specific of a territory. This is also the reason why a great importance was given to the problem of sediments flowing on Romania's rivers, as an indirect expression of the dynamic state of the landscape. Beginning with the main work of Diaconu (1971), we had, for the first time, a global image of the susceptibility to erosion of our country's territory, of an overwhelming importance for time predictions about dam reservoir silting. Two thesis concerning a general perspective over the dynamic of the Romanian relief have been subsequently elaborated. The first one, written by Moţoc (1984), proposes a general image over the whole territory of Romania, reffering to sediments effluence in comparison with the major types of morphogenetic processes and the main unities of our country landscape. It is a pioneer work as far as Romania is concerned. The other synthesis was published by Mociornița and Brateş (1987), who have updated the outflow map after 1970–1980, when most of our rivers reached the maximum liquid flow with 1% or even 0.1% protection rate. It is a work that relies on the entire data base resulted from the national measurement network, over a more than 35 years period. Other updated syntheses have not been known after this date, but for reeditions and interpretations of the above mentioned works, such as, for example, the one from UNESCO volume, edited by Zăvoianu, Walling, Şerban (1999), and entitled *Vegetation, land use and erosion processes.*

As far as we are concerned, on the general context concerning the sediments sources problems a new synthesis has been given (unfortunately it hasn't been realised for the entire territory of Romania, but a large part has been treated), on the account of an updated data base. Our approach focuses on the definition of the sediments sources such as: a) *source area* related to the slope basin or riverbeds and with the land use (agricultural, forest, buildings, mining etc.) and b) *in comparison to the generating processes*, namely, those that make transition to and into the riverbeds of sediments.

The processing of a large amount of data obtained from various sources (measurements in hydrometric cross-section from the national network ensured by the *Romanian Waters* Administration, indirect estimations on the account of sediment stock from some reservoirs, personal measurements on small basins) has led us to the selection of two control factors as criteria of sediments sources analysis for a large territory, such as Romania. They are: **the lithological composition** of the rocks generator sublayer and **the size of the drainage basins** which provide a selection of the amount of the sediments conveyed from the origin area to the discharging area. The choice of these two factors is also motivated by arguments acquired on the account of the speciality literature analysis (that is authors who have suggested prognosis models of the sediments production such as: Gregory and Walling, 1976; Burns, 1978; Janson, 1982; Zachar, 1982; De Villiers, 1985; etc), but also on the account of personal experiences (the model of multiple regression for the estimation of the sediments production in hydrographic basins with a 400 sq.km (Ichim and Rădoane, 1987).

Our proposal focused on the acquiring some predictive equations of sediments production for Romania in which the two controlling factors (the **lithologic substratum** and the **size of the drainage basins**) should be considered independent variables. The data base which we had at our disposal refers to 212 cross sections, controlled by basins varying from 0,17 km^2 to over 10 000 km^2, for 13 areas from our country, lithologically and geomorphologically different. The data processing consisted of many stages which have ultimately led to the equations listed in the table 1. These relations are rendered in figure 2, from which we can easily infer that for the Romania's territory there is a pretty big variability of sediments generating in different areas of the country. These equations are power functions, and their parameters (mainly *a* and *b* regression coefficients) can be used in subsequent classification analysis.

a. regression coefficient has values from 42.861 to 10 006.4. Its meaning in the relation is that it is closely connected to the actual conditions for which the function was created (mainly morpholithological in our case). From this point of view *a* regression coefficient can be used in cluster classification analysis.

b. regression coefficient denotes the inclination degree of the slope regression line. In our case it varies between –0.0072 when the regression line is almost horizontal and –0.4316 when the line is more inclined, therefore there is a higher sensitivity. The other statistical tests have helped us to accept or refuse the predicative significance of the equations, some of theme being less sensitive then the others.

Table 1

The centralization of the relations between the specific sediments production and the reception basins surface for various morphological conditions in Romania (SY = sediment yield; A = drainage basin area)

Description of the area	Statistic parameters of $SY = a A^b$ relations				No. of obs. (n)
	a	b	r	R^2	
(1) The flysch mountain area (the Eastern Carpathians)	738.48	-0.167	0.799	0.639	49
(2) The Neogene molasse area (the Eastern Sub-Carpathians)	5677.47	0.220	0.904	0.817	35
(3) The Neogene molasse and Quaternary deposits area (Sub-Carpathians and Getic Piedmont)	9367.43	-0.277	0.647	0.419	11
(4) The crystalline mountains area (Jiu) -mining influences-	320.40	-0.103	0.364	0.133	12
(5) The Neogene molasse area (Jiu-Olteţ)	2094.93	-0.175	0.879	0.772	18
(6) The Getic Piemont(on the basis of lake sediments)*	10006.40	-0.194	0.336	0.113	6
(7) The crystalline mountains area (on the basis of lake sediments)*	1450.82	-0.124	0.746	0.557	4
(8) Small basins in the crystalline mountains area*	42.86	-0.007	0.451	0.203	8
(9) Moldavian Plateau (Bârlad)	2203.00	-0.318	0.670	0.449	15
(10) Moldavian Plateau, the Plain of Moldova (Jijia)	3217.98	-0.432	0.362	0.131	13
(11) The Plain of Oltenia	268.27	-0.284	0.511	0.261	12
(12) The crystalline and volcanic mountains area (Someş-Vişeu)	361.16	-0.224	0.491	0.241	12
(13) The region of the internal flysch (Someş-Vişeu)	435.25	-0.073	0.212	0.045	17

* the bedload was taken in calculation

Cluster Analysis was applied in order to find the best groups among the great number of studied data on the basis of which we should realise a territory regionalization with a similar power of generating sediments. With that end in view. we used the regression coefficient ***a***, whose variation synthesizes the complexity of the morphological and morphodynamic conditions in a certain area. The clusters were fixed by calculating the variance-within-the-groups and the variance-among-groups, according to the methodology described by Johnston (1980). The graphic result is rendered in figure 3 where it is observed that the coefficients tend to group into three clusters.

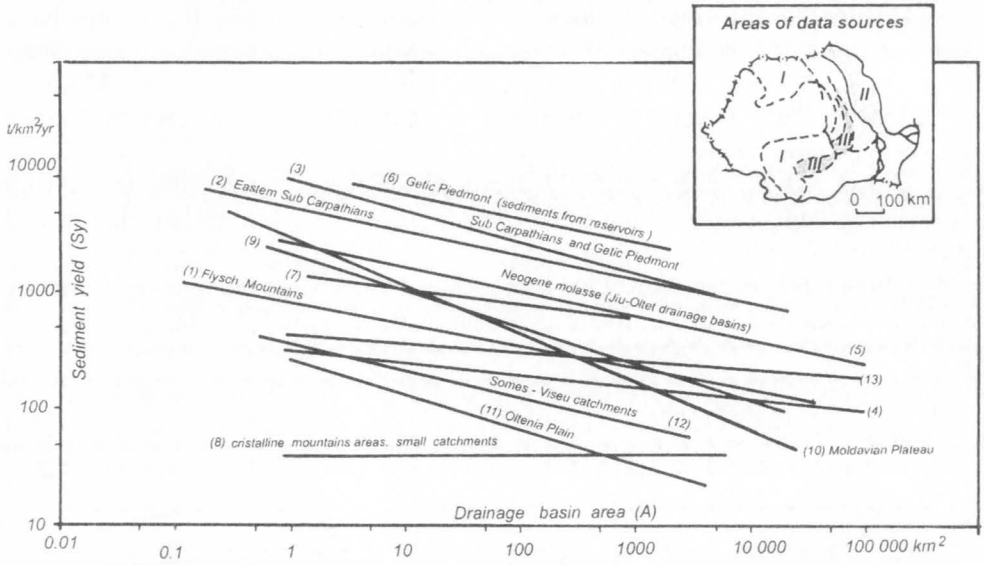

Fig. 2 – Relationships between the sediment yields and the drainage basin areas for different morpholithological conditions of the Romania (numbers have a correspondance with the table 1).

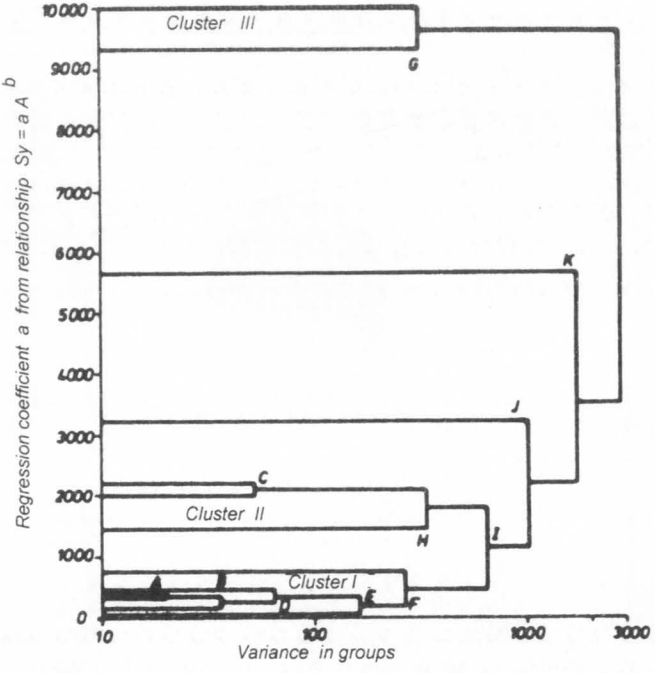

Fig. 3 – Cluster analysis on the *a* regression coefficients from the relationships $Sy = f(A)$ for the morpholithological conditions of Romania.

Cluster I brings together most of the coefficients (in which 4 groups have been concentrated) and characterizes the zones with sediments production of under 700 t/km^2/year. These zones include most of the regions in our country: Moldova Plain, Oltenia Plain, the area of the internal and external flysch, the crystalline zone and volcanic mountains.

Cluster II is made up of 2 subgroups and characterizes the zones with sediments productions of about 2000 t/km^2/year, mainly, Moldavian Plateau and Getic Plateau.

Cluster III characterizes the exceptional sediments productions registered by some small basins in the Bend Subcarpathians and the Getic Piedmont.

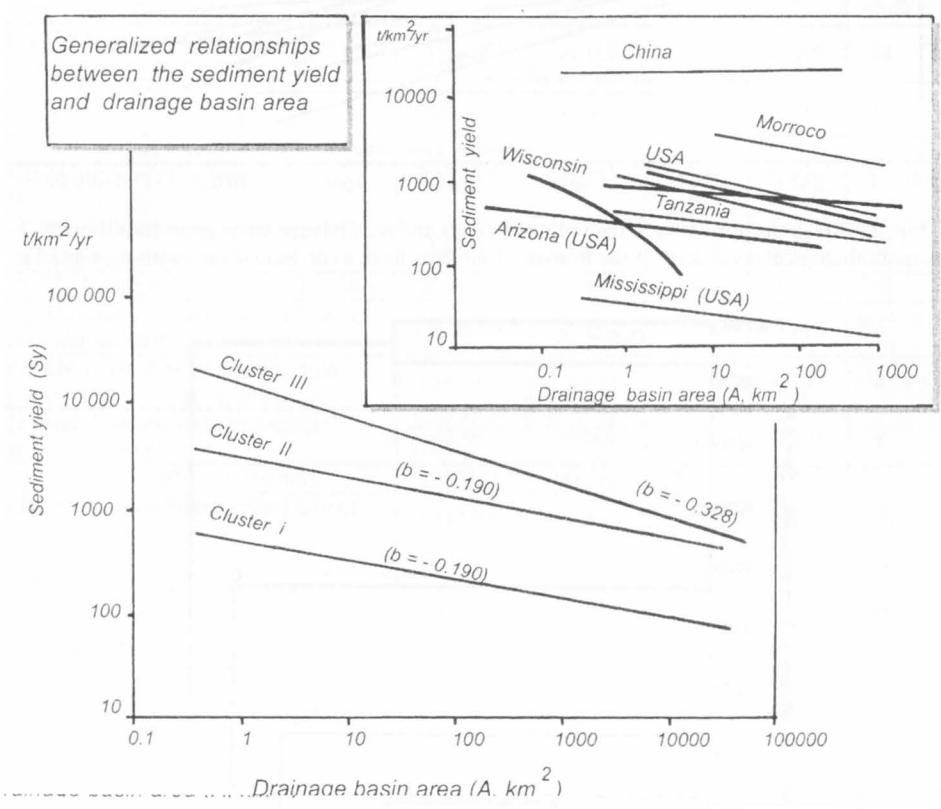

Fig. 4 – Generalized relationships between the sediment yield and drainage basin area obtained of Walling (1983) for different conditions of the world (up) and the tendencies centralized for the Romania's territory (down).

On basis of this classification we have obtained generalized relations $Sy = f(A)$ (fig. 4) for the mentioned groups, which may be compared to Walling's generalized tendencies (1983) for different regions of the world. The general observations which are to be keep in mind from this analysis are that:

– In Romania's case there is a "delay" in the sedimentsl transit from the source area to the effluence area expressed by the negative relation of the specific sedimentsl production once the size of the hydrographic basins has increased. The phenomenon is due to the selective transportation of the sediments inside a drainage system. This "loss of sediments" takes place on the slope of –0.190 for the areas in Groups I and II and on a higher slope of $b = 0.328$ for the areas in Group III;

– Most of Romania's territory's enters the global centralized tendency belonging to Walling (1983), with regression slope of – 0.125. We may estimste that the areas in Group I, which characterizes the most part of morpholithological areas in our country, are placed in the regression line of maximum intensity areas, situation which may be assimilated to a medium condition of specific sediments production for the most part of the Globe. On the contrary, the second and third group, although characterize areas with little extinction (the curvature sub-Carpathians and Getic sub-Carpathians), are registered as some of the most productive alluvial suppliers in the world.

THE RESERVOIRS SILTING

The interest for the reservoirs silting study has decreased immediately after the slowing down of the dam construction in Romania, although the present reservoirs need an attentive supervision from this point of view. But we must not neglect the fact that a study on the silting of dam reservoirs needs an expensive price, the main reason for which the researches in this domain have decreased lately.

As far as we are concerned, we have a rich experience in the study of the phenomenon and an important data base which helps us approach the problem of knowing better the dam reservoirs silting in Romania, the way it is now, trying to relate it to the morphodynamic characteristics of our country's territory, to highlight the extreme situations and the possible causes of this process.

The data base on which our observations ground, includes, on the one hand, a situation on the dimensions of the lacustrine basins (capacity, area, position inside the hydrographic basin), on the other hand a situation upon the silted volume of the basin and a evaluation of the silting time of 50% of the initial storage capacity of the lake. All these data have been obtained from extremely different sources, from our own researches on some lakes in Bistrița Valley, Siret Valley, Buzău Valley, to attentive research of scientific production appeared in the last decades, the archives of The Institute of Hydropower Studies and Projections, The Romanian Committee for Great Dams, INMH, Aquaproject and others. Because of the scanty space that our work dispose, we will present a part of this statistic data under the form of a table (table 2).

Table 2

The silting situations of some storage basins from Romania

Nr. Crt	The drainage basin	The reservoir	The initial volume 10^6 m^3	The silting volume		Year of exploitation beginning	The source
				%	10^6 m^3		
1.	Argeş	Vidraru	420,000	–	–	1967	Fl. Ionescu (1980)
2.		Oieşti	1,800	74	1,330	1967	I. Ichim et al.(1994)
3.		Cerbureni	1,620	68	1,100	1966	"
4.		Curtea de Argeş	0,890	88	0,700	1972	"
5.		Zigoneni	13,300	15	2,000	1973	"
6.		Vâlcele	40,000	62	2,500	1977	"
7.		Bascov	5,400	93	5,000	1971	"
8.		Piteşti	4,800	85	4,000	1970	"
9.		Ogrezeni	0,500	100	0,500	1967	"
10.		Baciu	0,600	38	0,230	1967	"
11.		Vîlsan	0,200	50	0,100	1967	"
12.		Cumpăna	0,260	38	0,100	1967	"
13.		Budeasa	26,44	10,3		1980	D. Roşca (1987)
14.	Ialomiţa	Paltinu	56,000	4	2,000	1972	Fl. Ionescu (1980)
15.		Pucioasa	10,600	22	2,300	1974	"
16.		Voila	0,500	70	0,350	1972	"
17.	Olt	Săcele	18,300	1,6	0,300	1976	"
18.		Vidra	340,000			1974	"
19.		R. Vâlcea	19,000	33	6,300	1974	"
20.		Dăeşti	10,800	32	3,500	1976	"
21.		Rîureni	7,300	14	1,000	1977	"
22.		Govora	18,500	27	5,000	1975	"
23.		Băbeni	59,650	8,3		1977	"
24.		Străjeşti	202,70	3,2		1978	D. Roşca (1987)
25.		Ioneşti		2,5		1980	"
26.	Mureş	Luduş	0,300	100	0,300	1964	Fl. Ionescu (1980)
27.		Mintia	5,000	74	5,700	1965	"
28.		Cinciş	43,000	3,5	1,500	1969	"
29.	Siret	Bucecea	14,400	12,8	1,85	1978 (evaluation 1978-1986)	P. Olaru (1992)
30.		Galbeni	40,000	18,9	7,500	1983 (evaluation 1984–1986)	"
31.		Poiana Uzului	170,000	1,40	2,500	1975 (evaluation 1975–1986)	"
32.		Iz. Muntelui	1230,000	1,3	16,000	1962	Rădoane (1983)
33.		Pîngăraţi	6,700	40	2,700	1964	Ciaglic et al.(1973) Rădoane (1986;1999)

(continues)

Table 2 (continued)

34.		Vaduri	5,600	34,6		1966	Rădoane (1999)
35.		Bîtca Doamnei	10,000	27,2		1966	"
36.		Piatra N.	12,000	3,4	0,400	1966	"
37.		Racova	8,600	36	3,100	1964	P. Olaru (1992)
38.		Gîrleni	5,100	37,4		1965	"
39.		Lilieci	7,400	12,6		1966	"
40.		Bacău	7,400	15,8	0,300	1966	"
41.		Belci	12,000	50	6,000	1964 (destroyed 1991)	"
42.		Puşcaşi (r.Racova)	17,200	62,3	10,900	1973 (evaluation 1973–1998)	Gh. Purnavel (1999)
43.		Antoheşti (r.Berheşti)	0,220	40,91	0,090	1984 (evaluation 1984–1995)	"
44.		Găiceana (r.Ghilăveşti)	0,410	41,46	0,170	1984 (evaluation 1984–1995)	"
45.		Cuibul Vulturilor (r.Tutova)	9,500	32,63	3,100	1978 (evaluation 1978–1992)	"
46.		Rîpa Albastră (r.Simila)	10,600	21,13	2,240	1979 (evaluation 1979–1993)	"
47.		Fiticheşti (r.Pereschiv)	5,500	52,60	2,890	1977 (evaluation 1977–1993)	"
48.	Bahlui	Tansa	33,000	1	0,300		Pricop et al (1990)
49.		Plopi	24,000	1	0,250		"
50.		Pod Iloaiei	37,000	32,3	11,948	1964 (evaluation 1964–1975)	Zavati, Giurma (1982)
51.		Cucuteni	14,000	5,43	0,761	1964 (evaluation 1965–1975)	"
52.		Ezăreni	3,500	13,6	0,476	1963 (evaluation 1963–1975)	"
53.		Ciubeşti	12,300	5,2	0,637	1963 (evaluation 1963–1975)	"
54.		Chiriţa	7,500	13	0,100		Fl. Ionescu (1980)
55.		Aroneanu		19,98	0,296	1964 (evaluation 1964–1985)	Pricop et al. (1990)
56.	Jijia	Hălceni	3,500		0,030	1981 (evaluation 1981–1989)	Amăriucăi, Hlihor (1990)
57.	Jiu	Işalniţa	5,000	92	4,600	1960	Fl. Ionescu (1980)

The estimation of the stage of the reservoir silting requires some knowledge about the initial capacity of the lakes, of a parameter which is called – accumulations coefficient (α) and which is defined as the relation between the volume of the hydrographical basin's liquid drain and the reservoir's initial capacity; of another parameter which is called silting time, of 50% from the reservoir's volume (T50). The analysis of these parameters has been done on the basis of a permanent correlation with the morphodynamic features of Romania's territory. Moreover, the table was completed with a map, which indicates the repartition of the anthropic reservoirs following the latest data supplied by the Romanian Committee for the Big Dams, superposed over the map of the specific production of sediments on Romania's territory, map brought up to date as well (fig. 5).

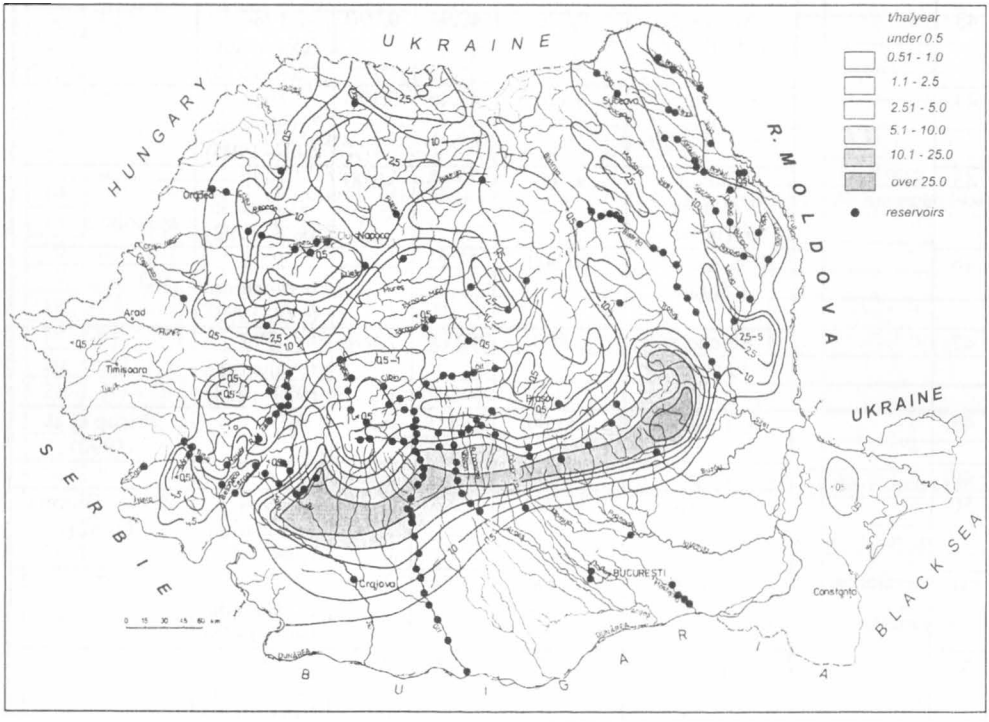

Fig. 5 – Position of reservoirs in relation with the specific production of sediments.

Concerning the capacity of the lacustrian basins. As one can see from the graphic representations belonging to the fig. 6, the reservoirs in Romania are characterised by storage capacities relatively small. Almost 90% of the existent reservoirs have capacities under 200 million m^3, and among these half of them have capacities under 20 million m^3. The relief conditions and the ones concerning the Romania's rivers flow offered smaller changes for the arrangement of big dams and, implicitly, of big lakes. The only a few exceptions are known: the Izvoru Muntelui Reservoir the biggest among the interior rivers of our country, Vidraru on

Argeş, Vidra on Lotru, Siriu on Buzău, Gura Apelor on Râu Mare etc. A lot of the existing rivers are arranged in waterfall on great rivers (Bistriţa, Siret, Buzău, Argeş, Olt), with specific exploitation conditions, which reflects directly over a certain silting rate. This is how the great number of lakes on the rivers Olt, Argeş and Siret illustrated on a graphic in the fig. 6 is to be explained. The reservoir capacity and the exploitation conditions are important elements, which control the sediments restraining degree, sediments from source area.

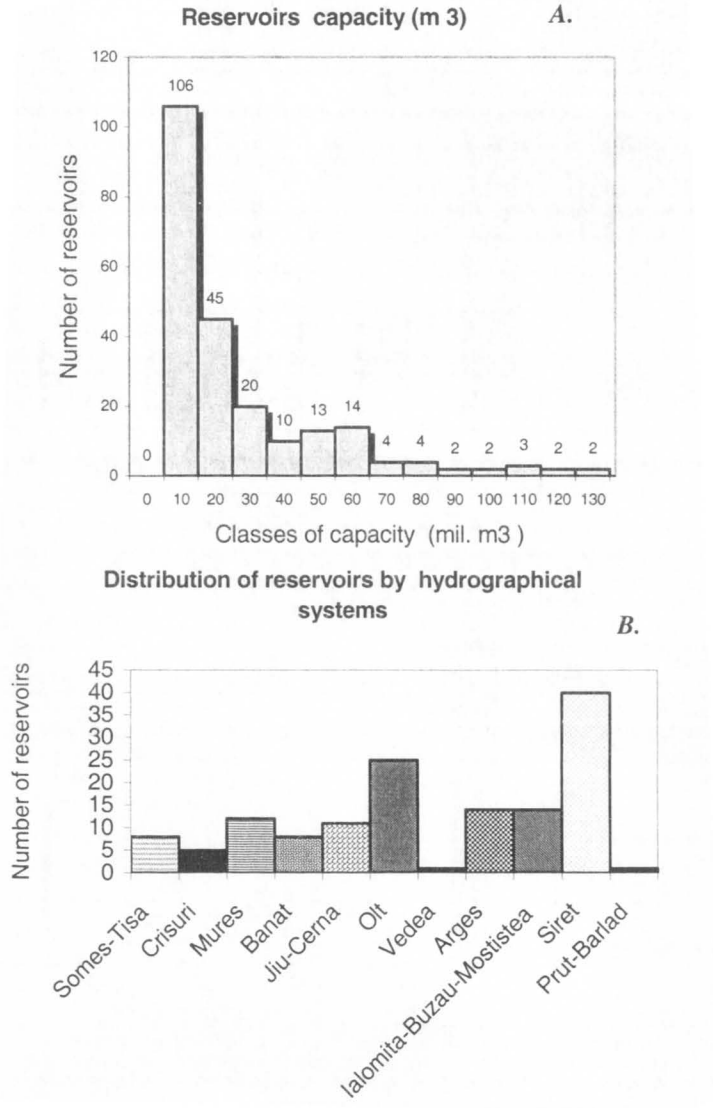

Fig. 6 – The repartition of the reservoirs in Romania (*A*, the histogram of the reservoir's capacity, under 140 million m^3; *B*, the repartition of reservoirs on hydrographical systems).

The capacity of lakes is decisive for the evaluation of the rhythm and of the silting length due to a very simple reasoning: the more a lacustrian basin is bigger, the more it can stock a volume of sediments large enough without affecting its functionality and there are many examples in this direction. On the contrary, a lacustrian basin with a reduced capacity can become silted in a relatively short period, of only a few or a few tens of years, even at relatively modest comings of sediments. The study of Dendy et al. (1973) for 1100 dam reservoirs in USA indicated that the great majority of small lakes are becoming silted in less than 30 years.

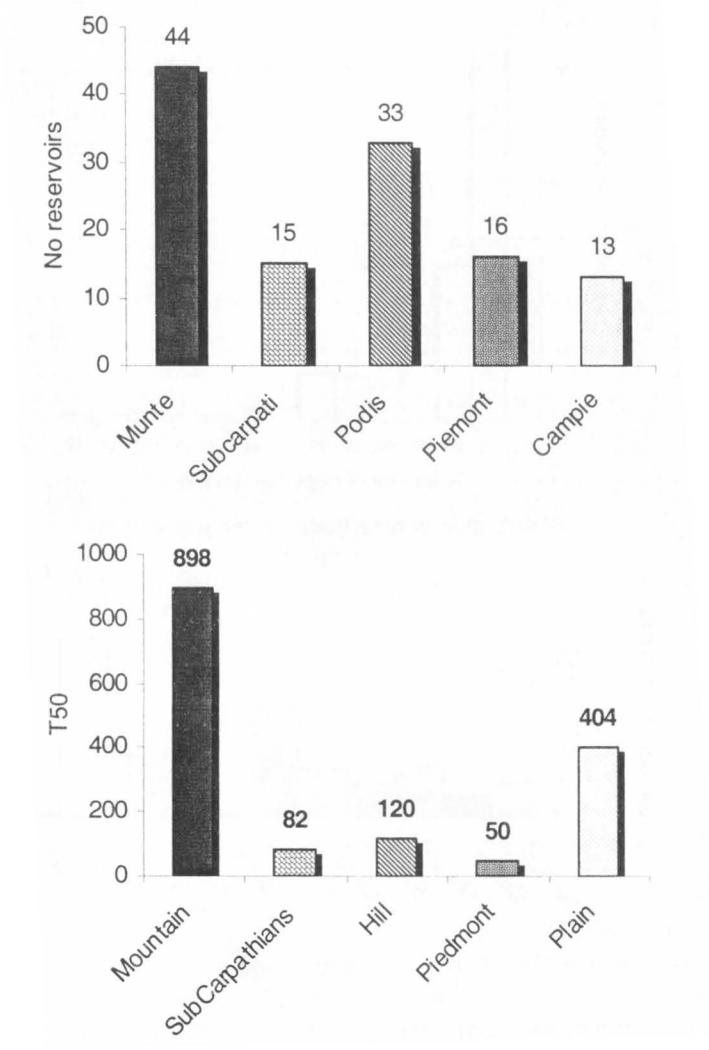

Fig. 7 – Distribution of reservoirs in relation with main units of landforms (up). Time of silting 50% of initial storage capacity (down).

The silting rate. There are, in Romania, dam reservoirs which have been functional for centuries (like those in Banat Mountain or Metaliferi Mountains), but there are also lakes which became silted in a period of a few years. From the data we have at our disposal we keep in our mind a few observations of general character:

– on the whole country, in an average period of 15 years, in the dam reservoirs from the interior rivers have been deposited about 200 million m^3 of sediments (from which almost a half only the reservoirs on the rivers Argeş and Olt), with an yearly instalment of 13.4 millions m^3, which represents 27% from the total supply of sediments, averaged and multi yearly;

– **the most important yearly rates of silting** have been on the lakes from the sub-Carpathian area with easy erodible rocks, on Argeş river: Piteşti 15.7%, Bascov 11.7%, Oieşti 9.5%, Cerbureni 7.3% and Curtea de Argeş 5.3%; also the lake Galbeni, on Siret, 10.6%;

– **average yearly rates of quick silting** have been recorded also at the first lakes, built on the Olt river: Govora 8.27%, Rm. Vâlcea 5.63% and Dăeşti 4.90%; in the same category are included the lakes Pângărați on Bistrița, 3.45% or Pucioasa, on Ialomița, 2.58%;

– **low rate of silting** have been registered at the big reservoirs, Izvoru Muntelui of 0.03% and Vidraru of 0.04%, which ensure them with a millenary running, unless some incalculable situations occur.

Retaining as a basis of interpretation the necessary time for silting of 50% of the initial volume of every lake, 138 reservoirs from Romania, with initial storage capacity between 1×10^6 m^3 and 1230×10^6 m^3 have been analysed. For these reservoirs determinations have been made, regarding the silting rate, using various methods and different experts. Their repartition depending on the major units of relief (fig. 7) indicates that from the total number of analysed reservoirs, only 44 are found in the mountain area of the country, the region with the smallest rhythm of sediments production. The other lakes are placed in the region of plateau and hill, sub-Carpathians, piedmont and plain, all these being characterised through an accelerated rhythm of producing the sediments, excepting the regions of plain.

In this general situation, the silting time of 50% of reservoir's volume reflects the means of reply, through silting, of the hydrographic basins, in comparison with the main morphodynamic regions of the analysed territory: it is reduced to less than 100 years for the lakes which are found in the regions with great production of sediments (sub-Carpathians, plateau and piedmont) and it' s three figure hundreds of years for the reservoirs situated in mountain and plain areas. In other words, only 57 reservoirs have enough silting time to justify the investment and important perturbation on the environment.

As a conclusion, the situation of the dam reservoirs silting from Romania is as follows:

– **very serious** for a number of 15 dam reservoirs with average dimensions o 8 mil. m^3 , all of them situated in the SubCarpathian area, one of important sediments production (over 500t/km^2/year); the silting time T50 of these reservoirs having values between 2–10 years;
– **serious** for a number of 30 dam reservoirs, with average capacities of 35 mil. m^3, and the silting time T50 varies between 10–50 years. In this case the reservoirs are also situated in the area of important specific sediments production of over 250 t/km^2/year, the case of the rivers Olt, Argeş, Buzău and Bistriţa but also of the reservoirs in Bârladului basin.
– **difficult**, for 13 dam reservoirs, with a silting time ander 100 years and which are usually situated at about 200t/km^2/year (e.g. Rogojeşti on Siret, Izbiceni on Olt, Bacău on Bistriţa, Văliug on Bârzava).

Following this general image of the silting phenomenon in the dam reservoirs in Romania we have to take into consideration the fact that in some arrangement projects priority it was given to the strict economic aspect and it was seriously eluded the knowledge the relief potential to reply in such an accelerated rhythm to sediments release and transport through the collector net. It is the situation of the reservoirs arranged in cascade on the rivers Argeş, Olt or Bistriţa. Important sums of money are spent efforts are made to desilt some important reservoirs for the hydropower system functioning, such as Oieşti reservoir on Argeş and Pângăraţi on Bistriţa. On the other hand it is admitted the fact that there haven't been done sediments keeping works in the source areas first and only after that the proper execution of the reservoir; in fact so many time the right order has been totally changed. The notorious examples in this situation are Bascov reservoir and Piteşti, entirely silted in two years.

As geomorfologists, it is or duty to admit that we owe to the other domains of activity a map with the morphodynamic potential of Romania, elaborated on quantitative grounds, with all the geomorphologic processes taken into consideration, so that it could represent a bases for the sustainable use of the territory.

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TERRITORIAL DISTRIBUTION OF WATER RESOURCES IN ROMANIA IN TERMS OF SOCIAL-ECONOMIC DEMAND

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Key words: water resources, territorial distribution,water balance, Romania.

La répartition des eaux par rapport aux exigences socio-humaines de la Roumanie. Les ressources d'eau de la Roumanie sont relativement modestes (elle occupant la position 21 parmis les états de l'Europe). En conformité avec les estimations, les ressources d'eau de surface des rivières internes représentent environ. 40,6 milliards m^3 par année (sauf le Danube) et les eaux souterraines offrent approximativement 9 milliards m^3 par année. La distribution spatiale au cours de l'année n'est pas uniforme. Les Carpates, qui couvrent 27,9% du territoire de la Roumanie, produisent 65,3% des ressources d'eau de surface; l'écoulement maximum se produit pendant le printemps (35–50%). La conséquence de cet état est la nécessité des dernières 40 années du $XX^{ème}$ siècle de construire des lacs d'accumulation. Vers la fin de l'année 2000 les plus importantes 400 accumulations retenaient 13 milliards m^3 d'eau. Les besoins d'eau pour l'alimentation de la populations, de l'industrie, de l'agriculture, pisciculture ont sont augmenté de 1,4 milliards m^3 en 1950 à 20 milliards m^3 1989. Après 1990, comme conséquence de la destruction de la plupart de systèmes d'irrigations et la désaffectation des unités industrielles, le besoin d'eau a baissé à 10–11 milliards m^3 dans l'année 2002. Pour une bonne gestion des ressources d'eau au niveau du pays, bassins hydrographiques ou départements, a été promu en 1976 «Le Programme National de l'Administration des Bassins Hydrographiques de la Roumanie». Dans le cadre de ce programme on a promue la construction des lacs d'accumulation, le transfert d'eau entre les bassins hydrographiques, l'extension des systèmes d'irrigation, le monitoring de la qualité des eaux. Ces objectifs ont été relativement résolues, mais certains ont été abandonnés après 1989. Les événements hydrométéorologiques des dernières années (sécheresse, inondations) ont attiré l'attention des facteurs de décision de la Roumanie pour la nécessité de la réconsidération du programme, la recherche des finances, etc.

Discussing water resources in Romania implies a twofold approach: water as a *sine qua non* of life itself and water as an important factor for the development of the contemporary society.

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From the very beginning of economic and social organization, water was a paramount asset of the human communities. There are lots of evidence bespeaking of ancient civilizations that thrived or felt into decay because they had or not the necessary water resources and because they knew or not how to use them.

As human society kept developing so did its demand for water increase. As a result, at the end of the 20th century water as resource, together with energy and soil fertility became major issues, and they continue to list among the top priorities of the 21st century, too. The demographic explosion and the need for greater comfort are intimately connected with the presence of water, and its consumption /capita is an indicator of the degree of civilization.

High quantities of water are taken up by industry, some branches using it completely, without anything returning to the network, not as waste even.

Intensive agriculture needs extended irrigation systems, that is ever more water in the conditions of temperate, Mediterranean, tropical and even Equatorial climates. Water is seen to undergo major changes when referred to human society. It decreases in quantity, as part of it is eliminated from the hydric circuit, and deteriorates in quality, with negative consequences for the environment and man's health alike.

Not so long ago, people were convinced that water is an inexhaustible source and they can dispose of it to their own liking. Today this view has been reconsidered, the states themselves being engaged in devising complex plans for the management of drainage basins and the judicious administration of water resources. Water is also a focal concern for world organizations like UNESCO and FAO, which have adopted long-term programmes for its conservation (e.g. the International Hydrological Programme).

Although in Europe the water circuit (evaporation-clouds-precipitation-surface waters) ensures the regeneration of this resource some 12.8 times/year, yet, there are regions in which quantities stay constant or are diminishing. In these conditions, states, world organization and the mass-media even, have radically changed their stance striving to secure the rational management of water and maintain its quality.

Major categories of water resources in Romania.Lying in a temperate zone, Romania's water resources are rather modest compared with other countries in Europe.

Inland rivers included in the Water Cadastre of Romania (1992) span 78,905 km (referred only to the 4,864 codified watercourses) at an average density: 0.38 km/km^2 and an annual volume : 40.6 billion m^3, which means 1,765 m^3/capita. According to a recent UN statistical report, Romania lists at position 21 among the 34 European states. That is we stand pretty far off the countries with over 20,000m^3/capita/year (Finland, Sweden, and Norway), 5,000–10,000 m^3/capita/year (Austria and Switzerland), coming closer to those with 3,500–5,000 m^3/ capita/year (France, Poland and Germany), and even to some from the Mediterranean zone (Portugal, Spain, Italy, Greece and Cyprus). There is no doubt that the figure of 40.6 billion

m^3/year produced by Romania's inland waters can be raised by adding the about 30 billion m^3/year discharged on the Danube (and even more with the 170 billion m^3/year which the river has at its entrance on Romanian territory, but this cannot be done one must maintain the level needed for navigation and abide by the conventions of the Danubian countries).

Ground waters. According to current knowledge ground waters are put at 9.62 billion m^3/year, of which 6 billion can be used in optimal technological and economic conditions. The distribution of these waters varies from one geographical unit to the other in terms of climate, rock structureand storage capacity. There are areas know to have a good aquiferous potential, capable to release significant flows. It is the case of the alluvial fans of the rivers Mureş, Timiş, Prahova-Teleajen, and Buzău; in the Someş Plain and the Făgăraş Depression, the karst waters (springing from the following montains: Postăvaru, Piatra Craiului, Vâlcan and Mehedinţi, Cerna-Soarbele, Anina, Pădurea Craiului, Bihor, Codru-Moma and the Southern Dobrogea zone), the gravels from the Moldava floodplain at Timişeşti, etc. Aquifers at great depth with good possibilities of exploitation are found in the Frăteşti and Cândeşti Strata, the Dacian sands in Oltenia, etc. Ground water deficient regions are Central Dobrogea, the Transylvanian and the Moldavian tablelands. The ground water potential has been assessed by means of 4,500 hydrogeological drillings made throughout the country, where observations are underway.

The water resources of natural lakes are replenished from precipitation and springs water every year. These reserves are estimated at around 1 billion m^3/year and are of local importance for water management schemes.

The Black Sea (in the Romanian sector) could become a major source if sea water desalting could be economical.

Temporal and spatial characteristics of the hydrological regime. The time-and-space variation of the water resources of inland rivers have some particularities of their own.

In the physical-geographical conditions of the Carpathian-Danubian area, discharge on Romania's rivers is the outcome of the temperate continental climate. Climatic conditions are shaped by altitudinal zonation, the former being genetic factors of discharge; heavy precipitation, in their turn, are also involved in this process.

The main features of discharge are dependent on the seasonal climatic variation, on altitude which shapes the vertical zonation, on latitude, on the torrential character and on azonal factors.

Seasonal variations are connected with the intensity and frequency of climatic phenomena which shape the phases of the flow regime. So, on in winter, *shallow waters* are the rule; on the other hand, floods may occur in the west and south-west of the country triggered by inversions of warm Mediterranean air which cause sudden snowmelt. In *spring waters* are high, with floodwaves even, as snowmelt is associated with rainfall. *Summer waters* are shallow, because rain is scarce and the ground water reserves are exhausted; however, heavy rainfall may

unleash summer floods. Autumn is a shallow water season, but floods may set in, obviously less robust than in spring or summer.

Mean specific discharge. At heights of 600–1,000 m. alt., on the western side of the Apuseni Mts., the vertical gradient of discharge is of 5–6 l/s/km^2 per 100 m. At equivalent altitudes it shows a west-to-east decrease. Thus, from 7l/s/km^2 in Crişana Hills at 400 m alt., it barely reaches 1.8 l/s/km^2 in the Central Moldavian Plateau.

The *uneven distribution* of discharge within the year is reflected also by the share of season to the annual flow volume (35–50% in spring, 15–35%, in summer, 8–20% in autumn and 10–35% in winter). In view of it, building reservoirs to store the spring waters and use them in the droughtier seasons is imperative.

The maximum/minimum flow ratio registered and analysed at some hydrometric stations shows low values in rivers with a compensated regime and extremely high ones in those with a torrential regime. A minimum of 11.4 was found at Ceatalul Chiliei on the Danube, with a maximum of 76,000 at Bârlad Station on the homonymous river. This large variation interval raises special problems for the management and administration of river water both in the flooding stage, when economic units, traffic routes and settlements must be protected, and in the shallow-water stage when an adequately sanitary discharge must be ensured.

Whether discharge turns torrential or not depends on basin size, fragmentation grade, relief energy, extent of afforestation, etc.

Azonal variations of discharge are specific to karst areas, substantially involved in thoroughly modifying the flow regime.

The average water flow/year shows great vertical variation, from the Black Sea level to the Carpathian crests. The Carpathian Chain covers 66,302 km^2 of Romania's territory, the inland rivers accounting for 839.1 m^3/s of the discharge. The periCarpathian regions (the Subcarpathian regions, the tablelands and the plains), which extend over 72.1% of the territory contribute only 447.7 m^3/s to the average flow. However, as if to compensate for it, they host the largest rivers in this country (the Siret – 201 m^3/s; the Olt – 187 m^3/s; the Mureş – 185 m^3/s; the Someş – 125 m^3/s; the Jiu – 95 m^3/s; the Argeş – 60 m^3/s; the Ialomiţa – 46 m^3/s, etc.), collecting their waters from the mountains and running into the Danube, which is the mainstream.

River-water resources on the main relief steps. Looking at the territorial coverage of smountains, hills and plains and the water volume formed in the respective units, an obvious disparity emerges as a consequence of climatic conditions and of altitude levels which, in turn, influence the climatic variables. Precipitation increases by some 20 mm/100 m with the altitude, while temperature decreases by 0.5–0.6^{0}C/100 m. Hence, the flow module grows with height, being therefore directly proportional to precipitation and inversely proportional to temperature.

Top discharge variation gradients with altitude (5–6 l/s km^2/100 m) are recorded in the west and north-west of Romania, basically on the eastern slopes of the Apuseni Mts and the Căliman-Gurghiu-Harghita volcanic chain, due to the influence of the moist (oceanic) masses of air. In the east of the country, on the eastern slopes of the Eastern Carpathians, at equivalent altitudes, the flow module

is 2–3 lower because of the continental air advections, on the one hand, and the influence exerted by the foehn upon the masses of air, on the other. It follows that the values of vertical gradients show territorial variations, having therefore but an orientational relevance for the all-country global analyses.

The water resources of the drainage network were calculated on the basis of the mean liquid flow map (scale 1: 500,000) worked out at the National Institute of Meteorology and Hydrology. The results produced a relevant picture of river-water resources in the major relief units (mountains, hills and plains)(Table 1) as follows:

Table 1

River-water resources in the main geographical units of Romania

Unit name	Surface		Discharge module (l/s km^2)	Flow volume (m^3/an m^2)	Flow rate (m^3/s)	Total volume	
	Km^2	%				billion m^3/an	%
Carpathians	66,702	27.98	12.6	399.4	839.1	26.48	65.3
Subcarpathians	16,509	6.90	6.8	214.0	111.2	3.51	8.7
Transylvanian Depression	25,028	10.53	3.4	107.1	84.9	2.68	6.7
Crişana and Banat Hills	12,210	5.14	4.7	144.1	55.8	1.76	4.4
Mehedinţi Plateau	785	0.33	9.3	293.0	7.3	0.23	0.6
Getic Tableland	12,942	5.45	3.7	116.0	47.5	1.50	3.8
Moldavian Plateau	23,088	9.75	2.1	67.1	49.1	1.55	3.8
Dobrogea Plateau	10,530	4.35	0.3	14.2	4.7	0.15	0.4
Banat and Crişana Plain	16,497	6.95	1.5	49.1	25.7	0.81	2.0
Romanian Plain	46,271	19.47	1.2	39.4	57.7	1.82	4.6
Danube lakes	3,322	1.40	0.5	18.1	1.9	0.06	0.1
Danube Delta	3,510	1.43	0.5	14.7	1.6	0.05	0.1
Razim-Sinoie Lake Complex	920	0.39	0.4	21.7	0.3	0.01	0.04
Mountain region	66,702	27.98	12.6	399.4	839.1	26.48	65.3
Hill region	101,092	42.41	3.6	112.9	360.5	11.38	28.0
Plain region	70,597	29.61	1.2	39.2	87.2	2.75	6.7
Total ROMANIA	**238,391**	**100.0**	**5.4**	**171. 0**	**1286.2**	**40.61**	**100.0**

➢ In the mountain region, which occupies only 27.9% of the Romanian territory, 65.3% (26.48 billion m^3 from a total of 40.61 billion m^3) of the water is formed and regenerated every year;

➢ In the hill region, which includes the Subcarpathians, the tablelands and the piedmont hills, and occupies 42.4% of Romania's territory, only 28.0% of the water volume is formed (11.38 billion m^3), of which 8.7% (3.51 billion m^3) in the Subcarpathians and 19.4% (7.87 billion m^3) in the other two units;

➢ In the plain region, inclusive of the Danube Delta,which covers 29.7% of the country's territory, the water volume formed there is small (6.7%), because the discharge module is low: under 2 l/s km^2 in the Crişana and Banat Plain and around 1 l/s km^2 in the Romanian Plain.

➢ The biggest disparity shows the Dobrogea Plateau. It occupies 4.35% of Romania's surface area, but produces a water volume of only 0.4. It appears that the relief units located in the moisture-deficient area, where there is a great demand of water for irrugation, drinking and industry, are poor in surface resources (Table 1).

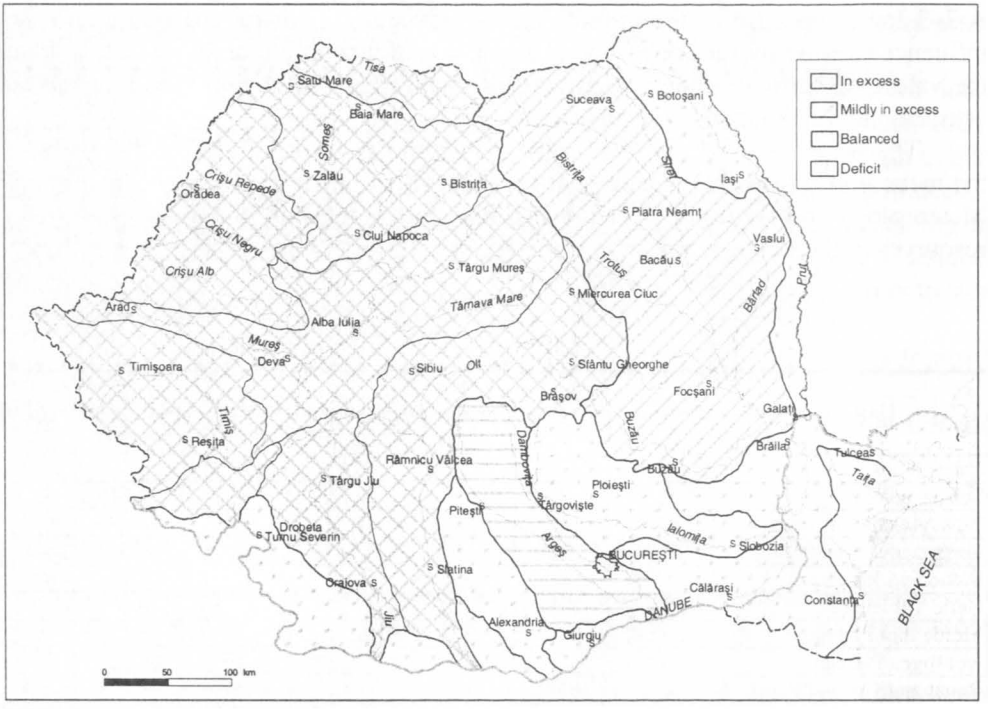

Fig. 1 – Water resources by hydrographic basins.

Water resources by drainage basins. Similar to the main relief units, 1st-order basins present quantitative disparities due to their distinct altitude location. Although must of them are found on all the altitude steps (mountains, hills and plains), yet their coverage is the highest in the hills and plains.

Depending on the percentage of drainage basins within the three relief steps and their exposure to the circulation of the air masses, one finds differences in the liquid flow value (liquid flow module: l/sec km^2) and ultimately in the water volume.

Drainage basins situated in the mountain region and exposed to the advection of west and north-west masses of air are, among others, the upper course of the Tisa (17.1 l/s km^2) which, together with the Vişeu its tributary, reaches 20.8 l/s km^2 towards the junction area (Bistra Hydrometric Post), and the Arieş at Câmpeni (19.6 l/s km^2). Likewise is the Cerna basin with 17.5l/s km^2 at its mouth (Orşova).

There are other basins, outside the geographical area of influence of western air masses, which in some cases are only partly located in the mountain zone, but their discharge module is fairly elevated. For exemple, the Jiu at Iscroni registers 22.3 l /s km^2, the Râul Doamnei at Bahna Rusului, 25.6 l /s km^2, the Râul Târgului at Apa Sărată, 22.2 l /s km^2, and the Lotru at Gura Latoriţei, 20.4 l /s km^2. When this analysis takes into account ever smaller basins situated in the mountain region the liquid flow value is seen to increase (over 20 l /s km^2).

Table 2

Water resources by drainage basins in terms of socio-human demand.

No	Basin name	Surface waters				Ground waters (mill m^3/year)	Total resources mill. m^3/an	No. Inh. (thous)/water volume (m^3)	Total demand (mill. m^3) / demand cap/y (m^3)	Water resources in terms of demand
		Area km^2	Annual mean volume mill. m^3	Annual mean discharge m^3/s	Mean specific discharge $l/s.km^2$					
1	Tisa sup.	4,540	2,509	79.5	17.5	132	2,641	300 / 8,800	120/400	in excess
2	Someş + Crasna	17,840	3,920	124.2	7.0	363	4,283	1,525/2,800	2,200/1,450	in excess
3	Crişuri + Barcău	14,860	2,957	93.7	6.3	832	3,789	1,100 / 3,444	1,300/1,182	in excess
4	Mureş + Aranca	29,390	5,898	186.9	6.3	776	6,674	2,450 / 2,720	4,300/1,755	in excess
5	Bega + Timiş + Caraş	13,060	2,187	69.3	5.3	765	2,952	1,000 / 2,952	1,600/1,600	in excess
6	Nera + Cerna	2,740	1,256	39.8	14.5	84	1,340	100 / 13,400	300/300	in excess
7	Jiu	10,080	2,944	93.3	9.2	706	3,650	1,200 / 3,042	1,900/1,583	in excess
8	Olt	24,050	5,832	184.8	7.7	1,137	6,969	2,400 / 2,904	3,500/1,458	in excess
9	Vedea	5,430	391	12.4	2.3	350	741	500 / 1,482	1,000/2,000	deficit
10	Argeş	12,550	2,313	73.3	5.8	1,017	3,330	3,100 / 1,074	3,200/1,032	balanced
11	Ialomiţa	10,990	1,515	48.0	4.6	634	2,149	1,100 / 1,954	3,000/2,727	deficit
12	Siret	42,890	7,420	235.1	505	1,618	9,038	4,325 / 2,090	6,700/1,618	mildly in excess
13	Prut[1]	10,990	577	18.3	1.7	214	791	1,100 / 719	1,400/1,272	deficit
14	Secondary tributaries in this Danube sector	33,250	789	25.0	0.7	2,848	3,637	2,300 / 1,581	10,500/4,565	deficit
15	Black Sea coast	5,480	63	2.0	0.4	209	272	500 / 544	1,500/3,000	deficit
16	Total	238,391	40,571	1,285.6	6.3	11,685	52,256	23,000 / 2,272[2]	42,500/1,850	mildly in excess

[1] Figures refer to the Prut Basin in Romanian territory

[2] Provided the whole inland river water (less the Danube water) and ground water are used

Large drainage basins with a balanced extension on the relief steps, have a specific discharge at the mouth, or on the borderline (if running into neighbouring countries) of 6–12 l/s km^2 (the Someș at Satu Mare – 8.6 l/s km^2, the Crișul Repede at Oradea – 12.0 l/s km^2, the Crișul Negru at Zerind – 11.9 l/s km^2, the Mureș at Arad – 6.8 l/s km^2, the Jiu at Podari – 10.2 l/s km^2, and the Olt at its mouth – 7.7 l/s km^2.

