AN INSECT TRACE FOSSIL (ORD. COLEOPTERA) IN THE RED FORMATION FROM THE BOZULUI BROOK PALEONTOLOGICAL REZERVATION (VRANCEA COUNTY)

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Abstract: The Insect trace fossil comes from the Paleontological Reservation of Bozului Brook, located in the Valea Sării (Prisaca Village) surroundings, Vrancea County. Bozului Brook, a right wing tributary of the Putna Valley, crosses downward the Red Formation and the Grey Formation, both of them Lower Miocene in age (Burdigalian). The considerable dimensions of the Vrancea trace indicate the activity of a large insect, probably a Coleopteran belonging to the Hydrophilidae family, probably belonging to the genus *Hydrous*. The morphological characteristics and the numerical values strongly support this hypothesis.

Keywords: paleo- and neoichnology, Insecta, Ord. Coleoptera, Red Formation, Burdigalian, Vrancea

INTRODUCTION

Very recently, Jarzembowski (2004) makes available a data base containing 507 genera for insects, which completes the monumental paper by Carpenter (1992) in "*Treatise on Invertebrate Paleontology*" left the 1983 level of knowledge. The Coleopterans - most of them Mesozoic - sum up 107 genera, of which, 17 genera originate in Miocene in the fossil deposits of Shan Wang (China).

In Romania, 7 Coleopterans genera have been identified (5 in Oligocene, 1 in Sarmatian, and 1 in Pannonian), exclusively as body or body part (see Brustur & Huică, 2000). Trace fossils of the Coleopterans, with regard to the interrelationship plant-insect (e.g. pupal tunnels, bite prints), are cited by Pax

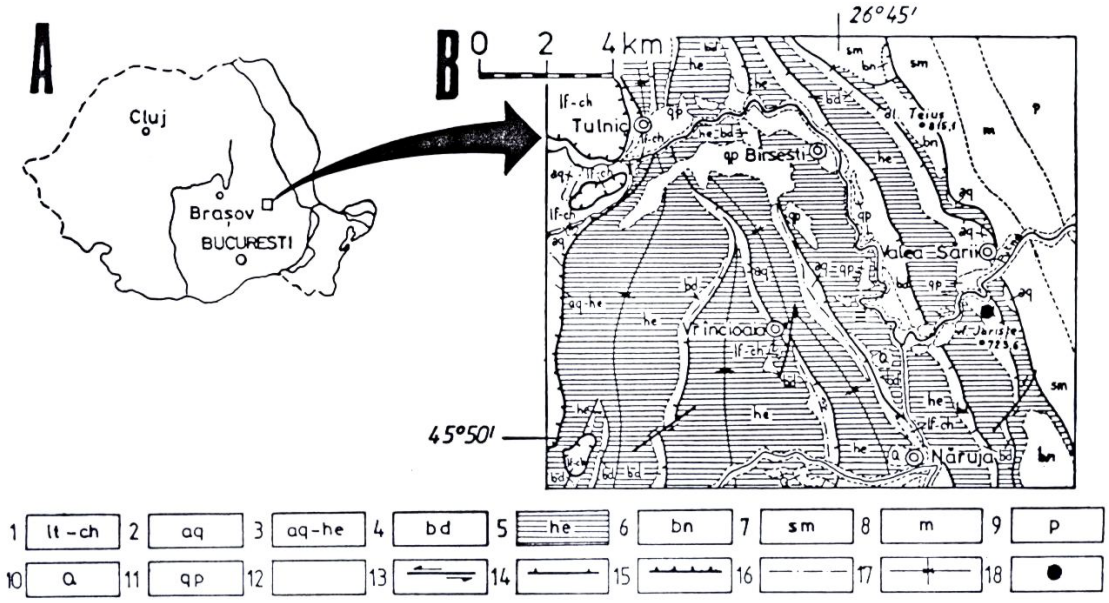

Fig. 1 Location of the insect trace fossils. A. Geographic location of the Bârsesti-Năruja area on Romanian territory; B. Geological map of the Bârsesti-Năruja area (acc. to geological map of Romania, 29 Covasna sheet, 1: 200,000, 1970): 1, Oligocene (Lattorfian-Chattian – Bituminous facies with Kliwa Sandstone); 2, Lower Miocene (Burdigalian – Lower Salt Formation); 3, Lower Miocene (Burdigalian – Hârja Beds); 4, Lower Miocene (Burdigalian – Red (=Măgiresti) Formation); 5, Lower-Middle Miocene (Burdigalian-Lower Langhian – Grey Formation); 6, Badenian; 7, Sarmatian; 8, Meotian; 9, Pontian; 10, Nondivided Quaternary; 11, Pleistocene; 12, Holocene; 13, Strike slip fault; 14, Reverse fault; 15, Thrust nappe; 16, Diapire contact; 17, Syncline axis; 18, Fossiliferous point.