The basins extending mostly in the hills and plains, regions occasionally influenced by the east- continental advections, register a specific discharge under 6 l/s km^2 (the Argeș at its mouth – 5.8 l/s km^2, the Ialomița at Slobozia – 4.99 l/s km^2 and the Siret at Lungoci – 5.57 l/s km^2).

The basins situated in hill and plain areas have the lowest specific discharge – under 3 l/s km^2 (the Bega – 2.9 l/s km^2, the Vedea – 2.1 l/s km^2, the Drincea – 1.4 l/s km^2, the Desnățui – 1.2 l/s km^2, the Călmățui – Brăila – 0.9 l/s km^2, the Bârlad – 0.9 l/s km^2, and the Jijia – 1.01 l/s km^2).

Values in the Dobrogea Plateau run under 1 l/s km^2 (the Telița – 0.8 l/s km^2, the Taița – 0.6 l/s km^2, the Casimcea – 0.7 l/s km^2 and the Slava – 0.6 l/s km^2).

A relevant image of water resources in drainage basins was obtained by referring them to the number of inhabitants and comsumption / capita in the year 2000. The results represent estimative figures varying from one year to the other in terms of demographic increases or decreases, the inclusion or elimination of some water comsumers from the system, the modernisation of drinking water supply systems and of technological processes.

Calculations concerning total resource and demand had in view both surface waters and ground waters.

Besides, estimations took into account all resources not only those having a technological and economic management potential. What was left out from these calculations was the River Danube and its 30–70 billion m^3, usable under conventions concluded with the riparian countries. A classification of drainage basins is feasible by looking at the hydrological parameters, at resources and demand (Table 2, Fig. 1) and referring the overall resource /capita to demand/ capita. This ratio may take on the following values: excessive, mildly excessive, balanced and deficitary.

In view of the above criteria, the map of 1st-order drainage basins offered two important conclusions:

- first, drainage basins facing the west have resources in excess of present demand, therefore the surplus can by shifted to another basin which is, or may become, deficitary in this respect;
- second, labelling a basin in excess of or in deficit of demand depends on the degree of human and technological load, that is, on the demand for water which shows temporal variations.

As a result, some basins located in the east of Romania, e.g. the Siret, fall into the category of resources mildly in excess of demand. Obviously, this grouping also depends on how reliable the information concerning the water consumers, mainly the industrial and agricultural ones, actully are.

Even a general, all-country assessment of the resource/ demand relation which is mildly excessive, has in our opinion but a relative, orientational value (Table 2 and Fig. 1).

Water resources by county.Assessing the resources of water in these administrative units is more difficult than estimating them in the big relief steps and in the drainage basins.

While calculations for the big relief steps focused on the mean specific discharge in surface waters (flow module) when it came to counties, the highlight fell on the autochthonous hydrographic basins and their fluid discharge. In the case of dranaige basins that extent into several counties (which is the ordinary situation), calculation look into account only a certain quantity supposed to form on the territory of the respective county.

The approach was pretty similar to the ground water resources one, namely only the quota pertaining to the respective county was taken into consideration from the maps of water structure and the flow module.

Water is an important part of the counties' economic and social development. Sufficient water resources are considerably diminishing investments to fetch it from a longer or shorter distance. In the case of ground water, there are situations when the distance to the supply point is fairly long. In Craiova city, for example, water is brought from the karst springs, as far as 115 km away; in the city of Iaşi water is pumped in from the gravels of the Moldova floodplain at Timişeşti, that is 80 km away, and the string of examples could continue.

However, a slight compensation between surface and subsurface water resources does exist. If the mountain zone has plenty of surface waters, tablands and plains (the Romanian Plain-Dobrogea) have significant ground water resources.

Yet, for all this compensation, the territorial spread of water resources is anything but balanced. Therefore the construction of storage-lakes to allow the distant supply of some localities (we would refrain from saying of the whole county) is still a necessity and a topical issue.

Meeting the water demand in a satisfactory manner could be achieved by inter-basin transfer, that is, from the rich hydrographic networks to those with a lower discharge.

Another method used in some countries is to inject into rock (sands, gravels) some water volumes in excess, or formed in periods of maximum discharge (e.g. high spring waters) and have them available for consumption.

Table 3

Water resources by county.

No.	County name	Surface area (km^2)	No. inhabitants (1999)	Ground water (mill m^3/y)	Surface water (mill m^3/y)	Total water resources	Water resources/ capita (m^3/y)	County picture of water resource
1	Alba	6,242	397,713	107.4	1,349.9	1,457.3	3,664.2	mildly in excess
2	Arad	7,754	476,624	539.8	774.5	1,314.3	2,757.5	balanced
3	Argeş	6,826	673,153	141.0	1,785.2	1,926.2	2,861.4	balanced
4	Bacău	6,621	750,777	245.6	1,052.3	1,297.9	1,728.7	mild deficit
5	Bihor	7,544	621,760	401.2	1,899.7	2,300.9	3,700.6	mildly in excess
6	Bistriţa-Năsăud	5,355	325,879	41.1	1,801.4	1,842.5	5,653.9	in excess
7	Botoşani	4,986	462,976	56.2	1,324.4	1,380.6	2,982.0	balanced
8	Braşov	5,363	630,744	267.6	1,238.7	1,506.3	2,388.1	mild deficit
9	Brăila	4,766	387,070	522.2	64.9	587.1	1,516.7	mild deficit
10	Buzău	6,103	505,280	278.7	928.5	1,207.2	2,389.1	mild deficit
11	Caraş-Severin	8,520	355,664	159.2	2,727.6	2,886.8	8,116.6	in excess
12	Călăraşi	5,088	331,368	562.5	215.3	777.8	2,347.2	mild deficit
13	Cluj	6,674	422,891	63.5	1,158.8	1,222.3	1,690.8	mild deficit
14	Constanţa	7,071	745,954	354.3	19.7	374.0	501.3	deficit
15	Covasna	3,710	230,542	117.8	729.3	847.1	3,674.3	mildly in excess
16	Dâmboviţa	4,054	552,271	252.4	497.8	750.2	1,358.3	deficit
17	Dolj	7,414	745,204	833.3	356.6	1,189.9	1,596.7	mild deficit
18	Galaţi	4,466	642,943	322.5	121.6	444.1	690.7	deficit
19	Giurgiu	3,526	295,401	497.3	206.0	703.3	2,380.8	mild deficit
20	Gorj	5,602	395,099	219.1	1,691.4	1,910.5	4,835.4	mildly in excess
21	Harghita	6,639	342,128	144.6	875.3	1,019.9	2,981.0	balanced
22	Hunedoara	7,063	526,834	64.5	2,750.7	2,815.2	5,346.6	mildly in excess
23	Ialomiţa	4,453	304,690	437.3	215.3	652.6	2,141.8	mild deficit
24	Iaşi	5,476	833,388	127.7	194.5	322.2	386.6	deficit
25	Maramureş	6,304	531,786	82.1	2,883.0	2,965.1	5,575.7	in excess
26	Mehedinţi	4,933	323,486	327.7	586.9	914.6	2,827.3	balanced

(continues)

Table 3 (continued)

27	Mureş	6,714	601,552	152.3	1,484.2	1,636.5	2,720.4	balanced
28	Neamţ	5,896	585,746	180.7	971.3	1,152.0	1,966.7	mild deficit
29	Olt	5,498	510,137	705.2	531.4	1,236.6	2,424.0	mild deficit
30	Prahova	4,716	857,761	232.7	908.8	1,141.5	1,330.7	deficit
31	Satu-Mare	4,418	390,704	334.4	612.4	946.8	2,423.3	mild deficit
32	Sălaj	3,864	256,856	40.9	503.6	544.5	2,119.8	mild deficit
33	Sibiu	5,432	443,622	96.7	890.2	986.9	2,224.6	mild deficit
34	Suceava	8,553	715,228	141.0	2,874.6	3,015.6	4,216.2	mildly in excess
35	Teleorman	5,790	459,529	477.2	236.1	713.3	1,552.2	mild deficit
36	Timiş	8,697	687,377	763.9	828.8	1,592.7	2,317.0	mild deficit
37	Tulcea	8,499	264,175	503	20.8	523.8	1,982.7	mild deficit
38	Vaslui	5,318	465,008	129.7	219.9	349.6	751.8	deficit
39	Vâlcea	5,765	431,328	163.8	2,433.5	2,597.3	6,021.6	in excess
40	Vrancea	4,857	391,205	392.5	614.7	1,007.2	2,574.6	balanced
41	Ilfov+ Bucureşti	1,821	2,286,129	204.5	106.5	311.0	136.0	deficit
Total		238,391	22,460,042	11,695.1	40,685.0	52,380.1	2,332.1	mild deficit

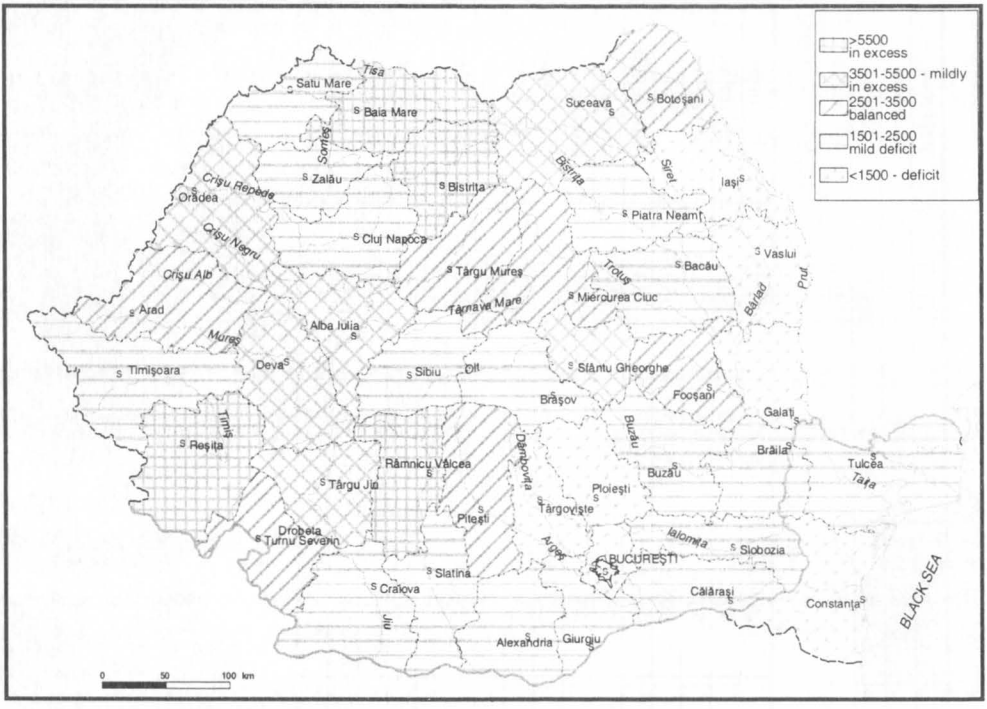

Fig. 2 – Water resources by county.

The map and table of water resources by county indicate a heterogeneous relation between major relief units and their hydrological potential, given the distinctively different number of inhabitants, which accounts for the greater or lesser demand of water for drinking, industry, irrigation and other uses.

One would hardly find water – deficient counties in the Carpathian and the Subcarpathian zones, or in the west of Romanian for that matter. Deficits or mild deficits are common to the counties situated mainly in the east and the south of Romania (Iași, Vaslui, Galați, Constanța, Brăila, Ialomița, Călărași, Dolj, Olt, Teleorman, and Giurgiu), but also Prahova and Dâmbovița, which dispute location in the mountain, hill and plain region, and have a numerous population. A similar situation have Bucharest and Ilfov County it lies in, which for all the rich subterranean resources, have a deficit because they, too, have a very large population.

A special case makes the county of Botoșani, bordered on the west and east by two major drainage basins: the Siret and the Prut. Moreover, compared to other counties, it has a lower, largely rural, population.

Summing up, we would say that the situation of water resources by county has only orientational relevance, it reflecting the current state-of-the-art and providing some ideas for projects focusing on prospective solutions to the water demand (Fig. 2 and Table 3).

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USE OF WATER RESOURCES IN THE SOUTHERN CARPATHIANS

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Utilisation des ressources d'eau dans les Carpates Méridionales. Les auteurs font une brève présentation des particularités morphométriques et climatiques qui expliquent la distribution des ressources d'eau dans le temps et dans l'espace. Les Carpates Méridionales couvrent 6% du territoire de la Roumanie et assurent 9,18 milliards d'eau, ce qui représentent 22,5% du volume total de la quantité d'eau comprise dans les rivières intérieures du pays. On mentionne les principales structures hydroénergétiques existantes dans chaque bassin hydrographique. On insiste sur les premières constructions de la région dans cet endroit, par exemple, la première localité électrifiée (Topleţ, 1893), les premiers tuyaux installés à Topleţ, le premier barrage d'enrochements édifié en Roumanie entre 1938 et 1940 pour l'usine hydroélectrique Sadu-Bumbeşti, le premier barrage voûte en béton haut de 62 m (Negovanu, monts de Cindrel), construit entre 1958-1961, le système hydroénergétique de Lotru, le plus puissant des rivières intérieures du pays etc. Afin d'utiliser le potentiel hydroénergétique des Carpathes Méridionales, on a réalisé 350 km de conduites et de galeries, plus de 30 retenues et usines hydroélectriques, ayant au total une puissance installée de plus de 2600 MW.

The Southern Carpathians unfold between the Prahova Valley in the east and the Timiş-Cerna Corridor in the west, cover some 15,332 km^2, are 250 km long and of variable width (50–70 km).

Precipitations, both liquid and solid, register over 1,400 mm on the highest summits, gradually decreasing with the vertical zonality, at 700–800 mm in the Olt Valley and the marginal depressions and from west to east at equivalent altitudes, in terms of temporal distribution, in the cold season the snow layer represents an important water reserve that progressively melts in the spring-summer interval, contributing, to a rich discharge during the high water flows characteristic of this period. Another particularity of the rain regime is the small lapse between rain spells, thus replenishing the ground water amount swiftly list in-between these spells. The rain regime rebalances the water regime, attenuating differences between maximum and minimum values. On the mountain tops watercourses are supplied by snow-rain falls (50–60% coming from snow) and rain-snow on the other relief

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steps (40–50% snow-related supply). A distribution of water resources by altitude steps reveals that 66.2% originate from heights between 1,000 and 2,000 m, 28% from below 1,000 m and only 5.8% from above 2,000 m (Zăvoianu *et al.*, 1999)

Mean specific discharge in the Southern Carpathians is obviously related to vertical zonality: 40–50 l/sec. km^2 at top heights and ca 10 l/sec. km^2 at lower altitudes. The highest value obtained from direct measurements was 52.8 l/sec. km^2 on the Porumbacu River, at Negoiu Chalet (average alt. 1,872 m). The other rivers on the northern slope of the Făgăraş Mts. (over 1,400 average alt.) register over 45 l/sec. km^2 . Elevated mean specific discharge values (42 l/sec. km^2) have also the Lăpuşnicul Mare, Râul Mare and Râul Şes in the Retezat Massif, the case of drainage basins situated at average altitudes of 1,700 m.

The overall flow rate of 291 m^3/sec. (9.09 billion m^3) in this unit amounts to about 22.7% of the water volume of Romania's rivers, despite the Southern Carpathians representing 6.45% of the country's surface-area. Mean specific discharge for the whole area is of 17.2 l/sec. km^2. Noteworthy, this water volume comes from a large number of rivers with small and very small drainage basins. Only a few of the watercourses draining this area have higher flows, e.g. the Jiu at Bozii Vineţi: basin area 1,115 km^2, average altitude 1,081 m and flow rate 21.6 m^3/sec; the Strei, 20 m^3/sec; the Lotru 18m^3/sec, mean specific discharge 19.5 l/sec. km^2; the Dâmboviţa, 10 m^3/sec, the other watercourses have much smaller discharges.

The high water flows, of very good quality, and their low turbidity (under 0.5 g/l) due to the step slopes, confer this mountainous unit a remarkably water power potential used in the course of history in keeping, with the technological means of each epoch.

The use of hydropower potential started being used as early as the 2nd–3rd cc AD, when the mill, the grandmother of modern turbines, was in use. A specimen of that mill is operated at the Museum of Technological History in München – Germany. Apart from mills, the power of waters was widely used for, and paper mills, at Sibiu and Tălmaciu near Brasov 16th cent., (1603), at Călimăneşti (in 1646), etc. An inventory made by Dorin Pavel in 1927 on the Sebeş River, indicates 28 water-wheels, saws and *pive*. Estimations made in 1930 pointed to the existence of some 50,000 mills and other hydromechanical devices in Romania.

The first water-power station in the Southern Carpathians and the second one in Romania, was built at Caransebeş, on the Sebeş River, in 1889, in the stead of a power mill, head of water 4.1 m and a 100 HP turbine station (Pop, 1996). In 1892, a hydroelectric power station was commissioned at Băile Herculane, with a 2 m high and a 20 m span spillway, extended into a 900 m canal, transport capacity 6 m^3/sec. The head of water at its end was of 10.4 m, the two turbines delivered 260 kW. In 1908, the plant was extended and updated, its output being of 500 kW. In 1893 the first tailrase in Romania, head of water 24 m, produced at Topleţ were obtained through capture of the Bârza River. Topleţ thus becomes the first electrified commune in Romania (1893). At the end of the 19th century (1896) a new station, Sadu I, began operating supplying electricity to Sibiu town and Cisnădie settlement. In 1897, its capacity was extended and modernised. The plant is still functioning (installed power 0.7 MW).

In 1897, a water-power station was built on the Peleş River (70 HP turbine) to supply the Peleş Castle (Sinaia). It was followed in 1898 by Sinaia I (1 MW) and in 1912 by Sinaia II. In 1907, at 5 km upstream Sadu I, with a 13.5 m dam was erected Sadu II plant (1.28 MW) are still in operation.

In the first half of the 20th century several hydro power stations were commissioned: at Râşnov I (1911), Fieni (1923), Brezoi (1925) and Dobreşti (1929–1930), the last one being supplied from the Scropoasa Reservoir through a 2 km feed pipe, and from Brătei Lake by a 3.5 km culvert and a forcing pipe of 683 m. In 1936, "Mărul" power station, on the Bistra Mărului River was ready. It was provided with a 4 m dam, a 5.3 km feed pipe; head of water 94 m (*Construcţii hidroenergetice*, 1990).

The first rock dam in Romania, 17 m high, was built (1938–1940) on the Sadu River (Southern Carpathians) for the Sadu-Bumbeşti water-power station. The Novaci station (650 kW) on the Gilort River, was built in 1938, head of water at the dam 48 m.

The hydroelectrical structures put in place between 1888 and 1938 had a total installed power of 48 MW, most of which came from Southern Carpathian stations. The Ialomiţa Valley alone delivered 17.2 MW (i.e. 35.9%). All these constructions had no spectacular impact on the discharge regime and the drainage network.

The second half of the 20th century was the peak period of water constructions in Romania, with remarkable achievements. Most structures were located in the Southern Carpathians. Here there were more numerous storage lakes, water power plants, concrete-sheltered culverts and galleries than in similar relief units elsewhere in Romania.

Creating storage lakes in an area where autochthonous rivers had a low discharge, it was necessary to capture the adjoining streams, a situation that substantially altered the flow regime of all the captured rivers.

The Mureş basin in the Southern Carpathian sector and its hydro power structures in the Sebeş and Râul Mare basins. The high hydroelectrical potential of the Sebeş was reported by Dorin Pavel in 1927. He suggested the construction of eight hydro power stations with an installed power of 100 MW . After numerous studies, works began in 1972, when a 91 m dam was erected. The lake Oaşa formed behind it had a 136 million m^3 of water. River discharge in the dam section was of 4.1 m^3/sec, reception basin 188 km^2, and mean specific discharge of 22 l/sec km^2. With a view to supplementing the water volume in the lake, the righthandside tributary – the Ciban, was captured by a 5.77 km gallery. An 8.5 km culvert carried the lake waters to Gâlceag plant; on the way, the head of water reaches 465 m. The waters of the Prigoaia, Cugirul Mic, Cugirul Mare and Gâlceag brooks flow through gravitation into an 11.3 km feed pipe. These secondary feed pipes supplement the discharge by 4.2 m^3/sec with waters collected from an area of 207 km^2. The waters are flown from the water-power plant (150 MW) back into the mainstream, entering Lake Tău formed behind a 78 m concrete dam situated at 940 m alt. An 8.2 km-long gallery directs the lake waters to Şugag station (150 MW).

In order to supplement discharge, before reaching the station, the waters of the captured Şugag, Şalău and Dobra brooks are flown through a 7.3 km feed pipe at a rate of 1.2 m^3/sec. From Şugag hydro power station, the waters run through a spillway tunnel into the Obrejii de Căpâlna Lake, and farther on, through a 4.5 km culvert, a head of water of 108 m spans the distance to Săsciori plant (42 MW), commissioned in 1987. Another spillway tunnel (3.7 km) carries the waste waters to Petreşti Lake and the homonymous water-power station (4 MW), wherefrom they flow into the mainstream, running freely to the junction with the Mureş River (Fig. 1).

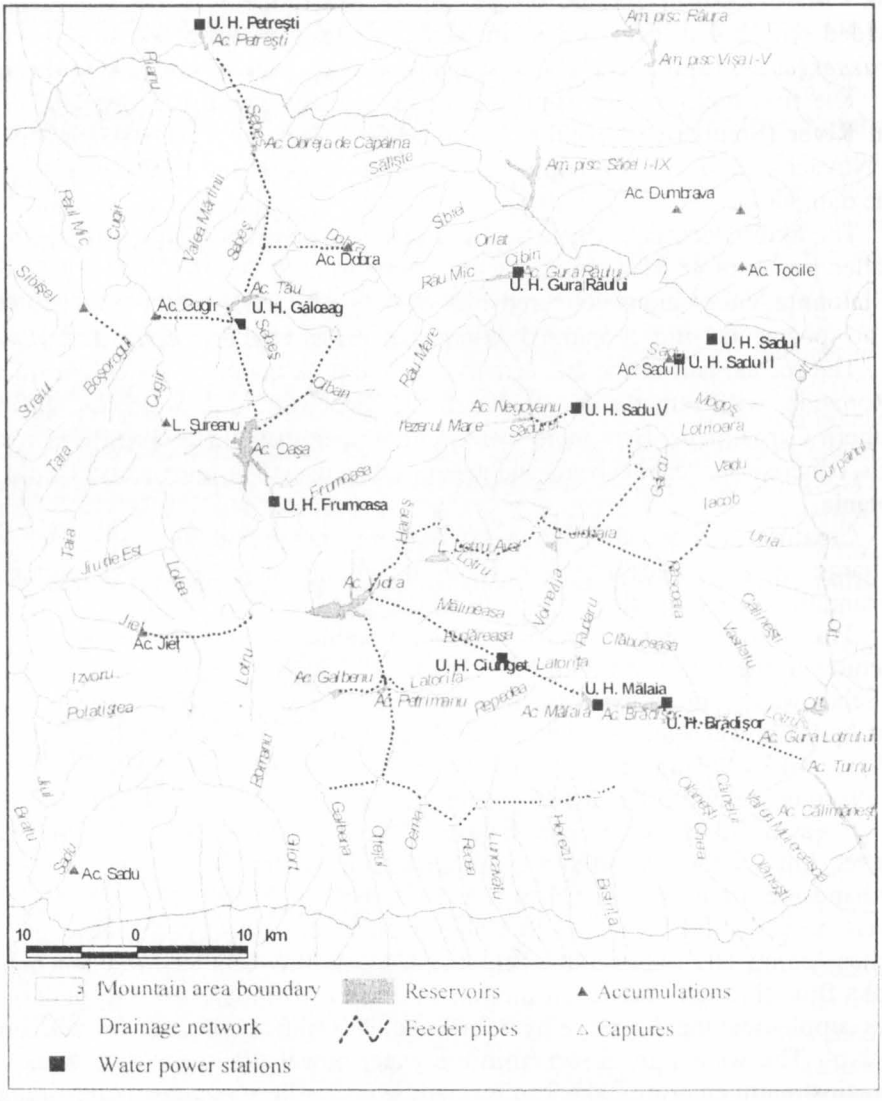

Fig. 1 – Water-power systems of the Olt, Cibin, Sebeş, Sadu and Lotru rivers.

The Sebeş hydroelectrical system comprises 57 tunnels and culverts, four storage lakes (totalling 156 mill. m^3 of water), covering over 6 km^2 and four water-power stations (346.2 MW). Beside, the region's dwelling-houses were modernised and roads were built to boost tourism in the area.

The Râul Mare – Retezat hydroelectrical system uses the hydro power potential put to advantage by the steep and elevated mean specific discharge. The 168 m high earth dam built downstream the Lăpuşnicul Mare/Şesul junction, developed a reservoir behind it a water volume of 220 mill. m^3. It is operational since 1987. This lake volume is maintained by the input of the two above rivers (15 m^3/sec) and by the capture of all of the Strei tributaries from the northern flank of the Retezat Massif. Secondary captures begin from the Râul Bărbat and continue with the Râul Alb, Paroş, Nucşoara, Râuşor, Zlata, Zlătuia and Radeş, brought together in a 29,3 km feed pipe, supplementing the flow rate by 10 m^3/sec (Fig. 2). A principal culvert (18.4 km) extends from the reservoir on the lefthandside of the Râul Mare to Brazi plant (335 MW) where the head of water reaches 582 m. Along this trajectory, the discharge is supplemented by the capture of the lefthandsides tributaries: the Netiş, Bodu and Valea Mare. Downstream, the waters are retained by another three storage lakes (Ostrovul Mic, Pâclişa and Haţeg) with small volumes and run on through ten water-power stations – Clopotiva (1), Ostrovul Mic (2), Ostrov (3), Cârneşti I (4), Cârneşti II (5), Pâclişa (6), Toteşti I (7), Toteşti II (8), Haţeg (9) and Sântămăria–Orlea (10) – totaling 148.9 MW (Fig. 2) (*Construcţii hidroenergetice*, 1990).

The Timiş–Bistra hydroelectrical power system puts to account the water power from the western side of the Ţarcu Mts, with steep slopes and rich flows. A 95 m concrete arched dam was built in the upper course of the Timiş River, downstream the Râul Mare/Hideg junction. Behind it stands Poiana Ruscă storage lake (35 mill. m^3). Increasing its volume meant capturing the upper courses of the Râul Lung and the Râul Alb by a 9.8 km feed pipe. A principal 4.4 km culvert directs the waters to the Râul Alb plant (40 MW). Used waters are spilled into the Râul Alb, in the Feneş and the Timiş rivers (Fig. 2).

Another important water plant is Poiana Mărului. It comprises a 125 m earth dam section and a reservoir of 96 mill. m^3 of water. The 12.3 m^3/sec river flow at the dyke is obtained from the Bistra Mărului River and the derivation of the upper courses of the Bistra and the Nemeş. From the Poiana Mărului Lake the water is flown to Ruieni plant (140 MW) through a principal feed pipe long of 10 km. A 2.7 km spillway tunnel carries them from Ruieni plant to Lake Zerveşti and the homonymous power station (6 MW). The whole system is scheduled to have three principal culverts (23.6 km), three tailrices (3.6 km) and five secondary feed pipes (89.2 km), installed power 266 MW.

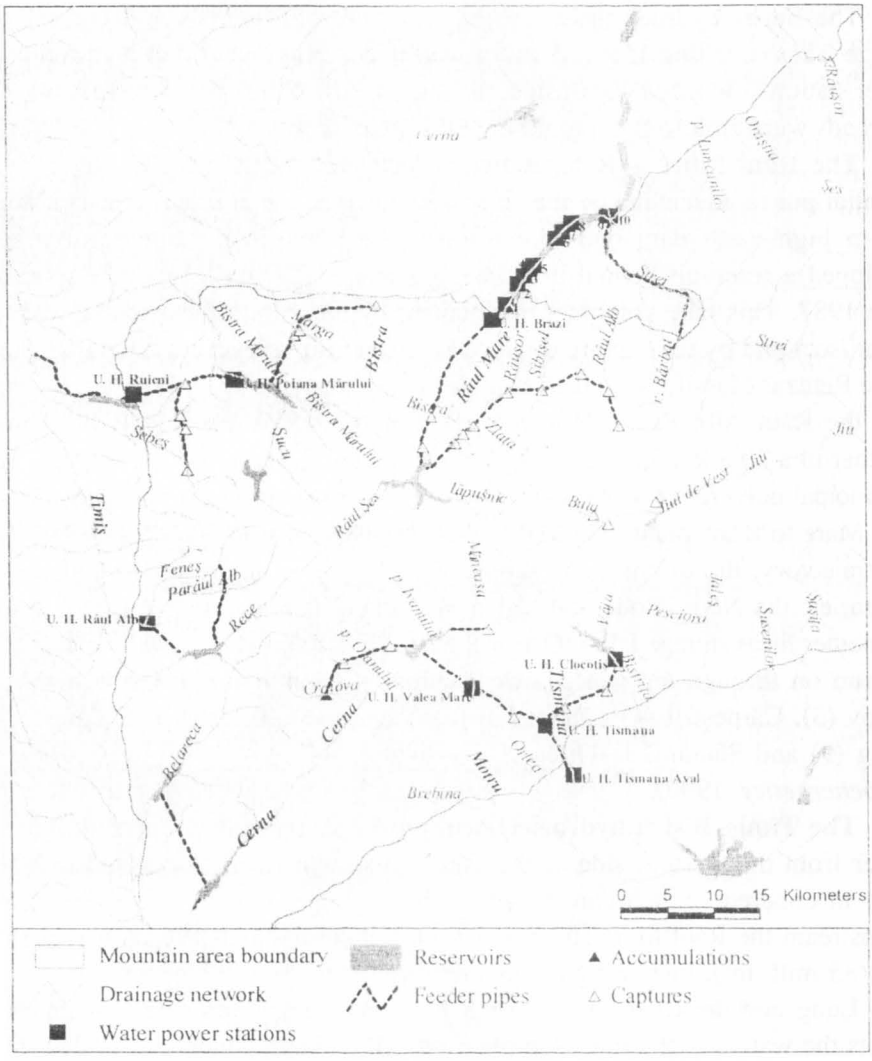

Fig. 2 – Hydroenergy constructions Râul Mare–Retezat, Timiş–Bistra and Cerna–Motru–Tismana.

The Cerna – Motru – Tismana system has been created to supply electric power and supplement flow rates on the middle and the lower course of the Jiu River. To this end, a earth dam (Valea lui Iovan) was built on the Cerna River, downstream Cerna Sat Village, in the Lunca Largă point, where the river discharge reaches 5.8 m^3/sec. The lake contains 124 mill. m^3 of water. Discharges were supplemented with 4.2 m^3/sec by the capture of the righthandside tributaries of the Cerna (Craiova, Olanu, Balmez and Iovan), and of the upper course of the Motru through culverts long of 12.4 km and 3 km, respectively. From the lake Valea lui Iovan through a feed pipe long of 5,93 km, the water coming to the Motru Valley at

Motru hydro power station (50 MW). Then over by the 8.58 km. Motru – Tismana feed pipe, which gathers the waters of the captured Pocruia River. Before reaching Tismana hydro power plant (106 MW), flow rates are supplemented by the Bistrița – Tismana culvert (11.4 km) with waters coming from Lake Vâja, formed behind a 93 m high earth dam. A 1.9 km feed pipe runs from the lake to Clocotiș plant (10 MW) and the Valea Mare lake, wherefrom the waters are flown into the Bistrița – Tismana culvert which gathers also the waters captured from the Bistricioara, Tismănița and Tismana rivers (4.2 m^3/sec). From the plant, a 5.3 km spillway tunnel reaches Lake Tismana and Tismana–Aval hydro power plant (3 MW). Next, the waters flow into a canal dug along the former course of the Tismana down to the Jiu River (Pop, 1996).

Again on the Cerna River, a 58.5 m concrete dam was erected at some 5 km upstream Băile Herculane spa-resort, forming a reservoir that supplies the water-power station (34 MW) and the water demand of downstream localities. In order to supplement the lake water volume, a dam was built on the Belareca River. From the Lake Cornereva behind it, a feed pipe adds to the Herculane Lake volume (Fig. 2).

In the upper basin of the Jiu River, a dam (56 m high) and a storage-lake (Valea de Pești) were built on the homonymous righthandside tributary of the Jiu. Lake waters are used to meet the water demand of settlements in the Petroșani Basin.

In the **Olt Basin,** in the sector afferent to the Southern Carpathians, one finds storage-lakes on the mainstream and on the major tributaries. On the mainstream: at Turnu and Călimănești totalling 108 MW installed power in the respective stations.

On the **Cibin River,** a 73.5 m dam was raised at Gura Râului, the lake behind it has a capacity of 17.5 mill. m^3 of water, delivering 3.5 MW to Sibiu City and meeting its water demand.

On the **Sadu River,** beside the existing hydroelectrical stations, there is the Negovanu dam, the first concrete arched dam (62 m) in Romania, built over the 1958–1961 period. From the dam to Sadu IV station the water flows through a 5.4 km feed pipe set in rock, head of water between lake and plant (26 MW) is 402 m. All the three storing plants on the Sadu River produce 29.9 MW (Fig. 1).

On the **Lotru River,** the Ciunget hydro power station has a good position to increase the quantity of electrical energy. The capacity of the reservoir behind the 121 m rock dyke is 340 mill m^3, in the section where the multiannual average discharge on the Lotru was of 4.12 m^3/sec. Since conditions proved propicious to building the highest head of water in Romania (735 m from lake to plant), the discharge to the lake was to be supplemented by several water captures – basically the tributaries from the southern side of the Căpățânii Mts, in the Bistrița (east) – Galbenu (west) sector. Their flow rate reached 5.61 m^3/sec, culvert length 60.1 km. After being captured the waters are flown to Lake Petrimanu on the Latorița, downstream Lake Galbenu, which retains the waters from the upper course of the river. After catching other lefthandside tributaries of the Latorița, the waters are directed to the Vidra Lake after having passed through Petrimanu pumping station. In the north, the 34 captures included, among others, the lefthandside tributaries of

the Lotru between dam and mouth, plus the Uria and Găujani brooks, together with the tributaries from the upper course of the Latorița. The discharge of these captures was of 4.57 m^3/sec, entrained by gravitation into 61.7 km of feed pipes. This sector also has two pumping stations, Lotru-Aval and Jidoaia, pumping into the culverts the waters collected by the Lotru between the dam and the station and the waters of the Voineșița River between captures and Jidoaia station. In addition, the Lotru discharge is supplemented from the upper basin of the Jieț by eight captures and 10.3 km of feed pipes and 1.3 m^3/sec. All these water catchings raise the flow rate to the Vidra Lake at 15.7 m^3/sec, while the direct capture of the Noapteș, Mănăileasa and Rudăreasa brooks into the principal culvert adds another 2.8 m^3/sec, the final value being 18.5 m^3/sec.

The principal culvert (13.5 km) goes from the lake to the plant (flow-rate 80 m^3/sec). The head of water from lake to plant is 735 m, installed power 510 MW (three turbines of 170 MW each). From the plant, the waters run through a tailrace into Lake Mălaia formed behind a 31 m high concrete arched dam. After passing through Mălaia hydroelectrical plant (18 MW), the waters resume their natural channel up to Brădișor Lake. From the homonymous plant (115 MW), a spillway tunnel (13.2 km) dug under to mountain at Cârligu Mare directs them into the Olt River. The construction of the three water-power stations (Ciunget, Mălaia and Brădișor) brings the Lotru basin installed power at 643 MW, putting Romania's hydroelectrical potential to best account (Pop, 1996).

By and large, the Lotru system contains 132.1 km of galleries for secondary captures, of which 60 km are concrete sheltered, four arched dams and three pumping stations. Together with the principal culvert and the tailraces, there is a total of 166.6 km of galleries, the system ranking among the largest worldwide.

Obviously its construction had a severe impact on the environment, and its changes in the landscape are seen to this day, e.g. waste dumps from the gallery diggings, increased Lotru water turbidity etc. The system has nevertheless contributed to controlling maximum discharge throughout the basin, flood waves being fully retained by the storage lakes with a total capacity of over 400 mill. m^3. The water table was extended to over 13 km^2, hence increasing evaporation during the warm season, in particular.

The water-power system of the upper Argeș River was developed to obtain electrical power, attenuate flood waves, deliver irrigation water and meet the water demand. A first step was to erect the 166 m high concrete arched dam (1966), one of the biggest in the world at that time. At its base, at 104 m below the Argeș bed, the first underground station in Romania (220 MW) was built at Cetățuia, head of water 324 m. The Vidraru Lake is supplied by the 7.55 m^3/sec flow of the Argeș tributaries and two main culverts (east and west) (Fig.3). From the east, a 18.9 km feed pipe captures the waters of the upper courses of the Râul Doamnei, Brad, Cernat, Vâlsan and Dobroneag, discharge 9.3 m^3/sec. An 8.7 km feed pipe from the west caught the Topolog, Valea lui Stan and Limpedea, adding

another 2.82 m^3/sec. These secondary captures (27.6 km) control an area of 743 km^2, the discharge to the lake rising to 19.7 m^3/sec. The reservoir built at Râuşor on the Târgu River, has a capacity of 52.8 mill. m^3 (*Construcţii hidroenergetice*, 1990).

The Pecineagu earth dam (105 m, useful water volume 62 mill. m^3) on the Dâmboviţa River was commissioned in 1986. It retains a discharge of 3.66 m^3/sec. from a basin area of 103 km^2. The lake waters flow to Clăbucet hydroelectrical plant (64 MW) through an 8 km feed pipe. Supplementing the lake's discharge required capturing the upper courses of the Argeşel, Râuşor and Dâmbovicioara (Fig. 3).

Utilising the water-power potential of the Southern Carpathian implied water constructional works over the time, *i.e.* more than 350 km of pipes and galleries, more than 30 reservoirs (storing an annual volume of 1.8 billion m^3) some of very great capacity, which is very important to contain floods and limit their destructive effects.

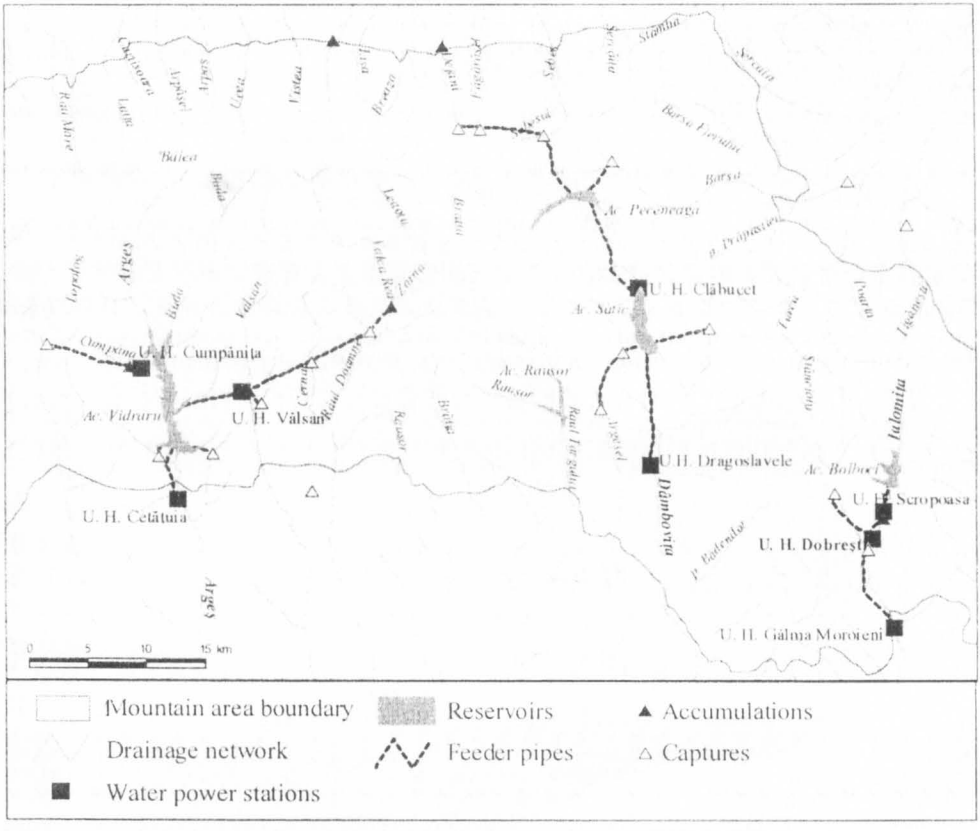

Fig. 3 – Water-power systems of the Upper Argeş, Dâmboviţa and Ialomiţa rivers.

By the big volume retained in storage lakes (about 20% of the annual discharge volume), the natural flow regime is substantively modified. The high floods on the mountain rivers retained by reservoirs, deplete maximum discharges downstream. In winter or summer, when waters are shallow, the quantities released from reservoirs increase minimum discharge, fact that attenuates extreme values, generally.

Although the water area of 125 km^2 represents only 1% of the unit's area, evaporation processes contribute to arising moisture values in the warm season.

The hydroelectrical systems created on the Southern Carpathian rivers with an installed power of 2,600 MW, beside controlling the discharge regime and being a water supply source to settlements, also substantially add to the national water-power system.

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THE FREEZE-THAW CYCLES FREQUENCY IN THE ROMANIAN CARPATHIANS

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Key words : gelivation, freeze-thaw cycle, solifluction, cryonivation, Romanian Carpathians.

La fréquence des cycles de gel-dégel dans les Carpates Roumaines. L'article traite l'éstimation du potentiel d'occurrence du cycle gel-dégel dans les Carpates Roumaines, en se basant de l'analyse de séries sur données des température des 27 stations meteo de montagne. Les phénomènes de météorisation par gel-dégel sont plus intenses au sein des montagnes et s'intensifie en altitude avec le nombre des cycles gel-dégel (c. – g.d.): Sinaia – 92,2 c. – g.d. (à 1510 m d' altitude), Babele – 96 c. – g.d. (à 2206 m), Vârful Omu – 104,7 (à 2504 m). Cette régle ne correspond plus aux depressions isolées et aux valées, à cause des inversions thermiques : Braşov – 101 c. – g.d. (à 504 m), Câmpulung Moldovenesc – 113,2 c. – g.d. (à 659 m) et Poiana Stampei – 124,2 c. – g.d. (à 920 m). L'effet dans la morphologie des montagnes des cycles gel-dégel est exprimé par les solifluxions sur les versants peu déclives. La couverture des bois protège les pentes, et en même temps les escarpements rocheux sont plus rares que dans les Tatras ou dans les Alpes. L'influence anthropique par le déboisement et les constructions a ouvert une voie de pénétration des cycles gel-dégel dans le sol et dans les roches. On a analysé les séries des données et on a établi la distribution temporelle et saisonnière des cycles gel-dégel dans les massifs montagneux . Les réprésentations graphiques couvrent la distribution spatio-temporelle des phénomènes dans toutes nos Carpates.

INTRODUCTION

The Romanian Carpathians join a category of mountains which reproduce at small scale the morphoclimatic characteristics of young mountains from the temperate zone.The Romanian Carpathians landscape is mainly the result of long-term developed freeze-thaw cycles (FTC) starting with the Pleistocene. The persistence in time of the cryonival processes is an argument for this assumption, though their intensity is much more reduced comparing with Pleistocene period. The absence of the glacio-nival altitudinal zone (Gerlach, 1970; Chardon, 1989; Bălteanu & Călin, 1996), well represented in the Alps or the Pyrenees, grants a note of originality to the morphoclimatic levels, standing out two altitudinal zones:

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the cryonival zone, and the fluvio-torrential zone, separated by the timberline (Posea, 2002). The extension of the periglacial domain, although limited to the highest altitudes, should not be simplified. In the Ice age of the Quaternary, this domain was more developed including all nivo-cryogene and cryo-nival subzones in the Carpathians (Posea *et al.*, 1974). Many processes still occur, even though the cryonival zone occupies the highest crests, peaks and plateaus (Starkel, 1968). Moreover, the human impact through grazing and, later, the mountain tourism have brought down its lower limit to about 1450–1600 m from 1700–1800 m. Some periglacial steepslopes are found at lower altitudes (even under 1000 m) as a proof of the Pleistocene periglacial processes, for instance in the Bârsa Mountains and the Bucegi Mountains, and they continue to evolve in the basin or isolated depression topoclimate conditions (Micalevich-Velcea, 1961; Grigore, 1981).

Using long-term meteorological data series, the great diversity of situations in the Carpathians requires a reconsideration of the opinion regarding the criergic potential of mountains from Romania, for every climatic/morphoclimatic altitudinal zone (Păun, 1998; Bogdan, 2000). This could help the analysis process of the impact of climate changes in mountain domains.

The freeze-thaw cycle (FTC), defined as a cycle in which temperature fluctuates both above and below 0°C (Prick, 2004), is the main way to estimate the relation between the thermic regime and rock, represented by gelifraction, frost weathering and crioclastism processes. Based upon the ratio between the frequecy and the magnitude of these processes had been distinguished two types of gelival cycles: Icelandic (high frequecy, low magnitude) and Siberian (low frequency, high magnitude), the first having only a shallow effect, while the last occurs at deeper levels.

In Romanian litterature, the FTC topic appears together with the development of geomorphological and climatological research in alpine and subalpine zones, after 1950. A series of regional studies dealt with this phenomenon through the cryonival landforms and the specific geomorphic processes in the Bucegi Mountains (Micalevich-Velcea, 1961), in the Southern Carpathians (Niculescu & Nedelcu, 1961; Nedelcu, 1964),in the Godeanu Mountains (Niculescu, 1965), in the Semenic Mountains (Grigore, 1981), and the Ciucaş–Buzău Mountains (Ielenicz, 1984). Recent contributions were added by Urdea for the Retezat Mountains (1995, 2000).

METHODS

The methodology followed some issues:

- The selection of the most representative meteorological stations for the illustration of the complementary topoclimate conditions (27 mountain stations), located on a relief energy of 2200 m, between Piatra Neamț (314 m) and Vf. Omu (2504 m), in valley corridors and depressions with different degrees of isolation, on erosion levels and Alpine crests, with different exposures.

- The determination of the mean number of days with FTC occurrence potential[1], for every month and year, for a range of 10 years, in accordance with the formula:

Ng=N(Tmin)-N(Tmax) , where:

Ng – the number of days with FTC occurrence potential;
N(Tmin) –the number of days with minimum day-time temperature < 0 ^{0}C (frosting days);
N(Tmax) – the number of days with maximum day-time temperature < 0 ^{0}C (winter days).

- The correlation of the obtained data with the position in altitude and the relief level or topoclimate, for the determination of the climatic potential for gelifraction processes and its confirmation with examples from the fieldwork.

The reference data series covers a range of 30 years (1961–1990). Only the reference data from the Omul Peak station cover 40 years (1961–2000).

RESULTS

The analysis began by correlating the number of freeze-thaw cycles (FTC) to the elevation of the metheorological stations (Fig. 1 and 2). According to previous theory, the number of days with FTC increases with altitude. The correlation coefficient is 0.73; this value is moderate and shows a direct correlation with a systematic deviation from the theoretic tendency. The graph analysis points out the greatest frequency of FTC occurrence potential, higher than 120 days per year, on the hypsometric zone of 500–1000 m. This corresponds to depressions, basin areas and valley-corridors, and particulary to those more isolated from the main atmospheric circulation or influenced by cold, polar air masses. This is the case of the Bârgău Mts.- Dorne Depression and Moldova River Valley Passage way opened northwards. The Scandinavian-Baltic cold air masses penetrate through relatively low saddles from the springs of the Moldova, Bistrița, Suceava and Humor rivers, increasing the thermic inversions frequency (Fig. 1).

According to our estimations we consider that the area with the biggest number of freeze-thaw cycles from the Romanian Carpathians is located to the western Dornelor Depression, at Poiana Stampei station (124,2 FTC). The thermic inversions encouraged the instalation of the spruce fir (*Picea excelsa*) forests, while the glacis are used mainly for anthropic activities. The depression alluvial plain is featured by the intense turbification of soil in the cold topoclimate that controls bioaccumulation. The periglacial morphodynamics is less obvious in terms of

[1] We use the attribute "potential" for the days with freeze-thaw cycles because, though the temperature of the air is at a certain moment of 0 ^{0}C, the thermophysical properties of the active surface (*specific heat, heat capacity, transmissivity*) and the local topograpfical conditions (slope aspect, gradient) also control the frequency and the magnitude of the freeze-thaw cycles.

gelifraction (limited to forest clearings, to pits resulted from the trees uprooting, to steep cliffs or small abrupts cut in rock). The coniferous trees forest features the majority of slopes. The podzolization is the main pedogenetic process.

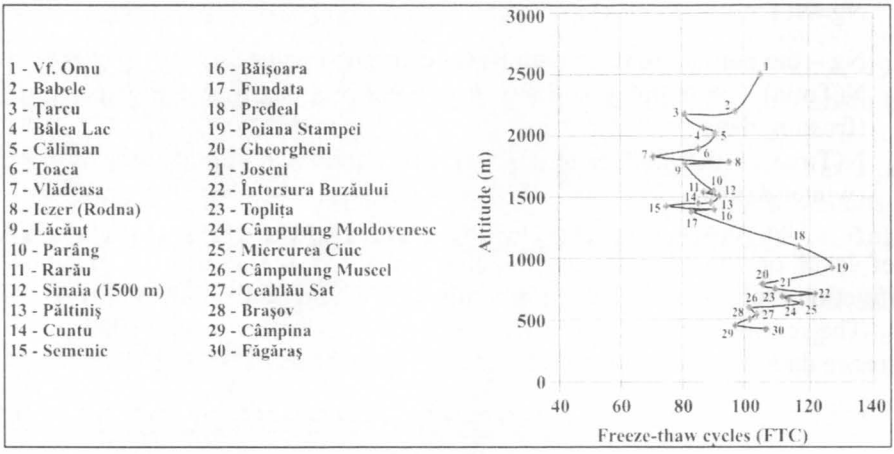

Fig. 1 – FTC frequency – altitude relationship in the Romanian Carpathians.

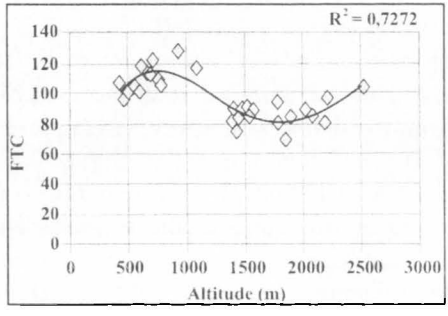

Fig. 2 – The frequency tendency curve of the freeze-thaw processes depending on altitude.

The smallest number of the freeze-thaw cycles corresponds to the Semenic station, situated in the Banat Mountains (1432 m), on the Semenic planation surface, shaped in granite. These macro-gelive rocks were the basis of a residual relief of sharp crags slightly prominent, like the peaks of Semenic and Piatra Goznei (Grigore, 1981). The submediterranean and oceanic influences decreased the number of days with FTC to 74 (on plateaus with secondary meadows), below the value of 75,5 recorded at Piatra Neamţ station (314 m) situated on the wide terraces of the Bistriţa River, to the foot of the Stânişoara and Goşmanu mountains (a valley with a passage way configuration and baltic/ continental influences).

Analysing the mean data series in relationship with the mentioned extreme data there can be differentiated, within the Romanian Carpathians, four types of freeze-thaw regimes:

1. **The isolated depressions type** (Fig. 3), with an average of more than 100 days per year (105–120 days) with FTC occurrence potential in the depressions: Dorne, Câmpulung Moldovenesc, Giurgeu, Ciuc, Braşov, Întorsura and Predeal-Timiş. The relatively isolated Făgăraş Depression is a particular case for its special topoclimate influenced by the Făgăraş Mountains through the protection offered by its northern cuesta (the Câmpulung Depression from the Getic Subcarpathians represents a relatively similar case). Slope processes related to congelifraction are dominated by solifluction, turbification of soil on plateaus and river floodplains, and, rarely, disintegration on massive rocks in quarries or outcrops like the steep surrounding slopes (Braşov, Lăzarea, Iacobeni etc.). Podzolization develops on slopes, where relic periglacial structures occurs (Reci, Întorsura Buzăului, Gheorgheni).

2. **The valley-corridors, basins and defilees type**, often in the Subcarpathians, with 75–100 freeze-thaw cycles and active atmospheric circulation due to their large both sides opening (Rucăr-Bran, Prahova, Bistriţa etc.); the temperature inversions are smoother and solifluctions are replaced by massive and superficial mudflows. Gelifraction features the steepslope areas on massive rocks (conglomerates, limestones, sandstones); comparing to the isolated depressions, solid discharge contribution among river floodplains is semnificative and lateral erosion intensifies few months per year (flow stopped by frost in December–February).

In both cases, isolated depressions and valley-corridors have a good logarithmic correlation between the freeze-thaw processes frequency and the meteorological station elevation (Fig. 3), on an over 700 m altitudinal distance (Târgu Jiu – 203 m; Poiana Stampei – 920 m).

DEPRESSIONS	Alt. (m)
1 - Târgu Jiu	203
2 - Deva	230
3 - Făgăraş	428
4 - Pătârlage	438
5 - Curtea de Argeş	448
6 - Câmpina	461
7 - Braşov	504
8 - Ceahlău Sat	552
9 - Câmpulung Muscel	639
10 - Miercurea Ciuc	640
11 - Câmpulung Moldovenesc	659
12 - Topliţa	687
13 - Întorsura Buzăului	710
14 - Joseni	750
15 - Poiana Stampei	920

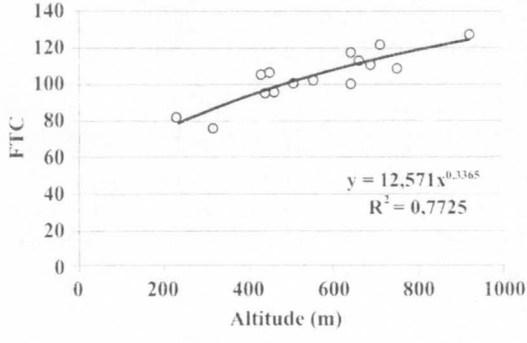

Fig. 3 – FTC frequency-altitude relationship in intermountains and submountains depressions.

3. **The mountain slopes and low interfluves type** (< 1800 m), covered with woods and meadows, have a 70–100 FTC as annual average and is probably the most frequent type in the frame of the mountains, between 350–500 m and 1500–1800 m, with intrazonalities like depressions and valley-corridors. Here predominate the spatial and seasonal alternance of stream and gully erosion with mudflows and

rocks disintegration (Ielenicz 1982, 1984), on lithological and structural steepslopes and residual peaks (Rarău, Semenic, Băișoara, Lăcăuți). Mountain slopes, closer to the depressions, show a change in the correlation between the FTC and altitude. The ideal repartition of the freeze-thaw processes on a mountain slope, shows a minimum of occurence for the lower-median part, with a fast increase towards the slope toe and a slow increase towards its upper part (the interfluve). A good example is that of the freeze-thaw cycles distribution on the eastern slope of the Bucegi Mountains: on the middle slope there are 91 FTC (Sinaia – 1510 m), while in the valley there are 103 FTC at Sinaia, in town – 787 m; on the upper slope, even on the interfluve, considerable increases are recorded: 95,7 FTC at Babele – 2206 m and 104,7 FTC at Omul Peak – 2504 m.

4. **The plateaus, crests and alpine summits type** (>1800 m) is island-shaped and limited to some massives (Rodna, Căliman, Ceahlău, Bucegi, Ciucaș, Făgăraș–Iezer, Parâng, Retezat–Godeanu, Bihor–Vlădeasa); there are 80–110 days per year with freeze-thaw cycles. The cycles with a great magnitude (of Siberian type, with great differences of temperature, resulting deep freeze and thaw penetration of soils and rocks) are meaningful for the freeze-thaw processes. They occur during transition seasons but less in the autumn. Interesting for this domain is that the freeze-thaw cycles can occur in every month, having a great frequency in summer. The Icelandic gelival cycles type dominates the May to September interval, having no important morphological reflexes. The great number of days with freeze-thaw processes and the alternating types of cycles determines a very efficient modelation, with a profound effect. Rocks disintegration produces debris on all the steepslopes. Avalanches and solifluctions occur on sandy and clayey delluvia. Cryoturbation, deflation and corrasion also occur (the aeolian regime has a low calm frequency <2–3%). Streaming and ravination alternates also with advanced peatforming and podzolization.

This typology refers to 32 climatic stations, distributed on all relief levels and in almost all mountain groups from which 27 are in the mountain and submountain area of the Romanian Carpathians and 5 stations in hills and plateaus regions. All of these form the central, national network for climate parameters monitoring (the Meteorological National Authority – ANM). A number of 11 stations are situated within the cryo-nival zone (alpine-subalpine vegetation zone) and 15 in depressions area, the rest belonging to mountain slopes and to low interfluves. The correlation altitude –freeze-thaw cycles number and the identification of the reference stations (Fig. 1) determines groups of points which represent, in fact, the freeze-thaw cycles regime typology. The graph analysis points out a slow decrease in number of cycles from E to W or from NE to SW directions, which confirms the climate continentalism effects. Elements depending on topoclimate generates a deviation from this rule; it is the case of the Lăcăuți station – 1777 m, situated on the graph between Vlădeasa – 1838 m and Iezer–Rodna – 1785 m, induced by altitude and western exposures.

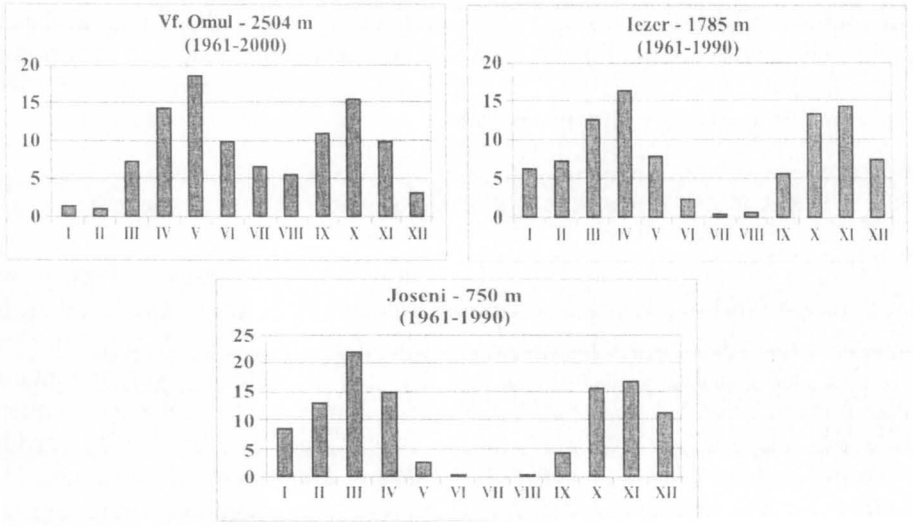

Fig. 4 – Monthly multiannual distribution of the freeze-thaw cycles for some representative meteorological stations in the Romanian Carpathians, displaying the differences between the isolated depressions (Joseni) and the highest mountain ridges (Omul peak).

The analysis of the monthly multiannual distribution of freeze-thaw cycles for three meteorological stations followed. The aim is to emphasize the differences between the mountains areas and isolated depressions. Comparing the three graphs (Fig. 4), for stations situated on an altitude difference of 1700–1800 m, the following characteristics can be noticed:

– the freeze-thaw cycles occurence features every month of the year at Omu peak, in the alpine tundra;

– the great frequency of these processes during the transitional seasons (spring, autumn) as a result of the repeated day-time temperatures of 0^0C, especially due to the succession of the anticyclonic regime (favourable to temperature inversions) with warm periods, with foehn phenomena;

– a disparity between the months with the greatest number of freeze-thaw cycles and the altitude of the representative stations: March for depressions, April for mountain slopes and interfluves with altitudes of 1300–2000 m and May for alpine crests;

– March is the month with the greatest number of freeze-thaw cycles for depressions (over 20), as a result of the alternation between the temperature inversions and the sudden warmings caused by foehn phenomena. This is the period with floods and lateral erosion, with solifluctions on meadows (glacis and terraces), frost-creep under woods on slopes of $20–25^0$, and rockslides on tough rocks outcrops; all these happen before the vegetation season on bare or sparsely covered soil;

– above the timberline (>1750 m), the number of the FTC is 15–18 per month, with their greatest intensity in April to May, and a snow persistence on soil and rock surfaces of interfluves (conditions for nivation); solifluctions are also specific

for the April–May period, on slopes with sandy-clayey soil and delluvia; avalanches start, in March, at the same time with the foehn phenomena, reaching the optimum after the FTC occurrence in April–May and even June, on shaded slopes of 30–40^0 (the north of Bucegi, Iezer, Rodna, Făgăraş etc.).

CONCLUSIONS

Rock disintegration processes by freeze-thaw processes, intensify with altitude on interfluves and mountain slopes, depending on the cycles number, like in the cases of Sinaia 92,2 FTC (1510 m), Babele 95,7 FTC (2206 m), Omu Peak 104,7 FTC (2504 m). Besides this "general rule", in the frame of every mountain, it can be noticed a sudden increase of the freeze-thaw cycles occurrence frequency caused by temperature inversions in the depressions and the valley-corridors domain like the cases of Braşov, 101 FTC (504 m), Câmpulung Moldovenesc 113,2 FTC (659 m), Poiana Stampei, 124,2 FTC (920 m). The morphodynamic impact of these microclimatical particularities, expressed mainly through solifluctions, is less visible due to the reduced slope gradients, to the lack of rock outcrops, the lack of the anthropogenic factor activity and due to afforestation on the valley slopes.

The multiannual analysis of the FTC frequency allow us to differentiate a freeze-thaw regime tipology in the Romanian Carpathians:

- the isolated depressions type, with over 100 days per year with FTC, the Icelandic gelival cycle type dominance and reduced penetration in rocks and soils;
- the valley-corridors, basins and defiles type, with 75–100 FTC;
- the mountain slopes and low interfluves type (<1800 m) with 70–90 FTC per year;
- the plateaus, crests and alpine summits type (>1800 m), featuring 80–110 days per year with FTC occurrence potential, where the Siberian type is prevailing, the freeze and thaw being deeply transmited, which increases the efficiency of the disintegration processes.

The reduced correlation between the number of the FTC and the altitude leads to the conclusion that the topoclimate plays an essential role in their spatial and temporal differenciation.

The greatest frequency of these phenomena features the depressionary area. Their degree of isolation towards the major atmospheric circulation increases this frequency (the maximum occurs within depressions like Dorne, Giurgeu, Ciuc, Întorsura and Braşov). The periglacial structures found in these areas confirm the continuity in time of these phenomena (Iancu, 1965; Ichim, 1973). The morphoclimatical background is complicated by the high occurrence of FTC at altitudes of 600–900 m, where the cryo-nival processes, from the cryo-nival altitudinal zone, occurs among the fluvial-torrential altitudinal zone (solifluction, frost-creep, disintegration, nivation, peatforming and even small avalanches on some steepslopes).

Our analysis points out a slow decrease of freeze-thaw processes frequency from E to W or from NE to SW, which confirms the role of climatic continentalism effects on FTC occurence.

The adaptation to this topoclimate conditions and, to these phenomena, also occurs within the space organisation. The middle mountain levels are differently used by society comparing to the lowest alluvial plains, where frequent temperature inversions and freeze-thaw cycles are the main features. Snow layer covering rocks and soils slows down the initiation of the gelival cycles and moderates the microclimate (a significant example are the plateaus and the crests). Another factor of slowing down the freeze-thaw cycles is forest, especially the spruce fir woods (Marcu, 1971).

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THE ARVAN MORPHOHYDROGRAPHIC BASIN (THE FRENCH ALPS). PRELIMINARY GEOMORPHOLOGICAL OBSERVATIONS

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Key words: morphohydrographic basin, Alpine Orogeny, vulnerability, Arvan, French Alps.

Le bassin morpho-hydrographique Arvan (Alpes françaises). Observations géomorphologiques préliminaires. Le bassin Arvan est situé dans les Alpes françaises de la Savoie, dans la région Maurienne, traversée par la rivière Arc, affluent gauche de l'Isère. Du point de vue géologique, le bassin Arvan appartient à la zone externe des Alpes, respectivement la zone dauphinoise et celle ultradauphinoise. La bordure orientale du masif Belledonne et le côté nord du massif Grandes Rousses s'inscrivent dans la zone dauphinoise, qui présente un socle cristallin précambrien-paléozoïque (formé de gneiss et de migmatites) et une couverture sédimentaire triasique et liasique, affectée par des plis déversés vers l'ouest et le nord-ouest. La zone ultra-dauphinoise se développe à l'est du contact tectonique majeur souligné par des gypses triasiques aux épaisseurs appréciables qui traversent la région du nord au sud, approximativement sur l'alignement de l'Arvan. Les dépôts superficiels sont la plupart quaternaires et ont résulté des processus glaciaires, périglaciaires, fluvio-torrentiels, favorables à l'intensification des processus contemporains. Les recherches interconditionnées géologie-relief mattent en évidence aussi bien la dynamique du relief, que les tendances évolutives dans un temps plus on moins prognosé. Ce fait permet de dépister les aires vulnérables et à risque imminent, aux effets négatifs sur la population et, en conséquence, la prise de mesures de faire limiter les désastres. Par exemple, la présence des évaporites en profondeur et les relations de ceux-ci avec lea éléments hydrogéologiques constituent des risques imminents surtout dans les régions peuplées. Les proccessus de dissolution conduisent à la création de trous souterrains, difficilement à dépister, qui favorisent les effondrements et des proccessus associés. Le phénomène est décrit aussi dans d'autres régions des Alpes (Rovera, 1993).

INTRODUCTION

The Arvan Basin is situated in the French Alps of Savoia, the Maurienne Region crossed by the Arc River, a lefthandside tributary of the Isère (Fig. 1). It largely overlaps the Pays des Arves geographical region which extends south of the Arc between the Belledonne Massif (in the north–west), the Grandes Rousses (in the south-west and south) and the Grande Chible (in the east), that continues southwards with glacial cirques and ridges of maximum height in the Aiguilles

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d'Arves (Aiguilles Centrale, 3,514 m) (Fig. 2). This is also the maximum altitude of the basin. The Arvan Basin is drained by the homonymous river which joins the Arc (at 550 m alt.) in the town of St. Jean de Maurienne. Thus, along some 20 km there is a level difference of nearly 2,965 m. The Arvan is a 7^{th} – order basin (Horton-Strahler scale) which extends over ca. 220 km^2.

The Arvan River emerges at some 1,270 m altitude, as a result of the confluence between the Arvan Torrent (west-east orientation, whose source-area, assumed to be at about 2,300 m, is difficult to establish precisely because of the multitude of gullies there) and the Arvette River (south-north orientation, in continuation of the confluence-formed river) in the locality of Entraigues.

The criteria used to establish the Arvan springs were maximum altitude and the continuity of the direction of the valley. In view of it, we assume the Arvette River to become a permanent watercourse at heights of 2,500 m, emerged from the torrents that drain the glacial cirque from below the Aiguilles Centrale, torrents which regress up to 3,000 m altitude.

The adjoining drainage basins are: the Vallorrette in the east and the Gordon in the west (lefthandside tributaries of the Arc) and Romanche in the south (righthandside tributary of the Drac which flows into the Isère River).

The name Maurienne stands for the northern side of the Ecrins Massif and the southern flank of the Vanoise Massif.

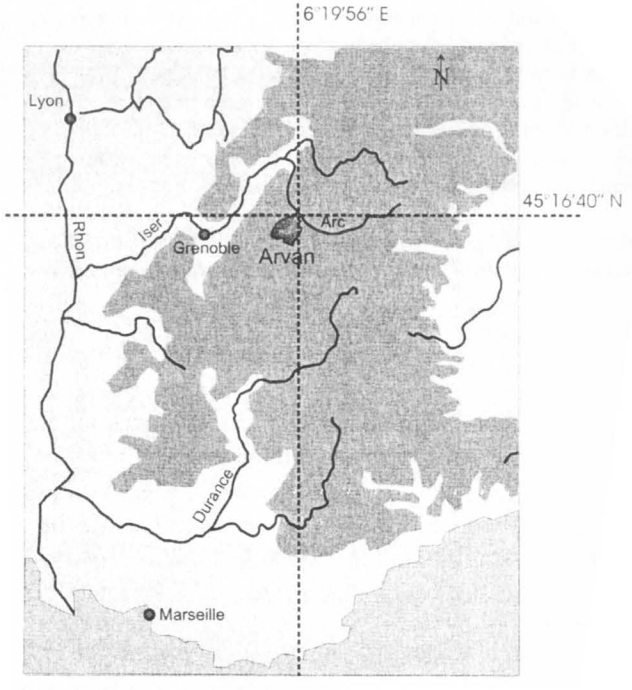


Fig. 1 – Geographic location of the Arvan basin.

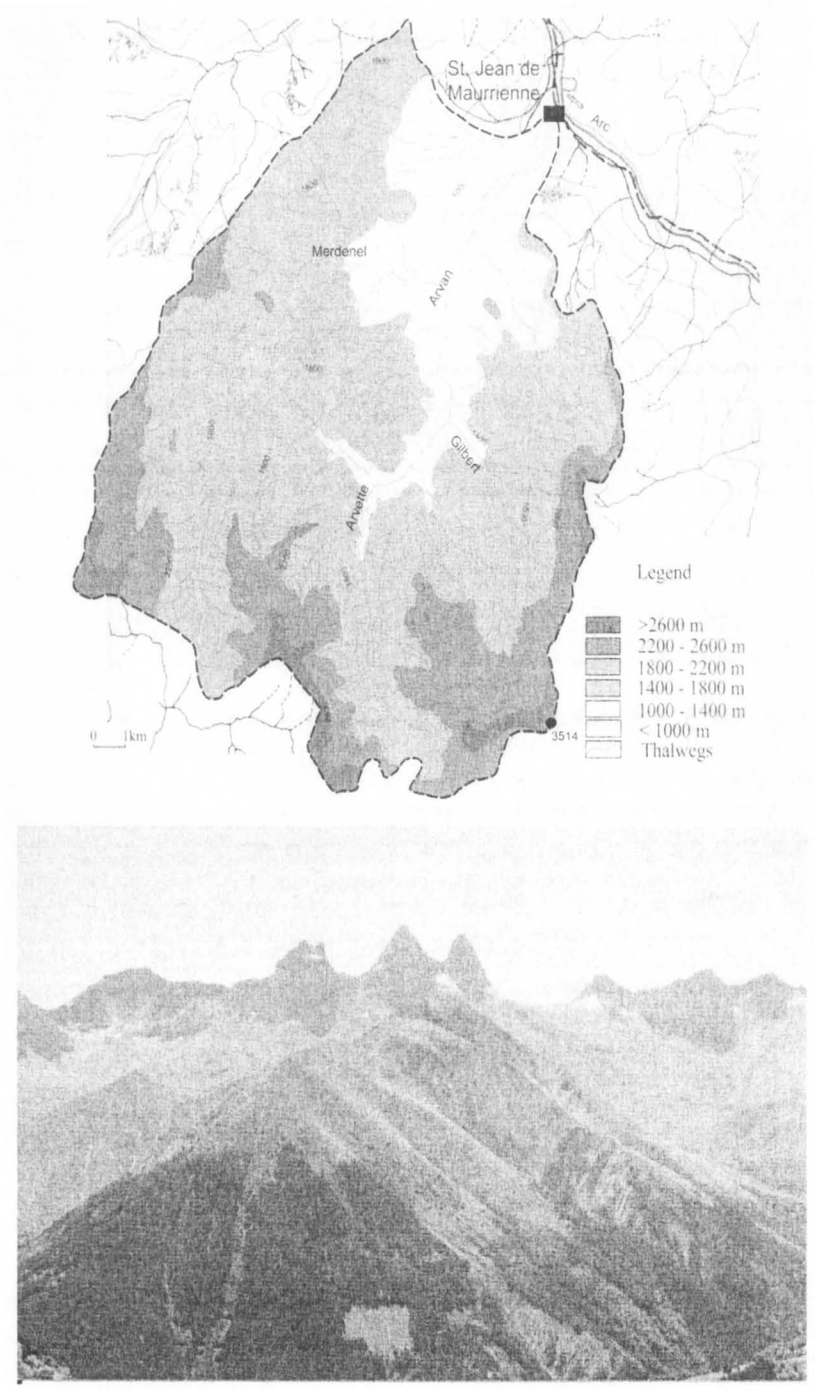


Fig. 2 – Hypsometric map (**A**); maximum elevation Aiguilles d'Arves (**B**).

The **geological and structural analysis** based on the geological map, scale 1:50 000 (and the appended text) (*Carte géologique de la France à 1/50 000, St. Jean de Maurienne*, 1977 and *La Grave*, 1976) shows the Arvan Basin to belong to the exterior area of the Alps, basically to the dauphinoise and trans-dauphinoise zones (Fig. 3).

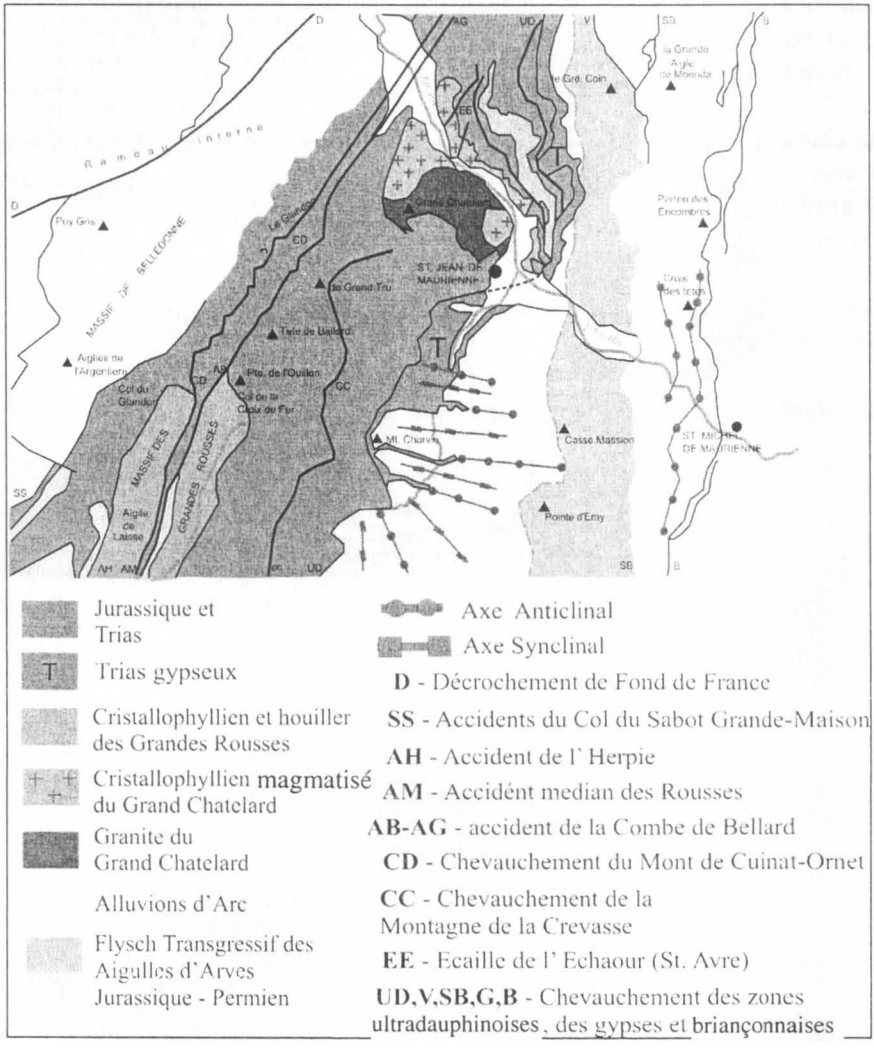


Fig. 3 – Structural scheme (scale 1/250.000) (after *Carte géologique de la France a 1/50000, St. Jean de Maurienne*, Service Géologique National).

The dauphinoise zone encompasses the eastern rim of the Belledonne Massif and the northern part of the Grandes Rousses Massif. This rim constitutes a

Precambrian-Paleozoic basement formed of gneisses and migmatites, with a Triassic and Liassic sedimentary cover folding west and north-westwards.

The Triassic deposits (conglomerates, sandstones and dolomites) of the outer crystalline massifs are quite thin, ranging between a few meters and some tens of meters thick and growing thicker towards the inside, developing into a deeper sedimentary basin. The Liassic consists of rather thin limestone and clay deposits (the Aalenian being extremely rich in clay). In the north of the basin is the Grand-Châtelard Massif (crystalline). It looks like a vast fold-scale of the north-west-trending basement. In general, the intense processes of disaggregation and gravitation (rockfalls), which take place in the highly metamorphosed crystalline massif, engender a pile of rubble visible at the foot of the Grand-Châtelard.

The trans-dauphinoise zone extends east of the major tectonic contact line represented by appreciably thick Triassic gypsum deposits which cross the region from north to south, approximately on the Arvan alignment. In the east is the Jurassic, whose lithology is similar to that of the dauphinoise zone, i.e. limestone (80% carbonate), sandstone and clays. To the south, the Jurassic is represented by the Aiguilles des d'Arves flysch: shales, banks of limestone and sandstone or conglomerates.

The Upper Cretaceous features a succession of tectonic phases of variable amplitudes. The tangential movements, which occurred at the end of the Cretaceous and during the Paleocene, led to the folding of previous deposits over large areas (in the Mont Charvin, Rousses and Châtelard massifs).

A new phase of tangential folding, first east-west, then south-north-oriented, took place at the beginning of the Lower Oligocene, enhancing previous folding in the Mont Charvin and the Albiez.

The Miocene witnessed the uplift of crystalline massifs. At the end of the Miocene and in the Pliocene new movements took place which folded the sedimentary cover and shaped the present-day structures.

SURFACE DEPOSITS AND LANDFORM DYNAMICS

The lithological particularities of **surface deposits** are essentially involved in shaping the type and intensity of geomorphological processes. The present study highlights the situation existing west of the Arvan Basin, basically in the dauphinoise zone, which is largely Jurassic, and in the trans-dauphinoise zone Triassic sequence (the Merderel and Bonrieu drainage basins).

The Liassic covers broad areas between the Belledonne, Grandes-Rousses, Grand-Châtelard crystalline massifs and the trans-dauphinoise overthrust. Here one finds two big lithological ensembles: a lower one, made up of limestone and an upper one containing clays and schists, discontinued in part by sandy limestone.

The "Liassic limestone" shows facies and thickness variations in terms of its proximity to the crystalline massifs: usually 50–60 m – thick banks in the west (e.g. on the eastern rim of the Belledonne Summit), or a few meter-thick (e.g. on the eastern rim of the Grand Rousses Massif). To the east, the Liassic contains marly-limestone, sandstone, schists and red limestone, as well as sandy marls (the le Corbier and Cret d'Ornon).

A significant area is covered with black aluminous-silicate, slightly micaceous and very little calcareous shales (Upper Liassic), estimated thickness 400–500 m, outcropping everywhere in the Jarrier-Villarembert-Corbier perimeter, in the Arves Pass and south of the town of Saint-Jean-d'Arves (Fig. 4).

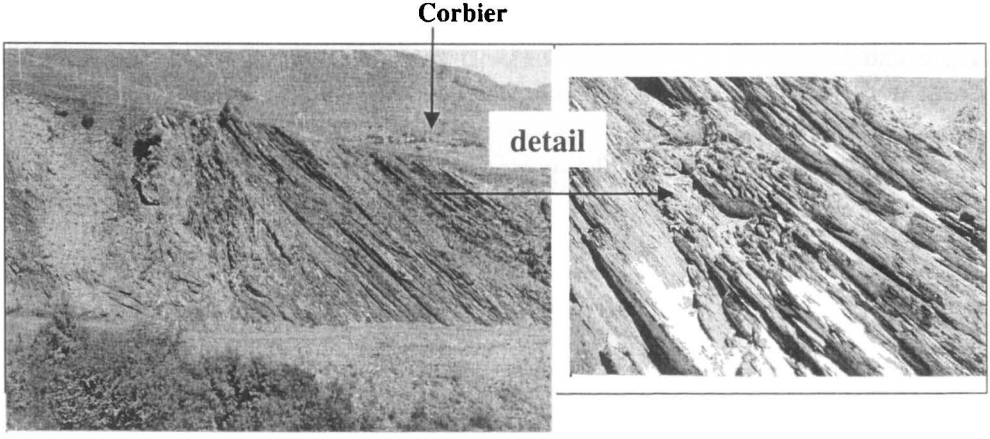


Fig. 4 – Black schist along the Corbier– La Chal alignment.

The Middle Jurassic consists of grey or black shiny clay shales alternating with sandy layers, limestone and microbreccia outcrops on the lefthandside of the Arvette River at Saint Sorlin.

In the town of Fontcouverte, in the Villard point, tens of meters thick Middle Jurassic outcrops stretch over a distance of 200 m (pink-coloured sandstone alternate with black clay shales favouring landslides and forming a mixture with Quaternary glacial formations).

The Triassic of the trans-dauphinoise zone is represented by discontinuous gypsum and anhydride outcrops alongside the Arvan River. One may also see shales with sandstone intercalations (the northern side of the Mont Charvin), as well as yellow, greenish-violet clay shales at the base (the righthandside outcrop on the Arvan before reaching Gevoudaz, includes 10–15 m of pale violet clay shales followed by 10 m of yellowish clays). The Liassic is comparable with its counterpart from the eastern dauphinoise zone, but it is much thicker here. The same characteristics show the Middle and the Upper Jurassic from the outer side: black marls and black sandy limestone.

The clay shale flysch with *Nummulites* (the Aiguilles des d'Arves flysch) exhibits four ensembles: sandstone and conglomerates at the base (Casse Massion); limestone flysch (the west side of the Grande Chible ridge); schistose flysch (an ensemble of limestone, sandstone and black siliceous schists in the upper basin of the Montricher and the Albane, with landslides and also slate exploitations); sandstone flysch; limestone and conglomerates, and an intercalation of limestone and black schists in the upper part.

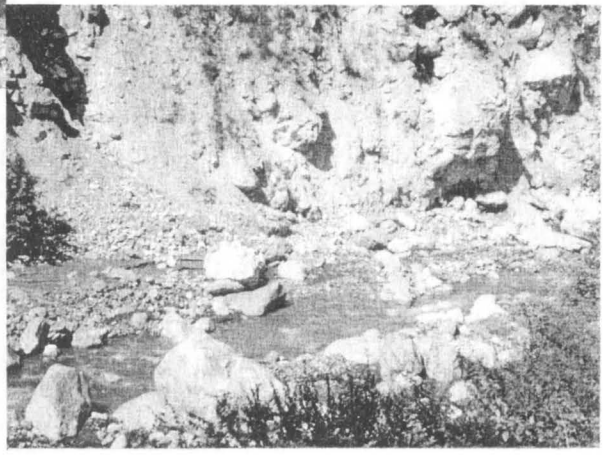
The characteristic **geomorphological processes** of this geological substrate are disaggregation (precluding erosion and weathering), movements triggered by rock-and-soil falls, landslides, glacial and periglacial processes. **The accumulation-related deposits are of Quaternary Age.**

Rock or soil falls generate piles of rubble at the base of steep slopes, and mainly at the foot of crystalline massifs; they are associated to the frequently occurring periglacial processes induced by freeze-thaw on the periglacial and glacial levels at over 1,500 m altitude. The rubble contains boulders resulting from the disaggregation of conglomerates and the Aiguilles des Arves flysch and is found at the base of the western slope of the basin's divide between Albiez-le-Vieux and the Emy-Grand Chibles overthrust. Present-day periglacial rubble, somehow smaller in size, borders the upper part of the cirques right below the escarpment. Recent rubble can be seen at the base of steep slopes towering over some rivers (e.g. the Arvan and the Arvette), supplying the streams with suspended sediment load.

A special situation has the rubble resulting from the detachment of some boulders from the sandstone and limestone layers intercalated between the easily erodable clay schists, often resembling actual landslides. According to some authors, the fluvio-glacial and lacustrine-glacial deposits, of appreciable thickness (tens and hundreds of meters), are the product of the stagnation of some Arc River tributaries barred by the Arc glacier during the Würm period (*La Carte geologique...*, 1977) and reclaimed by the recent geomorphological processes. It is particularly the case of the morphological surface at altitude of 1,500–1,800–2,000 m on the lefthandside of the Arvan which slopes from the western divide eastwards over the main drainage axis; on the righthandside it forms a plateau on which, despite imminent risk phenomena existing there, a number of permanent settlements have developed as winter-ski resorts in the main (Arvan, Corbier, Toussuire, Fontcouvert, St. Jean d'Arves) (Fig. 5, 6).

Slide deluvia are triggered by deep landslides associated with rockfalls and pipping through the dissolution of gypsum, Liassic clay schists with a low carbonate content appear in the form of slabs of variable thickness. Field observations and mappings have revealed a direct relationship between slope processes, **the evolution of the drainage network** and the formation of hydrographic basins, with special reference to the above area which is crossed by the rivers of the Merderel and the Bonrieu basins (6^{th}–and–5^{th}–order, respectively).

A



B

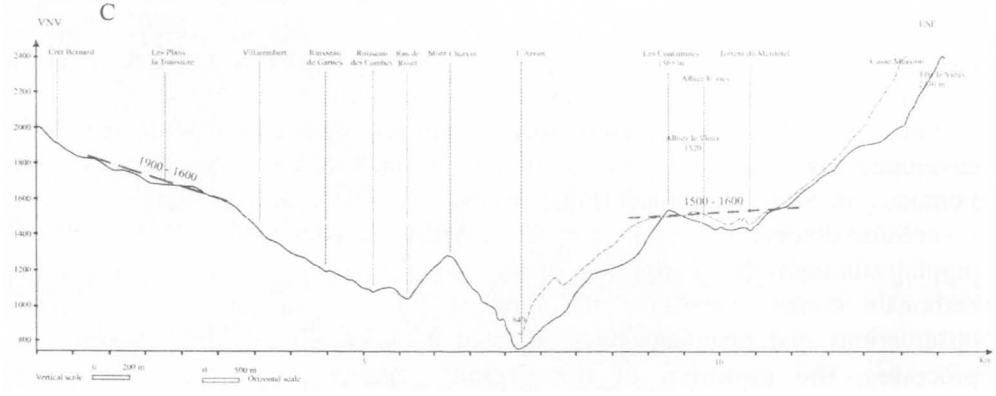


Fig. 5 – River left bank, upstream from Mont Charvin (**A**); right bank, cut in Triassic deposits (**B**); transversal profile of the Arvan basin (**C**).

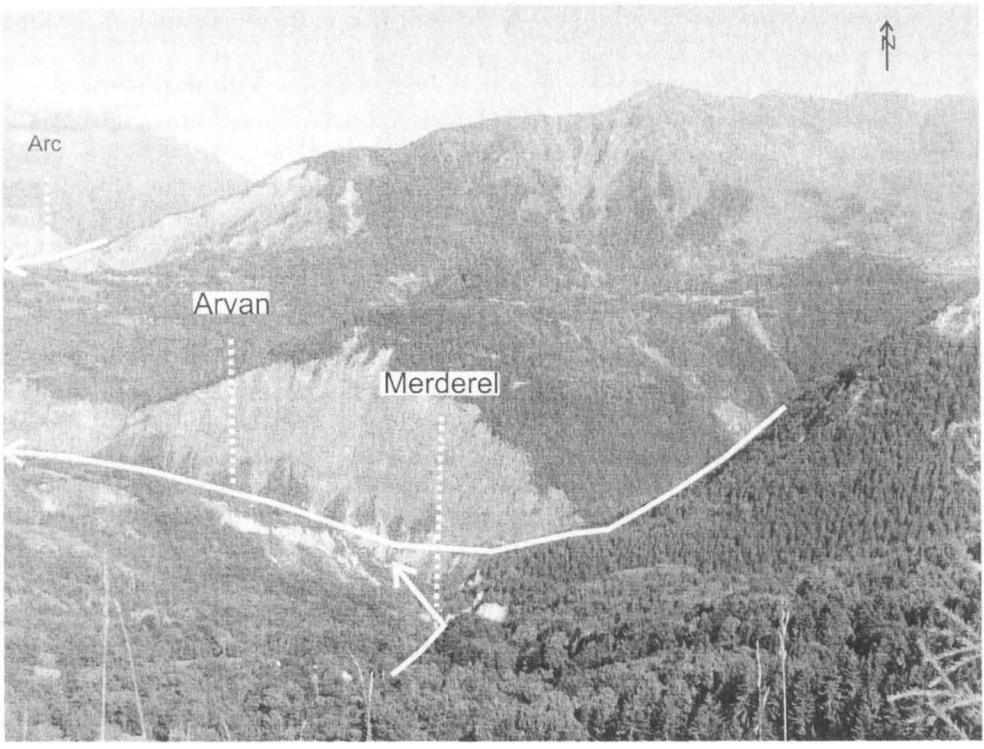


Fig. 6 – 1500–2000 m surface on the right side of the Arvan.

THE DRAINAGE NETWORK – EVOLUTION AND PRESENT-DAY DYNAMICS

The geomorphological particularities of the Arvan Basin and of the majority of its 6th -and-5th-order sub-basins, tributaries of the Arvan mainstream, are similar to torrents. They have large amphitheatre-like catchment basins; next to the confluence area the mainstream channel deepens, forming here and there true gorges with a steep flow track propitious to erosion and sediment transport, the alluvial fans at its mouth allow for the development of human settlements (illustrative is St. Jean de Maurienne on the Arvan fan). The main factors which have influenced the evolution of the drainage network, and implicitly of the respective morphohydrographic basins, are lithology and neotectonics, the dynamics of Quaternary glaciers and the local base level.

The amphitheatre-like shape of the upper basin is also the work of geological substrate and of Quaternary glaciers. In the case of Pays des Arves basins, bedded schists and black marls stimulate disaggregation and weathering on the schistose strata in which gullies would later evolve regressively, but also in-depth. The fine particles yielded by disaggregation and weathering are taken into the overland flow and next into the stream flow itself, as indicated by the dark gray-black-coloured

suspended sediment load of rivers, including the Arvan in the perimeter of St. Jean de Maurienne town, down to its outflow into the Arc River.

The generations of gullies formed on slope depend on their position on slope, degree of deforestation and thickness of Quaternary deposits, as shown also by the values of the confluence ratio which are higher in the case of 2nd-and-3rd-order streams. Regressive landslides contribute to enlarging catchment basin area (Fig. 10).

Against a general uplifting background and under the influence of the local base level of the Arvan and the Arc, streams would deepen their channels into strata of various age and rock structure, imbalancing the slope. Road-building also contributes to destabilizing it.

While the marked dynamics of the upper basin accounts for its extension over a relatively large area, the median basin features deep erosion and sediment transport.

In the lower basin, downstream of its junction with the Merderel (a lefthandside tributary), the Arvan has developed a 100–150 m-wide floodplain featuring quite thick deposits (Fig. 5A, B). Stream channel dynamics is influenced by its synergetic relations with the slope. The rubble stockpiled at the base of the escarpment and in the alluvial fans of the Arvan's direct tributaries are either taken over by the river or compel it to shift towards the opposite slope. In this way, channel deposits are formed not only through distant transport, but also through the input of colluvia and proluvia with specific shares of grain-size distribution (in the case of colluvia), little modelled by the river. An interesting case makes the Merderel Torrent (righthandside tributary of the Arvan River). Formed at the base of an escarpment, it runs parallel to the Arvan and compels the river that built it to flow parallel to the Arvan. Strong weathering, relief energy and torrential precipitation have essentially contributed to the formation of some of their alluvial fans also on other streams/torrents tributaries of the Arc River.

The Arvan River alluvial fan being fixed has allowed the development of the St. Jean de Maurienne town which extends also on the alluvial fan of its tributary Bonrieu and on the glacis at the foot of the Châtelard Massif.

THE PRESENT-DAY MORPHOMETRY OF MORPHOHYDROGRAPHIC BASINS, A REFLECTION OF LANDFORM EVOLUTION AND DYNAMICS

The model which best illustrates hydrographic network and landform dynamics is the drainage model proposed by Horton's classification system (1945), modified by Ponov (1948, cf. Zăvoianu, 1978) and completed by Strahler (1952). Higher-order streams are older, while 1st - and 2nd - order ones are younger, which means that their morphometric characteristics are more influenced by the current state of the basin area.

The laws governing the drainage model hold for the Arvan Basin, too. The stream segments of order 3–6 (7) follow the law whereby the number of successively higher-order stream segments form an inverse geometrical progression in which the first term is given by the number of 1st-order stream segments and the ratio by the

confluence ratio R_C yielded by the mean of individual ratios of two consecutive values of increasing order: $(N_1/N_2+N_2/N_3+N_3/N_4)/3$. The number of 1st-and-2nd-order stream segments was calculated by the known relation ($N_1=N_2 \times R_C$).

The density of stream segments calculated by referring the overall number of stream segments (6,744 of which 6,649 are of the 1st, 2nd and 3rd orders) to the whole basin area (ca. 220 km^2) yielded significant values: 30.65 segments/km^2. If only 1st, 2nd and 3rd – order streams are analyzed, the number of stream segments per surface unit is 30.22, each segment draining 3.30 hectares (Table 1).

The large number of *lower-order stream segments means that the basin must respond quickly to torrential rainfalls, because the time between the passage of the shower core and the run-off into the channel is quite short. So these basins have a high torrential character.* The high values of the partial confluence ratio between torrents (1st-and-2nd -orders, and 2nd and 3rd orders) and between the 3rd- and-4th-order stream segments for the whole basin, but especially for the 5th -and-6th-order ones (e.g. for the Gilbert R_{C1}=5.7) indicate the high frequency of these stream segments, most of the 1st, 2nd and 3rd – order stream segments remaining in this stage. These torrents, actually emerging from the glacial cirques, have a direct influence on Horton's laws. The transition from the upper system of torrential stream segments to the lower stream system (4th, 5th, 6th and 7th orders) crosses a threshold revealed both by the confluence ratio and the great difference between the lower-and-higher-order stream segments. It follows that in the above-mentioned conditions of rock and tectonics, deep erosion creates deep valleys.

Establishing *the length of each order stream-segment* and summating them by order of magnitude shows that the sums of successively higher-order stream length tends to form an inverse geometrical progression in which the first term is given by the sum of the first-order segments and the ratio by the ratio of lengths (R_l) (Zăvoianu, 1978, Grecu, 1980, 1992). In this case, too, the law holds best for lower orders, while higher orders register deviations, usually with elongated basins. The ratio of summated lengths R_L=2.00 for the Arvan River was determined by resorting to lower-order stream segments (Table 1) (Grecu *et al.*, 2005) .

The average length of each order stream-segment has been calculated on the basis of the summated lengths and of the numerical share of stream segments. The three value rows, expressed graphically by semi-logarithmic coordinates, tend to form a direct geometrical progression in which the first term is given by the average length of 1st-order streams and the ratio by the average lengths ratio (R_l).

This law is important because it enables to assess the average lengths of the 1st -and-2nd-order stream segments largely involved in drainage. The average length of these segments is 0.14 km and 0.30 km, respectively, values that indicate a short overland flow on slope due also to the steep gradient of glacial cirques.

The average lengths of 1st-and-2nd-order streams do not show significant differences between 6th – order basins with sources in glacial areas (the 6th – order Arvette and the Arvan, and partly the Gilbert). Lowest values throughout the basin register the 1st-and-2nd – order streams which are hardly 0.90–1.6 m long.

In the Arvette Basin, the lowest average length of a 2nd –order stream is 0.18 km (with 0.07 for the 1st-order stream), the highest value being 1.60 km (with 0.34 km for the 1st-order stream). These values are in agreement with the confluence ratio values and they result from the development of stream segments mainly in glacial cirques with high relief energy (the Arvette Basin). In the Gilbert Basin, torrential stream segments emerge in low-energy cirques and on Quaternary deposits with a slope less steeper than in the Arvette Basin.

The very active dynamics of the drainage network is illustrated also by the unevenness index of the basin (I_r) for a given order of magnitude (in terms of the numerical share of stream segments) (Grecu, 2004). For example, in the Arvan Basin I_r=96% indicates a state of equilibrium in this basin. In lower-order basins, an unevenness index of 0.53, (53%), on the Gilbert Basin, suggests a state of imbalance. The unevenness index of the sum of lengths I_l = 60% and of the average lengths of stream segments I_l=78% suggests a similar situation (Table 1–5).

Table 1

The Arvan Basin-drainage model data

Variable	M- measured C-calculeted	1st order	2nd order	3rd order	4th order	5th order	6th order	7th order	Rate
Number of stream segments *N*	M	-	-	296	71	19	4	1	R_C =4.16
	C	5,122	1,231	296	71	17	4.75	0.96	
Sum of lengths *L* (km)	M	-	-	187.72	89.17	52.50	19.65	14.72	R_L=2.00
	C	751	375.44	187.72	94.00	47	23.5	11.75	
Average length *l* (km)	M	0.14	0.30	0.63	1.25	2.80	4.52	14.72	R_l=2.23
	C	0.09	0.20	0.45	1.01	2.27	4.52	10.07	

Table 2

The Arvan Torr. (Upstream its confluence with the Arvette)-drainage model data

Variable	M-measured C-calculated	1st order	2nd order	3rd order	4th order	5th order	6th order	Rate
Number of stream segments *N*	M	-	-	73	18	4	1	R_C = 4.20
	C	1,305	311	74	18	4.28	0.95	
Sum of lengths *L* (km)	M	138	75	41.2	22	13	6.65	R_L = 1.83
	C	135	74	41.2	22	12	6.56	
Average length *l* (km)	M	0.10	0.25	0.55	1.22	1.25	6.65	R_l = 2.29
	C	0.10	0.23	0.53	1.22	2.79	7.44	

Table 3

The Arvette Basin – drainage model data

Variable	M-measured C-calculated	1st order	2nd order	3rd order	4th order	5th order	6th order	Rate
Number of stream segments *N*	M	-	-	73	17	6	1	R_C = 4.37
	C	1,395	319	73	17	4	1.37	
Sum of lengths *L* (km)	M	100.4	60.12	36	18.3	8.95	8.85	R_L = 1.67
	C	85.22	51.03	30.56	18.3	10.95	6.55	
Average length *l* (km)	M	0.07	0.18	0.49	1.07	1.49	8.85	R_l = 2.61
	C	0.05	0.153	0.40	1.07	2.79	7.28	

Table 4

The Merderel Basin-drainage model data.

Variable	M-measured C-calculated	1st order	2nd order	3rd order	4th order	5th order	6th order	Rate
Number of stream segments *N*	M	-	-	37	9	3	1	R_C = 3.36
	C	418	124	37	11	3.27	0.97	
Sum of lengths *L* (km)	M	-	-	27.8	11.575	9.65	2	R_L = 2.8
	C	217.95	77.84	27.8	9.92	3.54	1.26	
Average length *l* (km)	M	0.52	0.62	0.75	1.28	3.21	2	R_l = 1.2
	C	0.50	0.61	0.75	0.95	1.14	1.36	

Table 5

The Gilbert Basin-drainage model data.

Variable	M-measured C-calculeted	1st order	2nd order	3rd order	4th order	5th order	6th order	Rate
Number of stream segments *N*	M	549	96	24	6	2	1	R_C = 3.74
	C	391	104.6	28	7.48	2	0.53	
Sum of lengths *L* (km)	M	185	65.8	22.95	8.07	1.72	2,15	R_L = 2.84
	C	185	65.8	22.95	8.07	2.84	1,00	
Average length *l* (km)	M	0.34	1.6	0.96	1.54	0.86	2.15	R_l = 1.3
	C	0.51	0.73	0.96	1.25	1.62	1.70	

VULNERABILITY AND IMMINENT RISK

The dynamics, frequency and type of natural hazards in the Arvan Basin represent major criteria in delimiting areas with various degrees of vulnerability as follows (Fig. 7):

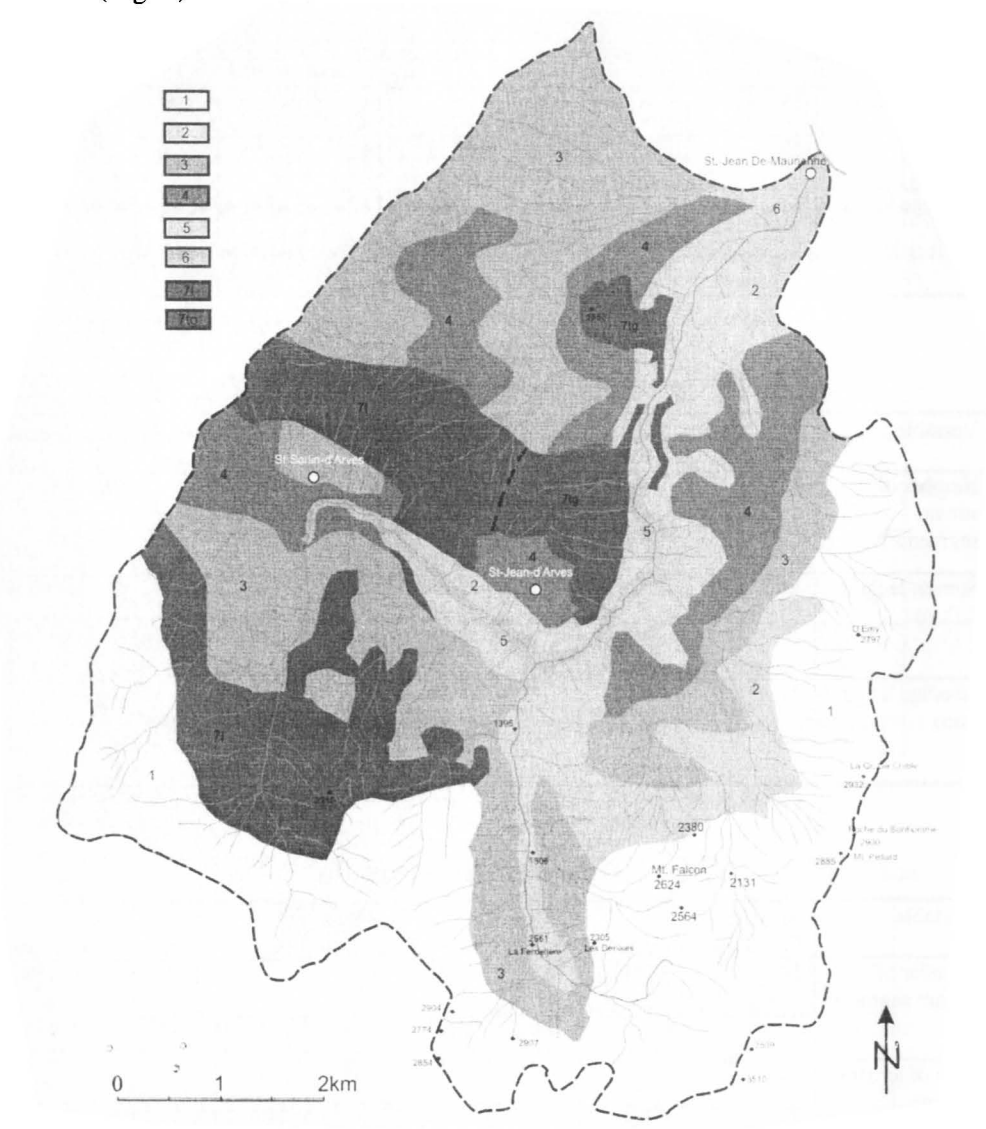


Fig. 7 – Terrain vulnerability map: *1* – high and very high vulnerability to actual glacial and periglacial processes; *2* – high and very high vulnerability to periglacial and gravity related processes; *3* – high and very high vulnerability to landslides and ravines; *4* – medium vulnerability to bank processes; *5* – high vulnerability to bank and riverbed processes; *6* – low vulnerability to riverbed processes; *7* – high vulnerability to subterranean voids present in Triassic (tg) and Liassic deposits (l).

1. *High and very high vulnerability to present-day glacial and periglacial processes* shows the upper basin (at over 1,800 m alt.) where freeze-thaw, gravitation and torrents are the frequent processes; disaggregated materials are moved by gravitation either in the form of topples and rockfalls on slope, or torrents forming cones, rubble stacks or rock streams. Present-day glacial erosion and accumulation are characteristic of the Saint Sorlin Glacier from the south-eastern extremity (Fig.8). They also engender a dense but short torrential drainage network in the Blanc Basin. The largest area covered by the glacier extends at altitudes of 2,700-3,100 m. Below 2,700 m the area shrinks suddenly giving way to a huge mass of rubble (moraines) criss-crossed by gullies. As the front of the glacier is retreating, tillites are outcropping. If in 1967, the front of the glacier stood at 2,630 m altitude (Vivian, 1969), at present (*Topographic Map* scale 1:25,000, 1998) this front stretches uninterruptedly at some 2,700 m (and below 2,660 m locally), which signifies a retreat by some 2 m/year. In the glacial cirques below Aiguilles d'Arves only small glacial pockets are still found.

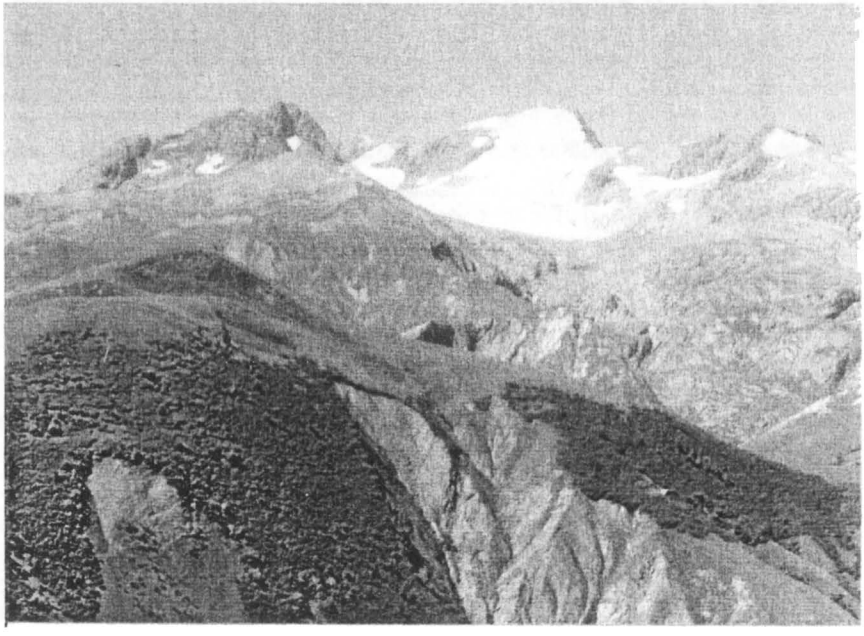


Fig. 8 – Saint Sorlin Glacier.

2. *High and very high vulnerability to periglacial and gravitational processes* (disaggregation and mass movements through take off) feature the steep slopes (usually consisting of granite, migmatite, amphibolites and a highly metamorphosed crystalline). It is the case of the Grand-Châtelard Massif, the valley-sides deepened into "gorges", etc.

3. *High and very high vulnerability through landslides and gullies* (caused by unstable Quaternary deposits overlaying the Aalenian schists) have the terrains of the Corbier , Touissuire, Fontcouverte and Jarrier area (Figs. 9, 10).

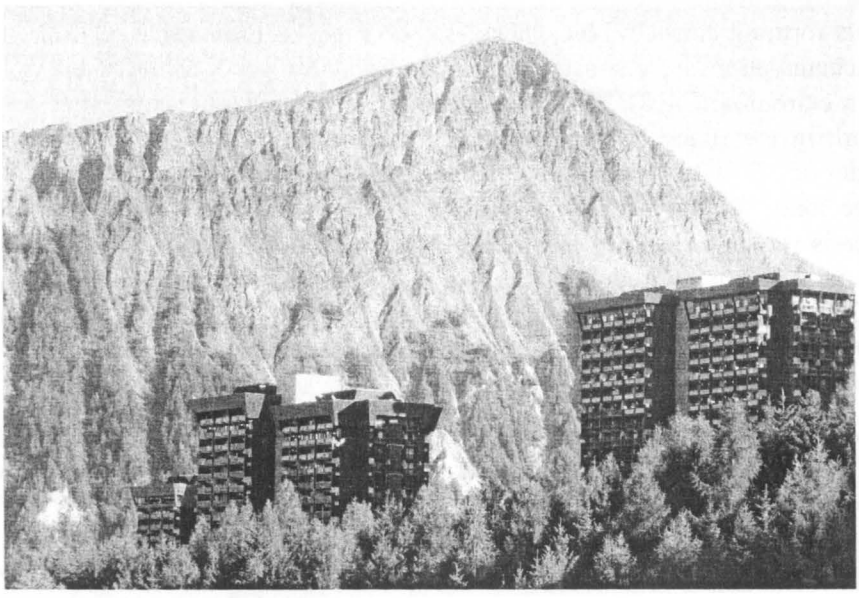


Fig. 9 – Blocks of flats in the Corbier resort.

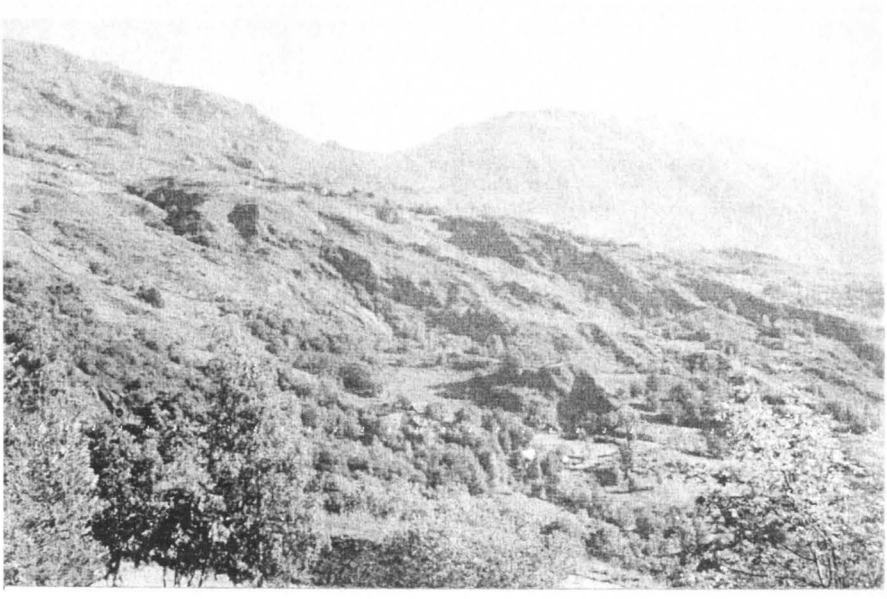


Fig. 10 – Landslides on Würmian glacial deposits in the Corbier-Touissuire area (buildings on the landslide's diluvium).

4. *Moderate vulnerability* due to unstable glacial and fluvio-glacial formations of Würm Age situated at heights of 1,500–1,800 m (2,000 m). The relief with moderate slopes constitutes a huge morphological surface on which important tourist centers have developed.

5. *High vulnerability to channel-slope processes* exhibit the areas in which stream channels come into direct contact with the slopes, so that outputs from the latter represent sediment input to the former. In the lower sector, the Arvan tributaries cut actual gorges, the slope-channel dynamics being particularly active here. With the exception of the Arvan downstream of its confluence with the Garney which has an up to 100-150 m-wide floodplain, the other floodplains are very narrow because of thalweg deviation imposed by alluvial fans or by colluvia.

6. *Low vulnerability show the alluvia and fix alluvial fans* in the lower sector of the Arvan.

7. *High vulnerability to underground voids through the dissolution of evaporates* present the areas underlain by Triassic gypsum in the upper basins of the lefthandside tributaries of the Arvan, in the righthandside upper Arvan area and on the north-west slope of the Mont Charvin. Underground voids are difficult to spot, but they can be found with the help of dissolution funnels. The presence of these voids formed in the wake of collapses, has led to the emergence of surface depressions with excess moisture or even to mini-lakes subsequently drained by the hydrographic network. This is how the upper basin of the Taraverray River was formed and evolved; also in the upper basin we find the Roset Depression on whose bottom a small lake still exists (*Carte geologique de la France a 1/50 000, St.-Jean-de-Maurienne*). The Le Corbier – La Chal tourist route cut into Aalenian schists, skirts the bottom of the depression, following the upper-median section of the slope (Fig. 4).

The areas highly vulnerable to characteristic processes (singled out in terms of the latter's intensity and frequency) represent a *great risk for the population living in the built-up perimeters and for the routes of communication as well*, for example, the Fontcouverte – Villarembert – Le Corbier highway, which runs over Quaternary deposits (fluvio-glacial formations and Würm moraines, slope formations and slide deluvia, etc.) close to the Merderel (Garney) River, wherefrom the highway cuts into Liassic black shales. Both deposits have a high risk potential.

Risk may materialize shortly or after long periods of time, especially when in the presence of gypsum and anhydrites. Such a phenomenon occurred in 1982–1984 in the Alps of Savoia, the Friolin-Isère Basin after a lapse of 25–30 years, triggering a landslide which entrained 10 million m^3 of rock (Rovera, 1993; Vivian *et al.*, 1994).

CONCLUSIONS

Integrated geological-relief researches highlight landform dynamics and evolution trends more or less predictable over time.

They also help to detecting vulnerable areas with imminent risks for the population and the necessary measures to contain disasters.

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VARIABILITÉ SPATIALE ET TEMPORELLE DE LA PLUVIOMÉTRIE DE LA RÉGION DE COURBURE DE L'ARC CARPATIQUE: ÉTUDE PAR ANALYSE EN COMPOSANTES PRINCIPALES

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Mots clés: variabilité pluviométrique, analyse en composantes principales (ACP), région de la Courbure de l'Arc Carpatique.

Space and time variability of rainfall in Carpathian Curvature region: study using Principal Component Analisys. The paper presents some specific features of the spatial and temporal variation of rainfall in the Carpathian Curvature region, resulted from applying the statistical method of principal component analysis (ACP) on the monthly precipitations. There have been turned to account the series of data from 23 meteorological stations for a period of 36 years (1962–1997), data taken from the National Administration of Meteorology of Romania and validated by it. The undertaken analysis shows a relatively homogeneous precipitation behavior throughout the studied region. Thus, the first two principal components explain more than 70% of the total variation of the 23 stations taken into account over a period of 9 months a year. The first principal component holds between 50% (in June) and 80% (in October) of the information regarding the total variability of precipitations. One can notice a good special structuring of rainfall in autumn (September–October) and in winter (December–January), periods when disturbances generally affect the whole region. On the other hand, the summer (especially the months of June and July) is characterized by a relatively reduced special structuring, due to a higher frequency of thunderstorms with local character. Subsequently, the two extreme months – June and October – have been analyzed, considering for June the first 3 principal components and for October the first 2. In this way have been emphasized the spatial differences due to the specific rainfall behavior of various stations in comparison with others, as well as the years with important contributions to the spatial variability of precipitations.

INTRODUCTION

La variation temporelle et spatiale des paramètres climatiques est le résultat de l'action d'un ensemble de facteurs qui agissent à différentes échelles spatiales. Parmi les méthodes utilisées pour étudier cette variabilité spatio-temporelle des paramètres climatiques à l'échelle régionale, ainsi que pour appréhender les facteurs qui les déterminent, l'analyse en composantes principales (A.C.P.) a l'avantage de

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synthétiser l'information de l'ensemble des données en laissant à part la partie considérée comme « non-structurée » (spécificité locale, erreurs). Ce type d'analyse permet d'une part, d'obtenir un regroupement des variables (ici les stations) qui ont une part de leur fluctuation commune ; d'autre part, d'obtenir des chroniques temporelles synthétiques des séries de données pluviométriques qui sont plus aptes à être corrélées avec d'autres paramètres synthétiques (climatiques, hydrologiques, indicateurs de la circulation atmosphérique), que les données brutes. Il est ainsi possible d'identifier les éventuelles relations entre plusieurs variables du système océano-atmosphérique et en particulier de détecter des indicateurs de la circulation atmosphérique (exprimés à l'aide des divers indices spécifiques tel l'Indice Nord Atlantique) qui contribuent à expliquer, au moins en partie, la variabilité climatique régionale.

Ce travail présente les premiers résultats d'une recherche sur une région qui correspond dans ces grandes lignes à la partie extérieure de la Courbure de l'Arc Carpatique (Roumanie), appelée brièvement « région de Courbure ». L'objectif final de cette recherche sera dans une première étape d'établir les relations éventuelles entre d'une part la variabilité spatiale et temporelle de la pluviométrie et d'autre part, le comportement hydrologique des rivières qui drainent la région. Une deuxième étape portera sur les éventuelles relations entre les indicateurs synthétiques de la pluviométrie et de l'hydrologie régionale (ACP mensuelle et trimestrielle des précipitations et des débits liquides) et des indicateurs classiques de la circulation océano-atmosphérique (Beltrando & Camberlin, 1993).

En forme d'arc de cercle ouvert vers l'ouest, la région d'étude englobe trois unités morphologiques distinctes qui descendent en marches progressivement de l'ouest vers l'est: une zone montagneuse (appartenant aux Carpates) à l'ouest, dont les altitudes maximales varient de 1800 (dans la partie est) à 2505 m (dans la partie ouest); une zone collinaire (appartenant aux Subcarpates) qui la borde vers l'est, avec des altitudes fréquemment entre 600 et 700 m, avec par endroits des sommets qui dépassent 900–1000 m; une zone de plaine (l'extrémité nord-ouest de la plaine Roumaine) (Fig. 1). La présence des dépressions intramontagneuses, intra-collinaires et des vallées profondes déterminent une mosaïque climatique assez diversifiée avec des particularités climatiques locales relativement marquées (inversions thermiques, brises ascendantes et descendantes, versants au vent, sous le vent, etc.).

Par sa position géographique, la région est située sur un important carrefour d'influences météorologiques dues principalement à :

– des circulations atmosphériques d'ouest, de type frontal (dominantes sur le territoire de la Roumanie), caractérisées par des phénomènes de fœhn et les processus qui lui sont associés (vent chaud, humidité relative faible, faibles précipitations);

– des circulations atmosphériques de sud et sud-est, avec des perturbations méditerranéennes surtout dans la partie extérieure de la Courbure qui reçoit alors d'importantes quantités de précipitations;

– des circulations d'est et de nord-est (dues à l'action des anticyclones sur la partie orientale de l'Europe) qui déterminent en hiver, un temps froid assez sec et nuageux et en été, un temps très chaud et relativement sec.

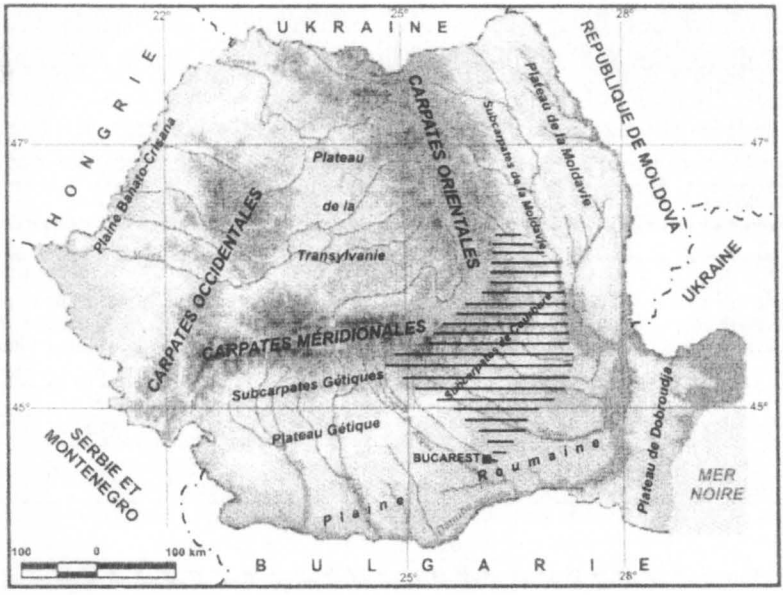

Fig. 1 – Localisation de la région d'étude (en hachure).

Les résultats de notre recherche complètent celles des auteurs qui ont étudié dans le passé les particularités climatiques de cette région et qui ont mis en évidence le rôle de la configuration carpatique sur la circulation atmosphérique de la région de la Courbure : Bogdan *et al.* (1974), Bordei-Ion E. (1983), Bordei-Ion N. (1971, 1988).

1. DONNÉES ET METHODES

Les données analysées ici correspondent aux séries des précipitations mensuelles de 23 stations météorologiques appartenant à l'Agence Nationale de Météorologie (A.N.M.) qui les a validées. La longueur des séries est de 36 ans (1962–1997).

Plus de la moitié (12) des 23 stations se situent à des altitudes inférieures à 300 m (zone de plaine), six se trouvent entre 300 et 900 m d'altitude (zone collinaire) et cinq à des altitudes supérieures à 900 m (zone montagneuse) (Tableau 1).

Pour analyser la variabilité spatiale et temporelle des précipitations de la région étudiée nous avons utilisé l'analyse en composantes principales sans rotation des axes factoriels sur les données standardisées des précipitations mensuelles des 23 stations météorologiques présentées ci-dessus.

L'Analyse en Composantes Principales (A.C.P.) est une technique statistique d'analyse factorielle permettant de résumer l'information d'un ensemble de données quantitatives contenues initialement dans un tableau comportant *n* lignes (les individus) et *p* colonnes (les variables). Les *n* points sont décrits dans un nuage à *p* dimensions. Le principe de base de cette méthode consiste dans le fait que l'essentiel de l'information est retenu par les axes factoriels (composantes principales) regroupant des informations communes à plusieurs variables (X1, ..., Xj, ...Xp) (Chadule, 1986, Lebart & al., 2000). Ici, les individus correspondent aux années (1962–1997) et les variables aux précipitations mensuelles des 23 stations météorologiques valorisées.

Tableau 1

Stations météorologiques dont les précipitations mensuelles ont été utilisées dans l'analyse.

Index	Station	Altitude (m)	Pluie moyenne annuelle (mm)	Index	Station	Altitude (m)	Pluie moyenne annuelle (mm)
1	Vf. Omu	2504	1017,4	13	Fundata	1385	888,9
2	Predeal	1090	952,4	14	Braşov	534	597,0
3	Sinaia	1510	1043,3	15	Întorsura Buzăului	707	644,8
4	Câmpina	461	728,2	16	Târgu Secuiesc	568	511,6
5	Ploieşti	177	630,4	17	Târgu Ocna	242	575,2
6	Pătârlagele	289	635,1	18	Adjud	101	544,2
7	Buzău	96	528,0	19	Tecuci	60	481,9
8	Râmnicu Sărat	152	551,6	20	Măicăneşti	18	447,9
9	Lăcăuţi	1776	824,4	21	Făurei	45	442,3
10	Tulnici	571	662,0	22	Urziceni	60	514,5
11	Târgovişte	296	649,6	23	Bucureşti-Băneasa	90	604,3
12	Câmpulung Muscel	680	668,1				

Les composantes principales (CP) représentent les axes du sous-espace de dimension inférieur à *n* résulté par la projection des *n* points–individus. Chaque axe est une combinaison linéaire de *p* variables originelles: F = a1X1 + ... + ajXj + ... + apXp. Il y a *p* composantes principales et l'information qu'elles résument décroît de la 1-ère à *p*-ième. Ainsi, la 1-ère CP explique (retient) le maximum d'information (c'est l'axe de plus grande dispersion du nuage des points) ; la 2ème CP prend en compte le maximum d'information résiduelle laissée par le premier axe, etc. Chaque axe factoriel apporte donc une part d'explication de la variance totale des données analysées, et la part de variance diminue au fur et à mesure que le nombre d'axes factoriels augmente. Le but étant bien évidemment de ne retenir que le nombre d'axes qui est nécessaire et de laisser sur les autres axes, qui ne sont pas pris en compte, l'information considérée comme «résiduelle».

Parmi les résultats obtenus par l'A.C.P. pour chaque axe factoriel le logiciel donne *les contributions* des variables/individus à l'explication de l'axe factoriel (le pourcentage de l'information contenue par chaque variables/individus de l'information totale retenue par l'axe factoriel) et les *coordonnées* des variables/ individus (les valeurs des projections des points correspondant aux variables/ individus sur l'axe factoriel).

L'A.C.P. a été appliquée ici en utilisant le logiciel XLSTAT Pro 5.2. Les résultats concernant les variables (les 23 stations) ont été cartographiés en utilisant le SIG MapInfo 6.5.

2. LA VARIABILITÉ SPATIO-TEMPORELLE DES PRÉCIPITATIONS MENSUELLES

Les douze A.C.P. des précipitations mensuelles mettent en évidence un comportement pluviométrique qui parait relativement homogène toute l'année. Ainsi, les valeurs des pourcentages de variance des deux premiers axes factoriels expliquent plus de 70% de la variance des 23 stations durant 9 mois de l'année (Fig. 2). La variabilité spatiale des précipitations est plus importante dans l'intervalle avril–août ; cela est probablement du à la fréquence élevée des phénomènes convectifs d'échelle sous-régionale à cette saison. Par contre, la période octobre–mars se caractérise par une pluviométrie, dont la variabilité est relativement homogène sur l'ensemble du réseau. Ce qui veut dire que les écarts (positifs ou négatifs) de la pluviométrie, par rapport aux moyennes, ont tendances à être de même sens dans toutes les stations.

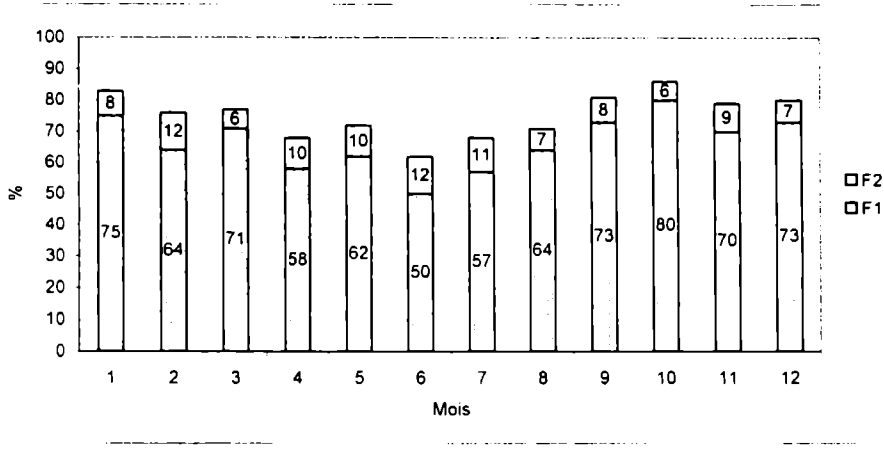

Fig. 2 – Variation annuelle du pourcentage de variance des précipitations correspondantes à la première (F1) et à la deuxième (F2) composante principale (A.C.P. réalisée par mois pour la période 1962–1997).

La variabilité spatiale de la pluviométrie dans la région de la Courbure de l'Arc Carpatique est donc plus importante dans la période chaude de l'année par rapport à la période froide. Compte tenu de ces différences dans la structuration spatiale, nous avons retenu pour une analyse plus détaillée les deux mois extrêmes, juin et octobre.

2.1. LA VARIABILITÉ SPATIO-TEMPORELLE DES PRÉCIPITATIONS EN JUIN

En juin, nous avons retenu les trois premières composantes principales qui expliquent 68% de la variance totale des précipitations. Le premier axe factoriel a le plus faible pourcentage de l'année (50%).

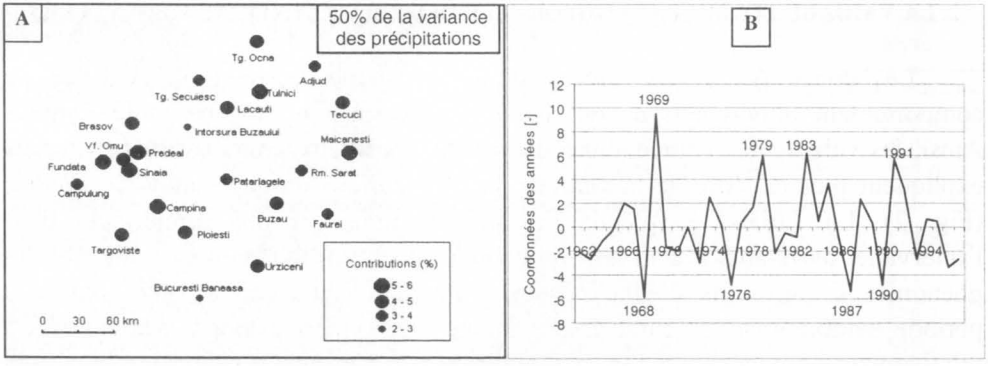

Fig. 3 – **A**, Contribution de la première composante principale à la variance des précipitations, en juin. **B**, Coordonnées des années sur la première composante principale, en juin.

Les contributions des stations à cet axe sont positives et relativement homogènes, elles oscillent entre 3 et 6% (Fig. 3A). Parmi les années les plus arrosées avec un poids important dans l'explication de cette première composante principale se détachent 1969, 1979, 1983 et 1991, et, à l'opposé, les années 1968, 1976, 1987 et 1990, avec de faibles précipitations sur l'ensemble de la région (Fig. 3B).

Le deuxième axe factoriel de juin explique 12% de la variabilité totale de la pluviométrie. Cet axe met en évidence des différences spatiales entre la moitié nord-est avec des contributions en coordonnées positives et celles du sud-ouest de la région, avec des contributions en coordonnées négatives (Fig. 4A). Il y a une opposition remarquable entre l'extrémité occidentale (où les stations de Câmpulung, Târgoviște ont eu de fortes contributions négatives, respectivement 10,1 et 8,8% à la variance de l'axe 2) et l'extrémité orientale (où les stations de Făurei et Tecuci ont eu de fortes contributions positives, de 11,4%, et 9,4%). Une contribution positive élevée concerne aussi la station de Intorsura Buzăului (11,9%) ce qui pourrait indiquer un comportement pluviométrique spécifique, dû à sa position dans une dépression intra montagneuse. Deux années ont contribué fortement à l'explication de la deuxième composante principale : 1985, avec des précipitations importantes dans la partie nord-est de la région et faibles dans la partie ouest, sud-

ouest et l'année 1979, plus humide en sud-ouest et sèche en est, nord-est (Fig. 4B). Ces deux années opposées expliquent une grande partie de l'axe 2.

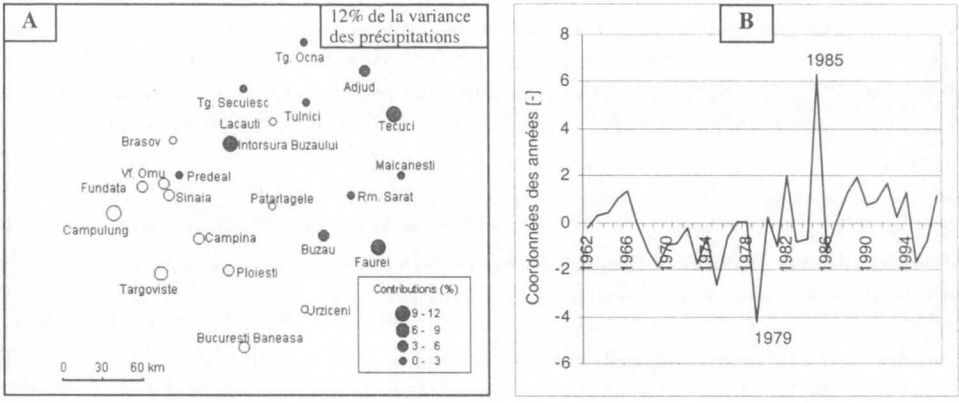

Fig. 4 – **A**, Contribution de la deuxième composante principale à la variance des précipitations, en juin (en noir contributions avec des coordonnées positives ; en blanc contributions avec des coordonnées négatives); **B**, Les coordonnées des années sur la deuxième composante principale, en juin.

Le troisième axe factoriel, pour le mois de juin, indique des différences spatiales entre, d'une part la région montagneuse avec des contributions négatives et d'autre part, la région collinaire et de plaine, avec des contributions positives.

C'est notamment l'extrémité NNO (les stations de Târgu Secuiesc, Braşov, Vf. Omu) qui s'oppose à celle SSE (les stations de Bucureşti-Băneasa et Urziceni) (Fig. 5A). Quant aux années qui ont contribué à l'explication de cette composante, la région montagneuse a été relativement arrosée en 1974 et 1981 par rapport à la région de plaine et de collines (Fig. 5B). A l'opposé, les années 1964, 1969 et 1983, ont été relativement sèches dans la partie montagneuse, alors que dans la région collinaire et de plaine, la situation avait une tendance inverse.

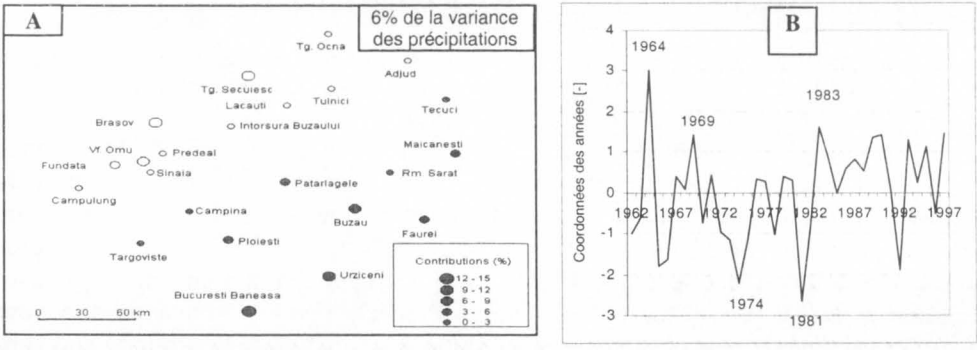

Fig. 5 – **A**, Contribution de la troisième composante principale à la variance des précipitations, en juin (en noir contributions avec des coordonnées positives ; en blanc contributions avec des coordonnées négatives); **B**, Les coordonnées des années sur la troisième composante principale, en juin.

2.2. LA VARIABILITÉ SPATIO-TEMPORELLE DES PRÉCIPITATIONS EN OCTOBRE

Le mois d'octobre se caractérise, comme nous l'avons déjà vu, par la plus forte structuration spatiale des précipitations dans la région étudiée, avec 80% de variance prise en compte par le premier axe factoriel. Sur la période d'étude, c'est donc le mois, qui possède le comportement pluviométrique le plus homogène. Un tel résultat veut dire que lorsque la pluviométrie à tendance à enregistrer un écart (positif ou négatif) dans une station, on a tendance à retrouver un écart de même amplitude dans les autres stations. L'altitude ou la position par rapport aux reliefs interviennent bien évidemment sur les valeurs absolues de précipitations mais peu sur le sens de la variation. On peut donc supposer que cela s'explique par un poids plus important des perturbations atmosphériques qui balaient la totalité de la région, la fréquence et l'intensité de ces événements conditionnant le total du mois.

Les contributions des stations météorologiques au premier axe factoriel sont positives et relativement homogènes (3 à 5%) (Fig. 6A). L'année 1972, avec des fortes précipitations qui ont dépassé de 4 à 5 fois les moyennes habituelles pour ce mois, au niveau de toute la région, contribue pour l'essentiel à la forte structuration des pluies (Fig. 6 B). Dans une moindre mesure, l'année 1975 a enregistré une tendance similaire. A l'opposé, en 1969, le mois d'octobre a été les plus secs, tout comme en 1978, 1986 et 1995.

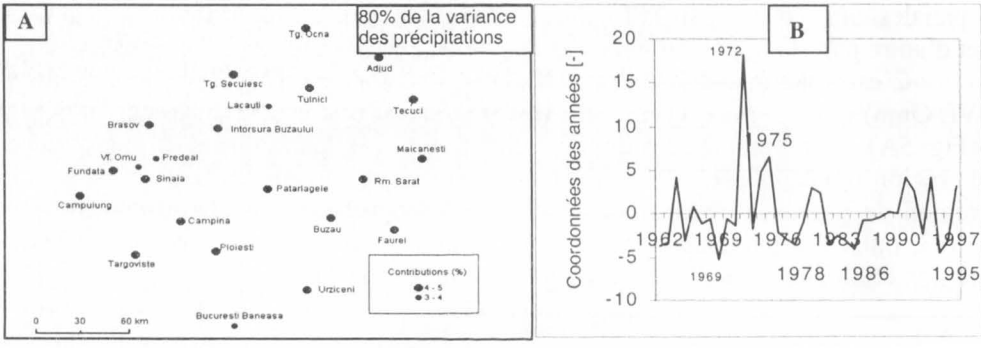

Fig. 6 – **A**, Contribution de la première composante principale à la variance des précipitations, en octobre; **B**, Les coordonnées des années sur la première composante principale, en octobre.

La deuxième composante principale explique seulement 6% de la variance totale des précipitations. Elle met en évidence une opposition mineure entre la région montagneuse et collinaire, avec des contributions négatives, et la région de plaine, avec des contributions positives. Comme la figure 7A le montre, les plus fortes oppositions par leurs contributions concernent les stations montagneuses situées à de hautes altitudes (Vf. Omul, Predeal, Fundata, Lăcăuți) avec des coordonnées négatives, d'une part et les stations de plaine de l'extrémité sud sud-est (București – Băneasa, Urziceni, Buzău), avec des coordonnées positives, d'autre part. Les années avec un rôle important dans l'explication du deuxième axe factoriel sont 1994 et 1997, qui s'opposent par leurs coordonnées aux années 1964,

1974 et 1980 (Fig. 7 B). Ainsi, les années 1994 et 1997, ayant des coordonnées positives, ont été les plus humides pour la région de plaine et les plus sèches dans la région montagneuse et collinaire. Dans les années 1964, 1974 et 1980, avec des contributions importantes en coordonnées négatives, la situation a été inverse.

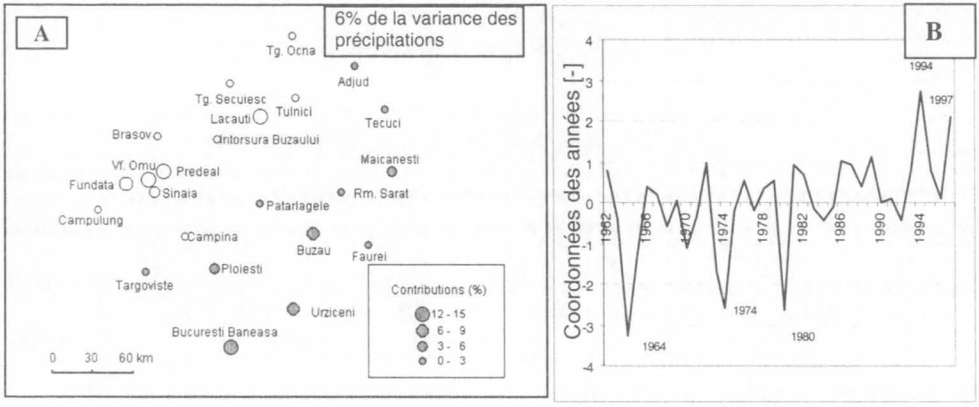

Fig. 7. **A** – Contribution de la deuxième composante principale à la variance des précipitations, en octobre (en noir contributions avec des coordonnées positives ; en blanc contributions avec des coordonnées négatives). B – Les coordonnées des années sur la deuxième composante principale. en octobre.

CONCLUSIONS ET PERSPECTIVES

L'analyse en composantes principales appliquée aux précipitations mensuelles de la région de courbure de l'Arc Carpatique nous a permis d'identifier:

– un comportement pluviométrique relativement homogène, mis en évidence par les pourcentages élevés de la variance des précipitations détenus par le premier axe factoriel ;

– une structuration spatiale des précipitations plus importante (correspondant à un comportement pluviométrique régional plus homogène) en automne (septembre–novembre) et en hiver (décembre–janvier), saison où les perturbations du front polaire sont susceptibles de balayer toute la région;

– une structuration spatiale des précipitations relativement faible en été (notamment en juin et en juillet) et au printemps, ce qui suggère qu'une partie relativement importante des pluies est due à des phénomènes orageux d'échelle sous régionale.

Les chroniques temporelles de la pluviométrie mise en évidence par l'A.C.P. vont maintenant être mises en relation avec le comportement hydrologique des rivières qui drainent la région afin de mieux comprendre les processus hydro-climatiques, ou celles de mieux cerner les relations entre les données pluviométriques et hydrologiques. Le but final de cette recherche sera d'identifier d'éventuelles relations entre les indicateurs synthétiques de la pluviométrie et de l'hydrologie

régionale. Puis, d'analyser dans quelles mesures des indicateurs classiques de la circulation océano-atmosphérique (indice ONA, indice méridien de pression sur l'est de la Méditerranée et l'Europe centrale) peuvent donner une indication de la pluviométrie et l'écoulement d'un mois donnée.

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MORPHOSTRUCTURAL AND MORPHOTECTONIC PARTICULARITIES IN THE RELIEF OF THE MEHEDINȚI MOUNTAINS

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Key words: tectonics, structural landforms, GIS, remote – sensing, Mehedinți Mountains.

Parcticularités morphostructurales et morphotectoniques dans le relief des Monts de Mehedinți. L'extremité de l'ouest des Carpates Méridionales, connue comme la Groupe Retezat-Godeanu (qui compris aussi Les Monts de Mehedinți) est l'une de plus intéressante région carpatique tant du point de vue évolutif que du point de vue géomorphologique. Ce fait est soutenu par la présence simultanée-seulement dans cette région-des trois unités tectoniques, specifiques aux Carpates Méridionales (l'autochtone danubien, nappe gétique et nappe de Severin). Il faut ajouter la présence de quelques duplicatures (la duplicature d' Arjana et la duplicature de la Cerna) ainsi que le systéme de failles, les unes en ayant une extention régionale. Bien que pour les Monts de Mehedinți la présence du relief carstique est considérée comme un trait morphologique général, on constate que dans cette région les éléments morphologiques et structurales s'imposent fort dans le relief, en étant celles qui déterminent les caractéristiques morphologiques générales, les caractéristiques de détails et en même temps les limites de cette unité montagneuse. L'étude du relief, en utilisant le modèle numérique du terrain, la réalisation des cartes géologiques digitales et l'analyse des images satéllitaires ont permis une analyse complexe et la possibilité de représentation tridimensionale du terrain, couvert par des couches tématiques (lignes téctoniques, géologie, images satéllitaires etc.), ce que nous a beaucoup soutenu le travail du terrain et a complété l'analyse géomorphologique. C'est pourquoi, nous pouvons affirmer que le relief structural des Monts de Mehedinți représente sans doute, comme le relief carstique, un trait spécifique de ces montagnes.

INTRODUCTION

The present geomorphologic landscape of the Mehedinți Mountains has a relief with many particular features given by complex geologic structure, with numerous plication, fractural and disjunctive elements. Because of the existence of a very spectacular karstic relief which has caught the entire attention of researchers, and also because the region is covered mostly by forests which make field researches difficult, the morphostructural features of these mountains have been little studied (Sencu, 1975; Badea *et al.*, 1981; Povară, 1997[1]; Török, 1999).

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[1] Povară, I., (1997), *Studiu fizico – geografic al bazinului hidrografic Cerna cu privire specială asupra hidrologiei carstice,* Doctor thesis (Mscr.), University of Bucharest.

In the Mehedinți Mountains the following tectonic units are present: the *Danubian Autochthonous*, covering the largest part of these mountains, the *Cerna Duplicature*, not as widely spread territorially, present only in the central and southern part of the mountain unit, the *Getic Nappe*, present as patches at the periphery, on the western and eastern ridges of unit, and the *Severin Nappe*, outcropping on small surfaces, at the contact with the Mehedinți Plateau. The main structural elements identified in these mountains are: *the Culmea Cernei Anticline*, *the Vârful lui Stan Anticline*, *the Cernei Anticline* and the north-western flank of *Orzești – Săliștea Syncline* (also known as *the Bahna Syncline*). These wide waves have been pointed out on geological profiles even since 1906 by Murgoci (quoted by Emm. de Martonne, 1907). These are completed by several elements of fractural tectonics: *the Cerna–Jiu fault, the Arșasca-Pârâul Ivanului fault, the Vârful lui Stan–Curmătura Oltețului fault, the Motrului fault, the Obârșia–Titirlești fault* and *the Izverna–Ponoarele fault*, the last two being strike-slip fault lines. Năstăseanu (1980) separates as a "major and independent tectonic element" *the Cernei Graben.*

The general orientation of all structural elements is north-west – south-east. A general first remark about this mountain unit is that there is an obvious correlation between the orientation of these structures and the orientation of the main valleys. Even more, altitudes decrease from north (Vârful lui Stan, 1 446 m) to south (under 700 m), due to the plummet on the same direction of all structural elements.

The second remark is that the limits of the Mehedinți Mountains are almost entirely morphostructural (Fig. 1). Thus the limit to the Cernei Mountains and the Almăjului Mountains is entirely morphostructural, given by the Cerna–Jiu fault and reinforced, at the north of the confluence of the Cerna River with Topenia, by the overthrust line of the Getic Nappe, constituting at the same time a complex physical-geographical limit. The eastern limit, towards the Vâlcanului Mountains, is established along the Motru fault line, while the contact with the Mehedinți Plateau is more complex, being mainly sculptural in the first sector (between Cloșani and Izverna villages) and morphostructural in the second, south from Izverna, where it loosely corresponds the overlap of the Getic Nappe over the Severin Nappe or the Danubian Autochthonous, or it follows some fault lines (Fig. 1). The only entirely sculptural limits are the northern and the southern, both of a very short length (Fig. 1).

THE LANDFORMS OF FOLDED AND OVERTHRUSTED STRUCTURES

We must mention that, as a consequence of the numerous elements of fractural tectonics, some with regional distribution, the relief of the folded and overthrusted landforms is, in most cases, "doubled" by that of fault structures.

Landforms Corresponding to Anticline Structures

The two anticlines, Culmea Cernei (named also the Piatra Cloşanilor – Culmea Cernei Anticline by Drăghici, 1963) and Vârful lui Stan, appear in the landscape as forms concordant with the structure, i.e. the main elevations correspond to these anticlines. The main crest of the Mehedinți Mountains coincides mostly with the axial part of the anticlines.

The Culmea Cernei represents the main ridge of the northern sector of the Mehedinți Mountains, and overlaps mostly the homonym anticline. North from Vârful lui Stan and up to Corcoaiei gorges, the axis of the anticline is formed by granitoid rocks, and towards the north, by the amphibolites of the Drăgşan Group, since the sedimentary cover being totally eroded away. The eastern flank of Culmea Cernei is fragmented by Vârful lui Stan – Curmătura Olteţului fault line by means of which it gets in contact with the formations of the Drăgşan Unit, while the eastern flank of the anticline disappears in the tectonic alignment of the Cerna Valley. A series of short and steep valleys, corresponding to flanks of anticlines, are present on one side and another of the anticline. Because faults are present on the eastern side, the valleys, mostly torrential, tributary to Cerna, have short longitudinal profiles in steps, with characteristics specific to obsequent valleys. In the valley head of some of these, small lithologic escarpments are present (Badea *et al.*, 1981).

Due to a very pronounced lift of the northern sector during the post-Cretaceous orogeneses, proved by the presence of rocks belonging to the bedrock at altitudes of 1 100–1 200 m, the sedimentary layer of the maximum height of the anticline was totally removed through erosion. It is present only on the western flank, where the layers are disposed monoclinally. In this area the sedimentary cover appears under the shape of a maximum 750 m wide stripe, made of Urgonian limestones alternating with Turonian–Senonian wildflysch. The contact between the two types of rocks is done through some longitudinal fault lines, associated to Cerna fault line, which determines the decrease in steps towards Cerna of the western slope of the Geanţuri ridge. The limestone generates in the relief a lime ridge, transversally fragmented, which forms the Geanţuri alignment. The strata are highly withdrawn (almost vertical) and in the contact area with the Cerna granitoides a sliding slope with friction marks is present. The angle of the slope is 80–85° north-west at the level of the ridges, and of 60–65° north-west at the level of the valleys (Iancu, 1976). This remarks lead to the idea of detachment and slide of the sedimentary formations off the crystalline base towards an area of lower altitude situated west from the Vârful lui Stan Anticline. This was possible through the high elevation of the axial part during Turonian–Senonian, period when the wildflysch with large Urgonian limestonesolistolithes was deposit (Iancu, 1976). Thus, is obvious the existence in the Geanţuri area of a tectonic contact between the crystalline basement and the sedimentary cover of the Danubian Autochthonous. This contact takes the form of a fault line with south-west – north-east general orientation and is one of the tectonic elements of the "Cerna alignment" called by Iancu (1976) the "*Arşasca-Pârâul Ivanului fault*".

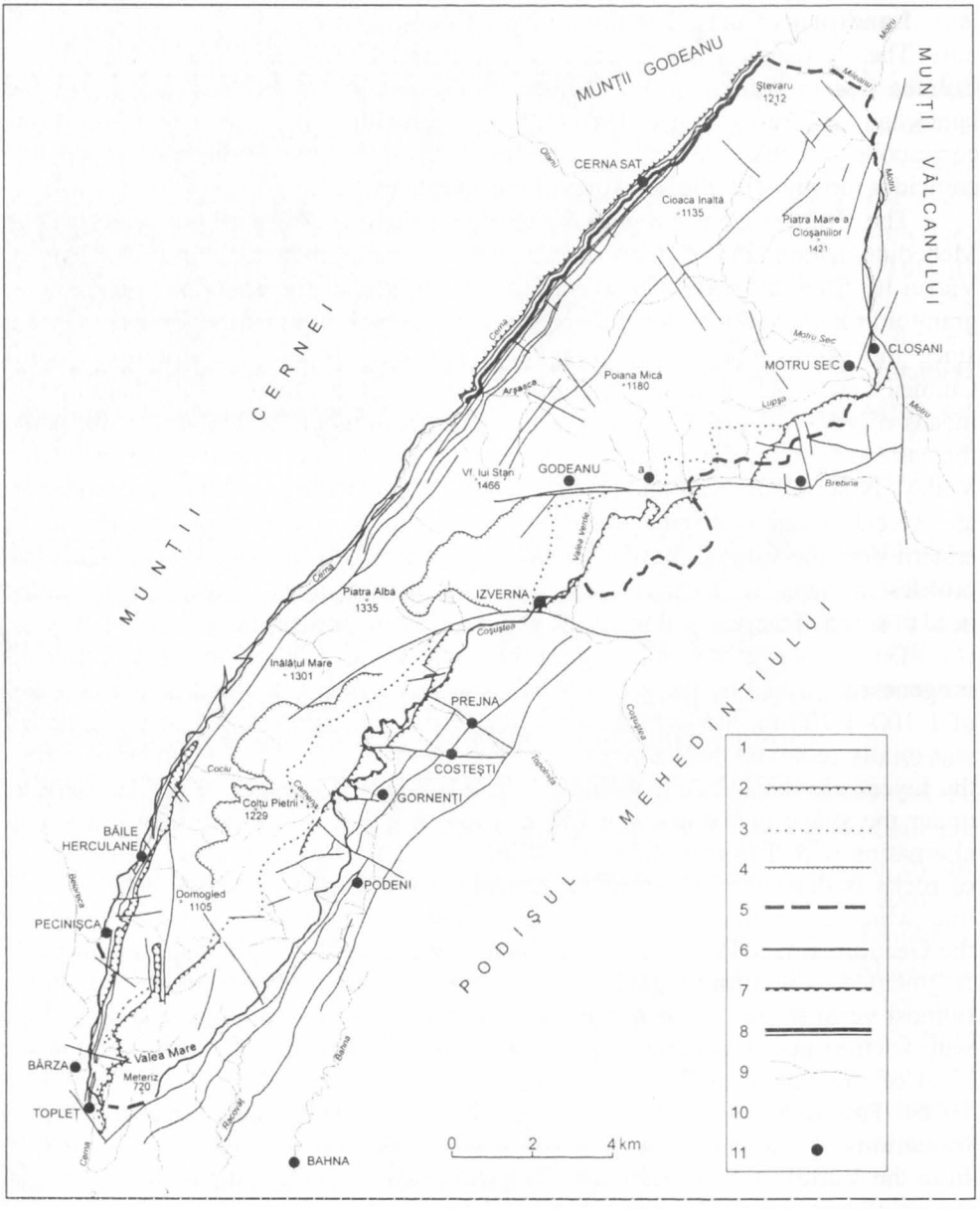

Fig. 1 – The Mehedinți Mountains – the main tectonic lines and the limits of the unit.
1, fault; *2*, the overthrust plane of the Getic Nappe; *3*, the overthrust plane of the Sevrin Nappe; *4*, the overthrust plane of the Cerna Duplicature; *5*, sculptural limit; *6*, limit along fault; *7*, morphostructural limit; *8*, morphostructural limit duplicated by fault; *9*, permanent streams; *10*, temporary streams; *11*, settlement; *a*, Obârșia Cloșani village; *b*, Mărășești village.

The Geanţului ridge is made of small hog-backs separated by transversal valleys, forming small size gorges, heavily deepened in the lime stripe. These generate an alignment of small massifs, each with distinct morphology and hydro-karstic water circulation. Two distinct situations are noticeable:

– *Between the Arşasca and the Râmnuţa Vânătă Valleys*, the carbonate series repeats itself two or even three times, generating two or three parallel limestone peaks, separated by lower areas, corresponding to the successions of the wildflysch. These are long and narrow and are called by the local population *prihoduri*. From a structural point of view, these are small subsequent basins. The entwinement of the non-karstifiable rocks complicates and particularizes the subterranean flow in this sector. The Geanţul Hermanului and the Geanţul Glodului (in its southern part) display three lime ridges with hog-back aspect. In both cases the central ridge is the highest and most imposing. The ridge towards Cerna is lower due to the tectonic decrease of the limestones towards Cerna, and the eastern ridge, situated at the contact between limestones and granitoides, is not as distinguishable, because the limestones do not exceed a 70 m width. Both the northern area of the Geanţul Glodului and the Geanţul Schitului have two limestone ridges. At the contact of the limestones and the granitoides, the affluents of the Cerna river have generated a series of contact depressions, with a suspended position in reference with that of Cerna river. These depressions are connected through wide saddles (Badea *et al.*, 1981). This series of low areas overlaps the axis of the Culmea Cernei anticline, forming, from this point of view, inversions of relief. If north from Cioaca Glodului Peak (1 023 m) the Culmea Cernei overlaps the homonymous anticline, south from this peak and all the way to the base of the northern escarpment of Vârful lui Stan, the axis of the anticline is heavily eroded. This erosion area may be considered to be the result of existence of some drainage basins tributary to Cerna and which are more developed than those of the opposite slope, with permanent rivers and streams which have managed to cross the limestone barrier without significant losses in the water flow level. This is the case of the Arşasca, Râmnuţa Mare, Râmnuţa Vânătă and Ogaşul Sec watersheds. The fact that the sidestreams of Cerna had a more powerful erosive force than those of Motru, not a common thing for the Mehedinţi Mountains, can be considered to be consequence of the fact that the slope towards Mededinţi Plateau is made entirely of the Mesozoic limestones of Culmea Obârşiei and Gorganul, which form a karstic region more extended and more massive than that of the Geanţuri ridge. Infiltrations and underground capturing prevented the formation of a permanent hydrographic network, capable of penetrating this region, which has evolved mainly by karstic processes, thus erosion having a more powerful effect west from Culmea Obârşia. The drainage divide between Cerna and Motru was gradually pushed towards east, and nowadays is covering the Culmea Obârşia. The small slopes and shelter conditions of these depressions and also the extension of the deforested surfaces turned into pastures gave optimal conditions to build the numerous shelters, sheepfolds, and even houses. The Geanţuri ridge dominates

these depressions by a limestone cliff which reaches in some areas 60 and even 100 meters. At the base of the steeps, in Pleistocene a mixed glacis was formed, in which detrital train with rock outcrops in place. Nowadays the deluvia is in general fixed by vegetation.

– *Between Ogaşul Sec and Corcoaia gorges* the morphology is simple, because the succession limestones – wildflysch is no longer present. The limestone ridge is unitary and narrows gradually. The karst drainage system is a hydro-geologic penetration type. Between Ogaşul Vânătorului and Cheile Corcoaiei the limestone stripe is no longer present. Just as in the previously described sector, the hog-back appearance is preserved for the entire length of the limestone ridge, although this feature is not that perceivable once the stripe limestone narrows.

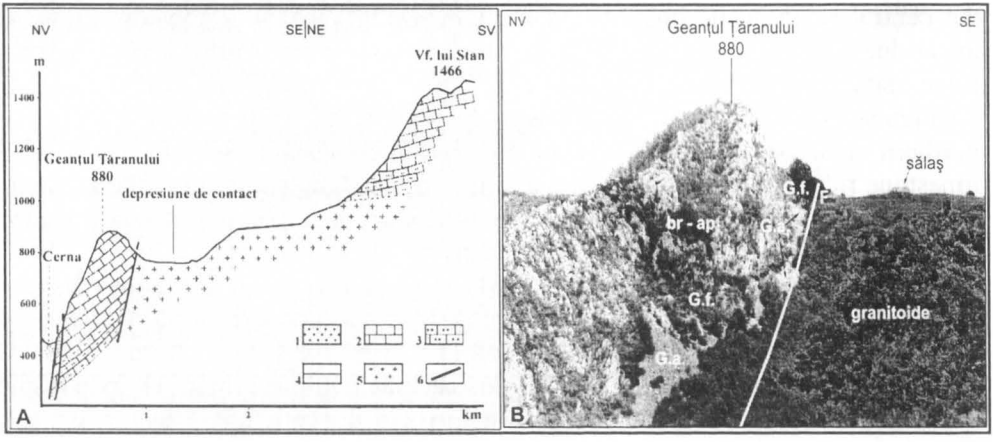

Fig. 2 – **A**, Geomorphologic profile between Vârful lui Stan (1466 m) and Geanţul Ţăranului (880 m). *1*, Turonian - Senonian wildflysch; *2*, Barremian – Aptian limestones; *3*, Tithonic – Neocomian silica limestones; *4*, Getic Nappe; *5*, granitoides; *6*, fault. **B**, The contact between limstones and granitoides east of the Geanţul Ţăranului. *br-ap*, Barremian – Aptian limestones; *G.a.*, active screes; *G.f.*, screes fixed by vegetation; *F*, fault.

This feature is strengthened by the strong transversal fragmentation of the limestone ridge, so that several of the limestone massifs have the aspect of asymmetrical towers. This is reflected also in the popular toponyms, being called by the locals *bolduri (needles)* (i.e. Boldul Corcoaiei or Boldul de la Moşoiu). At the contact between limestones and granitoides there are no longer contact basins, just saddles, which narrow towards north, once the limestone stripe narrows. The same situation is present south of the Arşasca Valley, where the Geanţuri ridge extends for another 3 km. The three limestone hog-backs: Geanţul Bobotului (869 m), Geanţul Ţăranului (880 m) and Geanţul Ţiganului (759 m) show just one crest with hog-back appearance (Fig. 2 A and B). The contact between limestones and granitoides is marked by contact basins, much smaller than those of the previous sector. The secondary summits that decrease towards Cerna are narrower. In the

lower one third, these are leveled down, being almost horizontal at the contact with the limestone.

In the region of Geanțurile are present all types of structural valleys (or valley sectors) characteristic to monocline structures:

- ***Obsequent valleys*** are short, steep and dry. The term valley is not in fact appropriate, these being in reality incipient valleys, not too deep, that cross the lime crest from the east. Many of these appear on diaclases, having a pronounced structural character.
- ***Subsequent valleys*** are parallel with the eastern slope of the Geanțuri and appear on granitoides, in the near vicinity of these's contact with the limestones. They are short, with a slow slope in the head of the valley and with a narrow slope in the confluence area. They are generated by the affluents of the main rivers, many of these having a torrential character, representing probably the generation of valleys immediately following diaclinal valleys. These had the purpose of detaching the Geanțuri ridge off the neighboring granite area.
- ***Consequent valleys*** are of two types:

  – valleys narrowed in the western crest, made mostly of structural surfaces, highly inclined. These are entirely dry karstic valleys, superficial and very steep (between 45° and 75°). In the case of the Geanțuri with only two limestone ridges, some of these valleys managed to cross the ridge so that the small basin between the two limestone crests is open towards Cerna. This type of valleys is only present in the Geanțul Hermanului and in the Geanțul Glodului, in the other areas forms like coves and consequent chimneys being present.

  – Diaclinal valleys, which manage to cross the limestone barrier, fragmenting it into small peaks. These have several features that differentiate them from the other known subsequent valleys. The structural character of these valleys is obvious only in the limestone sector. The sector developed on granitoides has a longitudinal profile with a high slope to the head of the valley and with a slight inclination in the area of the contact basins. On the limestones sector, all diaclinal valleys form small gorges, whose length depends on the width of the lime barrier. The declivity is here more pronounced and a slope failure appears giving them hanging valleys features. In the inferior sector, where the valleys are shallow on the surface of the glacis accumulated at the base of the steeps the slope is slightly clined.

At first view, due to the leaning of the limestones towards north-west, following the flowing direction of the rivers of the area, the consequent character of the diaclinal valleys is obvious. Nevertheless, these valleys (Râmuța Mare, Râmuța Vânătă, Ogașul Bobotului, Ogașul cu Bolovani, Ogașul Țiganului, Ogașul Sec,

Ogaşul Adânc şi Ogaşul Hotarului) have in the karst area, several morphological features specific to obsequent valleys developed in limestones (Fig. 3): narrow and deep gorges, inaccessible entirely or only in some areas; highly inclined longitudinal profile, with numerous slope failures, generating waterfalls; the presence of pot holes at the basis of the waterfalls and the presence of the lateral pot holes, excavated in the walls of the gorges. The infiltration, total or partial, of the water, in some sectors, and its reappearance, either in the same valley, or, as in most cases, in neighboring drainage basins, by means of karstic springs.

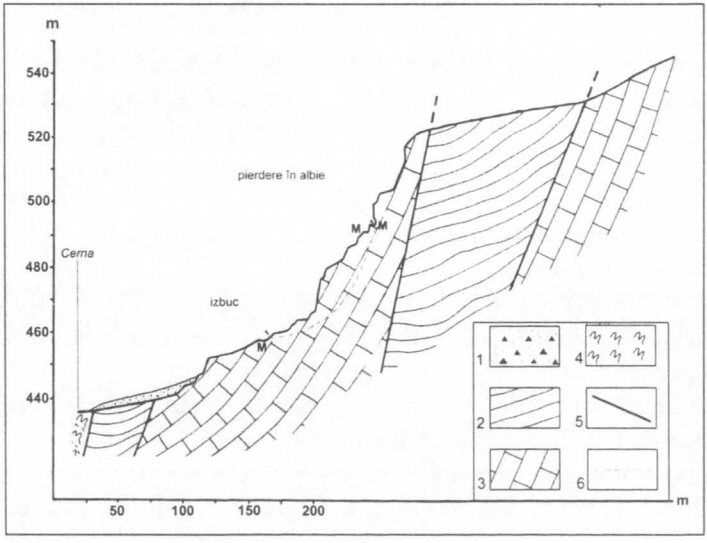

Fig. 3 – Longitudinal profile of the Râmnuţa Mare valley (gorge sector).
1, glacis; *2*, Wildflysch; *3*, limestones; *4*, schists; *5*, falie; *6*, supposed underground flow; *M*, pot hole.

The particular morphology of these valleys is explained by the fact that the layers of limestone have a very high cline, between 50 and 80° (Iancu, 1976). This thing explains the high slope of their longitudinal profiles and the fact that the thresholds coincide in most cases to the bedding planes. The highly regressed position of the limestones makes the valley-line cross the heads of the strata, this favoring the infiltration along the bedding planes of the water in the underground. These valleys are called by the local population *ogaşe*.

The only valleys that don't belong to this category are Arşasca and Cerna (in the Corcoaia gorges area) which, because of high and relatively constant water flows during the year, have a different longitudinal profile, less steep and without slope failures. This is more obvious in the case of Cerna that in that of Arşasca. This last one, however, shows a slope failure in the limestone sector, at approx. 500 m absolute height, but this slope failure is less pronounced and is 50-100 m below the slope failures mentioned above.

From a genetic point of view, these valleys are epigenetic. This fact is proven by the direction of the main rivers, i.e. perpendicular to the stripe of Urgonian limestones. They had a first stage of lowering in the sedimentary deposits that covered the widest part of these mountains and which are present just as small Miocene patches near Corcoaiei gorges (Macovei, 1909, quoted by Niculescu, 1965). Post-Miocene movements led to vertical erosion which generated the fast deepening of the rivers and the cross-sectioning of the limestone barrier. To almost all these valleys, the epigenetic character is doubled by a tectonic one, this appearing along some tense fault lines, associated to Cerna - Jiu fault (Fig. 1).

South from Vârful lui Stan, the main ridge overlaps the Vârful lui Stan Anticline, perceivable till south of Domogled, and then it sinks under the crystalline of the Bahna Patch. Due to the existence in the central and southern sector of the Cerna Duplicature, a short secondary overthrust, which covers this anticline mainly in its medial part, we cannot say anymore that we have to deal only with an anticline hill, like Culmea Cernei, but with the backbone of the Mehedinţi Mountains, with a hypsometry imposed by the sinking of this structure to the south. The existence of this anticline is proven by the appearance in some tectonic windows of both the granitoides of Culmea Cernei (in Ţăsnei and Jelărăului valleys and in the Balta Cerbului karstic depression) and of the autochthonous sedimentary from under the Bahna Patch, on Bârza Valley (Valea Mare). The anticline has a width of maximum 7 km, near Vârful lui Stan, than it becomes narrower to the south, reaching less than 3 km near Feregari Valley.

This anticline is fragmented by a series of longitudinal fault lines, parallel with the major structures, but also by some faults perpendicular on this direction. Some of these are strike-slip faults and some tension faults. Longitudinal faults affecting the western flank of the anticline belong to the tectonic alignment of Cerna and generate the falling into steps of some compartments towards the Cerna Graben. Due to this cause, the central and southern sector of the Mehedinţi Mountains forms an immense tectonic cuesta. The flank towards Mehedinţi Plateau is covered by the Cerna Duplicature, which, in its turn, gets in contact by means of the Izverna – Coşuştea fault with the Getic Nappe and the Severin Nappe, or is covered by the Severin Nappe (Fig. 4).

In the central sector of the Mehedinţi Mountains several negative karstic landforms appeared along a fault line parallel with the Cerna - Jiu fault. These are forms of large dimensions, i.e. huge sink-holes, uvalas, and open karstic depressions, known under the generic term "Poienile Închise" (*the closed glades*) or "Poienile Cernei" (*the glades of Cerna*) (Sencu, 1975). These spread between the Vârful lui Stan and the Ţăsna Valley and form a suspended depression area, above the western great steep of the Mehedinţi Mountains, at 980 and 1 200 m, with a length of over 8 km and a maximum width of 1 km in the Crovu Medvedului sink-hole. Situated immediately under the main ridge of the Mehedinţi Mountains, near the hinge of the Vârful lui Stan anticline, this chain of negative forms resembles an anticlinal valley (combe) (Fig. 4). This was generated mainly through lime dissolvement and,

only for polish, weathering, sheet wash and rill erosion. Front to front cuestas are present, the eastern ones with less steep slides, and those towards Cerna are hog-backs which form the ridge of the Cerna steep.

The karstic depressions appearing the near the covering front line of the Cerna Duplicature are sided by another eastern cuesta formed on the limestones of the overthruste. The most relevant example is that of Bruscan Peak which dominates the Crovu Mare sink-hole (Fig. 5).

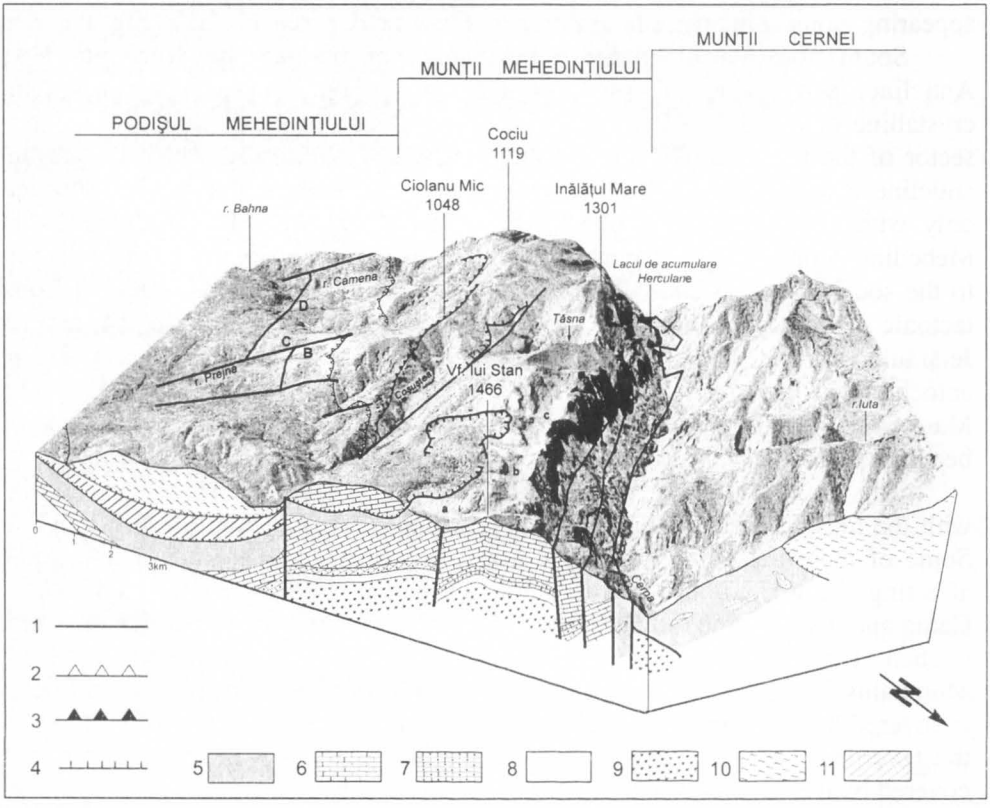

Fig. 4 – Correlation between petrography, structure, tectonic and relief in the central sector of the Mehedinți Mountains (Digital Terrain Model draped with Landsat ETM image – panchromatic band, 15 m resolution – and a tectonic lines layer; 3D representation). *1*, Fault; *2*, the overthrust plane of the Getic Nappe; *3*, the overthrust plane of the Sevrin Nappe; *4*, the overthrust plane of the Cerna Duplicature; *5*, Turonian – Senonian wildflysch; *6*, Barremian – Aptian limestones; *7*, Tithonic – Neocomian silica limestones; *8*, Middle Jurassic limestones; *9*, granitoides; *10*, Getic Nappe; *11*, Severin Nappe; *a*, Poiana Beletina karstic depression; *b*, Crovu Mare sinkhole; *c*, Crovu Medvedului sinkhole, Villages: *A*, Izverna; *B*, Prejna; *C*, Costești; *D*, Gomenți.

Although the most extended structural surfaces appear on the limestones of the Cerna Duplicature, there are some such forms on the limestones of the autochthonous. One of the most obvious such surface appears on the Domogled

Massif, south of the peak with the same name. It appears as a small sized plateau, with a 25–30° slope to south, covered by grassy vegetation and small patches of *Pinnus nigra ssp. Banatica*. Well shaped structural surfaces appear also at east of Coştegu Mic (1 315 m), Coştegu Mare (1 325 m) and Piatra Albă (1 335 m) peaks. They lean to south-east, towards the Mehedinţi Plateau and are covered by vegetation.

The detail structural elements are represented by rock steps developed on the bedding plane of the limestones of the Danubian Autochthonous. They are covered by xerophile grass and shrub vegetation, the black pine also appearing. In the case of the Cerna ridge, we can see limestone towers, made through corrosion, differential erosion and processes of gravitational atraction. The structural component of these towers is given by the fact that the top of these towers corresponds to a bedding plane. In certain circumstances, we have crests of intersection, with a highly structural character, which we have called *structural crests*. These are formed through the detachment of a narrow and relatively flat peak from the compact lime wall. The inclination of the crest is identical to that of the strata, and the actual crest is in fact a bedding plane in which lapis were formed and on which large blocks lay. These blocks were either detached from the limestone wall dominating the crest, or are residual forms.

Landforms correlated to synclines

On the eastern side of the northern sector of the Mehedinţi Mountains, the sedimentary of the Danubian Autochthonous have a monocline disposition on the north-western flank of the Orzeşti-Sălişte a Syncline (Drăghici, 1963). This forms a continuous ridge between Vârful lui Stan and Piatra Mare a Cloşanilor, oriented north-east – south-west. Between Cioaca Lacului peak (1 150 m) and Piatra Mare a Cloşanilor (1 421 m) this appears as a limestone ridge which dominates the neighboring areas. With an estimate length of 20 km, it shows the same features as Culmea Cernei, being cut in two by the Motru Sec Valley. From a structural point of view, it is a genuine hog-back, in which the Mesozoic limestone strata are oriented NE–SW and have a general proclivity of 30–45° to south – east. Its front sections layers of gritty limestones (Dogger) in the base, followed by silica limestones (Neocomian – Upper Jurassic) and Urgonian limestones, these forming also the reverse of the cuesta.

Orbârşia Peak is strongly eroded, having the aspect of a slightly waved plateau which divides the monocline strata so that the hog-back aspect is no longer perceivable. On Gorganului Peak, which is a relatively narrow limestone ridge, the situation is different. This is deforested in its superior part, and limestones outcrop on wide areas. The actual crest is formed of Neocomian – supp. Jurassic limestones, with silica accidents, and the reverse is given by the Urgonian limestone plate. A short subsequent valley was generated right beneath the crest line, at the contact between the quartzite – feldspath sandstones (inferior Jurassic) and the more friable rocks of the Poiana Mică (Devonian), doubling this crest.

Piatra Cloşanilor is situated north of Motru Sec. This is a small massif with hog back appearance also formed of limestones. The topographic surface is in concordance with the general proclivity of the strata and its limits are mainly tectonic. The structural surface covers the northern sector and is characterized by constant proclivity, of 30–40° and the appearance of shallow parallel dry consequent valleys. To the south – east, the reverse of the cuesta is represented by a lime plateau, with small proclivity (20–30°), with many lapies, sink-holes, sink-holes valleys and dry consequent valleys. It is the case of Albiilor Valley, Padina Mare, Padina Mică and Ogaşul Prrislop, dry karstic valleys, testimonies of an ancient surface hydrographic network, whose water was captured underground.

A particular situation is given by Motru Sec Valley which cuts transversally the Groganu – Piatra Cloşanilor hog-back. The flowing direction is in concordance with the structure. It is a consequent valley, and its big depth and steep slopes grant it an aspect of gorges. The genesis of this valley is complex. The valley has deepened, in the lime sector, along a strike slip fault and its direction, perpendicular on the limestones stripe, proves its epigenetic character.

The Piatra Coşanilor massif is sided on its north-west and eastern side by ridges. The north-eastern ridge is the most imposing, with a level difference of up to 450 meters, representing in fact the front of the cuesta. This is slightly fragmented by chimneys and dry valleys, named *foerogi*, with obsequent character, which did not manage to disrupt the almost-rectilinear aspect of the ridge. The eastern ridge, with lower altitudes, is also tectonic and it is parallel to Motru Sec Valley.

The influence of the nappes on the relief

South of the Arşasca – Brebina passage, a special feature of the relief is given by the limestones of the Cerna Duplicature. These are present only between Vârful lui Stan and Feregari Valley and cover the largest part of the suspended karstic plateau (Fig. 1). They appears as patches of irregular shape, overlapping tectonically the cretaceous wildflysch, being most likely a nappe of gravitational decollement (Stănoiu, 1976), put in place during the Getic overthrust. It is formed of Barremian – Aptian limestones in Urgonian facies, identical to those of the sedimentary of the Autochthonous, with slopes of 15–30° to east and south east. The overlap is marked by small steeps, which, due to the evolution of the limestone slopes through parallel withdrawal, can be considered inherited abrupts (Fig. 5). This is proven by the existence of the coluvial deposits as a continuous stripe at the base. These abrupts are sometimes more evident on the western side of the Cerna Duplicature, where small tectonic cuestas appear. Their front is steep; with heights of 15–40 m, oriented parallel to the Cerna Valley, while the reverse has a slight proclivity to east and south-east, and is represented by structural surfaces, in which lapies and dolinas were formed.

The eastern side of the Mehedinţi Mountains is generally made of the formations of the Severin Nappe and the Bahna Patch. The Severin Nappe covers the Danubian Autochthonous and, is in turn covered by the Getic Nappe, which in

some areas covers it entirely, coming in direct contact with the Autochthonous. Both nappes are disposed into an immense syncline, the Bahna Syncline. The influence of these nappes on the relief, although not very obvious, can be noticed especially in the sector north of Coşuştea Valley, at the contact between these nappes and the sedimentary of the Danubian Autochthonous (the Nadanova strata and/or the Cretaceous wildflysch). Thus it is obvious that the morphology of these areas is related to structure and differential lithology, the structural relief being in tight connection with that determined by the petrography.

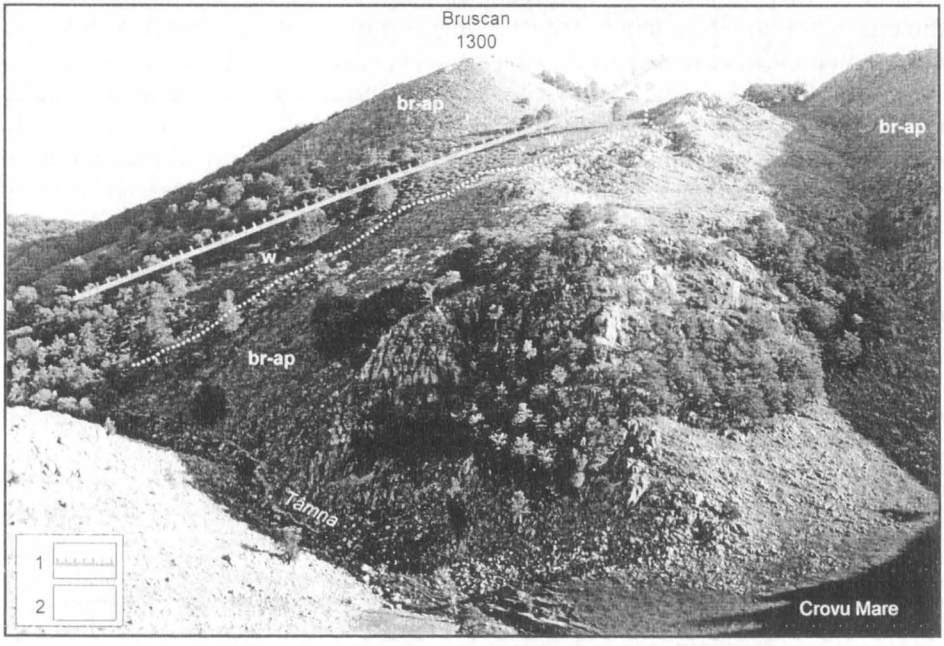

Fig. 5 – The Bruscan Peak (1300 m) and the Crovu Mare sink-hole.
1, Cerna Duplicature; *2*, unconformity boundary; *br-ap*, Barremian – Aptian limestones; *w*, wildflysch.

A first impression is the obvious asymmetry of the two secondary crests, oriented west-east, which form the watersheds between the drainage basins of Lupşa, Brebina, and Coşuştea. The overthrust line appears of the slopes with northern orientation, which are steeper than the southern ones. Initially, Lupşa, Brebina and Valea Verde rivers and Domnişoarelor creek followed the overthrust line. At the present, due to selective erosion, these rivers do no longer follow exactly the overthrust line, narrowing in the less resistant rocks. This can be easily noticed in the case of Lupşa River, whose course "slided" to the north, deepening in the conglomerate – sandstone – marl wildflish. This is suggested by the almost perfect parallelism between the present watercourse and the overthrusts of the Getic Nappe and the Severin Nappe. The valley has an asymmetric transversal profile with the right slope, and inherited abrupt, very steep.

The same situation can also be found on Valea Verde, an affluent of Coşuştea river. This vas formed along the overthrust surface of the Getic Nappe, which overthrusts the Severin Nappe. This surface is situated on the left flank of the valley, flank which represents in fact the front of the nappe. It consists of quartzite – feldspath gneisses and is steeper than the western flank, made of the Azuga strata belonging to the Severin Nappe (Drăghici, 1962). The valley deepened more in these friable rocks, its course being presently situated west of the overthrust line.

Domnişoarelor Valley, also known as Sohodolurilor Valley, a small affluent of Valea Verde, is situated at the contact between the Severin Nappe and the sedimentary of the Danubian Autochthonous, formed of Turonian – Senonian wildflysch and the Nadanova strata.

Although on Brebina Valley the same asymmetry of the transversal valley appears, this being more obvious upstream of Mărăşeşti village, this may be due not only to the nappes, but also to the fact that this valley was formed along the discordant Obârşia – Titireşti fault line, having a heavy tectonic character. Both the ridge between Lupşa Valley and Brebina and the ridge between Brebina and Coşuştea have in general the aspect of cuestas, with the front along the overthrust lines. These cuestas, due to their northern exposure and high proclivity, are forested, while the southern ones, less steep, are covered in glades, orchards, and even in agricultural plantations. The Brebina and Lupşa Valleys have a subsequent character, and all their affluents on the right have a contraclinal character.

South of Coşuştea, the influence of the nappes over the relief is not perceivable. Here alterations of the morphology due to differences in petrography are present and not to structural differences. The fact that the two nappes overthrust the Danubian Autochthonous, which sinks deeply to the east, till depths of 1 500–2 000 m, influences the Bahna syncline both on karst – hydrological aspect and, indirectly, on the present morphology of the karst. It also influences the future evolution of the karst. The immense pile of rocks that overpose the limestones of the Autochthonous determines that the cracks in the block of limestones be closed due to lithostatic pressure, so that the drainage of underground waters does no longer take place according to the structures, but is directed south, towards the intermittent springs at Bârza, in the south of the Mehedinţi Mountains. This is confirmed by the extremely high and constant water flow rate of the three karstic springs on the Bârza Valley, indicating a large water supplying area, and, especially the lack of karstic springs on the eastern flank of the Bahna syncline, in the Mehedinţi Plateau, where the limestone reappear to the surface in the eastern flank of the Bahna syncline.

THE RELIEF OF THE FAULT STRUCTURES

After it was previously presented, the limits of Mehedinţi Mountains are situated, in the vast majority, along fault lines. The Cerna – Jiu fault, continuous through the entire surface of the mountains, separates them from the Godeanu Mountains and the Cernei Mountains. In the eastern part, the contact with the

Mehedinți Plateau is given, in many areas, by faults: Motru fault, Obârșia - Titirești fault, Izverna – Ponoarele fault and the faults affecting the Getic Nappe. From this point of view, the Mehedinți Mountains represent a horst (in certain areas a semi-horst) of large dimensions, with a general orientation north-east – south-west. It is flanked by two tectonically lowered regions: at the west, the Cerna Graben and at the east the Baia de Aramă Graben (Stănoiu, 1972). The monocline block appearance is obvious, being illustrated by all morphometrical indicators, but also by morphography, and is given by the high elevation of the eastern compartment of the Cerna – Jiu fault, which corresponds to the Mehedinți Mountains. The faults of the tectonic alignment of the Cerna fragment longitudinally the north – western ridge of the mountains, which presents two lowered compartments, falling into steps and belonging to the Cerna Graben. These are obvious in the field, characterized by small proclivity. The steps are separated by steep slopes, easily mistaken for terraces. The relatively small slope explains the presence of the numerous shelters and the replacement of the beech forests with pastures and anthropic hay fields. It is the case of Poiana Diconi and Dealul Poienii, in the case of the compartment situated immediately under the Cerna steep, and the Poiana Scundari and Poiana lui Drăgan, for the lower compartment. The superior compartment, at the contact with the Cerna steep, is covered by Pleistocene screes, fixed now by the forest vegetation. Even at the base of the limestone abrupt, near some coves or steep chimneys, are some active screes.

The Cerna Graben can be followed from the confluence of Cerna with Belareca near to Vârful lui Stan. North of it, the existence of the graben is contested by some authors (Iancu, 1976; Bercia, 1975). The Cretaceous deposits have a low position, between two faults, and are discordantly covered by the nappe outliers of the Getic crystalline (Năstăseanu, 1970). The Cerna Valley placed itself over this low structure and north of Vârful lui Stan, along Cerna – Jiu fault, represents a tectonic valley (Fig. 6).

The eastern limit of the graben is well represented, being noticeable along the eastern fault, at the base of the Cerna steep, for approx. 40 km, between Pecinișca village and Vârful lui Stan. The western fault, situated along the Cerna Valley, is instead more difficult to notice, being covered by Quaternary deposits (Năstăseanu, 1980). A certain indicator of this fault is the existence of the Cerna granites. In the Cerna Graben, the carbonate series is sunk at depths of over 1 100 m, proven by drillings (Povară, Lascu, 1978) This mass of limestones, supplied with water from both the central sector of the Mehedinți Mountains and from Cerna (in the Bobotului gorges and Piatra Pușcată sector) is responsible for the apparition of the thermo-mineral water system with ascending character (Simion, 1985, quoted by Povară, 1997).

Due to the low height – maximum 500 m (Năstăseanu, 1980) – of this graben, its mark on the relief is noticeable only by the tectonic abrupts, the Cerna Valley having the aspect of a defile, characterized by the alternation of narrow sectors (Bobotului gorges, Gura Iuții, the Cociu – Domogled sector) with wide areas: the

sector between the confluence of the Cerna with Topenia and the confluence of the Cerna with Ogaşul Ursului and the sector between Pecinişca and the confluence of the Cerna with Belareca (Badea *et al.*, 1981). The faulting of the western side of the Domogled – Vârful lui Stan anticline and the "disappearance" of it in the Cerna Graben, and also the monocline shape of the Mehedinţi Mountains in the sector between the Arşasca Valley and Pecinişca Valley, are elements that grant to the Cerna steep the character of tectonic cuestas of large dimensions. Its sectioning by chimneys and torrential valleys, the majority of which are formed on diaclases or faults, led to the fragmenting of the steep into triangular or trapezoidal faces, easily perceivable from the Cerna Mountains. Because this fault steep dominates with 300–850 m the Cerna Valley and has a remarkable continuity, Sencu (1975) proposes for it the name of "The Great Steep of the Mehedinţi Mountains" or, "The Great Steep". Considering the particular withdrawal way of the lime ridges, which preserve the initial proclivity of the ridge, this tectonic steep can be considered an inherited fault steep.

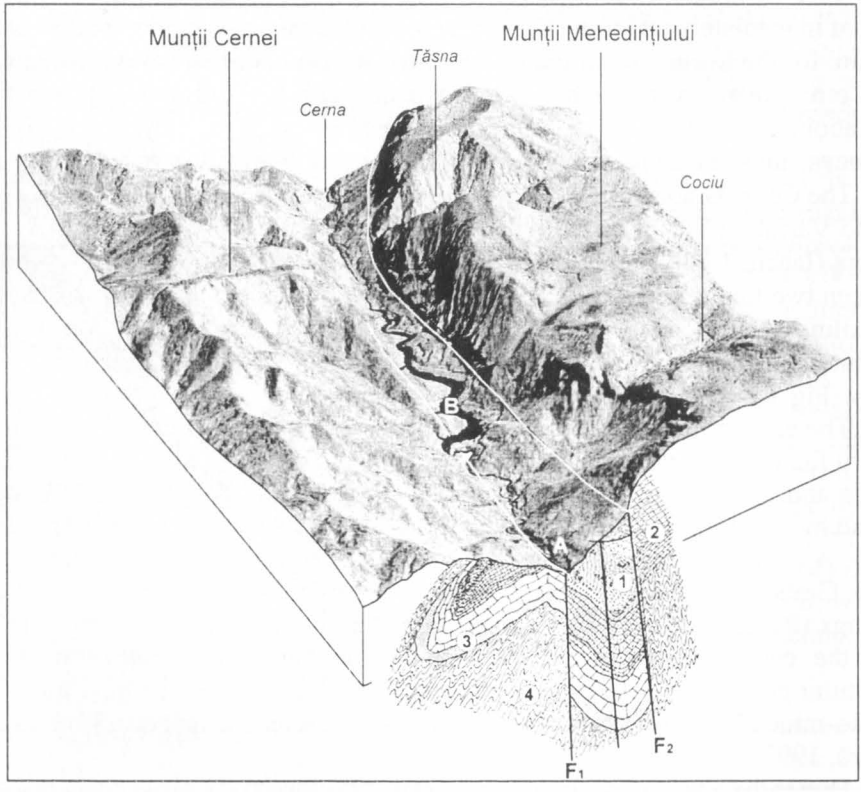

Fig. 6 – The Cerna Graben between Băile Herculane spa and Ţăsna Valley.
A, Băile Herculane spa.; *B*, Herculane reservoir; *1*, wildflysch; *2*, Barremian - Aptian limestones; *3*, Upper Jurassic limestones; *4*, schists; *F1*, eastern fault; *F2*, western fault (geology from Năstăseanu, 1980).

Most of the valleys affluent to the Cerna show, from a structural point of view, a complex character, imposed by the fractural tectonics. In the circumstances in which the Domogled – Vârful lui Stan Anticline would not have been fragmented by faults, all these valleys would have been consequent, valleys of flanks of anticlines. The genesis of the tectonic steep led to the succession of some valley sectors with different structural features:

– In the head valley sector they have a consequent character;

– In the sector corresponding to the steep, the valleys have a high proclivity, are narrow and have an obvious contraclinal character, with numerous slope failures, which whenever there are permanent or temporary water flows determine the apparition of spectacular waterfalls, like Cociului waterfall, with a fall in steps of over 100 m.

We may add to these, in most valleys, like a common genetic feature, the appearance of the valleys on tension tectonic lines, which justifies the perpendicularity of these valleys on the direction of the Cerna. The majority are dry karstic valleys, with sectors of gorges, called *foeroage* or *ogașe*. Another characteristic of this valley is the fact that the majority show sectors suspended with several hundred meters towards Cerna, consequence of the karstic captures and of the lift of the eastern sector of the Cerna – Jiu fault.

The fault scarps are frequently encountered in these mountains, appearing especially into limestones. The most relevant examples are, except the Great Steep, the steep north of Izverna, the steep of Piatra Cloșanilor towards Motru, the northern steep of Vârful lui Stan. All these are steeps of composite faults. In the case of the Geanțuri ridge, both the steeps towards Cerna and those from the suspended depressions are steeps of composite faults, generated by the Cerna – Jiu fault i.e. the Arșasca – Pârâul Ivanului fault. Noticing the perfect alignment of the major negative karstic elements of the central sector of the Mehedinți Mountains and their vicinity to the Great Steep, Sencu (1975) mentions that "...they mark out a gravitational traction lithoclase...". Because this type of lithoclase supposes the existence of an initial discontinuity in the mass of rock (Bleahu, 1974) it is more likely that the genesis of these forms must be connected to the existence of a fault line parallel to Cerna – Jiu fault and which was later on widened gravitational traction. The analysis of the satellite images confirmed this hypothesis, even more, it was noticed the fact that this fault line, which does not appear on any geologic map, continues both to the north, up to the drainage basin of Capra river, and to the south, till Balta Cerbului karstic depression (Fig. 7). The existence of this fault line is also proven by the existence of some morphologic elements visible in the field:

– The occurrence of slope failures, on the same geologic substrate, both along valleys and secondary summits that come down from the Cernei Peak to north-west (Fig. 7, A). These small steeps remained covered by forests, contrasting visibly with the less inclined surfaces in the vicinity that have been deforested.

– The Arșasca Valley changes its course through an 90 degrees curve to south-west, along the identified fault (Fig. 7, B). This change appears on a homogeneous geologic layer, made of the Cerna granitoides.

– The alignment of the karstic depressions of the central sector along this fault line (Fig. 7. C).

– The Țăsna Valley expands till the crystalline bedrock, so that it is possible to see this fault in the northern slope in the shape of a joint of large dimensions which determines the strong withdrawal of the ridges of the gorges in this sector (Fig. 7, D).

– The doubling of the peak of the Inălăț Massif (Fig. 7, E), also mentioned by Sencu (1975).

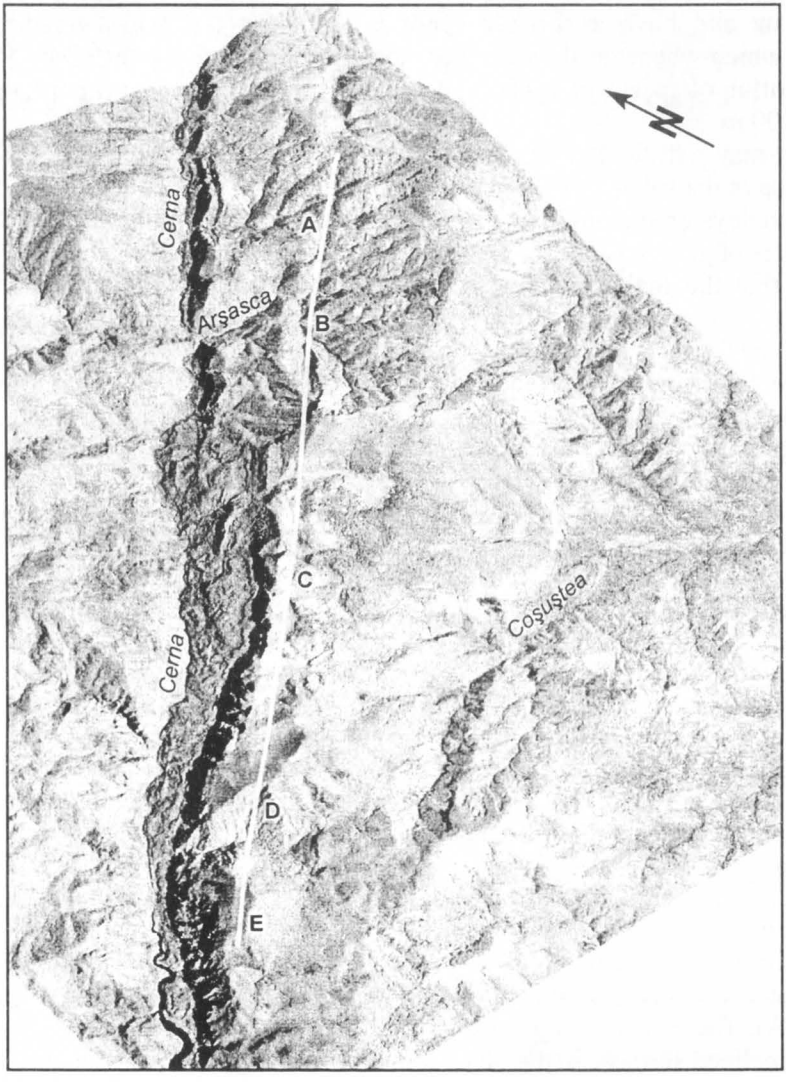

Fig. 7 – Fault line detected by remote sensing (the fault is drowned with white colour). Digital Terrain Model draped with Landsat ETM image, August 2000; panchromatic band at 15 m resolution. **A – E**, identification fault elements in the field (details in the text).

It is possible that this fault line continues to the south, but this could not have been established by the satellite images.

The influence of the faults on the hydrographic network is profound, many valleys having been formed, totally or partially, along fault lines: Cerna, along Cerna – Jiu fault; Motru, in the area between the confluence with Păltinei River and with Motru Sec river, along Motru fault; Arşasca and Brebina by Godeanu – Titireşti fault line; the superior course of Coşuştea on Izverna – Ponoarele fault and Prejna and Coseşti rivers. The affluents of the Cerna with courses perpendicular to Cerna Valley have the same features. These appear along faults and tension cracks associated to Cerna – Jiu fault, i.e. the valleys of Pecinişca, Feregari, Şaua Padina, Cociu, Femea, Ţăsna, Râmuţele and almost all valleys called *foerogi* and *ogaşe* on the western Slope of the Mehedinţi Mountains.

By comparing the fault system with the hydrographic network (Fig. 1) can explain the sudden change of direction of some valleys, or even the course chosen by these, this having a major influence in the evolution of the relief on some areas. This is the case for Motru Sec river, the course of which corresponds in the limestone sector to strike strip fault. This makes this valley to be the only which managed to cross the karstic region represented by Obârşia – Gorganu – Piatra Cloşanilor ridge. This permitted the deepening of the hydrographic network of Motru Sec drainage basin in the same time with the lowering of the base level and the pushing, through reverse erosion, of the watershed between Motru and Cerna, represented today by the Culmea Cernei almost in the immediate proximity of Cerna river.

Sudden changes of direction appear even in the Arşasca, Capra and Dobrota valleys or on some sectors of the valleys of the drainage basins of the Bahna, i.e. Topolova.

In the karstic regions, the tectonic determination of the exo – and endo – karstic forms is more obvious: the existence of large karstic depressions at the crossing of some fault lines, the alignment of sink - holes along faults and the concordance of the direction of the main fracture systems associated to the main faults and the orientation of lapies and of the underground galleries formed on joints, the prevail of joint lapies in many lapies fields etc.

We may state in conclusion that structure and tectonics play a very important part in the configuration of the geomorphologic features of the Mehedinţi Mountains, in the genesis and development of the drainage network and in the formation of the hydro-karstic systems.

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HYDROGEOMORPHIC RESPONSE OF URBAN LANDSCAPE TO FLOODING (CASE STUDY OF THE DANUBE RIVER BEACH IN BRATISLAVA)

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Key words: flood, assessment, hazard, river, hydromorphology Danube, Bratislava.

Les effets morpho-hydrographiques des inondations subis par le paysage urbain (étude de cas la rive du Danube à Bratislava). Dans le contexte des modifications climatiques présumées, les inondations deviennent de plus en plus des phénomènes géomorphologiques qui modifient le paysage. L'article se concentre sur les effets géomorphologiques subis par la rive et la plaine inondable du Danube et le cours inférieur de la Morava, près de la confluence avec le Danube, dans les environs de Bratislava, à la suite des deux crues, de mars et d'août 2002.

INTRODUCTION

The frequent occurrence of flood events in recent years in Central European region has roused attention of a wide spectre of specialists. Varied manifestation of flood events, their consequences and implications found reflection in the increased interest of geographers and geomorphologists who concentrated upon floods as the natural hazard and an important morphological phenomenon. In spite of the fact that in the past in many countries such as USA, Great Britain, Australia, South Africa or in Poland the fluvial geomorphology or hydromorphology developed, less attention was paid to the issue in Slovakia or Czechia. The fact that fluvial-morphological theme was neglected by the Slovak geomorphology and geography manifested above all in insufficient terminology. In recent years the issue of floodplains and especially fluvial-morphological aspects of floods was addressed in works of Grešková (2000, 2002). The work of Pišút (2002) which dealt with history of the river channel and the floodplain of the Slovak section of the Danube is an important contribution. Works of Lehotský (2001, 2002), Lehotský and Grešková (2003, 2004) contain an overall view of the theme and enlightenment of the basic terminological notions concerning the channel-floodplain system. The effect of big floods on the channel morphology and sediment transport was widely studied and researched in the world scientific community. For example, considerable

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attention was given to fluvial morphology and especially morphological effects of floods in Poland. Morphological changes during floods in small mountain valleys were reported by Klimek (1989), Bamugart-Kotarba (1983), Wyzga (1997). Gebica et al. (1998) described erosive and accumulation forms which originated after breach of dikes during the floods of the Wisla River in 1997. Kotarba (1999) studied the geomorphic effect of the 1997 flood in valleys of the middle-mountain forest belt of the Tatras. Zielinski (2002) described deposition effects of two great floods of the Nysa drainage basin, as well as the alluvial forms and deposits of channels and floodplains. Geomorphic effects of the July 1997 flood in the Northern Moravia and Silesia was studied by Hrádek (2000). Channel widening is one of the most typical geomorphological changes in the Sudeten and the Carpathian region. The effect of big floods on the transport of sediments, channel morphology and patterns of channel change were described by Eaton and Lapointe (2001) on the Sainte Marguerite River in Canada. The geomorphic impact of large floods on channel and floodplain changes and implication for valley-floor ecosystems in floodplain surface of the Lamar River in the Yellowstone National Park has been investigated by Meyer (2001). In the case study of the valley floor in the piedmont zone of the Scottish upland, Werritty and Leys (2001) have studied valley reworking, channel shifting across the floodplain while they recognised the robust and responsive landforms.

2. AIM

Activities in the field of integrated flood management were initiated at the world level through programmes involved in care after water. Integrated flood management is based on holistic interpretation of mutual interactions and processes which take place inside and between the natural and anthropised environment in the framework of the whole basin. Recently, the myth of absolute safety against floods (c.f. Hajtašová et al. 2004) proved to be unsustainable. Experts understand now that safeguarding or absolute protection against floods is not possible both from the technical and economic aspects. Flood control is linked to estimates of sizes of extreme floods; they are generally imprecise and they will most probably modify under the global climatic change effect. The present modern society will have to address the issue of floods, as well as the management of uncertainties and risks as the flood risk is connected above all with hydrological uncertainties. It will be necessary to seek a balance between the flood risk and development of the territory in question. Hydromorphological manifestations of floods are spatially and temporally located in a differentiated and hierarchized way. Sudden extreme hydrological and climatic anomalies provoke instability of the channel-floodplain systems, they predetermine unclear future. On the other side, complexity and dimensions of their impacts must be recognised. Due to the deficit of hydromorphological terminology, methods, and standard procedures in field work,

no detailed research focused on morphological efficiency and response of floods exists. This paper concentrates on identification and understanding of spatial distribution of morphological responses to floods, as well as generation of source material for survey and monitoring of morphological response to floods, confrontation with the intentions of territorial plans and estimation of flood risks and hazards in the hinterland of Bratislava.

3. STUDY AREA

The study reach of the Danube and Morava Rivers coincides with the channel-floodplain system characterised by the following specific features (Fig. 1). The model territory is situated in the western part of Slovakia, on the contact of the **Záhorská nížina Lowland** and the westernmost promontory of **the Podunajská nížina Lowland**, in the wider environs of **the Devínska brána Gate**. It is about 5.5 kilometre long left bank riverine landscape of the lower reach of the Morava above its mouth into the Danube and the 25 kilometre long riverine landscape with anti-flood dikes on both sides of the Slovak reach of the Danube from its confluence with Morava as far as the Čuňovo village (fig. 1). Both streams more or less stabilised in this space already during the Lower Pleistocene. In the west, the Danube flows from the confluence with the Morava through the centre of Bratislava on the left bank and Wolfstahl village on its right bank and on through **the tectonically determined graben valley** between the Hainburg Mts. and Little Carpathians.

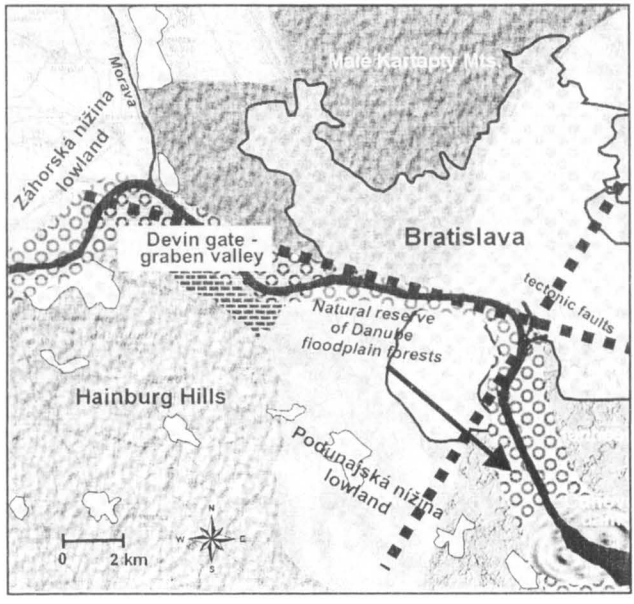

Fig. 1 – Geographical position of study area.

The eastern part of the channel is situated in **the neotectonically very active** transitory edge of the Gabčíkovo basin and from the point of morphology, it represents **the head of the bulky alluvial fan**. From the point of view of fluvial morphology, both rivers represent the alluvial type with a **high aggradation potential and lateral channel shift**. They are also characterised by **sinuous, anastomosing and anabranching channel patterns** and **asymmetrical right-bank development**

of floodplains in the western part of the study area and the relevant spatial structure of relief microforms. Existence of the bulky ford of the Danube system in and around Bratislava has of course determined, inter alia, the founding and development of **the town and its hinterland**. On the other side, high aggradation which manifests in many places as the river bed raising contributes to the probability of flood occurrence. Human interventions into the Danube riverine landscape were relatively common and frequent in the past, though increasing fluvial activity during the 18th century was responsible for their limited efficiency. **The effect of floods was probably amplified by human works which resulted in stabilisation of the side channels** and tributaries, simplification of the river channel pattern and concentration or widening of the main channel (Pišút 2002). The study area of the Danube River along with its arm system represents a territory with remains of original **floodplain forests unique in Central Europe**, with high ecological value of the landscape and high retention capacity. Floodplain forest had significantly contributed to the natural flood control in the past.

The final stage of adaptations of the Danube riverine landscape was carried out by the end of the last century along with **the construction of the Gabčíkovo dam**. A new system of **protective dikes,** which was supposed to solve the problem of as much as 500-year water for Bratislava, was constructed. However, **the intensified aggradation process and building up of the Danube bottom accompanied by its proceeding up the stream** (all effects of putting the Gabčíkovo dam in operation) modify the conditions determining the morphological response to inundation events on the Danube and the adjacent Morava – now distinctly affected by the global climatic changes. If **urbanising intentions in the inundation area** and the high possibility of flooding of the wider centre of Bratislava are taken into account, the aggradation process on the one side and the erosive effect on the other are among the most complicated problems of the Capital to be addressed in the middle-term future.

4. HYDROMETEOROLOGICAL SITUATION IN TIME OF FLOOD EVENT

In the last decade the floods on study reach of the Danube normally occurred in summer. In 2002 floods occurred both in March and August.

4.1. THE FLOOD IN MARCH

The March flood in Bratislava stemmed in the upper part of the Danube basin where the pronounced increase of water table was caused by abundant precipitation which struck Bavaria, including the upper and later also the lower parts of Austria. Between 19th and 22nd March the frontal disturbances proceeded eastward in strong western flows over central Europe.The effect of snow thaw was originally negligible. The onset and process of flood was rapid. In four days the water table of the

Danube gauged at Bratislava-Devín increased by 577 cm (Fig. 2). The culminating water table in Bratislava-Devín (on March 24) reached the value of $H_{max.}$ = 828 cm and discharge Q = 8628 $m^3.s^{-1}$. The Danube culminated in Bratislava (The Nový most bridge) at $H_{max.}$ = 872 cm (discharge in Bratislava is not expressed as it is influenced by the Gabčíkovo dam).

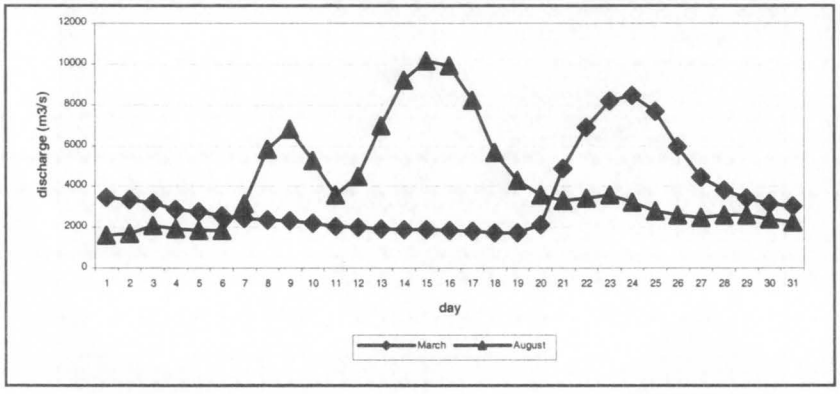

Fig. 2 – Mean daily discharges of the Danube river in Bratislava.

In the consequence of abrupt increase water table and rapid increase of discharges, the stream of the Danube was fierce. The waters carried wooden debris even whole trees which got stuck by bridge pillars and other barriers and accumulated in the channel nooks and backwaters. Although mean water level were reported on the Morava River, its lower reach was impounded due to high waters of the Danube.

4.2. THE AUGUST FLOOD

Two flood situations in a very short interval occurred on the Danube in August. The first of them was indeed extraordinary both from the hydrological and historical points of view. It was caused by abundant precipitation which covered a large territory in the German and Austrian parts of the basin. The most abundant precipitation fell on 6th and 7th August. The following precipitation fell on the already waterlogged basin and caused the second extraordinary flood on 9th to 12th August. The Danube culminated in Bratislava-Devín with 948 cm and discharge of 10,390 $m^3.s^{-1}$ on 16th August, what is more than a 50-year water. The highest water level in Bratislava was at 991 cm. The interesting thing is that the high water (over 900 cm) maintained in Bratislava for more than two days. It only dropped below 700 cm on 18th August. The flood situation also manifested on the lower reach of the Morava. The impoundment caused higher levels on the Morava as far as the village Záhorská Ves. The extent of floods in August was larger than in March. Inundation flows directions are showed in Figure 3.

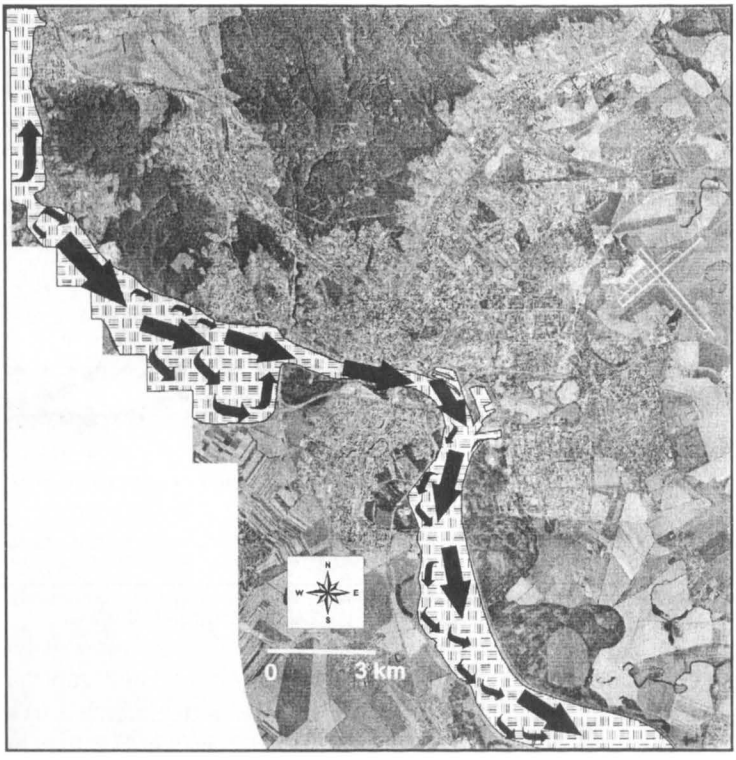

Fig. 3 – Inundation flows directions.

5. METHODS AND HYDROMORPHOLOGICAL SURVEY

The first step was to divide the study territory into sections in the sense of the River Morphologic Hierarchical Classification (RMHC, Lehotský, Grešková 2003, 2004) based on maps (1:10 000), ortho-photo maps, aerial photographs and field research (Table 1, Figure 4).

Table 1

Criteria of division of the Morava (1-3) and the Danube Rivers (1-10) into reaches.

	Morava			*Danube*									
River reach / *Criteria*	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1.valley setting	c	b	b	a	b	b	b	c	c	c	c	c	c
2.river channel pattern	b	a	a	d	a	c	d	b	b	c	c	c	c
3. river reach according to degree of sinuosity	a	a	a	b	b	a	a	a	b	b	b	a	a
4. channel width	a	a	a	b	b	c	b	b	b	c	b	b	b

(continues)

Table 1 (continued)

5. floodplain width in interdike area	c	b	b	b	d	d	c	-	a	b	c	c	c
6. morphological character of floodplain	a	a	b	b	b	b	b	-	a	b	b	b	b
7. type of L bank	2a	2a	2b	1a.2c	1b	1c	2d	2d	2d	2d	2d	1c	2a
7. type of R bank	1c	1c	2a	1b	1a	1c	2d	2d	2d	1b	1a	1c	2a
8. influencing of the lower reach	b	b	c	c	c	c	a	a	a	c	c	c	b
9. channel bed and floodplain sediment character	b	b	b	a	a	a	a	a	a	a	a	a	a
10. land cover in interdike area	a	b	b	b	b	b	b	c	c	b	a	a	a
11. restriction of L inundation	c	c	b	b	b	b	b	a	a	a	a	a	a
11. restriction of R inundation	c	a	c	c	a	a	a	a	a	a	a	a	a
12. direction of flow as against thalweg	d	d	d	a	b	b	c	a	a	a	b	b	c
13. occurrence of water bodies	a,b	a,b	a	a	a	a	b	-	-	a	a	a, b	a,b

Explanatory notes: Criteria applied to division of the river into reaches (static, dynamic and other)

Criteria:

1. valley setting: a) confined, b) asymmetric partly confined, c) alluvial valley setting

2. river channel pattern: a) anastomosing, b) single main channel, c) pleisio and paleo side channels, d) main channel and paleo side channels

3. river reach according to degree of sinuosity: a) straight, b) in bent

4. channel width: a) <100 m, b) 260–300 m, c) 300–400 m

5. floodplain width in the interdike area (not quoted if not identified): a) <500 m, b) 500–1000 m, c) 1000–2000 m, d) >2000 m

6. morphological character of floodplain: a) undulating, b) dissected (with side channel)

7. bank type (separate for each bank side; L – left, R – right): 1) natural – lateral movement possible: 1a) concave, 1b) convex, 1c) straight, 2) adjusted: 2a) toe protection, revetment, spur-dike field (lateral movement partially limited), 2b) embankment (lateral movement limited)

8. influencing the lower reach regarding permeability and retention of water and sediments: a) narrowed, accelerating – vertically expanding, b) widened and slowing horizontally expanding – retentive, c) asymmetrically widened – horizontally expanding – asymmetrically retentive

9. character of bottom sediments and of floodplain: a) permeable, b) less permeable

10. land cover interdike area – barrier effect : a) reach with permeable land cover, b) reach with semi-permeable land cover, c) reach with relatively impermeable land cover

11. restriction of inundation (separate for each bank side; L – left, R – right: a) dike, embankment, b) slope with communication, c) none

12. prevailing direction of inundation flow with relation to thalweg: a) parallel, b) divergent, c) convergent, d) impoundment

13. occurrence of water bodies: a) pleisiochannels, b) paleochannels, c) artificial water bodies, d) none

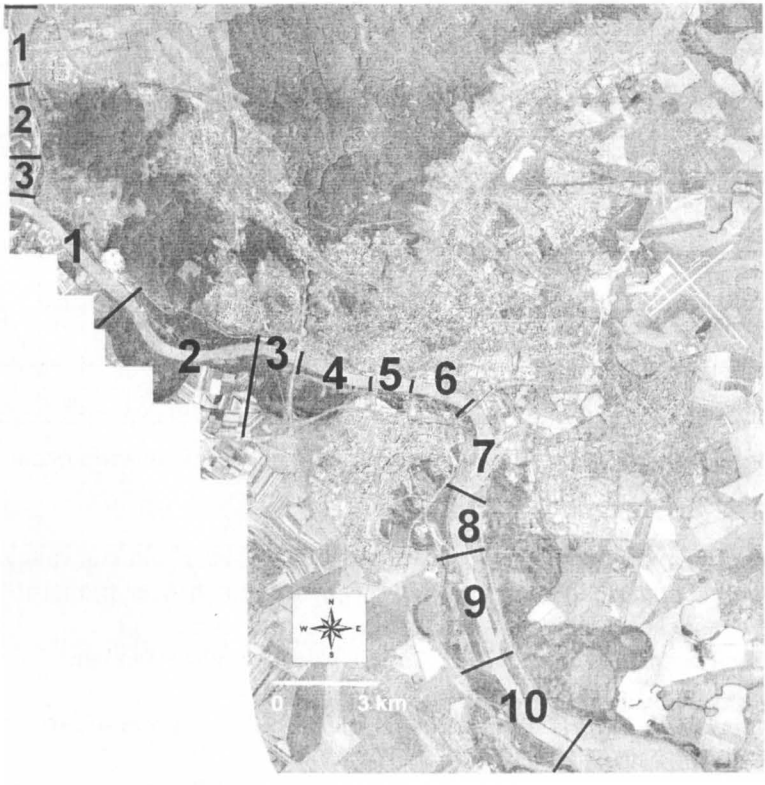

Fig. 4 – River reaches of Morava and Danube rivers.

In order to identify the geomorphic response to floods, a detailed morphological survey in river reaches – small scale mapping (reach scale) was carried out immediately after the retreat of the March and August floods in 2002.

The depth of sedimentation was determined by probes. The difference between sedimentation deposited by the March and August floods was assessed by means of herb vegetation. The speed of sedimentation in the course of the last decades was determined by:

A. dendromorphochronological method relying on:

1. assessment of tree age though a sample collected by the dendrological auger,
2. assessment of the depth of the collar root of the tree (in cm), i.e. assessment of sediment thickness

3. assessment of sedimentation speed based on the ratio of the identified sediment thickness and the age of the tree (cm/year)

B. analysis of artifacts (military bunker) leaning on the known age of the artifact and sedimentation thickness deposited on it.

At the same time corresponding hydrological data were statistically processed.

6. RESULTS AND DISCUSSION

Applying a similar geomorphic survey, the processes and geomorphologic manifestations of floods (sedimentation, erosion, transport and other) were identified in the individual reaches. Table 2. brings the results of field mapping.

Table 2

Morphological response of floods: sedimentation (S), erosion (E), transport (T), other (O).

River reach	Morphological response of floods in the river reaches
M1	**S: overbank deposits, floodplain deposits, slackwater sediments, E: moderate bank erosion, T: trash line, O:**
M2	S:, floodplain deposits, muddy traps, slackwater sediments, E: moderate bank erosion and erosion of toe protection, flat avulsion runnels, T: trash line, O: –
M3	S: overbank deposits up 30 cm, floodplain deposits, muddy trapes, slackwater sediments, E: minimum bank erosion, T: trash line, LWD (large woody debris), O: –
D1	S: floodplain sand deposits. E: avulsion trough, avulsion runnels, T: –, O: –
D2	S: overbank deposits, E: –, T: –, O: –
D3	S: slackwater sediments, E: bank erosion, erosion of revetment, erosion bank-nook, avulsion runnel, T: LWD, O: –
D4	S: –, E: –, T: predominante transport and sediment redeposition of allochtonous material, O: –
D5	S: slight sand overbank deposites, E: –, T: transport predominante over sedimentation, LWD, O: piping, seepage,
D6	S: slight overbank deposits, E: –, T: –, O: –
D7	S: overbank sand deposits, floodplain ripples and dunes build by sand deposits, E: bank erosion, undercut bank, river-cut cliff, bank cracking, erosion bank-nook, avulsion runnels, bar and swale, T: LWD, O: –
D8	S: overbank sand deposits, floodplain dunes, E: –, T: LWD, O: –
D9	S: floodplain deposits, floodplain dunes, E: –, T: LWD, O: –
D10	S: floodplain deposits, floodplain dunes, E: –, T: LWD, O: –

Field research and comparison of two flood events from 2002 showed that the geomorphic response to August floods was proportionally larger to the water volume flowing down the channel and the duration of flood event. August floods intensified the sedimentation processes which started in March and deepened the manifestations of erosive processes. Great amount of sediments was transported and redeposited. Survey of the trash line proved that during the August flood less organic material (above all large wooden debris deposits, fallen trees) was transported and deposited than in March which in fact cleaned the river channels and riverine areas.

Age of trees in the M2 river reach was estimated applying dendromorpho-chronological survey to about 30 years and the thickness of alluvial deposits to about 42 cm, what represents a yearly increment of sediments about 1–1.5 cm a year. Dendromorphochronological survey of younger stands (8-year old trees) in the M3 river reach also revealed that about 30–32 cm of sediments was deposited since the 1997 flood. The sediment increment on consolidated surface of older sediments and on solid surface (trail for cyclists in the vicinity of the river channel) to 6 cm was identified after the March flood in 2002. Thickness of sediments after the August flood was up to 20 cm.

Military bunker is situated on the bank of the D8 river reach, which was part of defensive structures of Czechoslovak frontiers in the 1930s. In locality „bunker" the sediment thickness was established at 100 cm (above its doorstep) and the speed of aggradation was set at about 1.6 cm a year. Since 1937 when the bunker was built, 22 flood events occurred on the Danube with discharge surpassing 6,000 $m^3.s^{-1}$. The survey results indicated that the aggradation speed of floodplain deposits was increasing with frequency of flood events in recent years. Results confirmed that the largest increment of overbank sediments has been deposited by the 2002 floods. Apart from accumulation forms the 2002 floods manifested through numerous erosion forms and processes disturbing banks and riverine zone above all (Table 2). Repair and remedy for erosion and accumulation phenomena after every flood require considerable finances.

7. CONCLUSIONS

The possible consequences of the potential climatic changes, increasing frequency of floods and flood risk in study are manifest through acceleration of active and ever present fluvial-geomorphologic processes. The results suggest high sensitivity, susceptibility and instability of the study reaches in the context of flood pulse which is a long-term permanent natural threat in the intensively urbanised hinterland of Bratislava. The level of flood threat is determined by a wide scale of factors beginning with possible climatic change, coincidence of floods of the Morava and Danube Rivers, the Gabčíkovo dam, longitudinal and transversal dimension of the channel-floodplain systems, silting of the river beds and inundation

and ending by dredging and other earth works in the area. The presents of two contradictory fluvial-geomorphologic processes (bank erosion, accumulation on the bottom of the river channel and on the floodplain) requires a permanent maintenance of the channel bed and riparian zone accompanied by confrontation of urbanisation intentions in territory with these facts.

Uncertainty of a successful technical solution to floods in the territory of Bratislava is high. Search for solutions and alternatives to coexistence of man and natural threat on artificial surfaces calls for applications based on sustainable development, management of acceptable flood risk and future development of the territory.

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THE QUALITY OF OXYGENATING SURFACES. THE GREEN AREA OF BUCHAREST. A CASE STUDY

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Key words: green areas, management, renaturation, environmental dysfunctions, urban ecology, Bucharest.

La qualité des espaces oxygénantes. Situation des espaces verts à Bucarest. Etude de cas. Les espaces verts représentent un des composants principaux du milieu urbain pour l'amélioration de la qualité de l'environnement et de la valeur esthétique du territoire. Durant la période 1990–2003, à Bucarest on enregistre une diminution des espaces verts (environ 50%) et une augmentation des surfaces bâties. En même temps, la majorité des espaces verts a été mal administrée, ce qui suppose l'accroissement de leur vulnérabilité. À Bucarest, au niveau des espaces verts on a identifié: l'utilisation des espaces verts comme parking, espaces commerciaux, dépôts non organisés de déchets, l'augmentation des surfaces construites dans les parcs, la dessiccation des arbres déterminées par l'inadaptation des espèces ou de la pollution excessive de l'air. Pour les espaces verts à grande surface on a observé que les autorités publiques les considèrent comme espace libre pour les investissements (les projets pour bâtir la Mairie de 2ème Secteur en Parc Obor, une église orthodoxe dans le Parc Plumbuita, de la Cathédrale de la Rédemption du Peuple dans le Parc Carol, de la Mairie de 3ème Secteur et un centre commerciale dans le Parc Titan etc.). Pour tout cela, la promotion urgente des mesures s'impose pour résoudre la crise des espaces verts à Bucarest : l'interdiction de bâtir ou d'autre forme d'occupation du sol dans les espaces verts, le respect du rôle des espaces verts dans l'écosystème urbain, l'augmentation de la densité dans l'alignement des arbres, la sélection des espèces d'arbres d' après la résistance à la sécheresse et à la pollution urbaine etc.

INTRODUCTION

Research-work carried out by the Centre for Environmental Research and Impact Studies (CCMESI) of the University of Bucharest over the 1995–2003 period, had in view the spatial and temporal dynamics of some elements of urban ecology in Bucharest city. The analyses made, targeting dysfunctions in the management of oxygenating surfaces, proved extremely valuable to urban planners (Zonal Territorial Planning Scheme for the Metropolitan Area – P.A.T.Z., Urban

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Master Plan for Bucharest city – P.U.G. and zonal urban plans – P.U.Z.) who resorted to our studies when forecasting spatial development trends.

The subject broached here is intended to emphasize the dysfunctions occurring in the administration of the urban green, which plays a major role in diminishing the effects of air pollution and urban stress.

Green areas have multifunctional attributes that contribute to improving the quality of the town's environmental components, its aesthetic aspect, at the same meeting some of the population's demands for recreation, purer air, etc. Green areas have basically a psychosomatic influence, through the aesthetic component and their relation, be it momentary, to the natural environment, also purifying the air, releasing oxygen, filtering powders, reducing phonic pollution, barring high winds and improving the microclimate and the aesthetic urban function.

Green areas represent "*the environment in which human life patterns correlate with their natural or artificial elements*" (Muja, 1994). As the framework in which individual dwelling-house's, the big blocks-of-flats quarters and moreover the urban functions separate the town from its natural surroundings, finding „*compensation*" in nature becomes ever more necessary (Pătroescu *et al.*, 2000).

Studies carried out in Bucharest between 1990 and 2003 revealed that green surfaces kept shrinking (by some 50 %) and green areas degrading.

Taking verdure areas to be an available space for constructions (garages, terraces, buildings, commercial units, etc.) is a dangerous precedent, given that the present space can no longer offer the urban green required by the city.

Over the 1989-2003 period, the green area / city-dweller shrank from 16.79 m^2 to 8.89 m^2. The situation is really alarming since parks and public gardens represent only 18 % of the green surfaces, which leaves 1.62 m^2 verdure per capita.

Increased vehicle traffic, construction erected on the private domain and more numerous services units (petrol stations, car-wash, vulcanisation, etc.) make green areas in this city hardly sufficient to oxygenate the air as they should. Besides, they are unevenly spread, major differences existing even within one and the same district (Table 1).

The management of the city's green areas devolves on **Bucharest City Hall** through the agency of the *Administration of Parks and Gardens* (Herăstrău, Cişmigiu, Tineretului, Unirea, Circului and the verdure spaces in Piaţa Universităţii, Central Zone, Colţea Zone; in front of the National Theatre, on Nicolae Bălcescu, Gh. Magheru and Lascăr Catargiu Blvds.), the *Administration of Churchyards and Human Crematories*, the *Administration of the Zoological Garden;* **district city halls** through the intermediately of the *Administrations of the Public Domains*, **University of Bucharest** (administrator of Botanical Garden), **ICAS** *(nurseries)* and **Bucharest Forest Range** *(periurban woods)*. Pest control and treatment is supervised by the **Bucharest City Halls**, *Centre for Plant Protection and Phyto-sanitary Quarantine.*

The administration of green areas is regulated by Decision of the General Council of Bucharest Municipality / May 4, 1994 regarding the "*Norms of environmental protection on the territory of Bucharest city*", as modified and

completed by Decision No. 10 / January 25, 2001. Decision No. 38 / December 16, 1999 stipulates that the grounds lying in-between the blocks-of-flats (component parts of the residential quarters), designed and destined as local verdure areas and play-grounds for children, represent public property and fall into the administration of district City Halls. Apart from these decisions, each department assigned the administration of green areas has its own internal norms.

Table 1

Free access on public domain green areas in Bucharest in 2002 *.

District	Parks		Alignments		Gardens around blocks-of-flats and squares		Total
	m^2	% of the total	m^2	% of the total	m^2	% of the total	m^2
1	1 106 013	47.15	540 516	23.04	699 280	29.81	2 345 809
2	844 437	23.98	451 500	12.82	2 225 485	63.20	3 521 422
3	159 000	3.56	475 000	10.63	3 833 000	85.81	4 467 000
4	97 965	3.45	533 000	18.78	2 207 840	77.77	2 838 805
5	342 676	15.98	306 579	14.30	1 495 000	69.72	2 144 255
6	684 981	24.42	625 000	22.28	1 495 000	53.30	2 804 981
Total	3 235 072	17.85	2 931 595	16.18	11 955 605	65.97	18 122 272

*data supplied by Bucharest City Hall (2003)

CATEGORIES OF GREEN AREAS AND ASSOCIATED DYSFUNCTIONS

A classification of Bucharest's oxygenating surfaces proposed by Decision of the General Council of Bucharest City Hall refers to layout and usage criteria[1].

Layout:

- *Green areas inside the built-in perimeter* – parks, public gardens squares, street alignments, plantations in the residential areas, inside socio-cultural structures, exhibitions, architectural and historical monuments, graveyards, etc.;
- *Green areas inside the periurban perimeter, outside the built-in zone – the forest fund, managed agreement zones, plantations for the protection of natural waters, etc.*

***Usage*:**

- *Green areas freely accessible to visitors,* implying, in theory at least, the access paths existing within the respective perimeter; parks, public gardens, agreement zones, residential quarters;

[1] **** (1997), Master Plan (PUG) Bucharest – *Delimitation of protected areas built-in areas* - Chapter VI.3 – *The natural framework and its values*, CCMESI Research report, Institute of Architecture and General Council of Bucharest Municipality Archive.

- *Green areas of limited access* – around institutions, exhibitions, graveyards, botanical and zoological gardens, private gardens;
- *Green areas with a specialised profile* – protective plantations, botanical gardens, nurseries and test plots.

Our approach focuses on the freely accessible green areas inside the built-in zone.

a. Parks

The complex functions of these spaces and the careless behaviour of visitors impose permanent maintenance works.

Parks in Bucharest are oddly spread, many residential quarters (e.g. Theodor Pallady, Panduri, Şoseaua Alexandriei, Prelungirea Ferentari, etc.) being situated at a great distance from these zones of recreation. The park territory in Districts 3 and 4 is very small in terms of people's needs for recreation or other social activities. A disturbing situation has been created by the fact that most economic agents and the local authorities even, perceive parks as a space open to construction works. Projects underway have in view the building of District 2 City Hall in Obor Park, an Orthodox Church in Plumbuita Park, the Cathedral of the Nation's Redemption in Carol Park, District 3 City Hall and a commercial complex in Titan Park, the „*Romania of Tomorrow*" Foundation in Tineretului Park, etc. When works actually begin, the vegetation will be destroyed, while some species, unable to adapt to the conditions of the urban ecosystem, will face extinction.

The green surfaces of the majority of parks are shrinking also because ever larger areas are occupied by installations and constructions for various purposes (booths, terraces, restaurants, etc.).

Such constructions do but diminish the ecological and recreational potential of parks, sustaining the perception of the local authorities and of the population that parks are space available for investments and devoid of urban value.

Therefore, listing parks into the category of ***zones closed to construction***, whatever the destination of the latter, should be a priority. The parks conserving cultural elements (the case of Cişmigiu, Herăstrău, Tineretului, Carol, etc.) ought to be paid greater attention to.

The construction works scheduled to begin in Carol and Tineretului parks, besides destroying their natural and cultural components, will entail noise and air pollution, making them inaccessible to the population for a long period of time because of inherent noise and air pollution. Unfortunately, no green space of similar size and functions exists in the neighbourhood.

b. Gardens

A characteristic feature of the old town of Bucharest were the vineyards, which actually skirted it, most such areas stretching as far as the central perimeter, close to the Princely Court (see the Brankovan and the Ipsilanti documents issued in 1709 and 1775, respectively on „*The gardens of Bucharest*", in Vătămanu, 1973;

Potra, 1981). The end of the 17th century winterised the development of *„agreement gardens"*, isolated from the traffic routes by high walls. In the second half of the 18th century, as constructions extended, the town's gardens became smaller. The kiosks that were being built on the outskirts proved to be a great attraction (Vătămanu, 1973; Potra, 1981). In the early half of the 19th century, most gardens were situated in the Dâmbovița Floodplain, a vegetation-rich zone due to the moisture of the substrate and the wealth of springs (Pătroescu *et al.*, 2000).

Today, neither park, nor "*garden*" are a restrictive notions. In Bucharest, many would be gardens are in effect flat trips alongside some thoroughfares, or small parks. According to the present norms, ***public gardens*** are green areas between 30,000–200,000 m^2 in size, the larger ones being designated ***parks*** and the smaller ones ***squares*** (Bucharest City Hall).

There are very many gardens, indeed, most collective residential quarters and institutions being delimited by a green surface more or less adequately managed. The gardens adjoining the blocks-of-flats are particularly important because they contribute to reducing air and noise pollution. In some cases, they represent places of recreation for the dwellers, especially in summer-time when a few benches and tables are placed there.

The state in which gardens are maintained is different from one zone to another, in terms of delimitation from the street, periodic works of maintenance or modification of floristic diversity. If the garden is not fenced in, then it can more readily be turned into a parking space provided with garages, or not, or a garbage dumping site. Unauthorized car-parking obviously reduces the green surface.

Apart from the gardens attached the block-houses, private dwellings also have gardens tended by their owners. The aspect of these gardens and the density of trees are very different, too, it depending on the owners` upkeep interest.

Public gardens (e.g. the crossing George Coşbuc Blvd. with Albă St.; Filaret Station Square; Pieptănari, etc.) are in a state of degradation, being a choice place where garbage is discarded (e.g. Filaret Square garden, Pieptănari) or cars are parked (e.g. George Coşbuc intersection with Albă St.).

c. Squares

The notion of square does not derive from that of "*small public garden*", usually placed at a street crossing.

Lying at the crossing of two or several thoroughfares, squares are expected to be in a very good shape, enhancing the aesthetic aspect of the neighbourhood. And yet, with the exception of the main crossings, they are in an advanced state of degradation, and moreover, being fenceless, some people uses them as parking spaces (the west side of Cotroceni Palace, the intersection of Ion Nuțu St. with Sebastian St.; Tudor Vladimirescu Blvd. with Calea Rahovei; Cuțitul de Argint St. with Constantin Istrati St., etc.).

Just like parks, squares ought to undergo frequent maintenance works, having in view their public administration, number of users, functional aspects relating

directly to the quality of urban life, the identity of the urban community, education, health, etc.

d. Street alignments and flat strips

The trees lining the streets had been initially planted for aesthetic purposes, for the protection of pedestrians and of dwellers from sunshine, dust, wind, noise etc., and the isolation of industrial units from traffic routes. The studies undertaken so far in the world have shown that a 50-100 m-wide green belt may depress urban air powders by 50 per cent.

Bearing in mind that 60 % of Bucharest's streets (a standard for a lowland city with excessive-continental climate) should be lined with 7-12-year-old trees planted at a distance of 3-12 m, floristic diversity is a must.

Street alignments are very different in regard of structure, composition and sources of degradation. As a rule, there is a simple, one-row tree-structure separating the sidewalk from the road. Some streets show a two-row alignment, but this pattern cannot be extended because of scarcity of space, or the distinct historical periods of urbanisation when they had been set up.

The trees commonly used were lime, ash, American oak, chestnut, poplar, maple, sycamore and acclimated species. There are certain peripheral streets in which one can see fruit-trees, while the newly-built avenues have been planted with *Sophora japonica*, *Catalpa*, resinous (white cedar, pine, spruce) and other species. A characteristic of the Bucharest landscape is the one dominant species-type, and this has with negative effects on the management of green areas. This mono-type pattern depresses the aesthetic function, creating a sensation of monotony, moreover, if the species fails to adapt itself to the urban microclimate, then some pests may develop, in which case all the trees must be replaced, which raises the maintenance costs.

Most by-streets have no alignments, or if they have, these in an advanced state of degradation, through trees being very old, maintenance works missing, illegal cuttings, dryness, etc. Observations made on the major streets showed usual densities of 1–5 trees / 100 m (Fig. 1) illustrative of the extent of damage done to this category of urban green. Besides, alignments being discontinuous, they cannot fulfil their functions adequately.

Apart from low-density, there is no tree-training, hence partial or total drying up. The species sensitive to pollution or moisture deficit (chestnut, lime, sycamore, maple, hybrid poplar, etc.) dry up or lose their leaves as early as July.

It is only in exceptional cases that alignments are separated from the sidewalk by a metal fence or a kerb stone to keep organic or inorganic matter in the rabbet.

In terms of their condition, street alignments can be grouped as follows:

– ***zones severely degraded*** are frequently met on the side-streets with old trees, no maintenance works, cuttings without subsequent plantings, etc., all of which have generated discontinuous alignments with low tree densities, detrimental to urban aesthetics;

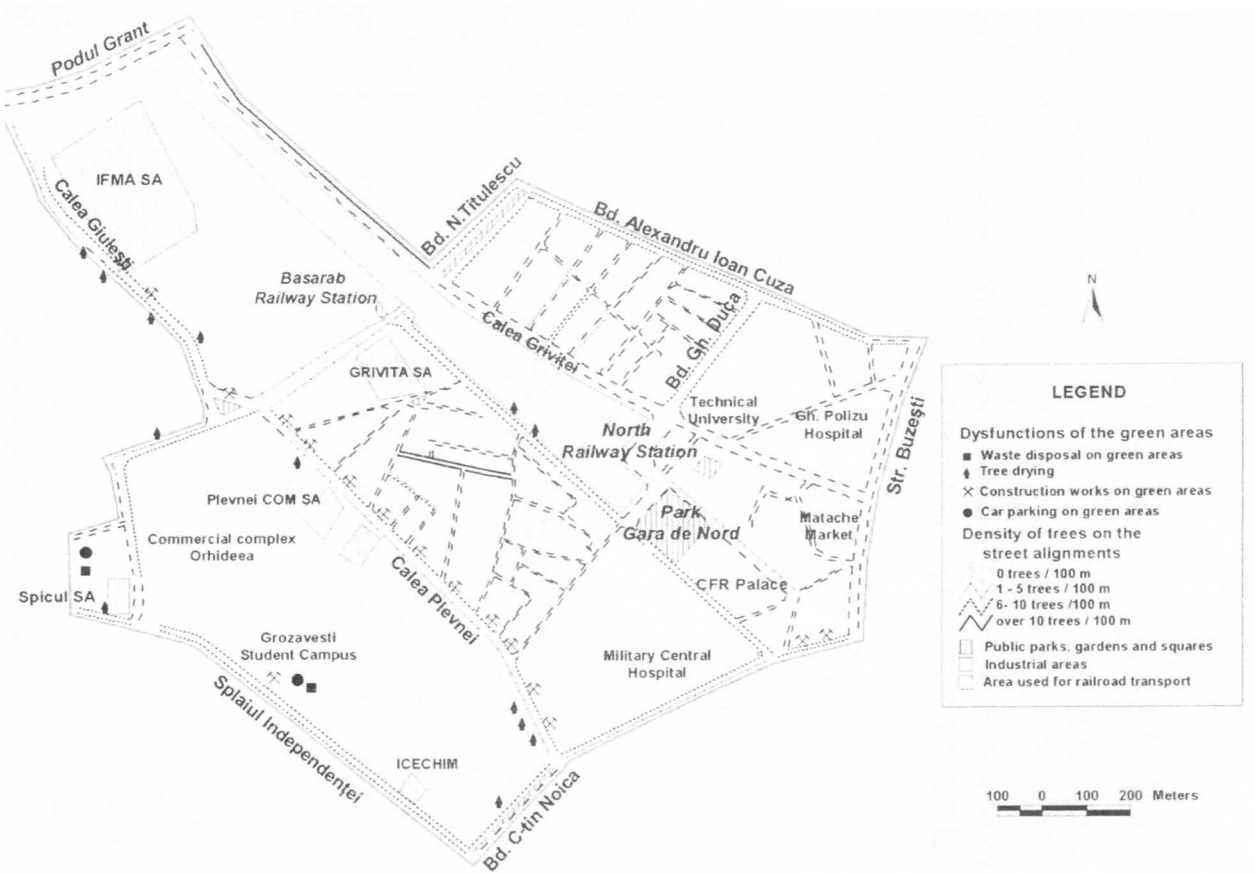

Fig. 1 – Dysfunctions of green areas in an urban tissue of Bucharest. Case study – PUZ Gara de Nord, July 2003.Buildings or other structures raised on green areas (at the crossing between Tudor Vladimirescu Blvd. with George Coşbuc Blvd.; Theodor Pallady Blvd. with Nicolae Grigorescu Blvd.; Alunisului St., etc.);

– ***zones with street alignments in a satisfactory condition*** are seen along the most thoroughfares. High average tree density (10–12 trees / 100 m) no car-parking or commercial units. The marked tendency to degradation is obvious because the old trees that have not been replaced are drying up, acts of vandalism are going on, etc.

– ***zones with street alignments in good and very good condition*** represent 2 % of all alignments and occur along the main boulevards; these green areas are fenced and upkeep.

Flatstrips are green areas placed on the roads to separate traffic lanes or tramlines from sidewalks. Most of them are in a relatively good condition, but wherever flat strips divide tramlines from the sidewalks, people crossing randomly degrade them, as does vandalism on trees (e.g. Theodor Pallady Blvd.) and on the floral arrangements (Drumul Taberei St., Unirii Blvd., etc.).

DEGRADATION OF GREEN AREAS IN BUCHAREST CITY

Commercial booths, car-parking or the destructions caused by pedestrians and builders, are the main forms damaging the plantations in alignments and flat strips.

The absence of adequate and coercive legislation and of actions to raise people's awareness and emotional sensitivity in respect of the ecological value of the urban verdure, will inevitably sustain the destruction of these oxygenating surfaces so very necessary to improving the state of the urban environment and the health of its inhabitants. So, the absence of legal regulations in force and people's disregard for ecological norms has left the city's verdure spots at the mercy of aggressive behaviours. Investigations conducted by CCMESI have shown forms of aggression or vandalism on these areas in all the city districts, consisting most frequently in:

- Illegal car-parking on the green areas surrounding the blocks-of-flats or adjoining some institutions (Cotroceni Palace; the play-ground between Cegan and Urdăreanu streets; the crossing between Tudor Vladimirescu Blvd. and George Coşbuc Blvd.; the garden lying at the intersection of George Coşbuc Blvd. with Albă St.; the play-ground between Vistierilor St. and Năsăud St., the residential area in Oltenița Road up to Văcărești Lake embankment; Ştefan Dimitrescu, Braşov, Timişoara, Unirii streets etc.);
- The random crossing over flat strips and squares;
- Vandalising green spaces during certain phenophases, or the cutting of trees for fire-wood;
- Drying up through air pollution or lack of maintenance works (e.g. Calea Rahovei, Viilor Road, Veseliei St., Splaiul Unirii, Unirii Blvd., Braşov St., Timişoara Blvd., Calea Plevnei, etc.);
- Drying up and early loss of leaves, especially in species sensitive to air pollution (chestnut, lime, maple, hybrid poplar);

- The dumping of household waste (e.g. Văcărești Park, Pieptănari Garden etc.);
- Alignments with old trees, mainly in streets leading up to important thoroughfares.

A crisis situation in the administration of green areas[2] has been determined by several factors, among which the lack of funds to rehabilitate green areas, expansion of constructions, and reallocation of terrains to rightful claimants, economic activities and the failure of some species to adapt themselves to the urban environment.

DYSFUNCTIONS INDUCED BY THE GREEN AREAS OF BUCHAREST CITY

The degradation of verdure spots and the absence of maintenance works bear upon the quality of air, urban aesthetics, etc. Green areas produce vegetal wastes of different compositions in terms of the vegetation season. There is more wastes in autumn, when the leaves are shed, in winter, when dry branches fall under the weight of snow, as well as in periods of blossoming and fructification. Waste products dirty the streets and roads and pollute the air with potential allergens.

Besides this aspect common everywhere in Bucharest, there are zones (Colentina St., Pallady Blvd., etc.) in which dysfunctions ensure from the fact that street alignments are not separated from pedestrian walks or roads, a situation that increases the amount of powders in the air, on the sidewalk and the road.

There are a number of streets (Silexului, Roznov, Braşov, Vespasian, Splaiul Independenței, Cotroceni), where fences, sidewalks and the foundations of houses are deteriorated by the roots of the old trees planted very close to the walls. Since these trees are protected, dealing with the situation is a real problem.

If the root of old trees is not pivotal, the asphalted pedestrian walks and roadways are degraded.

In by-streets and on some avenues (e.g. Ferdinand Blvd., Olari, Braşov, Rahovei, Viilor, Vasile Lascăr streets, etc.), dry or very old trees represent a risk both for vehicles and the near-by constructions.

PRIORITIES IN THE ADMINISTRATION OF GREEN AREAS

Maintaining the functions of green areas is imperative if urban ecosystems are to develop harmoniously (Pătroescu *et al.*, 2000; Cenac-Mehedinți, 2000)[3]. In order to attain this goal urgent measures must be taken as follows:

[2] **** (1995), *Assessment of sanitation condition in Bucharest and its influence zone by physico-geographical analysis*, CCMESI Research Report, Urban Design Centre of Bucharest City Hall Archive.

[3] **** (1995), Prospects for development of green areas in Bucharest Municipality. A prefeasibility study, CCMESI Research Report, Proiect București Archives.

– turning abandoned terrains into green areas;

– ruling out any changes in the functioning of green areas in order to prevent them from shrinking and help maintain their role of oxygenator of the urban ecosystem's physiology;

– stopping the degradation of green areas by up keeping, fencing, etc., and employing watchmen to guard them against acts of vandalism;

– forbidding economic agents or physical persons from using verdure spots permanently or temporarily for commercial purpose or car-parking, and have severe sanctions instituted in these cases;

– monitoring the state of green areas in street alignments and replace the plant species unable to adapt to the urban climate;

– laying down maintenance standards for gardens attached to collective or individual households in order to stimulate the interest of administrators or owners to tend them;

– replacing old or degraded trees which contribute to urban dysfunction;

– adapting tree species to the urban microclimate;

– rehabilitating street alignments degraded by unauthorized car-parking and commercial constructions, lack of maintenance works and waste dumping.;

– increasing the number of medium-sized green areas on abandoned terrains (e.g. at the crossing of Calea Rahovei with Şoseaua Progresului, the boundary between the residential area on Pallady Blvd. and Policolor industrial zone, Răzoare intersection, etc.);

– increasing the density of alignment trees and bushes to attenuate noise and protect inhabitants against vehicle-releasing emissions;

– remarking the belts protecting or separating residential areas from industrial estates or from some manufactures spread within the built-in perimeter.

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AIR CIRCULATION TYPES IN THE LOW TROPOSPHERE ABOVE THE ATLANTIC-EUROPEAN GEOGRAPHIC ENVIRONMENT AND THE WEATHER EVOLUTION IN ROMANIA

ECATERINA ION BORDEI[*], *GABRIELA TAULESCU*[**]

Key words: circulation types, lower troposphere, classical or anomalous trajectories, air advections, orographic, Carpathian cyclogenesis.

Types de circulation de l'air dans la troposphère inférieure au-dessus de l'espace géographique atlantique européen et l'évolution du temps en Roumanie. L'ouvrage ramène en premier plan le problème de la désignation des quelques structures thermobarriques troposphériques qui déterminent certains types de temps en Roumanie. On aborde le sujet d'un façon synoptique et on accorde une importance majeure à la manière dans laquelle les cyclones et les anticyclones euro-atlantiques s'entraînent et se conjuguent dans le cadre de la circulation générale de l'air dans l'hémisphère inférieure et encore un ensemble synthétique des trajectoires des cyclones méditerranéens. On peut voir ainsi la relation directe entre les types de temps en Roumanie et les types de circulation de l'air à l'échelle synoptique, conception consolidée pendant plus de trente années de pratique synoptique.

Through its position on the Globe and through its physico-geographic characteristics, Romania is not in the situation of generating air masses, or large or medium-sized pressure centers involved in the general air circulation[1] at planetary scale; nor is Romania directly in the way of large, north-hemispherical cyclones or anticyclones of European concern, i.e. the Icelandic Low, the Azores High or the Polar Cap High.

Romania is a country only partially crossed by such weather centers or even, most of the times, just touched tangent simultaneously by the periphery of one or even two such major pressure centers (Figs. 1–7). However there are aero-synoptic circumstances favouring sometimes the detachment of mobile nuclei from the Azores High, predictably stationary over Romania also (Fig. 1), as well as circumstances allowing the displacement of secondary cyclonic nuclei (detached

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[1] Through general air circulation, meteorologists understand the ensemble of the tropospheric air particle motions within ceaseless exchanges of heat mass, moisture and impulse occurred according to scientific laws, between the areas markedly affected by the solar radiation and the polar ones.

from the Icelandic Low thalweg) along trajectories that may cross Romania from west to east, with a very rare chance of occurrence whatsoever.

We are not wrong, therefore, to assert that Romania is situated at a real crossroads of winds. Not even the Mediterranean cyclones are able to cross the country easily and entirely (Fig. 8a), since they are second rank personalities in the hierarchy of the north-hemispherical pressure centers, since they act at a sub-synoptic scale.

The presence of the Carpathian chain, double-arched exactly in the Romanian geographic environment induces additional complication to the dynamics of the air particles in motion, within the friction layer (roughly between ground and 1500 m.a.s.l.). This is so much the more evident when the contact between the periphery of a cyclone and that of an anticyclone occurs above the Romanian territories (Figs. 2a, 2b, 4a, 4b, 5, 6, 7).

The interference of the air in motion with the so much contorted Carpathian obstacle always generates local, specific deformations to the main acting pressure centres. These deformations, though bearing sub-synoptic values, systematically impose in the differentiated evolution of the weather in the country's environment, either through additional precipitation or through abrupt and massive cooling episodes, severe rotations of the prevailing wind direction, in one province or another.

These deformations or peculiar evolutions of the pressure fields over Romania, induced by the shape and bulkiness of the Carpathian Mountains are well known by the synopticians' community under the generic denomination "Bordei-type events". They are called "peri-Carpathian anticyclonic foiling", "peri-Carpathian moulding of the Icelandic thalwegs' periphery by the side of the Eastern Carpathians", Coanda-type "flows at the wall" in a cyclonic pattern, eastern and western "interference of circulations" between Olt and Mostiste valleys respectively and not lastly the "Carpathian-type orographic cyclogenesis".

At the basis of establishing the circulation types rendered in figs. 1–7 for the low troposphere, the author has put the types of combinations of the cyclones and anticyclones of permanent interest in the Atlantic-European area that the author has personally identified and used in synoptic practice during 32 years.

Eight schemes are rendered for as many circulation types (Figs. 1–4a and b, 5, 6, 7, 8), which ensure the synoptic support for the four different advection directions over Romania: westerly (in excess of 46%, according to N. Topor), northerly, southerly and easterly but also for the occurrence of the remarkable mesoscale events, like the snowstorms (Fig. 4b), the Carpathian-type orographic cyclogeneses (Figs. 2a, 5) etc.

For each of the four advection directions a graph representation is made of the anticyclonic variant (Figs. 1a, 2a, 3a, 4a) and of the cyclonic one respectively (Figs. 1b, 2b, 3b, 4b), since they determine various weather types in Romania.

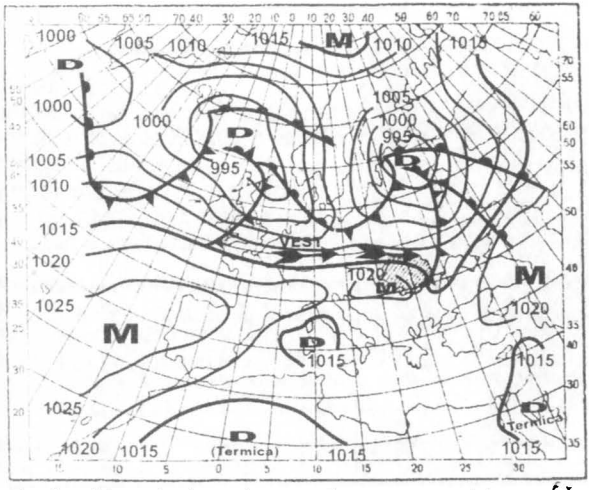


Fig. 1a - Westerly circulation over Romania, in a high pressure pattern (ridge or western nucleus of the Azores High)

Weather in Romania

In the cold season: warm weather, with scanty precipitation

In the warm season: thermally normal weather, yet generally unsettled in the north of the country and in the mountains

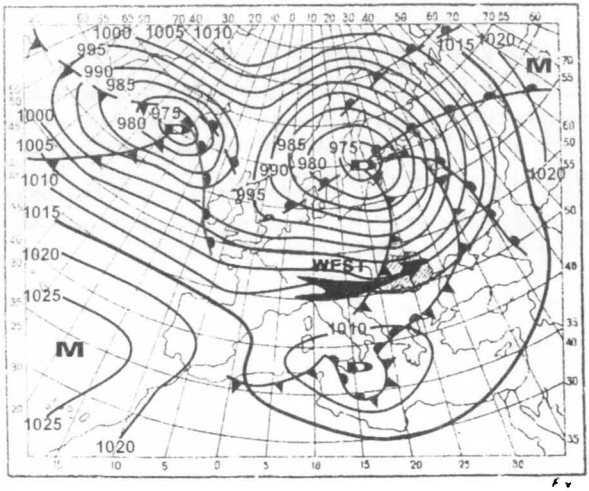


Fig. 1b - Westerly circulation over Romania, in a low pressure pattern (at the southern border of an Icelandic Cyclone set on its trajectory).

Weather in Romania

In the cold season: relatively warm weather, but windy, with sporadic precipitation, mostly in the east and north

In the warm season: cool and slightly unsettled weather; windy and unsettled weather in the mountains

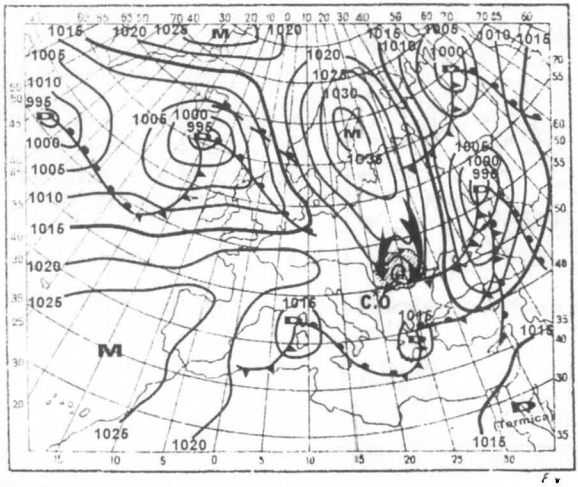


Fig. 2a - Northerly circulation over Romania, in a high pressure pattern (Scandinavian Anticyclone on an North → South trajectory perpendicular to the Carpathian Mountains).

Weather in Romania

In the cold season: brisk, massive cooling all over the country, starting from the north-east, with snowfalls and hard wind in the first 6-12 hrs. mostly in the east and south. Frosty weather settles afterwards

In the warm season: The weather cools markedly, mostly in the east and south, showery rain falls there and the wind gusts in the first 12 hrs.

C.O "Bordei"-type symmetrical orographic cyclogenesis (in all cases for this circulation type)

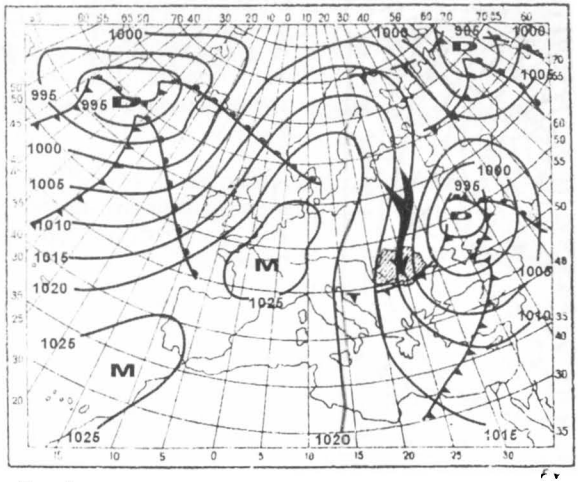


Fig. 2b - Northerly circulation over Romania in a low pressure pattern (Cyclone usually centred over Kiev).

Weather in Romania

In the cold season: brisk, massive cooling episodes occur, yet with sporadic precipitation

In the warm season: the weather turns rapidly unsettled, cooling markedly

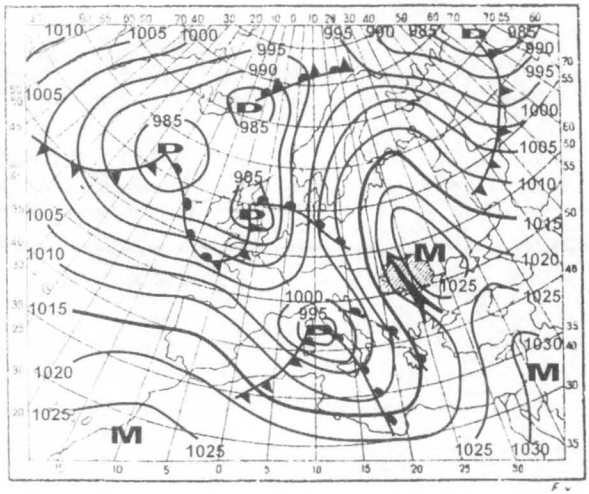


Fig. 3a - Southern circulation over Romania, in a high pressure pattern.

Weather in Romania

In the cold season: warm but foggy weather in the extra-Carpathian plain areas with some wind gusts in the south-west of the country ("Coshava" wind)

In the warm season: warm, even sultry weather, with some wind gusts in the south-west of the country ("Coshava" wind)

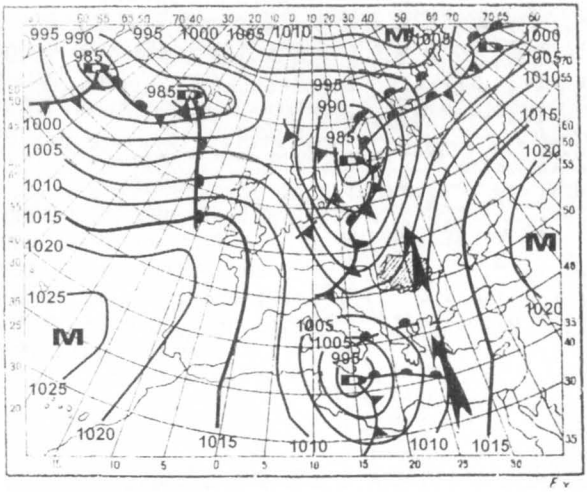


Fig. 3b - Southern circulation over Romania, in a low pressure pattern.

Weather in Romania

In the cold season: warm or very warm weather, but foggy in the plains, with local precipitation falling in the hills and mountains and in the east of the country

In the warm season: weather warming markedly but slightly unsettled in the west of the country, in the hills and mountains

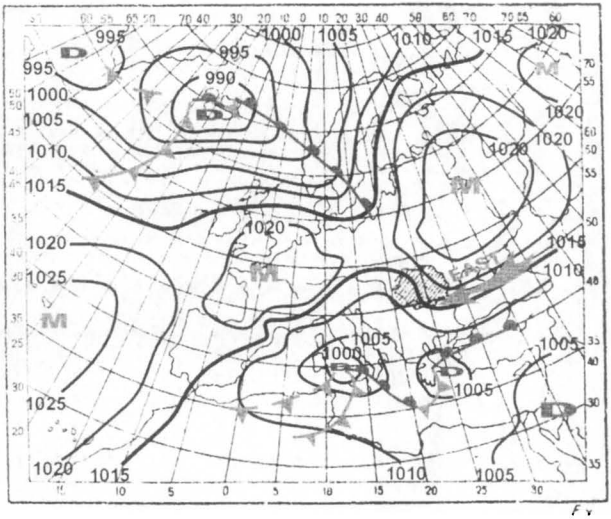


Fig. 4a - Eastern circulation over Romania, with a stationary east-European anticyclone (Azores - originated).

Weather in Romania

In the cold season: it brings dry frosts, the "Crivat" icy north wind or the "Bora" wind

In the warm season: it brings tropical air masses, boiling-warm, dry dusty and an eastern wind in the south-east of the country, called "Suhovei".

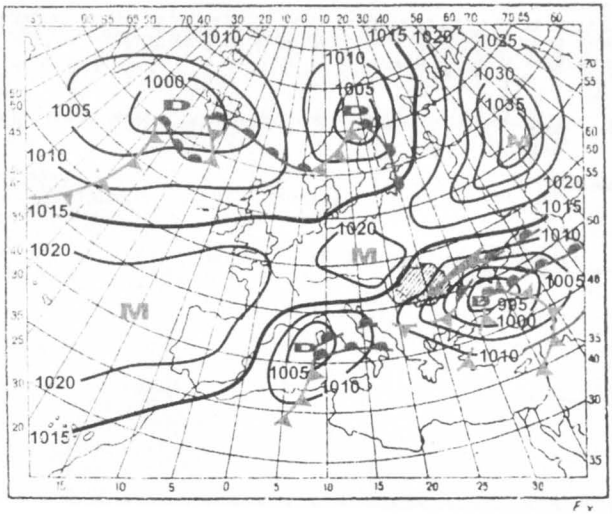
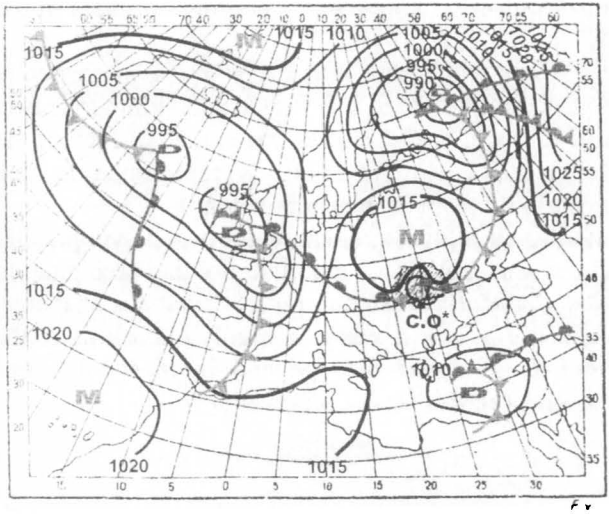


Fig. 4b - Eastern circulation over Romania, in a low pressure pattern.

Weather in Romania

In the cold season: it brings abundant precipitation, eastern winds in the south and east of the country, often snowstorms and snowbound spells

In the warm season: it brings dull, humid weather, with abundant rainfalls in the south and east of the country and temporary wind gusts. In the rest of the territory the weather becomes unsettled.



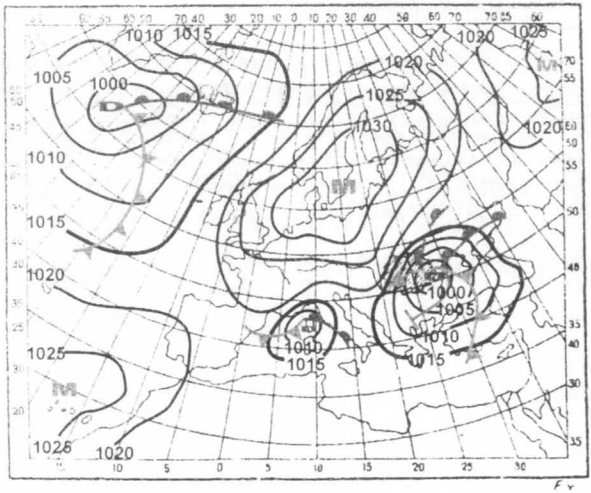
Weather in Romania

In any season: it causes the weather to deteriorate in just several hours (6 to 18) starting from northern Moldavia and northern Crisana.

After the last evolution phase (occlusion) had consumed, the weather cools but improves.

C.O Carpathian-type orographic cyclogenesis (Ecaterina and Nicolae Ion Bordei)

Fig. 5 - Carpathian-type orographic, symmetric cyclogenesis.



Weather in Romania

In any season: the weather becomes humid, precipitation yields large amounts in all regions and flooding is likely to occur

Trajectory of the retrograde cyclone centre

Fig. 6 - Euro-Atlantic air pressure configuration favouring retrograde cyclonic activity over Romania (after Margareta Struțu, 1974).

Figures 5, 6 and 7 represent those types of combination of the European-Atlantic pressure centers, which determine peculiar circulation types, either specific to the Carpathian orographic cyclogenesis, to the severe retrograding of a Mediterranean cyclone (Fig. 6) or to massive, long-lasting cooling episodes in the extra-Carpathian area. (Fig. 7).

The original synthetic maps the author proposes in figs. 1–7 comprise side notations regarding the type of weather specific to the winter and summer season respectively, but also regarding air pressure "personalities" combined in each of the cases. Through the arrows drawn close to the country's representation, the advecting sense is suggested, as disclosed from each synoptic coupling.

Figure 8 is a collage rendering an eighth circulation type, sub-synoptically ranked, the author considers, however, critically important to the precipitation behaviour in Romania. The issue is about the Mediterranean cyclones that may take classical (Fig. 8a) or anomalous (Fig. 8b) trajectories, highly interesting to the weather evolution in central and south-eastern Europe and in most situations impacting dramatically the environment in Romania.

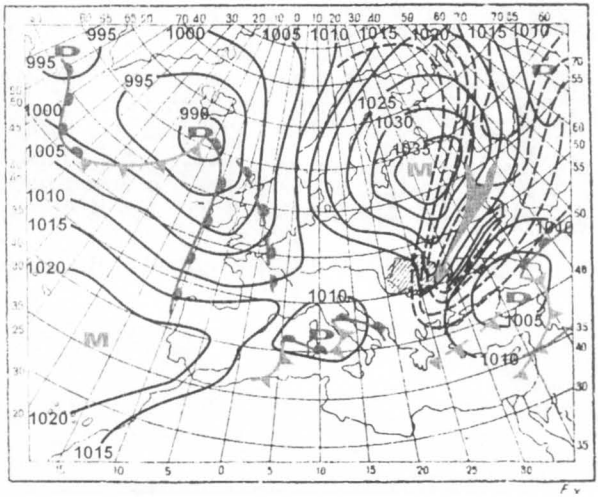


Fig. 7 - Ultra-polar circulation over Romania (at ground level and in the free atmosphere).

Weather in Romania

In winter it brings bitter, persisting frosts in the east and south o Romania, sometimes preceded by hard winds or brief snowstorms

In summer: this circulation type does not occur

Isohypses of an altitude, ultra-polar deep thalweg

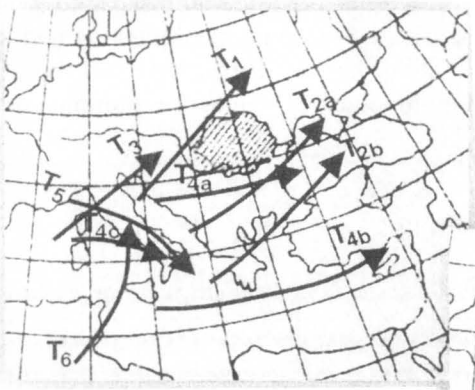


Fig. 8 - Collage of 8a, 8b, 8c and 8d, with the classical and anomalous trajectories of the Mediterranean cyclones and with an example of recent kinematics (7 May 2005).

Fig. 8a - Classical trajectories of the Mediterranean cyclones (after C. Şorodoc, 1962).

Fig. 8b - Trajectories deviating east of the T1 classical trajectory ("anomalous trajectories", after Ecaterina Ion Bordei, 1983).

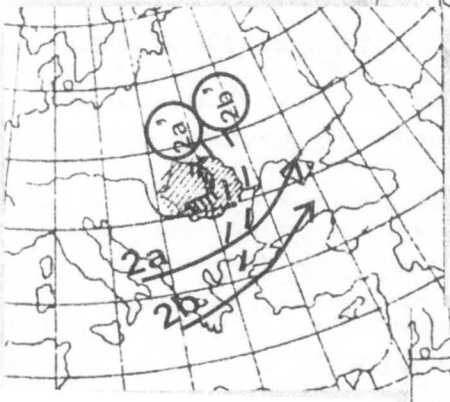


Fig. 8c - Trajectories deviating north of the T2 classical trajectories ("anomalous trajectories" after Ecaterina Ion Bordei, 1983).

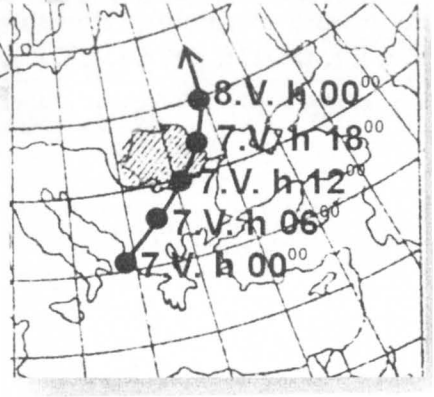


Fig. 8d - Kinematics of the Mediterranean cyclonic center in the interval 7 May 2005, 00 UTC - 8 May 2005, 00 UTC over Romania ("anomalous trajectories" after Ecaterina Ion Bordei, 1983).

Since they need be approached differently and are not separate types themselves, we did not approach in this paper the aero-synoptic contexts in which the convergence between the air motions within the low troposphere and those in the mean or high troposphere lead to unfavourable weather evolutions over Romania.

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ETHNICAL HETEROGENEOUSNESS OF THE POPULATION WITHIN THE DANUBE DEFILE (BAZIAŞ – EŞELNIŢA SECTOR). GEOGRAPHICAL CONSIDERATIONS

*COSTELA IORDACHE**

Key words: ethnical heterogeneousness, ethnical minorities, Danube Defile.

L'hétérogénité ethnique de la population du Défilé du Danube (secteur Baziaş – Eşelniţa). Considérations géographiques. L'humanisation du Defilé du Danube a été favorisée par plusieurs facteurs parmi lesquels : les richesses naturelles, le potentiel d'habitation du relief, le climat doux et le Danube ; ce corridor naturel a facilité pas seulement les liaisons entre le sud et le centre de l'Europe, mais aussi la cohabitation des communautés humaines avec d'origines différentes. En exceptant l'élément roumain autochtone – à cause des conditions historiques, politiques et socio-économiques, plusieurs populations d'autres origines ont été amplacées dans cette région, mais elles sont restées tout le temps minoritaires. L'analyse de la structure ethnique de la population entre 1930-1992 met en évidence le caractère majoritaire des Roumains pendant tout l'intervalle de temps analysé et les régressions enregistrées par les autres minorités, à l'exception des tziganes; l'étude analyse aussi, le nombre, l'ancienneté et la répartition des minorités ethniques dans les établissements.

The continuous humanization of the Danube Defile was possible because of natural resources, the habigenous potential of relief, mild climate and the Danube, a natural corridor that has favoured not only the communication between Southern and Central Europe, but also the various communities that lived together.

Except the autochthonous Romanian element, various allogenous populations, that have always been in minority, settled in this area due to some historical, political, social and economical conditions.

The analysis of the ethnical structure of the population between 1930-1992 (Table 1) reveals the following aspects: Romanians formed the majority throughout the whole period, their progressive evolution both in the whole area and in the rural settlements, the diminuation of the others ethnies except for Gipsies.

In 1930, when a census took place, beside Romanians that accounted for more than a half (54.1 per cent) of the entire population, there were also Serbians (30.5 per cent), Czechs (12.2 per cent), Gipsies (1.5 per cent), Germans (0.8 per cent), Hungarians (0.2 per cent), Ukrainians, Bulgarians, Slovaks, Croats, Russians, Turks that accounted for 0.7 per cent of the total number of inhabitants within the area (Fig. 1).

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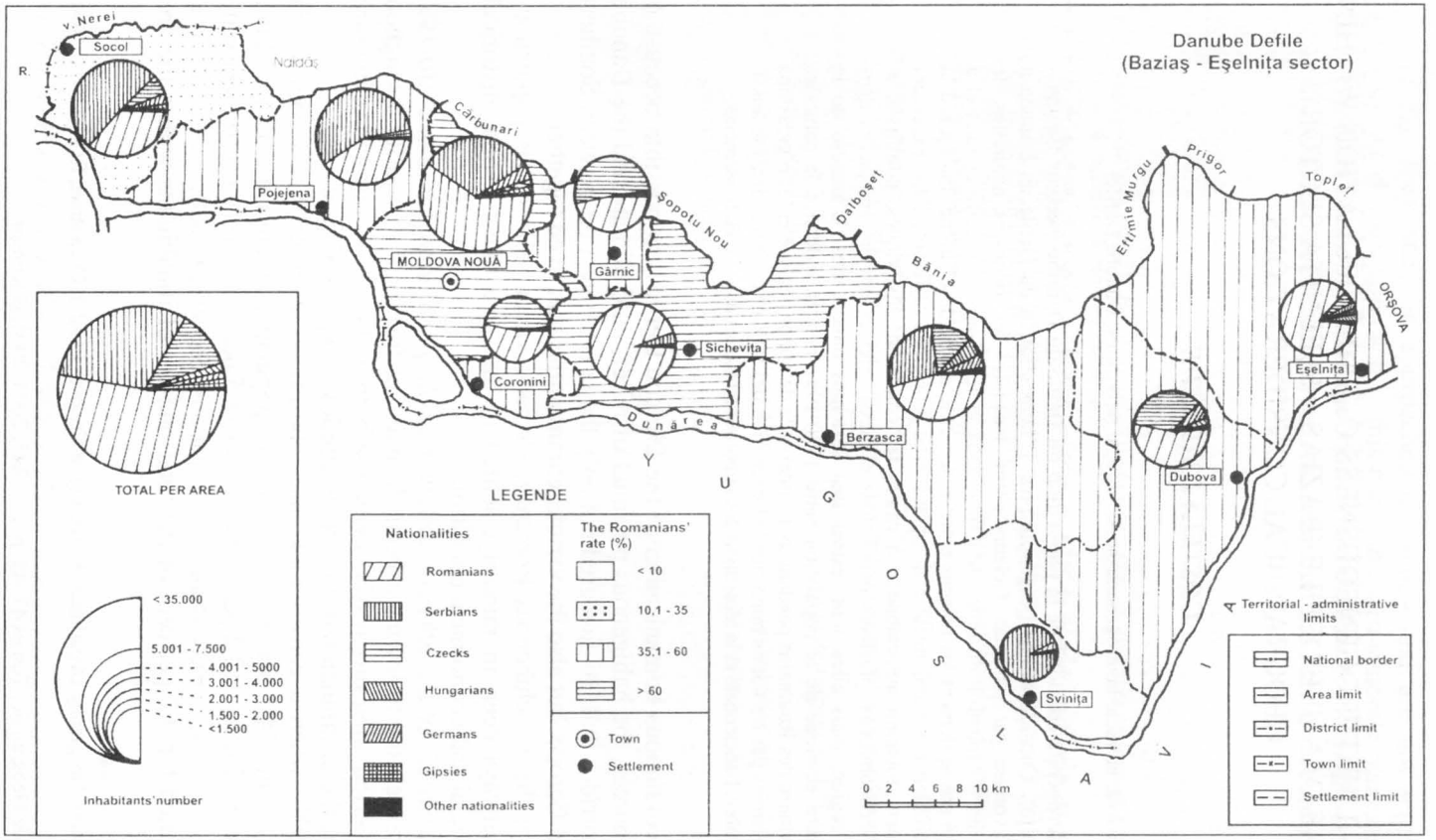

Fig. 1 – The ethnical structure of the population in 1930

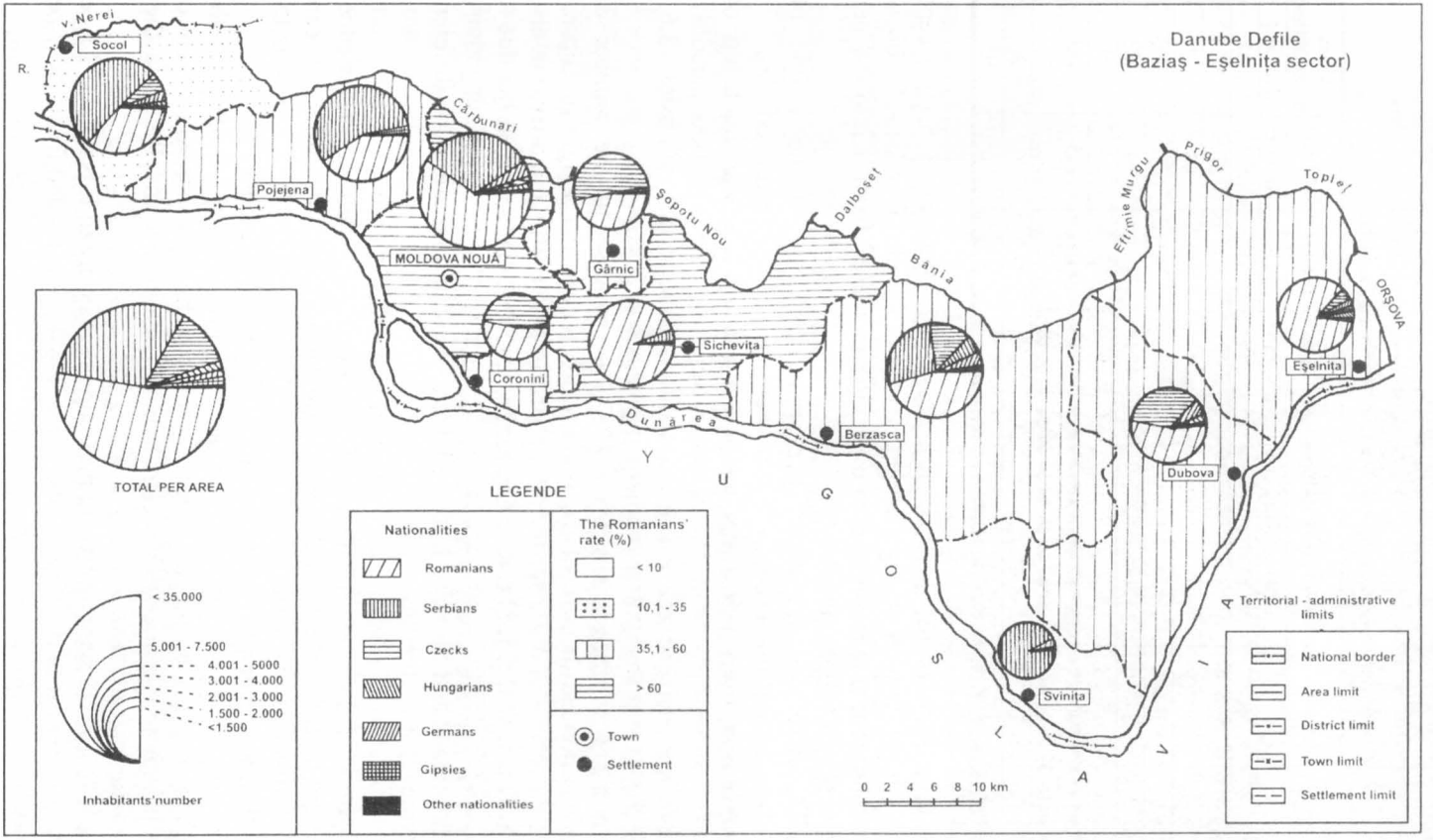

Fig. 2 – The ethnical structure of the population in 1992.

Table 1

The evolution of the ethnical structure between 1930–1992

Year	Specification	Total population	Romanians	Serbians	Czecks	Gipsies	Hungarians	Germans	Other nationalities
			Number	Number	Number	Number	Number	Number	Number
1930	Total	33552	18153	10180	4105	508	91	274	241
1966	Rural	25538	13744	6524	2848	130	63	56	2131
	Urban	10868	7840	2580	61	78	240	95	22
	Total	36406	21584	9104	2903	208	303	151	2153
1977	Rural	24056	13311	6251	3052	1018	68	74	282
	Urban	15973	12471	2557	167	92	534	81	71
	Total	40029	25782	8808	3219	1110	602	155	353
1992	Rural	21948	12862	4968	2887	1078	62	50	41
	Urban	16874	13378	2490	233	298	377	46	52
	Total	38882	26240	7458	3120	1376	439	96	93

At the following census, in 1966, an increase of Romanians by 5.1 per cent was registered, together with the significant decrease of Czechs, Germans, Serbians and Gipsies, Hungarians and other ethnies having increased from 0.2 to 0.8 per cent, and from 0.7 to 5.9 per cent.

In 1977, there was the same ascensional tendancy of the weight of Romanians, Hungarians, but also Gipsies and the decline of the resting ethnies.

At the census from 1992, the population in this area was made up of Romanians (67.5 per cent) and 15 minorities (approximately 13.000 persons): Serbians (19.3 per cent of the entire population), Czechs (8.1), Gipsies (3.6), Hungarians (1.1), Germans (0.2) and other nationalities (0.2) (fig. 2).

In contrast with the census from 1977, an increase in the number of Romanians was noticed in most of the settlements; second the weight of Gipsies grew not only because of a greater fertility, characteristic to this minority, but also because many persons did not hesitate any longer (as it had happened earlier due to various reasons) to declare their nationality; the number of Germans, Hungarians, Serbians, Ukrainians and Slovaks decreased due to external migration and different birth rate, typical for each ethny.

The ethnies distribution in settlements highlights the following aspects:

- *Romanians* are present in all studied localities, where their number is either very high (100 per cent of the entire population in 13 villages, 50 per cent in 34 villages) or, on the contrary, very small (in Sfânta Elena there is the smallest Romanian community, made up of only 7 members).
- *Serbians* are encountered throughout the area, in 93 per cent of the settlements; in the village of Divici, the Serbians represent 90 per cent of the population, while in Măceşti, Svinița, Belobreşca and Radimna they form the majority also.
- *Czechs* live in 20 settlements and make up the majority in Eibenthal (99.1 per cent), Sfânta Elena (98.9 per cent), Gârnic (98.4 per cent) and Bigăr (90.7 per cent).

- *Gipsies* have settled in 13 villages, the most important being Eşelniţa (27.2 per cent of the commune population), Liubcova (8 per cent of the village population, Moldova Nouă (3.6 per cent), the rest having a smaller per cent.
- *Hungarians*, present in 18 settlements, are numerous in Moldova Veche (2.9 per cent), Baziaş (1.9) and Câmpia (1).
- *Germans* were registered in 17 localities, but their number is quit small in all the settlements, the biggest German communities being at Moldova Veche and Berzasca.
- *The other* numerous *nationalities* are not very large, the per cent they own being insignificant in the total population within this area.

In 1930–1992 there were some changes both in the Romanians and national minorities numerical evolution and in their spatial distribution.

Called "Danubiens" – "dunăreni" or "dunărinţi" as they were living along the Danube (Călătoru, 1923, 31) Romanians were gathered, in 1930, in communities varying in size. The only pure Romanian core was at Padina Matei, the village of "bufenii" that came from the Northern Oltenya and settled here in the 18th century. High concentrations of the Romanian population were at Sichevita, Berzasca, Dubova, Tisovita, Coronini. In the Serbian villages (Svinita, Divici, Belobreşca), Romanians accounted for less than 10 per cent of the total population, while in the Czech ones, either there were no Romanians at all (Eibenthal), or their per cent was inferior to 2.5 (Bigăr, Sfânta Elena).

According to the census from 1966, while Padina Matei remained a highly Romanian community, the number of villages where Romanians represented 94–99 per cent (Coronini, Dubova, Sichevita, Plavişevita, Şuşca, Berzasca) increased. Significant growth had also Liubcova (where Romanians became the main community), Baia Nouă and Bigăr (due to resuming the mining activities in the area which have requested more labourers; this led to an increase in the number of Romanians in Bigăr by 10 times).

The construction of Iron Gates I hydroenergetic and navigation system, the intensification of mining exploitations and administrative – territorial reorganization have led to movements in the ethnical structure of the settlements. This way, at the 1977 census Romanians in rural settlements accounted for 55.3 per cent and in the town Moldova Nouă for 78 per cent. The decline at Pojejena is due to the important share of Serbians as a result of merging the commune Belobreşca (almost entirely of Serbian nationality) and Pojejena (its villages Pojejena de Sus and Radimna had a majority of Serbians). The doubling of the Romanians' percentage at Socol is a result of Serbians' migration abroad or towards urban areas as well as of the increasing share of Romanians once the village merged with the commune Zlatita.

At the 1992 census, the Romanians' rate increased with 3.3 per cent in the rural area, especially within the settlements of Eşelniţa, Berzasca, and Socol. Within Dubova, Pojejena, Sichevita etc. even if the Romanians' rate increased, from a numerical point of view, there were registered decreases (between 40 and 558 persons).

Within the studied area, *the oldest ethnical minority is the Serbian* one. The documents present a special situation of this population that came organized in an Illyrian regiment to defend the southern border (Istoria României, III, 1964, p. 491). The Serbians' arrival in Banat represented a harsh blow for Romanians, especially due to the fact that the Romanian Church was under the jurisdiction of the Serbian Church; the process of transforming Romanians into Serbians began through education in school and church at the end of the 18th century (Păcurariu, 1992, p. 87).

At the 1930 census, there were the following Serbian villages: Svinița (95 per cent of the total population), Divici (88 per cent), Radimna (84.2 per cent), Socol (80 per cent), and Liubcova (70.4 per cent). In 1966, the Serbian community represented 25.5 per cent of the population within the area. Compared to 1930 census there was an increase at Zlatița and Divici and a decline at Liubcova and Svinița. There were also some villages (Ogradena, Pojejena de Jos, Sfânta Elena, Gârnic, Gornea, Cozla, Coronini etc.) where this minority had no members. At the 1977 census, the statistical data showed insignificant changes of this nationality; even if there was a slow decrease, both numerical and procentageous, at the scale of the entire area, within the countryside, the Serbians represented more than a quarter of the population. At the 1992 census, in comparison with the one in 1977, the Serbians' rate decreased with 3.3 per cent due to the migrations for Timişoara, Resița etc. The largest communities were at Moldova Veche (1,782 persons), Svinița (1,137 persons), Socol (647 persons), Belobreşca (622 persons), Divici (90 per cent of the village population).

The presence of the *Czechs* in the area was signalled in the first half of the 19th century, when they settled here to clear forests and set up the wood industry. At the 1930 census, the largest communities were at Gârnic (1,090 persons), Sfânta Elena (935 persons), Eibenthal (entirely Czech), Bigăr (482 persons). The Czechs' number continuously decreased, one of the main causes being the returning of some Czechs to Czechoslovakia (from Gârnic and Sfânta Elena) after the Second World War. At the 1966 census, the Czechs represented 11.1 per cent of the rural population, the highest rate being registered at Gârnic and Sfânta Elena (97.9 per cent), Eibenthal (94.3 per cent), and Bigăr (70.2 per cent).

Lower percentages were registered at Baia Nouă (37.9 per cent), Zlatița (15.1 per cent), Cozla (11.8 per cent), Berzasca (7.1 per cent), Ogradena Nouă (5.7 per cent) and Liubcova (4.3 per cent). The statistical data from 1977 showed that the inhabitants number, rate per settlement and territorial distribution did not undergo significant changes, except for the Czechs from Ogradena Nouă that entirely moved at Orşova, as their village was flooded by the Iron Gates Lake. In 1992, within the rural area, the Czechs registered a regression of 165 persons as compared to the previous census, but the total Czech population underwent a slight increase (0.5 per cent). With regard to the settlements, more than 500 Czechs were at Gârnic, Coronini, Berzasca, and Dubova; at the level of villages, higher rates

were registered at Sfânta Elena (98.9 per cent), Gârnic (9.4 per cent), Bigăr (90.4 per cent), and Eibenthal (90.1 per cent). Sfânta Elena and Gârnic had and still have a more numerous population than the other Czech villages as the relief and climate allowed cereal crops to grow; thus, the population was more stable.

The *Gipsies* are different from other minorities due to their behaviour, way of living, anthropological features and specific consciousness. At the 1930 census, they accounted for 1.5 per cent of the population in the area, the largest communities (up to 50 persons) being located at Eşelniţa and Radimna. During the following decades, the Gipsies' number decreased, their territorial distribution was widened, but their share was insignificant. The statistical data for 1966 show that the Gipsies' number reduced to a half, most of them dwelling in 6 villages; it is necessary to underline that in the villages of Eşelniţa and Radimna, there was registered no member of this minority. This situation is probably a result of deportation and hiding its own ethny. At the following censuses, the Gipsies' rate increased both within the rural area (they had 5 per cent of the total population) and in the town of Moldova Nouă (their number increased with 1.2 per cent). The largest communities are at Eşelniţa (861 persons, namely 27.2 per cent of this settlement's population), Liubcova (8 per cent) and Sichevita.

The *Hungarian minority* was slightly represented during the entire analyzed period, their per cent oscillating between 0.2 and 1.1 of the total population.

Within the rural area, the Hungarians had a constant rate (0.2 per cent only with displacements in their territorial distribution. If in 1930, about 75 per cent of the Hungarians were settled in 4 villages (Berzasca, Socol, Eşelniţa, and Plavişeviţa), at the 1966 census, due to their decreasing rate at Berzasca (from 22.9 per cent to 9.8 per cent) and Socol (from 21.9 per cent to 14.5 per cent), an extension of their territorial distribution took place as they settled in Ogradena Veche (27.4 per cent of the total population), Coronini, Radimna, Şuşca, Zlatiţa and Drencova.

The following censuses emphasized the same process of territorial extension, the result being that Hungarians were present in 18 villages (Moldova Veche – 2,9 per cent, Baziaş – 1,9 per cent, Câmpia 1 per cent, Dubova, Socol-0,5 per cent, Eşelniţa, Pojejena, Sviniţa – 0,3 per cent).

With regard to the *German minority*, the same decline was noticed (0,8 per cent in 1930, 0.2 per cent in 1992), its great dispersion, and small number within villages (1–8 persons). The continuous decrease in the Germans' number is the direct result of their migration in Germany or to the towns of Orşova, Anina, Resiţa and Timişoara.

In time, there have been noticed *other minorities* among which we can mention: Ukrainians (in large number at Socol and Berzasca), Bulgarians (Sichevita, Padina Matei, Gârnic), Slovaks (Coronini, Eşelniţa), Croatians (Sichevita, Socol), Russians (Coronini) and Turks (the number of which decreased considerably due to migration).

Concerning *the number of minorities within settlements*, Moldova Nouă has the most heterogeneous structure due to the 14 nationalities it includes. Within the rural area, Zlatița and Câmpia have 6 minorities, while at the opposite pole are Moldovița and 12 dispersed villages (which are part of the settlement of Sichevița), with homogenous population, made up entirely of Romanians.

According to the statistical data of the latest census, the *ethnical compactness* of the analyzed area was of 2.5 per cent (calculated according to the following formula):

$$S = \frac{n_1^2 + n_2^2 + \ldots + n_k^n}{N^2} \times C$$

where: n=minority; N=total population; C=coefficient

(after British Encyclopedia, 1987, p. 39)

This value underlines *the heterogeneousness of the ethnical structure*. The existence of more minorities within a restricted area led to a merging human community in which interests were above the ethnical affiliation. That is why it was possible to take advantage of the inventive spirit much more obviously and efficiently than in other regions, as well as to preserve the collective traditional values, as a result of the contribution of multiple identity.

The intellectual values, as well as these minorities' degree of civilization have formed a common heritage due to living together. If we accept the idea that this heritage has a multiple origin, it is easier to better understand history and present time. This patrimony left its mark on the habitat as mixed villages have always been a bit different, a thing obvious in the way houses are built, farms are organized, food is prepared and stored, etc. (V. Neumann, 1997, p. 7)

With regard to the relations between the major population and minorities, the communication was remarkable, its support being the bilingualism, which was practiced within all ethnical communities.

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THE UPPER LIMIT OF THE LUVOSOLS FROM ROMANIA. EXAMPLES FROM THE EASTERN CARPATHIANS

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Key words: luvosols, periglacial belt, Eastern Carpathians.

La limite supérieure des luvosols de Roumanie. Exemples des Carpates Orientales. Des recherches pédologiques propres, confrontées avec des données publiées, indiquent que la limite supérieure moyenne des *luvosols* (dans le Système Roumain de Taxonomie des Sols/SRTS, 2003) se trouve à presque 800 m altitude. Cette limite est une bande avec des bords diffuses, situées entre 700–900 m altitude. Cependant, il y a des situations, assez rares, où les *luvosols* se trouvent au dessus de 1 000 m. Ainsi, on présente trois cas extrêmes concernant les Carpates Orientales, situés dans des conditions géomorphologiques et géologiques différentes: (1) *luvosol tipic* (P. 202 Gheorgheni), situé à l'altitude de 1 096 m (les Montagnes de Giurgeu); (2) *luvosol stagnic* (P. 13 Budila), situé à l'altitude de 1 090 m (les Montagnes de Întorsura), et (3) *luvosol albic-stagnic* (P. 6 Apa Roşie), situé à l'altitude de 1 002 m, dans la dépression Apa Roşie (Montagnes de Nemira). Dans la bande diffuse de la limite supérieure extrême, à l'altitude de 1 000–1 100 m, la couverture de *luvosols* est fortement fragmentée (les aréales sont rares et leurs surfaces sont réduites). L'association se fait surtout avec les *cambosols* et moins avec les *preluvosols*. Il est possible que dans les Carpates les *luvosols* se trouvent au dessus de l'altitude de 1 100 m, mais on peut s'attendre que le dépassement d'altitude ne soit pas grand et les aréales soient très restreints. A la fin de la période würmienne, au-dessus de l'altitude de 800 m commençait l'étage détritique, caractérisé par des processus de pente très actifs, qui ont modifié la couverture antérieure des sols. Au-dessous de ce niveau se trouvait l'étage de la toundra (ou des solifluxions), mais la limite entre ces étages était loin d'être nette. Dans la partie inférieure de l'étage détritique, à côté des surfaces plus ou moins dénudées, persistaient des lambeaux bien préservés avec des anciens sols. La partie supérieure de l'étage détritique a été complètement dénudée et les sols antérieurs ne se conservent plus. Ce type de processus destructifs a eu lieu quelques fois en Würm (dans chaque stade glaciaire). Les sols antérieurs à ces périodes sévères étaient des sols évolués avec horizon Bt / B argic (des sols évolués pendant le dernier interglaciaire ou dans les interstades würmiens). Sur les couvertures minces qui ont couvert la partie inférieure de l'étage détritique, dans l'époque postglaciaire les *cambosols* ont apparu dans la plupart des cas.

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INTRODUCTION

According to the Romanian Soil Taxonomy System / SRTS (Florea, Munteanu, 2003), *luvosols* are basically "soils having A ocric horizon (Ao) followed by the eluvial horizon E (El or Ea) and B argic horizon (Bt) with a degree of base saturation (V) of over 53% in at least one sub-horizon from the superior part; they do not present a abrupt textural change (between E and Bt on < 7.5 cm)". Defined like this, *luvosols* include *brown luvic soils, reddish-brown luvic soils*, and *albic luvisol* from the Romanian Soil Classification System / SRCS (1980). Only the first and the last of these three (SRCS) may be found at higher altitude; that is why we will not discuss here about the *reddish-brown luvic soils* (*reddish luvosols* – SRTS 2003), too.

In WRB-SR system (FAO, 1998), *luvosols* (SRTS 2003) are divided in two reference groups: *luvisols* (the majority of *luvosols* subtypes) and *albeluvisol*.

The main natural forming conditions of the *luvosols* discussed here (the *albic luvisol* and the *brown luvic soils*, cf. SRCS 1980) are synthesized in Geografia României (1983), in the table no. 8.3 (pp. 510–511): average annual temperature (°C) 6...10.4, average annual rainfall (mm) 580...1 000; forests with *Quercus*, *Fagus*, *Fagus* and *Picea*; plains, terraces or platforms, hills, tablelands and depressions. These are dominant values / characteristics of the spread of the above mentioned *luvosols*. Under certain circumstances they are exceeded.

According to our own research, including the records of P.A.S.O. (in Romanian O.S.P.A.)

Braşov, confronting them with the published data, the superior average limit of the *luvosols* is at around 800 m altitude. This limit is, in fact, a strip with diffuse limits between 700–900 m altitude.

Still, there are situations, rare enough, when the *luvosols* are found at altitudes at over 1 000 m. Between 1 000–1 100 m it can be talked about the extreme altitudinal strip of *luvosols*. We will present three cases of *luvosols* from the Eastern Carpathians found in different geomorphic and geological conditions situated within this extreme altitudinal strip.

The soil analysis were made in the laboratory of O.S.P.A. Braşov (tables 1, 2 and 3), using the following methods: humus – Schollenberger; soil reaction (pH) – in H2O or KCl extract (1:2.5); total exchangeable bases (SB) – Kappen-Chiriţă; total acidity (SH) – Cernescu (percolation with sodium acetate at 8.2 pH); exchangeable aluminum (Al) – Sokolov (KCl extract); mechanical composition – Kacinski treatment, sieving and pipeting.

SOIL PROFILES CHARACTERISTIC TO THE SUPERIOR LIMIT OF THE LUVOSOLS

Profile no. 202 Gheorgheni: *TYPICAL LUVOSOL (LV ti)*

Localization: the Giurgeu Mountains, 300 m south of the top of the Ciobot Hill (Dealul Ciobot, 1 096 m), 1.8 km NNE of the Gheorgheni town center, Harghita county.

Table 1

Profile no. 202 Gheorgheni (*LV ti*). Analytical data

Horizons		Ap	Ao	El_1	El_2	Bt_1	Bt_2
Depth of the samples (cm)		0–15	23–33	35–45	50–60	70–80	100–110
Coarse sand (2.0–0.2 mm) %		10.64	14.77	20.84	29.43	15.95	13.26
Fine sand (0.2–0.02 mm) %		40.56	35.03	38.96	35.77	48.85	42.14
Silt I (0.02–0.001 mm) %		14.4	15.1	8.3	19.0	8.6	9.6
Silt II (0.001–0.002 mm) %		5.0	16.2	16.8	3.3	11.5	12.4
Clay (<0.002 mm) %		29.4	18.9	15.1	12.5	15.1	22.6
pH / H_2O		5.0	4.75	5.6	5.9	6.0	5.95
Humus (%)		4.44	4.62	1.26			
Total exchangeable bases	(me/ 100g soil)	10.2	9.8	7.7	9.6	16.8	20.9
Total acidity		13.5	14.0	6.7	5.7	4.1	4.4
Cation-exchange capacity		23.7	23.8	14.4	15.3	20.9	25.3
Degree of base saturation ($V_{8.2}$%)		43.0	41.1	53.4	63.1	80.3	82.6
Exchangeable Al^{3+} (me/100 g soil)		2.740	2.260	0.540			

Analyst: Rodica Barb (1988)[1]

Parent material: middle loams with skeleton.

Underlying rock (1–1.5 m deep): crystalline metamorphic rock from the Tulgheş series (acid volcano sedimentary rocks) from the superior Paleozoic+ Proterozoic (*Harta geologică*, *12*, 1968).

Relief: middle third of the slope, 12% N; the profile altitude, 1 070 m; the maximum altitude of the map unit, 1 090 m.

Climate: annual average temperature, 4...5°C; annual average rainfall, 800...1 000 mm (Atlas, 1974 – 1975).

Vegetation: cultivated (potato clones); spruce forests.

Ground water; drainage: >10 m; well drained.

The aspect of the land surface: covered with 10–20 (25) % stones (of crystalline metamorphic rock).

The type of soil with whom it associates (existing on slopes with a bigger inclination, of 15–20 %, and on the narrow summit): *eutricambosol.*

The description of soil profile (Băcăinţan, 5.09.1988)[1]:

Ap, 0–23 cm, loam with 5% skeleton (0.5–3 cm diameter), dark yellowish brown (10YR 3/4) moist, yellowish brown (10YR 5.5/4) dry, small angular blocky structure moderately developed, loose, abrupt boundary;

Ao, 23–33 cm, sandy loam with 2–3% skeleton (0.5–3 cm diameter), the same colors, structure as Ap, soft compact, clear boundary;

El1, 33–45 cm, sandy loam with 20–25 % skeleton (0.5–3 cm diameter), dark yellowish brown (10YR 4/4) moist, yellowish brown (10YR 5/4) dry, medium angular blocky structure, compact, clear boundary;

[1] N. Băcăinţan, *Studiu pedologic complex al I.C.P.C. Braşov*, scara 1:10 000, anul 1988 (O.S.P.A. Braşov records).

El2, 45–62 cm, loamy sand with 25–50 % skeleton (0.5–3 cm diameter), dark yellowish brown (10YR 4/5) moist, yellowish brown (10YR 5/4) dry, very compact, clear boundary;

Bt1, 62–90 cm, sandy loam with 20–30 % skeleton (0.5–3 cm diameter), dark yellowish brown (10YR 4/4) moist, medium angular blocky structure slightly developed, very compact, gradual boundary;

Bt2, 90–125 cm, loam with skeleton as Bt1, medium angular blocky structure slightly developed, very compact, clear boundary;

Rp, 125 cm+, over 90 % skeletons from the crystalline metamorphic rocks (fossil rubble).

The index of texture differentiation (Bt2/El1) is 1.49.

Profile no. 13 Budila: *STAGNIC LUVOSOL (LV st)*

Localization: Întorsurii Mountains; 8 km east of the Budila village center, Braşov county.

Parent material: middle loams.

Underlying rock (1–1.5 m deep): Albian siliceous sandstone (*Harta geologică, 12*, 1968).

Relief: broad ridge, 3% slope; profile altitude, 1 080 m; the maximum altitude of the map unit, 1090 m.

Climate: annual average temperature, 4...5°C; annual average rainfall, 800...1 000 mm (Atlas, 1974–1975).

Vegetation: mesophytic meadow (*Argostis tenuis, Festuca rubra, Nardus stricta* and so on); beech tree forests altitudinal belt.

Ground water; drainage: >10 m; moderate drained.

The type of soil with whom it associates (existing on the convex forms from the summit and on the adjacent slopes): *districambosol.*

The description of soil profile (Perepeliţă, 19.09.2002)[2]:

Aot, 0–6 cm, sandy loam, very dark grayish brown (10YR 3/2), very small granular structure, well developed, abrupt boundary;

Ao, 6–15 cm, loam, dark yellowish brown (10YR 4,5/4), very small granular structure, well developed, abrupt boundary;

El, 15–35 cm, loam, yellowish brown (10YR 5/4), small angular blocky structure, moderated developed, abrupt boundary;

EB, 35–47 cm, loam, yellowish brown (10YR 5/6), medium angular blocky structure, well developed, abrupt boundary;

Btw1, 47–90 cm, loam, yellowish brown (10YR 5/4) with frequent grayish spots (7,5 GY 5/1), big angular blocky structure, well developed, abrupt boundary;

Btw2, 90–125 cm, loam with 10 % skeleton, colors and structures identical with Bt1, abrupt boundary;

Rp, 125 cm+, stones of siliceous sandstone.

The index of texture differentiation (Bt/El) is 1.21.

[2] V. Perepeliţă, *Studiu pedologic şi agrochimic al terenului agricol al comunei Budila*, judeţul Braşov, scara 1:5 000, anul 2003 (O.S.P.A. Braşov records).

Table 2

Profile no. 13 Budila (*LV st*). Analytical data

Horizons		Aoţ	Ao	El	EB	Bt	BC
Depth of the samples (cm)		0–6	6–15	20–30	36–46	60–70	110–120
Coarse sand (2.0–0.2 mm) %		1.61	0.83	1.51	1.79	1.39	7.27
Fine sand (0.2–0.02 mm) %		44.99	39.37	34.19	30.51	33.41	37.83
Silt I (0.02–0.001 mm) %		10.9	12.8	12.8	12.5	11.9	9.8
Silt II (0.001–0.002 mm) %		22.5	25.8	25.6	25.4	21.9	16.7
Clay (<0.002 mm) %		20.0	21.2	25.9	29.8	31.4	28.4
pH / H_2O		4.7	4.7	4.9	5.1	5.4	6.0
Humus (%)		8.28	5.76	3.30	2.07		
Total exchangeable bases	(me/	11.7	9.4	7.4	7.0	9.7	
Total acidity	100g	7.9	11.5	9.6	8.1	4.5	
Cation-exchange capacity	soil)	19.6	20.9	17.0	15.1	14.2	
Degree of base saturation ($V_{8.2}$%)		59,7	45,0	43,5	46,3	68,3	
Exchangeable Al^{3+} (me/100 g soil)		3,724	4,275	3,249	2,470		

Analyst: Antonela Petreanu (2003)[2]

Profile no. 6 Apa Roşie: ***ALBIC-STAGNIC LUVOSOL (LV ab-st)***

Localization: Apa Roşie Depression from the Nemira Mountains, 900 m SE from the confluence of the Apa Roşie river with the Pârâul Românului river; Poian village, Covasna county.

Parent material, underlying rock: loess-like deposit / 'diluvium-proluvium' Quaternary deposits; the slopes from the surroundings are sculptured in sandstone flysch (facies of Tarcău), Paleocen-Lutetian (*Harta geologică, 21*, 1968).

Relief: alluvial glacis, slope of 3–4%; profile altitude, 1002 m; the maximum altitude of the map unit, 1 020 m (this is the superior limit of the mapped area, but the soil may reach the altitude of 1 050 m, or even more).

Climate: annual average temperature, 5...6°C; annual average rainfall, 800...1 000 mm (Atlas, 1974–1975; it is possible for the real data to be a little different, especially in the case of medium temperatures, which may be smaller).

Vegetation: *Deschampsia caespitosa* (dominantly), with *Juncus effusus*, *Ranunculus* sp. and s.o., grown after the upturning of the meadow, made two decades ago; spruce fir forests altitudinal belt (Atlas, RSR,VI-2, 1976). We would like to mention that on the same soil, not too far upstream, potatoes, rye, and oats are cultivated. The cultivated land, on which the Potato Research–Development Station from Târgu Secuiesc produces potato clones, has a system of closed drains (which works imperfectly), while the not cultivated land from around the profile no. 6 (described below) is covered by only surface drainage.

Ground water; drainage: >5 m; imperfect drained.

The type of soil with whom it associates: *stagnosol* (met in glacis micro depressions) and *districambosol* (on the surroundings slopes; it was mapped on slopes of 15–20%)[3].

[3] N. Băcăinţan, *Studiu pedologic complex la S.C.P.C. Tg. Secuiesc, trupul Apa Roşie*, scara 1:5 000, anul 1988 (O.S.P.A. Braşov records).

Human influences: drenage works (made in 1985), functioning imperfectly.

In a former study (Băcăinţan, 1988)[3], made near the piece of land on which the study from 2004[4] was made and for the same Research Station, on the glacis we met identical soil subtypes (*albic–stagnic luvosols* and *albic stagnosols).*

The description of soil profile (Băcăinţan, Zăgreanu, 23.07.2004)[4]:

Ap, 0–23 cm, loam, very dark grayish brown (10YR 3/2) blended with grayish brown (10YR 5/2), small angular blocky structure moderately developed, soft compact, abrupt boundary;Ea1W, 23–35 cm, loam, light grayish brownish (2.5Y 6/1.5) moist, light gray (2.5Y 7.5/1.5) dry, small composed structure (angular blocky and platy structures) weakly developed, soft compact, straight clear boundary;

Ea2W, 35–49 cm, loam, light grayish brownish (2,5Y 6/1.5) medium angular blocky structure moderately developed, moderately compact, straight clear boundary;

Bt1w, 49–85 cm, loam, yellowish brown (10YR 5/6), with very frequent light brownish gray spots (2.5Y 6/1.5), medium composed structure (angular blocky and prismatic structures) moderately developed, very compact, straight gradual boundary;

Table 3

Profile no. 6 Apa Roşie (*LV ab-st*). Analytical data

Horizons		Ap	Ea_1W	Ea_2W	Bt_1w	Bt_2w	BCw	Cnw
Depth of the samples (cm)		0–15	24–34	37–47	62–72	97–107	125–135	145–155
Coarse sand (2.0–0.2 mm) %		12.49	17.32	19.55	11.2	6.53	6.78	7.38
Fine sand (0.2–0.02 mm) %		27.81	27.48	31.15	30.3	28.47	29.72	31.02
Silt I (0.02–0.001 mm) %		10.60	7.50	9.30	9.10	7.1	7.00	6.60
Silt II (0.001–0.002 mm) %		21.60	17.40	18.20	19.90	15.5	14.20	14.50
Clay (<0.002 mm) %		27.50	30.30	21.80	29.50	42.4	42.30	40.50
pH / H_2O		4.95	5.10	5.10	5.40	5.90	6.00	5.90
pH / KCl		4.00	4.00	3.95	4.00	4.30	4.35	4.35
Humus (%)		3.82	0.81	0.52				
Total exchangeable bases	(me/ 100 g soil)	6.20	4.60	6.10	15.00	19.20	19.80	19.80
Total acidity		12.00	8.40	9.30	6.40	4.80	4.00	4.00
Cation-exchange cap.		18.20	13.00	15.40	21.40	24.00	23.80	23.80
Degree of base satur. ($V_{8.2}$%)		34.07	35.38	39.61	70.09	80.00	83.19	83.19
Exchang. Al^{3+} (me/100 g soil)		4.686	4.070	5.632	3.663			

Analyst: Antonela Petreanu (2004)[4]

Bt2w, 85–120 cm, clayey-loam, yellowish brown (10YR 5/6), with frequent light brownish gray spots (2.5Y 6/1.5), medium composed structure (angular blocky and prismatic structures) moderately developed, very compact, straight gradual boundary;

[4] N. Băcăinţan, G. Zăgreanu, *Studiu pedologic complex şi bonitarea terenurilor pentru S.C.D.C. Tg. Secuiesc. trupul Apa Roşie, comuna Poian, judeţul Covasna*, scara 1:5 000, anul 2004 (O.S.P.A. Braşov records).

BCw, 120–140 cm, clayey-loam, yellowish brown (10YR 5/6), with rare light brownish gray spots (2.5Y 6/1.5), big prismatic structures weakly developed, moderately compact, straight gradual boundary;

Cnw, 140–160 cm, clayey-loam, yellowish brown (10YR 5/8), with rare light brownish gray spots (2.5Y 6/1.5), unstructured, moderately compact.

The index of texture differentiation (Bt2/Ea2) is 1.94.

DISCUSSIONS

Within the average superior altitudinal belt of *luvosols* and above it, at about 800–1 000 m altitude, these soils do not form a large covering. Within this altitudinal interval they have a fragmentary distribution, alternating, usually, with *preluvosols*, *eutricambosols* and *districambosols*. While the *luvosols* cover the large summits and the mild slopes, *preluvosols* cover chiefly the mild to moderate slopes, and the *cambosols* cover the moderate to steep slopes.

Within the more diffuse strip of the extreme altitudinal belt, at the 1 000–1 100 m altitude, the *luvosols* covering has a similar structure, but the fragmentation is more advanced i.e. the areas are more rare and smaller, and the association is chiefly with *cambosols* and less with *preluvosols*. In the first two examples above presented (P. no. 202 Gheorgheni and P. no. 13 Budila) the extent of each area of *luvosols* is of several hectares. The third example is a particular case due to the large area, some tens hectares, covered by *luvosols* (very probably over 100 ha, but the depression was not fully mapped). Its particularity is determined by the presence of a gentle and large slope (alluvial glacis) at the altitude of 1 000–1 050 m. It is possible to find *luvosols* above the 1 100 m altitude in the Carpathians, but we do not expect the *luvosols* to exceed the altitudinal limit too much or the areas to be too large.

At the end of the würmien period, higher than 800 m altitude the detritic altitudinal belt began (Păunescu, 1967; 1971, Ichim, 1979; Băcăinţan, 1999 etc.). It was characterized by vigorous slope processes, which altered the previous soil covering. Under this level the altitudinal belt of tundra (solifluxions) was spread, but the boundary (between these altitudinal belts) was far from being an abrupt one. The intensity of theses processes was, generally speaking, directly proportional with the altitude and the slopes. In the inferior part of the detritic altitudinal belt, next to the more or less denudated areas, persisted well kept (not too large) areas of older soils. In the upper part of the altitudinal belt the denudation was complete and none of the previous soil was kept. This type of destructive processes took place several times in Würm (in every phase). The soils prior to these sever periods were evolved ones, with B argic horizon (soils developed in the last interglacial period or even in interstadials). In postglacial on the thin covering, which coated the inferior part of the detritic altitudinal belt, *cambosols* evolved in most cases. In some situations the old argilluvic soils (situated around the 900 m altitude) were not completely destroyed, only 'rebuilt'.

This reshuffle took place in the periglacial conditions, especially through solifluxions processes (Băcăinţan et al., 1987).

The evolution of the geomorphic processes and of the bioclimatic altitudinal belts at the end of Pleistocene and in Holocene seem to be the most plausible explanation for the present structure of the soil covering, especially within the altitudinal interval of 700–1 000 m, there where in Quaternary existed major oscillations of the geo-bioclimatic boundaries of the altitudinal belts.

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LE STRESS BIOCLIMATIQUE CUTANÉ DANS LA PLAINE ROUMAINE

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Mots clés: stress cutané, indice hypotonique, indice hypertonique, caractère relaxant, Plaine Roumaine.

The dermal bioclimatic stress in the Romanian Plain. The authors analyse the monthly dermal climatic stress at 21 stations at 7.00 a.m. and at 1.00 p.m., for five years (1991–1995). In the cold months, the hypertonic index is stress-inducing by arousing thermogenesis. In the hot months, the hypotonic index is considered stress-inducing the thermolytic mechanism of the body. A non-stressing, relaxative, thermally neutral index characterises the spring and the autumn.

On étudie le stress bioclimatique cutané d'après la formule de Becancenot (1974) qui établit une relation entre la température de l'air, la vitesse du vent et le pouvoir réfrigérant (ou de refroidissement) de l'organisme humain,

On établit des limites entre la zone relaxante et les zones stressantes par une échelle de valeurs du pouvoir de refroidissement. De 0 à 299 kcal/m^2/h se produit un stress hypotonique, par déclenchement de la thermolyse; pendant l'été. De 300 à 599 on parle d'un caractère relaxant, qui ne sollicite pas la thermorégulation, alors que les valeurs qui dépassent 600 kcal/m^2 /h déterminent le stress hypertonique, par le déclenchement de la thermogenèse, pendant l'hiver.

Pour établir *la variation saisonnière de l'indice de stress cutané* on a calculé les valeurs moyennes mensuelles de la température de l'air et de la vitesse du vent, pour 7 heures du matin, comme stress nocturne et pour 13 heures, comme stress diurne, pour la période 1991–1995, pour 21 stations météorologiques situées dans la Plaine Roumaine.

On constate que pendant les mois d'hiver est prédominant le stress hypertonique qui sollicite l'organisme humain pour le déclenchement de la thermogenèse (spécialement dans la partie ouest de la Plaine), mai aussi le caractère relaxant du climat, en général à midi, dans presque toute la Plaine Roumaine. Il faut mentionner que la période 1991/1995 est plus chaude que, par exemple, la période de 1966–1975, (Teodoreanu *et al.*, *1984*) dans laquelle l'indice relaxant était presque absent.

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En général le stress hypertonique détermine une adaptation de l'organisme humain au froid et au vent, qui doit produire de chaleur interne par l'intensification du métabolisme, par l'utilisation des protéines alimentaires. L'homme aussi doit s'habiller avec des vêtements plus chauds, doit faire des mouvements physiques etc. Pour les personnes âgées et pour les malades c'est mieux de rester à la maison et d'éviter spécialement les vents forts et les températures très réduites. L'organisme humain est exposé aux infections virales.

Pendant l'été, les températures élevées et le calme atmosphérique déterminent un caractère hypotonique prédominant, généralement à midi, dans la vallée du Danube et dans la partie Sud et Est de la plaine. Le temps relaxant est présent le matin et peu fréquent à midi, quand prédomine le stress hypotonique (Fig. 1).

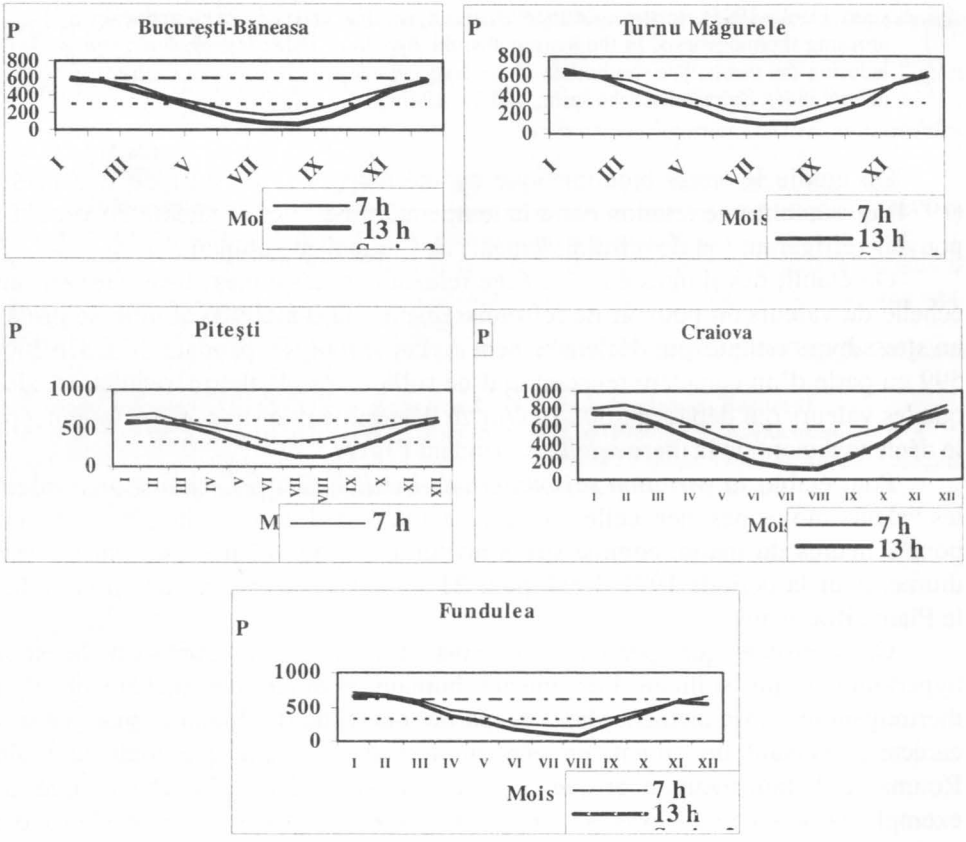

Fig. 1 – La variation mensuelle du stress cutané dans quelques stations météorologiques de la Plaine Roumaine.

En conditions de stress hypotonique, l'organisme humain intensifie les modalités de diminuer sa chaleur interne, par radiation, convection, conduction, évaporation, par vasodilatation cutanée, par transpiration, quand la température de

l'air dépasse 29–30^{0}C et la température de la peau dépasse 34^{0}C. Mais dans ces conditions se produit un déséquilibre minéral, un état de fatigue, l'organisme perd une partie de son pouvoir de protection contre les microbes et il est soumis aux infections gastro-intestinales.

Pendant le printemps, presque toute la journée est relaxante, dans la plaine, mais on peut observer que dans la vallée du Danube, en mai, à midi, il y a déjà un stress hypotonique avec des valeurs réduites, alors que dans la partie ouest de la plaine (à la station de Craiova), pendant le mois de mars il y est encore présent, spécialement le matin, le stress hypertonique.

En ce qui concerne l'automne, le mois de septembre est encore caractérisé par les chaleurs de l'été, donc on enregistre le stress hypotonique dans toute la plaine, alors que les mois d'octobre et de novembre sont relaxants, à l'exception de la partie ouest, où commence le stress hypertonique de la période froide de l'année.

On peut dire que le printemps et l'automne sont les saisons les plus favorables de la vie, car le climat, avec ses components principaux, la température, l'humidité et la dynamique atmosphérique, est confortable pour l'organisme humain. Il n'y a pas des restrictions pour le travail à l'extérieur, dans l'agriculture ou dans les constructions, aussi que pour les loisirs passés dans plain air, dans les forêts ou au soleil, pour l'aéro- hélio- hydrothérapie.

En ce qui concerne *la variation diurne de l'indice du stress*, on peut observer que la modification diurne des paramètres climatiques entraîne une modification des indices diurnes. Par exemple, en janvier, le stress à 7 heures du matin, mais aussi à 13 heures varie entre hypertonique (plus de 600 kcal/m^2/h) et relaxant (300–600 kcal/m^{2}h)(Fig. 2).

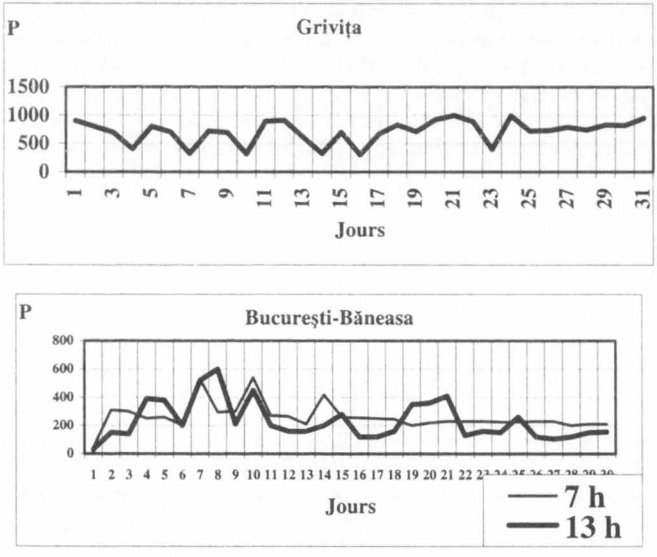

Fig. 2 – Variation diurne du stress cutané en janvier à Griviţa et en avril à Bucureşti – Băneasa.

Au printemps, en avril, dans le centre de la plaine, la variation diurne est comprise entre les conditions relaxantes et hypotoniques.

Pendant l'été, à midi et même le matin, est prédominant le stress hypotonique (moins de 300 kcal/m^2/h).

Bien sûr, il y a quelques fois des mois très froids en hiver, avec des températures très réduites, sous –10...-15^{0}C, des vents forts plus de 5...10 m/s, neige abondante. Dans ce cas, tous les jours sont fortement hypertoniques, mais dans la période prise en considération il n'y avait pas de telles situations.

Le stress cutané est une partie du stress bioclimatique total qui comprend aussi et le stress pulmonaire. Il contribue a définir le caractère général du stress bioclimatique dans une région et ainsi l'influence des facteurs climatiques sur l'état de la santé des hommes.

L'étude du stress cutané dans la Plaine Roumaine permet d'apprécier d'une manière objective le caractère du bioclimat qui est défini comme excitant – sollicitant pour l'organisme humain.

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THE HARMFUL ACTION OF SOME FAUNISTIC ELEMENTS ON FORESTS AND AGRICULTURAL LANDS IN COVURLUI HILLS

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Key words: faunistic elements, detrimental action, nemoral belt, sylvosteppe, agroecosystems, Covurlui Hills.

Die schädliche Wirkung mancher faunistischen Elemente auf die Wälder und landwirtschaftlichen Flächen in den Covurlui-Hügeln. Die Tierwelt bildet eine dynamische Komponente des physisch-geographischen Systems. In der Struktur der Ökosysteme im Zustand des natürlichen Ausgleichs gibt es bestimmte Gattungen, deren Anwesenheit ständig ist und deren Bestand zwischen normalen Grenzen schwanken. Die Gründe, die die Vermehrung mancher Zooelemente über diese Grenzen hinaus bestimmen, die physisch-geographischen Bedingungen und Faktoren innerer Natur der jeweiligen Biokomponente sind verschieden. Die untersuchten Zooelemente sind geradezu schädlich, indem sie Entblätterungen, Skelettierungen, Zernagen der verschiedenen Teile von Holz- und Graspflanzen oder den Verbrauch von Samen von Früchten bewirken und dadurch teilweise oder gänzliche Entartungen der Pflanzenwelt bewirken. Auf den Covurlui-Hügeln, einer Untereinheit der moldauischen Hochebene im Kontaktgebiet der biogeographischen dakischen und pontischen Provinzen gelegen, wirkten sich schädliche Vorgänge sowohl auf Unwirbeltiere (Ungeziefer der *Lepidoptera-*, *Coleoptera-* und *Heteropteraart*), als auch auf die Wirbeltiere (der *Rodentia-*, *Passeriformes-*, *Lagomorpha-* und *Artiodactylaart*) aus. Im Ganzen war die Intensität der Angriffe schwach und die aufgezeichneten wirtschaftlichen Schäden gering.

GENERALITIES

The animal world is a dynamic component of the physical-geographical system. Some species are permenently present withim the structure of well-balanced natural ecosystems. Their effectives vary withim a normal range, forming the so-called "normal contingent" or "resistant generation". In view of the relationships established with the biocoenosis in terms of biotope conditions, the animals of an ecosystem are relatively stable.

What causes the excessive multiplication of some zooelements, producing economic and landscape damage, are the physical geographical conditions and the internal factors (e.g. age, structure, physiological condition) of each bio-component.

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Any impairment of the trophic chain disturbs the normal numerical evolution of the animal populations, with density thresholds being surpassed by a marked reproduction dynamic. In this way, the dynamic equilibrium among the various groups of plants and animals (coenotic homeostasis) is disturbed. One of the basic physical-geographical conditions involved in this disturbance is the climate (periods of drought, lack or abundance of snow or much wind) and less so the soil and its properties.

The zooelements discussed herein inflict *direct damage* through defoliation, skeletisation, and gnawing at the various ligneous and herbaceous plant parts, eating up the seeds or the fruit. Thus, the vegetation is partly or fully depreciated.

In the Covurlui Hills, a sub-unit of the Moldavian Plateau edging the Dacian and the Pontic biogeographical provinces, the action of both nonvertebrate (insects of the *Lepidoptera, Coleoptera* and *Heteroptera* orders) and vertebrate species (*Rodentia, Passeriformes, Lagomorpha* and *Artiodactyla*) proved very damaging. In the years of mass multiplication ("gradations"), insect species feeding on *Quercus* (actually their primary consumers) damage the forest vegetation through defoliation. They have a negative geoecological impact. There are four gradation phases: incipient (the number of individuals starts growing due to abundant food, lack of competitors and drought); overmultiplication, outburst (the number of individuals is suddenly soaring; when top values have been reached, the scarcity of food leads to an as sudden population decrease), and depletion (crisis), when only tough individuals remain in a state of latency until the next gradation (Ene, 1971).

After several years, as insect population densities rose and their defoliation capacity was high but available food pretty scarce, they died in proportion of over 90%. In view of it, attacks became hardly noticeable. The relatively constant quantity of foliated mass acts as control factor (Gabriela Dissescu, 1982). The intensity of defoliation within a gradation period depends on the age and structure of the stands. The widest defoliations suffer the old and sparce *Quercus* stands. However, this species has a good ability to remarke its foliage devastated by the insects.

ZOOELEMENTS DIRECTLY IMPAIRING THE BELT OF NEMORAL FORESTS (OAK GROVES AND OAK-MIXED FOLIAGE FOREST)

NONVERTEBRATES

Insects are the first among the biotic factors to compete with man for the resources offered by the forest, they having a great reproduction capacity and as great destructive power.

a) *Tortrix viridiana (Lepidoptera)* was first detected in the south of Moldavia in 1950. It eats up particularly the upper part of the crown, impairing the annual tree growth.

In the years1959–1964, it mildly attacked the forests of Fundeanu, Banciu, Jerdia-Stroiu, Rediu Cristea, Moteş, Dealu Negru, Talaşmani, Tihuleşti-Bălăneşti, Tâmpa, Tainiţa and Cărăpceşti (Fundeanu, Rădeşti, Hobana and Jeravăţ forest units), damaging 1,900 ha in 1959; 1,850 ha in 1960; 723 ha in 1961, 1,842 ha in 1962; 1,782 ha in 1963 and 1,611 ha in 1964. (Fig. 1)

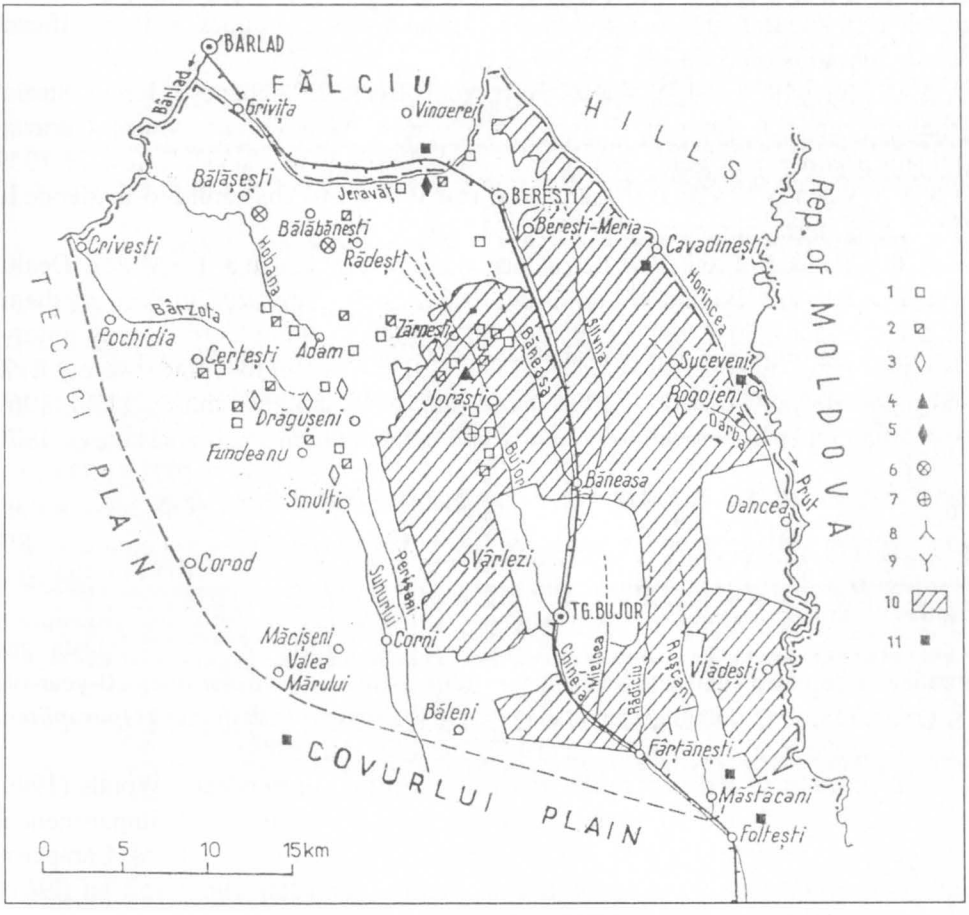

Fig. 1 – Harmful action of some insects in Covurlui Hills. 1, *Tortix viridiana*; 2, *Operophthera brumata*; 3, *Lymantria dispar*; 4, *Cerambyx cerdo*; 5, *Melolontha hippocastani*; 6, *Bruchus rufimanus*; 7, *Thaumaetopoea processionea*; 8, *Lytta vesicatoria*; 9, *Epicometis hirta*; 10, *Locusta migratoria*; 11, *Zabrus tenebrioides*.

In the 1965–1975 period, it affected the *Quercus* species of five forests: Fundeanu, Moteş, Banciu, Stroiu, Jerdia and Tâmpa (Drăguşeni and Bălăbăneşti communes), in a mild attack: 1,789 ha (1965); 1,148 ha (1968), 1,204 ha (1969), 1,028 ha (1970), 912 Ha (1971), 1,046 ha (1972), 862 ha (1973) and 999 ha (1975). The attack can be mild, moderate and severe, sometimes within one and the same

forest body: 1,789 ha (1966); 1,486 ha (1967) and 887 ha (1974). Control measures were taken only in two forests: Moteş (1975) and Fundeanu (1968, 1970 and 1975).

As mild was its attack in the SSE of Bălăbăneşti commune (Rădeşti forestry unit) in April 1998. In May 1999 it hit small areas, eating up the *Quercus* leaves. The attack moderate was at Cerţeşti (200 ha) and mild at Moteş (50 ha).

b) *Operophthera brumata (Lepidoptera)* used to show a preference for forests growing on summits or having southern exposition. A first attack, with significant defoliation, took place in 1957.

Between 1959 and 1964 ten forests were affected: Bălăbăneşti, Jerdia, Stroiu, Tihuleşti, Banciu, Brăieşti, Cerţeşti, Cărăpceşti, Nicoriţa and Moteş (Jeravăţ, Hobana, Rădeşti and Fundeanu forest units). Damage was sensibly low in 1959 (1,870 ha), 1960 (2,142 ha), 1962 (80 ha) and 1963 (2,443 ha); mild-to-moderate in 1964 (2,332 ha) and moderate in 1961 (321 ha).

In the years 1965–1975 it roamed in five forests: Nicoriţa, Moteş, Dealul Negru, Jerdia and Banciu with 1,300–2,166 ha being impaired in each of them: 1965 (2,166 ha – 50% very mildly and 50% mildly); 1966 (2,116 ha very mildly, also moderately in some small areas); 1967 (2,050 ha – mildly 71%; severely 21% and moderately 8%); 1968 – 1,689 ha (mildly 89% and very mildly 11%); 1969 (1,747 ha mildly in general, very mildly and moderately in small areas only); 1970 (1,689 ha – mildly 68%, very mildly 16% and moderately 16%); 1971 (1,724 ha – mildly 68%, very mildly 16%, and moderately 16%); 1972 (1,688 ha – mildly 75%, very mildly 15% and moderately 10%); 1973 (1,302 ha – very mildly 88% and mildly 12%); 1974 – the situation resembled the year 1973; 1975 (1,394 ha – mildly impaired).

In 1976 and 1979 the insect targeted the forests of Jeravăţ cuesta and Fundeanu area; in 1980 and 1984 it was found especially in the over 20-year-old *Quercus* forests of Bereşti. Chemicals to control *Tortrix viridiana* and *Operophtera brumata* were sprayed on 3,417 ha (1980) and 1,500 ha (1984).

c) *Lymantria dispar (Lepidoptera)* was detected in Fundeanu Woods (1949) moderately attacking 73 hectares[1]. It was immediately controlled. Impairment is produced by caterpillars. Mild attacks occurred in three forests: Moteş, Cărăpceşti and Nicoriţa (Drăguşeni and Corod communes) over 1960–1964: 152 ha (1961); 120 ha (1962); 745 ha (1963); 304 ha (1964); a very mild attack (100 ha) took place in 1960. In 1965, 34 ha in the Moteş Woods suffered a severe attack. Subsequently, control measures were put in place.

In 1986, both *Lymantria* and *Tortrix* launched an attack on Fundeanu Woods; chemicals were sprayed to control the latter.

d) *Haltica quercetorum (Coleoptera).* Over the 1965–1975 interval it was quick to attack some 2,503 ha (1965) – 53% moderately and 47% mildly, repeating it in

[1] National Archives, Vaslui Direction, Fond Direcţia Regională de Statistică Bârlad, File 46/1949, p. 58, 69.

1966. In 1967 it impaired 1,500 ha (56% mildly and 44% moderately); 2,103 ha (55% mildly and 45% moderately) in 1968; similarly over the next two years, followed by a decrease in 1972 (1,703 ha – 68% mildly, 32% moderately); 1971 (1,263 ha – 67% mildly, 33% moderately); 1973 (908 ha – 86% moderately, 14% weakly); 1974 (485 ha – 96% moderately, 4% mildly); 1975 (150 ha – 67% moderately, 33% mildly). Impairment is produced by adults which gnaw at the buds and leaves while the larvae turn them skeletal.

Melolontha hippocastani (Coleoptera) ,defoliated in 1943 the stands lying on the fringes of Tihuleşti and Bălăneşti woods, yet not at an "alarming extent" as specified in a report of the time.

VERTEBRATES

Some hunting species, too, may cause damage when their effectives are large. In the winter of 1975/1976, for exemple, *Sus scrofa (Suidae)* destroyed the pine plantation of Năpârca Valley (Stroiu Woods, Hobana forest unit). In the winter of 1977/1978 hunting species severely impaired seedlings in the Hobana Valley, including those protected in polyethylene bags. In 1987, 5.9 ha of pine seedlings on the eastern fringe of Nisa Woods (Hobana forest unit) were eaten up. In February, 2000, 1 ha of *Robinia pseudacacia* from Brăieşti Woods (Rădeşti forest unit) was gnawed at by *Lepus europaeus (Leporidae)* while *Dama dama (Cervidae)* destroyed 0.4 ha in the NE of Banciu and Stroiu woods (Hobana forest unit). In the winters of 1975–1995, the large numbers of *Sus scrofa*, *Dama dama* and *Capreolus capreolus (Cervidae)* present in the Hobana Valley gnawed the terminal buds and non-lignified stems, mostly of pine, but of *Robinia pseudacacia*, too (Fig. 2).

DIVERSITY OF ZOOELEMENTS DIRECTLY OR INDIRECTLY AFFECTING THE SYLVO-STEPPE ECOSYSTEMS SYLVO-STEPPE FOREST STANDS

a) *Tortrix viridiana* attaked the tips of tree crowns in Zărneşti and Rediu Carpen woods. The first reports date from the 1955–1959 period (Marcu, 1966). A mild attack (1959–1964) was documented in the forests of Zărneşti, Lunca, Valea Bănesii, Rediu Vasilache, Valea Gavosului, Valea Covurlui and Coasta Jorăşti (Zărneşti forest unit) as follows: 1,252 ha (1959), 1,528 ha (1960); 772 ha (1961); 84 ha (1962); 244 ha (1963) and 431 ha (1964). It was particularly old rarified stands that suffered.

Later on, in 1965–1975, the insect would prefer only the *Quercus* species from Zărneşti, Lunca, Valea Bănesii, Covurluiu de Sus and Valea Gavos woods. In 1965 the attack was mild (200 ha) and so it was in 1968 (600 ha); 1969 (1,100 ha); 1970 (600 ha); 1971 (100 ha); 1972 (129 ha); 1973 (52 ha) and 1975 (200 ha). It

was a combination of mild, moderate and severe in 1966 (1,600 ha), 1967 (1,700 ha) and 1974 (90 ha) and again mild over the 1975–1985 interval in the forests south of Suceveni.

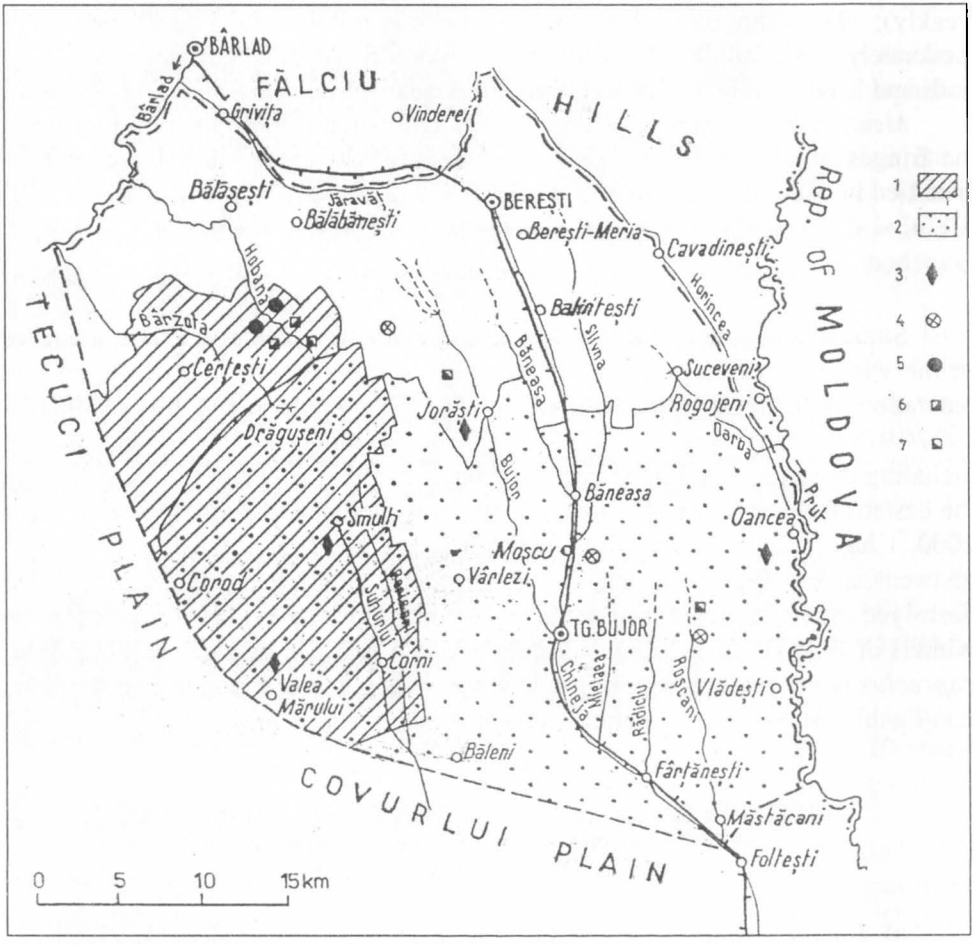

Fig. 2 – Harmful action of some vertebrates in Covurlui Hills. *1*, Şoarece de câmp (*Microtus arvalis)*; *2*, Şoarece de pădure (*Apodemus sylvaticus)*; *3*, Cârtiţă (*Talpa europaea)*; *4*, Iepure (*Lepus europaeus)*; *5*, Mistreţ (*Sus scrofa)*; *6*, Cerb lopătar (*Dama dama)*; *7*, Căprior (*Capreolus capreolus).*

In 1965 and 1975 control measures were implemented in Zărneşti and Lunca woods; in the years 1965 and 1970 in Valea Bănesii, Covurluiu de Sus and Valea Gavos.

b) *Operophthera brumata* defioliated the forests of Zărneşti, Lunca, Covurlui, Valea Bănesii, Coasta Jorăşti and Rediu Vasilache over the 1959–1964 interval. It was a mild attack in 1959 (406 ha); 1960 (118 ha); 1962 (83 ha) and 1963 (96 ha),

growing moderate-to-mild in 1964 (321 ha) and moderate in 1961 (10 ha). Mild attacks were also reported in 1966 at Zărneşti, Valea Gavos, Rediu Vasilache, Lunca, Covurluiu de Sus and Valea Bănesii (394 ha in all) and in 1975 at Zărneşti, Valea Gavos, Rediu Vasilache and Lunca (146 ha in all). Control measures were undertaken in either period.

c) *Thaumaetopoea procesionea (Lepidoptera)* was reported in two forests alone: Lunca Covurlui and Valea Gavos. The damage was mild in 1963 (18 ha); 1966 (162 ha); 1975 (94 ha) and moderate in 1959 (140 ha); 1973 (20 ha) and 1974 (105 ha). It defoliated rather the old *Quercus pubescens* stands of weak consistency. Caterpillars feed collectively on leaves and move around in rows.

Mild defoliations caused also *Lymantria dispar* in the forests of Roşcani Brook Basin (1954); in Zărneşti Woods 3 ha in 1961 and 34 ha in 1963; the Suceveni area was affected over the 1975–1985 period. Episodic occurrences of *Lytta vesicatoria (Coleoptera)* were signaled at Târgu Bujor in 1949 and in its surroundings during 1955–1957.

A xylophagous insect, digging large and deep galleries, is *Cerambyx cerdo (Coleoptera)*. It launched mild attacks in Zărneşti Woods (25 ha in each of the 1965, 1966 and 1967 years, when control measures were undertaken).

Among the vertebrates it was only *Lepus europaeus* who destroyed *Robinia pseudacacia* seedlings on a parcel of Moscu Woods.

FARMING LANDS IN THE SYLVOSTEPPE

NONVERTEBRATES

In the years of excessive reproduction they would damage the crops.

a). *Aelia rostrata, A. Acuminata (Heteroptera)* launched small attacks on wheat and rice crops (1947–1948). Large wheat-growing areas suffered mild impairment (1997) in the communes of Măstăcani (1,440 ha), Cavadineşti (1,000 ha), Băneasa (1,000 ha), Bereşti-Meria (1,000 ha), Vlădeşti (1,000 ha); between 600 and 1,000 ha in Bereşti, Jorăşti, Vârlezi, Folteşti and Oancea area. Least hit were Bălăbăneşti and Bălăşeşti communes (200 ha and 520 ha respectively).

In 1997 moderate damage was recorded at Suceveni (1, 670 ha), Cavadineşti (1,380 ha), Bălăşeşti (1,000 ha), and Târgu Bujor (1,000 ha), as well as at Smulţi, Cerţeşti, Corod, Băneasa and Bereşti-Meria.

b). *Pyrausta nubilalis, (Lepidoptera), Polychrosis botrana (Lepidoptera)* caused losses of 60% to cereal crops and 8% to vine cultures in the east of Covurlui Hills during the 1947/1948 interval.

c). *Calandra granaria (Coleoptera)* impaired much of the crop in 1947–1948; *Bruchus rufimanus (Coleoptera)* in 1948–1949 at Bălăbăneşti and Bălăşeşti (10–12%), and *Tanymecus dilaticolis (Coleoptera)* (1954) in a massive attack on the central-southern part of Covurlui Hills;

d). *Anisoplia austriaca, A. lata (Coleoptera)* population registered moderate and high densities in the 1949–1950 farming year;

e). *Entomoscelis adonitis (Coleoptera)* severely affected the crucifers in the SE of the area.

f). *Agriotes ustulatus, A. lineatus (Coleoptera)* launched a strong attack (1952–1953) on various categories of plants grown in the central and southern parts of Covurlui Hills.

g). *Haplothrips trici (Thysanoptera)* proved detrimental to the cereal crops around Târgu Bujor (1955–1957);

h). *Epicometis hirta (Coleoptera)* damaged the plum-trees grown in Docăneasa Village (1957);

i). *Daclylosphaera vitifolii*, attacked the parent plant and the common vine plantations of Pochidia Village (1956 and 1957);

j). *Opatrum sabulosum (Coleoptera)* impaired the sun-flower and the maize cultures in the central-south of Covurlui Hills (1955–1957);

k). *Loxostege sticticalis* launched sporadic attaks on the pastures and lucerne cultures in the north of Covurlui Hills (1957–1959); in 1931, it had been rarely reported (at Ciureşti) by the name of *Phlyctaenodes sticticalis*[2].

l). *Lema melanopa (Coleoptera)* attacked mildly the wheat crop in the communes of Cerţeşti (1,500 ha), Drăguşeni (700 ha), Smulţi (1,900 ha), Corni (1,300 ha), with moderate damage on 1,200 ha (Băneasa), 1,700 ha (Suceveni), 2,000 ha (Cavadineşti) and severe impairment of 640 ha (Măstăcani), 610 ha (Bereşti-Meria) and 600 ha (Fârţăneşti). Two large areas were mildly damaged in 1998: 1,900 ha (Oancea), 1,400 ha (Băneasa), 1,300 ha (Bereşti-Meria), 1,050 ha (Bălăşeşti), 1,000 ha (Măstăcani), 880 ha (Bereşti) etc.

m). *Zabrus tenebrioides (Coleoptera)* mildly damaged wheat crops in the communes of Cavadineşti (2,000 ha), Vârlezi (1,700 ha), Fârţăneşti (1,600 ha), Bereşti-Meria (1,600 ha), Băneasa (1,600 ha), Suceveni (1,200 ha), Vlădeşti (1,100 ha) and Jorăşti (900 ha).

Occasionally, strong *locust* invasions occur. As a rule, locusts are spread all over the region in a dormant state, without causing economic losses. They would multiply massively in the hot years with few precipitations, erupting in the Prut Floodplain where there are vast seed-covered areas – turgescent plants, the main food of locust larvae. When there is high density of their population, locusts become gregarious and migrate to neighbouring areas, damaging crops and trees. Massive multiplication registered *Locusta migratoria* in 1923–1924 and 1927–1933. A report on the effects of the 1927 invasion on Vinderei commune (northern margin of Covurlui Hills) reads: "several waves of large locusts would invade the villagers cultures; they would swarm in (from the Prut Floodplain a.n.) destroying maize, beans, grass and tree leaves. After having eaten all that was green, they would move westwards (...); it was a sad sight beholding the barren fields" (Arion, 1994, p. 12). The 1931 invasion took on alarming proportions, with locust eggs

[2] National Archives, Vaslui Direction, Fond Camera Agricolă Tutova, File 3/1931, p. 4.

being found in the Prut Floodplain (Folteşti, Măstăcani and Rogojeni). The following year, they would extend to the western fields, e.g. at Cavadineşti and Rogojeni, severely damaging the crops. In May–June 1939, locust occurrence in the SE of the region, at Măstăcani and Folteşti, was kept under control (Călinescu, 1942). In the Prut Floodplain and in a small part of the Chineja Floodplain, invasions of *Dociostaurus maroccanus* were reported in 1936, 1938, 1947, 1952 and 1954 (Alexandri, 1956). Damming and dessecation works conducted in the Prut Floodplain have eradicated locust reproduction foci. Even so, locusts did appear there (*Dociostaurus marrocanaus* and *Calliptamus italicus)* within a mild attack on some culture plants (1993).

Locusts were reported also in the past in 1644, when they destroyed the crops of Cudalbi Village. In 1860-1861 the villagers "using spades or hoes would again struggle with the armies of locusts that darkened the sky" (Andronache, 1997, p. 17).

VERTEBRATES

Some of the vertebrates causing great damage to crops – from germinated seeds to the new harvest, and indirectly spreading around the seeds of certain weeds, are the rodents. Their numerical outburst within the agroecosystems is also due to some trophic-structural changes in the respective ecosystem, eg. lack of competition and lower pressure from predators (carnivorous, mammals: foxes, martens and weasels (Hamar, 1978).

a). *mice*, a big invasion in 1946, and an even bigger one in 1947–1948 represented an actual disaster for the then counties of Covurlui, Tutova and Tecuci, the territories of which englobed parts of the Covurlui Hills. The main invadors were *Microtus arvalis* (*Microtidae*) (1947) and *Mus musculus (Muridae*) (1948–1949). Large numbers of the latter devastated the crops from the NW of the Hills. The following year they would attack the northern parts. In the autumn of 1951 and in the spring of 1952, the large population of *Microtus arvalis* impaired the winter and spring wheat and the fodder plants. In 1954, it sporadically attacked the nothern and western parts of Covului Hills (the former counties of Bereşti and Tecuci). In 1996, it launched mild attacks on the crops of the communes situated in the west and south-west of the region: Valea Mărului, Cerţeşti, Smulţi, Drăguşeni, Corni and Corod. In 1997, it mildly impaired lucerne cultures at Folteşti (50 ha) and Vlădeşti (10 ha), moderately affecting the cereal crops at Cerţeşti, Corod, Corni, Drăguşeni, Smulţi and Valea Mărului. In March 1998, the attack was mild, without affecting very large areas, in the communes of Jorăşti and Valea Mărului (150 ha each), Bereşti-Meria, Măstăcani, Folteşti, Oancea, Drăguşeni (200–300 ha), Bălăbăneşti, Bereşti, Târgu Bujor, Băneasa, Cavadineşti (300–400 ha), Bălăşeşti, Vârlezi, Vlădeşti, Suceveni, Fârţăneşti, Smulţi, Corni, Cerţeşti, and Corod (400–600 ha).

b). *Apodemus sylvaticus (Muridae)* caused great damage to maize, barley and wheat crops in the central and southern parts of the region (autumn 1952). In May

1954, it headed towards Griviţa Forest Range, impairing 100 wooden hectares [3]. Another 100 ha in 1965 and 50 ha in 1966 in Băleni Woods, on the southern margin of Covurlui Hills; then control measures were undertaken.

c). *Cricetus cricetus (Cricetidae)* produced mild losses to cereal cultures in the central and southern parts of Covurlui Hills (1951 and 1997), reaching as far as the village hearth in the years 1947–1949 (Marcheş, 1956).

d). *Citellus citellus (Sciuridae)* increased its population very much over the 1949–1950 and 1951–1952 periods in the north of Covurlui Hills, and in the years 1952–1953 it was very numerous in the southern half of the area. Its occurrence frequency in 1957 was particularly high. Before the years 1938–1942, in Măcişeni commune, "villagers, carrying a barrel of water in their carts, would go uphills looking for graphers holes, turn water inside and wait for them to come out, and kill them"[4];

e). *Talpa europaea (Talpidae)* launched a mild attack on the wheat crop of Oancea commune (1987). The galleries dug by moles displace plant roots which whither. Before 1944, the pasture lands of Valea Mărului, Smulţi and Jorăşti were degraded by lots of mole hills[5].

f). *Corvidae* are very numerous and detrimental. They caused great damage to crops in 1949–1950 and 1951–1952, as well as in the spring af 1959 when their population was particularly large. In 1926–1927, they were very often seen at Fârţăneşti and Oancea. The most frequently reported species is *Corvus frugilegus*. It is sedentary and lives in colonies. Another species is *Corvus corone*. Crows damage not only the crops (eating the cereal seeds in spring and then picking up the young plants), but they also feed on the eggs of some hunting birds. On May 13, 1928, the inhabitants of Criveşti Commune destroyed 600 crow nests[6]; the same happened in 1941 at Umbrăreşti-Târgu Bujor (250 nests) and in 1943 at Balinteşti (150 nests)[7]. At a meeting held on March 18, 1939 at "Stroe Belloescu" Culture House, Griviţa Commune, the chief of the local Forest Range spoke about "The elimination of crows and ways of doing it"[8]. The big drought of 1946 favoured their proliferation. Control measures were undertaken in 1999, with the following number of crow specimens (*Corvus corone* and *Corvus frugilegus*) being hunted: 400 in the north and north-west of Covurlui Hills (Griviţa Forest Range), then in other hunting fonds: 362 at Bujor, 345 at Suceveni and 17 at Matca. *Pica pica*: 60 at Suceveni, 37 at Bujor, 22 at Matca, 21 at Adam, 20 at Smulţi, 14 at

[3] National Archives, Vaslui Direction, Fonds Direcţia Regională de Statistică Bârlad, File 63/1954, p. 236

[4] National Archives, Bucureşti Direction, Fonds Ministerul Culturii Naţionale, File 782/1942, f. 452

[5] National Archives, Galaţi Direction, Fonds Camera Agricolă Tecuci, File 404/1945–1946, Fonds Eforia de Păşuni Covurlui, File 417/1944-1945, 436/1945

[6] National Archives, Vaslui Direction, Fonds Pretura Plăşii Criveşti, File 2/1928

[7] National Archives, Bucureşti Direction, Fonds Fundaţiile Culturale Regale-Cămine Culturale, File 1152/1940, p. 13, File 1113/1943, p. 8

[8] National Archives, Bucureşti Direction, Fonds Fundaţiile Culturale Regale-Cămine Culturale, File 3976/1939, p. 14

Rădeşti, 10 at Viile, 10 at Băneasa, 10 at Cerţeşti, 9 at Zărneşti, 5 at Vlădeşti, 4 at Vizureni, 4 at Jorăşti and 2 at Vinderei, in total 228 specimens, by far fewer than in 1986, when they caught 5,949 specimens distributed by hunting fonds as follows: Suceveni-1,150; Bujor-800; Viile-562; Smulţi-471; Zărneşti-438; Cerţeşti-412; Adam-403; Grivița-370, Rădeşti-340; Băneasa-278; Jorăşti-265; Vinderei-250 and Bereşti-210. *Garrulus glandarius* is detrimental to plants and cynegetic birds because it eats their eggs or young. In 1999, hunters killed 14 specimens at Smulţi, 12 at Adam, 10 at Matca, 8 at Viile, 5 at Băneasa, 5 at Zărneşti and 5 at Jorăşti.

CONCLUSION

This analysis focused only on some of the zooelements (insects and vertebrates) harming the woods and cultivated fields of Covurlui Hills. In general, their attacks were mild and the economic losses were not very big.

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Atlasul Etnografic Român, Vol. I, Habitatul, (The Romanian Ethnographic Atlas, vol. I. "The Habitat"), coordinator prof. Ion Ghinoiu, Institutul de Etnografie şi Folclor "Constantin Brăiloiu"al Academiei Române, Editura Academiei Române şi "Monitorul Oficial", Bucureşti, 2003, 272 pages, format 37 × 28 cm, 111 polychrome maps and 106 plates (titles and legends in foreign languages and photographs), texts in Romanian, English, French and German.

The idea of an ethnographic atlas had long been cherished by sociologists, phylologists and geographers, but its elaboration, due to Romulus Vuia, began only in 1960.

This collective work is the fruit of over 40 years of field surveys and laboratory investigations conducted by several generations of researchers from the Institute of Ethnography and Folklore. The first volume, – which presents **The Habitat**, was published in 2003. The forthcoming four volumes, totalling nearly 600 maps, will be devoted to **Occupations, Folk Techniques, Folk Art, Customs and Myths.**

The Atlas theme was completed during the 1967–1979 period, but the elaboration of this comprehensive work began much earlier (peak moments 1900 and 1972–1982), with several types of questionnaire-based data collection. A number of 536 settlements were selected for enquiery; their density varied with geographical location (in the plain, hills and tablelands, low mountains, and intramontane depressions) and their balanced distribution by counties.

When this work began crystallising (1977–1982), a 9-volume *Bulletin of the Romanian Ethnographic Atlas*, including theoretical and methoedological studies and cartographic experiments was put out. Its aim was to create a unitary approach. Obviously, controversial issues did crop up, e.g. disagreements between theory and practice, between the general aspect of the work and its concrete achievement, but eventually things were harmoniously solved by the mutual contribution of researchers, editors, cartographers and technicians, the coordinating body assuming responsibility and decision-making, a practice used in all major scientific productions which present little known or totally unknown realities, often involuntarily omitted, sometimes wilfully hidden or distorted.

The primary material was collected on the ground by questioning over 18,000 persons, the majority elderly people. The data were processed in the laboratory, interpreted and transposed by the authors on basic maps (sometimes in several variants) in terms of the theme of each map. The whole material was centralised and synthetised, first in a dummy atlas with 903 author maps and commentaries, presented in volume 9 of the above mentioned Bulletin.

Much of the field information, which was not included in the maps (together with the cartographed data), represent the largest ethnographic and folkloric archives in Romania, containing over 6,000 questionnaires (totalling more than 4,000,000 pages), 150,000 photographs, and sketches made on the ground.

The maps were drawn up by the authors themselves, first on the scale of 1: 1,000,000, by using the base-map of the *National Geographical Atlas* (in print at the time) adapted to ethnographic requirements; subsequently, the scales were lowered close to the final size of the Atlas.

Cartographic experiments tried to represent the phenomena, make map models combined with photographs in order to suit printing techniques to the best.

The first volume, devoted to **The Habitat**, discusses essential problems of the old man / environment relation, with highlight on the settlement of a community in a certain territory.

The introductory chapter is signed by Profs Adrian Năstase and Eugen Simion, President of the Romanian Academy. The preface is due to Dr. Ion Ghinoiu, the coordinator of this work. The Atlas contains four sections.

Section One with four introductory maps: The Geographical Position of Romania in Europe, the Physico-Geographical Map, the Administrative Map with small black circles indicating the 536 villages investigated and the Map of Data Collectors. The questionnaires contain information about

the village, the household, the house and its interior. This map represents a kind of cartographed bibliography.

The next section deal with the *Village, the Household, the House and Its Interior* (232 pages, 106 maps preceded by texts on the problems and phenomena tackled, their particularities and historical-evolutive substrate). The texts, written by Ion Ghinoiu, make a synthetic presentation with focus on the essential elements, and express the author's integralistic outlook developed during his early training as a geographer. A staunch promoter of field investigation, Ghinoiu is dedicated to fulfilling his own tasks and see that his numerous co-workers do the same in order to best outline the ethnographic specificity of the Romanian people.

Section Two – **The Village** (26 analytical maps) expound on a wide range of topics. from the ruling princes who had founded villages, to the village precincts preserved either on the original site, dislodged, or deserted but still documented by toponyms; from the selection of the place for the foundation of the village to the ritual acts of setting up the village precincts and the commons; from the name of the village parts connected with ethnic groups, to crafts, nicknames, etc; from water supply sources, types of water uses and folk customs relating to land measurements, to burial places, crosses, monumets and funerary customs.

Section Three – **The Household**, (29 maps) reports on the individual terrain, the yard and annexes, the fance, the gate, the roof, traditional building materials and techniques, etc.

Section Four – **The House and Its Interior** (43 maps) contains house plans, the names of rooms, the entrance hall and the larder, the verandah, the arbour, the house walls with interior and exterior decoration, the hearth, the smoke evacuation system, the furniture – the bed, the children's craddle, the table, the dowery chest and lighting facilities.

The last four pages of the work present the titles of the next volumes of the Atlas, a brief summary of their contents and photographs representative for different epochs.

The rich scientific material of the Romanian Ethnographic Atlas is embodied in 106 maps of which 96 approach the scale of 1: 2,500,000 (34 × 23 cm) and 10 approximate 1: 3,500,000 (23 × 16.5 cm), all placed on the righthandside pages (odd numbers). Whatever the scale, the Romanian territory (landforms, too)is outlined by shades of pale yellow-cream; what lies outside its borders is coloured in gray.

The topographic elements, which represent the support and reference point of ethno-folkloric phenomena, are the drainage network (in blue), the county limits and the towns (in gray). The overall topography, depicted in discrete pale colours, contrasts with the lively coloured geometrical signs endowed with different significations characteristic of each thematic map. On many maps, colours are assigned to the dynamics of the phenomena which occurred between 1900 and 1990.

Left-and-righthandside pages make a harmonious whole. Even number pages contain fine images suggestive of the subject-matter, titles and legends in foreign laguages; highly accurate photographs depict the objects marked out on the maps and elucidate many of the Romanian popular terms that can hardly by translated.

The editorial conception has succeeded in harmoniously blending scientific rigour with a subtle presentation liable to attracting the interest of specialists and of the broad readership. A special mention deserve the technical editing and the printing which contribute to placing this Atlas next to the art albums found in our libraries .

This first Atlas volume, *The Habitat*, inaugurates a scientific-artistic series of national interest. It is a promising step forward in the effort to unveil the spiritual lore of the Romanian people, so far overlooked and not as yet integrated into the culture and civilisation of Europe.

As a conclusion we would cite a few lines from the jacket of the Atlas, illustrating profound judgement in a nutshell: 'Drawn from the memory of a whole series of generations which, for thousands of years now have been carrying us on their shoulders, the Romanian Ethnographic Atlas is an oral history document of our becoming. Therefore, this work can be considered a great achievement which, through maps and images, creates an authentic and credible portrait of our nation, essentialised from the unaltered depths of the Romanians' collective memory'.

Gheorghe Niculescu, Ioana-Jeni Drăgoi

ION NICOLAE, *Suburbanismul ca fenomen geografic în România* (Le sous-urbanisme comme phénomène géographique en Roumanie), Editura Meronia, Bucureşti, 2002, 397 pp.

L'auteur présente dans ce volume, un sujet assez rare dans la littérature géographique roumaine (et non seulement): le phéomene du sous-urbanisme, du *sururb*, sur le territoire de la Roumanie, de l'Antiquité jusqu'à nos jours, avec toutes les conséquences antropogéographiques, socio-économiques et surtout culturelles.

Le phénomène du sous-urbanisme est d'une actualité significative. En 2007, pour la première fois dans l'histoire, plus de la moitié de la population mondiale va vivre en zone urbaine, pour l'essentiel en banlieue. Le *suburb* style se répand dans tout le monde. Chaque jour dans le monde, 180 000 personnes quittent les campagnes pour s'installer à la péripherie des villes, précisent les Nations unies. La croissance démographique des villes ne touche plus seulement les grandes métropoles mais aussi les villes moyennes, au dépens des banlieues. Le phénomène a des conséquences socio-culturelles plus graves dans les pays du Tiers-Monde.

Le livre est structuré en sept chapitres principaux: 1. Le phénomène suburbain dans la littérature géographique (pp. 37–82); 2. Les coordonnées générales de la genèse du phénomène suburbain en Roumanie (pp. 83–104); 3. La ville et le phénomène suburbain dans l'Antiquité (pp. 105–135); 4. ... dans le millénium de silence (pp. 136–154); 5. ... dans la période prémoderne (pp. 155–218); 6. ... dans l'époque contemporaine (pp. 278–365).

Après une intéressante analyse concernant les mots utilisés pour exprimer en roumain les réalités socio-géographiques suburbaines, l'auteur souligne le fait que "la réalité suburbaine est clairement, nettement et obligatoire un thême de recherche géographique", la banlieue ayant presque le même âge que la ville. Si pour l'Occident la banlieue désigne "des éspaces habités par une population avec un niveau de vie et de civilisation au moins égale à la moyenne nationale", pour la Roumanie existe "une différence de perception et d'interprétation" (plus précisément, le mot à des connotations péjoratives), édifié dans les derniers 100–150 ans, la période de la modernisation de la société roumaine.

Dans cette perspective, de la différence de perception et d'interprétation, sont signalées et analysées à l'intérieur même de la Roumanie des réalités *banlieusardes* differentes. Egalement intéressante se prouve la discussion sur la colorature ethnique étalée par les banlieues existantes autour des villes du Moyen Age: beaucoup de roumains près des bourgs de la Transylvanie, beaucoup de gitanes en Moldavie et en Valachie, des aspects soulignés par les noms de lieux, rencontrés dans les documents de l'époque.

Cette colorature a disparu au long des années, surtout après la moitie du XIX-eme siècle, quand dans l'espace roumain commence le processus de la modernisation socio-économique. L'éspace près des villes est celui qui a reçu avec priorité des émigrants ruraux à la recherche de nouvelles opportunités de travail et de la vie en contribuant à la formation du cliché péjoratif concernant le banlieuesard, defini surtout dans le domaine du comportement individuel et communautaire, différent de celui rural mais insuffisant urbain.

Dans la période communiste, d'après la dernière guerre mondiale (jusqu'a 1989) dans le rythme d'une industrialisation soutenue (même excessive dans beaucoup de situations), les banlieues se sont transformées en large mesure dans des simples dortoirs, ayant aussi comme doublure fonctionelle l'agriculture périurbaine.

L'auteur souligne pour cette période un intéressant élément d'originalité: il s'agit d'un suburbanisme exprimé par les localités componentes et des villages tenants au point de vue admmistratif des villes existantes. Dans cette situation, la localité principale qui donne le nom de la ville "se constitue dans un véritable noyau urbain vers lequel tournent les autres localités groupées du point de vue administratif sous le même nom".

Les changements survenus après les événements de 1989 dans la société roumaine mènent rapidement vers un rapprochement de la banlieue roumaine "comme expression géographique et fonctionnelle", des celles de l'Occident de l'Europe, un aspect positif de la dyamique actuelle du

phénomène suburbain, doublée en même temps par des éléments d'involution (démographique, fonctionnelle) signalés surtout aux alentours des petites et moyennes villes forcement industrialises durant la période communiste.

L'auteur a utilisé une vaste documentation (plus de 250 de titres géographiques, statistiques, historiques, littéraires, sociologiques etc.) et a amené vers la fin une appréciation intéressante en elle même: "nous assistons à la victoire de la géographie (au sens le plus large du mot) sur l'histoire (sur l'arbitraire politique, sur le volontarisme)". C'est une victoire possible dans le contexte de la normalisation de la société roumaine aprés 40 ans de régime totalitaire.

Vasile S. Cucu

ION IONIŢĂ, *Formarea şi evoluţia ravenelor din Podişul Bârladului (Formation and evolution of gullies from the Bârlad Tableland)*, Editura CORSON, Iaşi, 2000, 169 p., 78 fig., 29 tab.

The Bârlad Tableland is a subunit of the Moldavian Tableland, situated in the eastern part of Romania. The gullying processes affect powerfully this subunit, predominantly made of sandy-argillaceous Pliocene formations. The pressing character of the gullying processes from Bârlad Tableland on the one hand, and the passion for the research on the other hand, determined the author to approach this study, despite the difficulties imposed by the large amount of work and the length of necessary time.

The work consists of seven chapters and bibliography. In the first chapter, *General considerations*, the author discusses the terminology problems, and the classification of the gullies and the developmental stages of the gullies (taking into account different authors' points of view). In the second chapter, *Data sources, aims and the work methodology*, the methodology of approaching the study theme is explained. It consisted in the field work (periodic measurements and surveys), the use of aerial photographs and of the topographic maps. In this chapter it is also presented the scheme of the gullies classification (established by the author, based on the field and laboratory work); the gullies are grouped into two classes: the discontinuous gullies class and the continuous gullies class. The third chapter, *Results concerning the class of the discontinuous gullies* is the most extensive. Here, the author presents different subtypes of this gullies type, the initiation mechanism of gullies, the development of the discontinuous gullies and the hydrologic efficiency of the discontinuous gullies. With the help of complex measurements, comprising several decades, it was outlined the pulsating character of charging and discharging of the liquid currents from the discontinuous gullies. The emphasis of this way of stage joining of the erosion sectors and the regressive accumulation makes the step by step approach of the development of the discontinuous gullies to be irrelevant. We'd like to highlight the introduction of a new hydrologic efficiency indicator ("Ioniţă's indicator"), the ratio between the present section and the colmatating section. Because the determination of the colmatating section is difficult, it is proposed another parameter which permits an easier estimation of the hydrologic efficiency, the ratio between the width of the bottom and the breadth of the gully. The fourth chapter, *Results concerning the class of continuous gullies*, treats about the gullying processes indicators and the average annual regime of the gullying processes. Between 1961–1990 it was remarked a decrease in the rhythm of the gullying processes. This trend was determined by the reducing average annual precipitations and by the effect of the land improvement works. With the help of the stationary measurements of long standing, the average annual regime of the gullying processes was established. Rigorous monitoring of the erosion processes permitted the delimitation in time of the critical period of deep erosion. This period, which lasts four months, is situated at the end of the cold season and the beginning of the warm one. In the fifth chapter, *The scenarios for producing and evacuating the sediments* are investigated. In the studied region, the author distinguishes two scenarios: synchronous and asynchronous. The former, implying the simultaneous producing and evacuation of the solid material (associated with the gullying processes) is very rarely

met. The latter, quite frequently met, has two phases: (1) producing the alluvial deposits and (2) the variable evacuation of the materials previously prepared. The sixth chapter, *A note regarding the prediction of the gullying processes*, treats, briefly, several types of prediction patterns of the gullying developmental processes. The author draws the conclusion that the issue of the mathematical prediction of the gullying processes development is still open. The last chapter, the seventh, is of *General conclusions*.

The original contributions brought by the author regarding the issue of the gullying processes enrich the theoretical aspects linked by this process of relief shaping. They represent a solid base to choose the most efficient measures of land improvements. Unfortunately, such a valuable work has neither a content nor a summary written in an international language.

Nicolae Băcăinţan

ELENA TEODOREANU, *Geografie medicală* (Géographie médicale), Edit. Academiei Române, Bucureşti, 2004, 144 p., 46 fig., 9 tab., bibl., résume en anglais

En Roumanie, les changements structuraux d'après décembre 1989 ont déterminé aussi dans le domaine de la géographie une tendance de diversification des préoccupations et une implication plus grande dans les problèmes politiques et socio-économiques de la société humaine.

Dans ce contexte apparaît *La Géographie médicale* , le premier ouvrage de synthèse dans ce domaine en Roumanie, ayant comme auteur dr. Elena Teodoreanu, chercheur principal et professeur associé à l'Université d'Oradea. Le volume suit à une autre parution éditoriale d'exception de l'auteur, à savoir *Bioclimatologie humaine* .

La réalisation de cet ouvrage a été possible grâce a une solide formation scientifique de l'auteur et à une longue expérience de chercheur formé dans le collectif de climatologie de l'Institut de Géographie de l'Académie Roumaine et puis de l'Institut de Médecine Physique, Balnéoclimatologie et Récupération Médicale du Ministère de la Santé, ou elle a activé comme chef du Laboratoire de recherches des facteurs thérapeutiques. Aussi, comme professeur associé de l'Université de Bucarest et, maintenant, d'Oradea, où la géographie médicale est devenue une discipline d'enseignement, elle a obtenu l'expérience didactique nécessaire à rédiger un livre scientifique, synthétique, claire, sobre, accessible.

L'ouvrage est structuré en douze chapitres; aux quels on ajoute une dernière section qui présente quelques conclusions pertinentes et un résumé en anglais.

Au commencement, après une ample incursion dans l'historique des recherches, des études mentionnant traités parus dans le domaine, les organismes internationaux qui s'occupent de la relation environnement – santé, et après la dénomination avec clarté de la terminologie spécifique, l'auteur présente les notions de base de la relation environnement – organisme humain, notions bien venues pour comprendre les connexions existantes entre les deux entités.

En mettant en évidence la relation milieu – organisme humain, l'auteur surveille l'effet de chaque facteur naturel de cure de la Roumanie, pour traitement et repos, notamment les sources minérales, les lacs salés, la boue, la plage de la mer, les mofettes, l'air pur aux environs des forêts ou des salines. Ainsi, dans l'idée que le traitement naturiste représente l'utilisation des facteurs naturels thérapeutiques, l'auteur analyse ces facteurs et présente leur impact sur l'état de santé de l'homme. Méritoire c'est l'importance accordée au relief, à la structure géologique et du sol, où on insiste sur la radioactivité du sol et de l'air, sur le champ géomagnétique, mais spécialement sur la telluropathie (les éléments minéraux du sol en excès ou absents qui peuvent déterminer diverses maladies). On mentionne les maladies et les dérèglements dépendants de métaux, mais aussi l'importance de la tellurothéraphie sur la santé.

Comme fin connaisseur des facteurs et des éléments climatiques, on remarque le professionnalisme par lequel l'auteur analyse, d'une manière climato-géographique, l'impact du climat sur l'organisme

humain, à savoir les paramètres météorologiques et les indices bioclimatiques sur les problèmes liés à la climatothérapie et à la météoropathologie.

Nous apprécions aussi la présentation des sources d'eau, la pollution, le rôle de l'eau dans l'organisme et les épidémies hydriques. On insiste sur les macro- et micro-éléments qui se trouvent dans les eaux buvables, leur importance pour la santé, sur les eaux minérales, comme facteur thérapeutique, sur la thérapie marine et sur l'hydrothérapie en général.

Dans l'analyse de la phytosphère en liaison avec la santé, l'auteur passe en revue les surfaces couvertes de végétation et découvertes, quelques aspects de la médecine naturiste locale, basée sur les végétaux, pour que le lecteur se familiarise avec la phytothérapie, représentée par aromathérapie, gemmothérapie, herboristerie, homéopathie et la phytothérapie chinoise ou par phytothérapie pharmaceutique.

Par la suite, on fait une correcte présentation du milieu anthropique (urbain et industriel), en soulignant les désagréments liés à la pollution et les problèmes vis-à-vis de la santé, donc les aspects de la pathologie et de la thérapie de ce milieu.

Nous apprécions la présentation graphique et médicale du microclimat thérapeutique de l'intérieur (mofettes, solphataires, salines abandonnées et aménagées, grottes karstiques) qui atteste encore une foi l'importance thérapeutique des facteurs de cure.

Un ample espace est accordé aux maladies spécifiques des diverses zones climatiques, en soulignant leur dispersion géographique et quelques aspects démographiques caractéristiques aux pays de ces zones, qui se réfèrent à la fécondité, à l'espérance de vie, à la natalité, à la mortalité et l'indicateur du développement humain. De toutes ces données on met en évidence la discordance qui existe entre les pays civilisés et ceux du tiers monde, qui détiennent un pourcentage élevé de morbidité et mortalité.

Dans la dernière partie de l'ouvrage, on remarque l'esprit objectif de présentation des particularités géographiques de la pathologie de la Roumanie, en contexte eurasiatique. Les données statistiques médicales commentées mettent en évidence la différence existantes sous rapport du développement socio-économique et du comportement hygiénique de masse entre les département, plus développés de la Transylvanie, du Banat et quelques districts de Moldavie, de Valachie et de la Dobroudja.

En même temps, les provocations de la réforme de la santé de Roumanie mettent en relief les déficiences existantes aujourd'hui dans le système de santé, ce qui réclame mesures urgentes gouvernementales, pour élever le niveau de vie, le niveau de santé et d assistance sanitaire et, finalement, l'indicateur du développement humain.

La « Géographie médicale » s'impose aux lecteur par la nouveauté et l'inédit, par le contenu et langage scientifique adéquat, par la richesse de l'information et par une graphique expressive. C'est un ouvrage de référence qui s'adresse tant aux étudiants que notamment aux lecteurs intéressés par la connaissance des relations entre le l'environnement et l'organisme humain.

Gheorghe Măhăra

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