(1923, *in* Protescu, 1938) in the Sarmatian wood from Avrig, by Mateescu (1934, 1957) in the Liasic coal of Banat and by Givulescu (1984) in the Upper Pontian leaves of Chiuzbaia.

Up until now, from the Lower Miocene molasses from Vrancea, prints of arthropod locomotion attributed to crustaceans of Ord. Isopoda (*Oniscoidichnus miocenicus*; Alexandrescu *et. al.*, 1986) and Ord. Amphipoda (*Talitrichnus panini;* Brustur & Alexandrescu, 1993).

Known through the extraordinary richness in mammal and bird tracks (Panin, 1961; Panin & Avram, 1962; Kordos & Prakfalvi, 1990) and invertebrate trackways (Alexandrescu *et al., 1986:* Brustur & Alexandrescu, 1993), the Paleontological Reservation of Bozului Brook represents an extremely important ichnofossil site for the study of Upper Miocene fauna diversity in Romania.

GEOGRAPHICAL LOCATION AND STRATIGRAPHICAL POSITION

The Coleopteran print comes from the Paleontological Reservation of Bozului Brook, located in the Valea Sării (Prisaca Village) surroundings, Vrancea County (Fig. 1). Bozului Brook, a right wing tributary of the Putna Valley, crosses downward the Red Formation and the Grey Formation, both of them Lower Miocene in age (Burdigalian).

PALEOICHNOLOGICAL DESCRIPTION

Adopting the identification scheme and description of the arthropod traces proposed by Trewin (1994) and modified by Braddy (2000), we may summarize morphological characteristics and numerical data of the Coleopteran trace as presented below (Table 1).

The Vrancea trace (Plate 1a), preserved on a surface layer of red-green siltite, ca. 5 cm in thickness and obvious graded bedding stratification, comes from the Red Formation wide open in the left bank of the Bozului Brook at circa 450-500 m upstream of the intersection with the Putna Valley.

The trace of 16 cm total length has an average external width (E) of 2.6 cm (N = 8), an average internal width (I) of 0.94 cm (N = 8; E/I = 2.8). The bifide prints, positioned parallel to the mid line, have a length between 7 and 12 mm (x = 9.4 mm; N = 8), and the repeat distance (R) between them is between 6 and 14 mm (x = 9.4 mm; N = 8; E/R = 2.7). The simple no series track rows, with a straight trajectory, presents the bifide prints symmetrically opposite to the mid line.

Table 1 Morphological characteristics and numerical data of the Coleopteran trace in the Paleontological Reservation of Bozului Brook (Red Formation, Burdigalian)

1. Trackway width [cm]					
External width [E]	<1	1-4	4-10	10-20	>20
Ratio E/I [I=internal width]	1-1.5	1.5-2	2-2.5	2.5-3	>3
Vrancea trace [E]; N = 8	-	►***2.6***	-	-	-
Vrancea trace [E/I]; N = 8		-	-	►***2.8***	-
2. Imprint characteristics					
Morfology	bifid				
Imprint orientation [*vs.* mid line]	parallel				
Vrancea trace	► ***parallel bifid imprint***				
3. Track rows					
Simple					
Vrancea trace	►***simple no series track rows***				
4. Repeat distance [R]					
Vrancea trace: ►***R = 0.96 cm***; [N = 8]; ►***E/R = 2.7***					
5. Symmetry					
vs. mid line	opposite	alternate	staggered	asymmetric	
Vrancea trace	►	-	-	-	
6. Continuous marks					
Vrancea trace – ►***continuous marks***					
7. Trakway curvature					
straight	gentle curve	looped	meandering	angular change	
►	-	-	-	-	

The chance of observing and photographing (July 1996) a contemporary print, circa 34 cm in length, produced by a specimen of *Hydrous piceus* L. (Plate 1b) on the fine sand of the Sulina Beach (Plate 1c), offers the possibility of comparing the E, I and R parameters and the E/I and E/R ratios (Table 2, Fig. 2), from where the following observations result.

a) external width (E) and internal width (I) of the two traces are actually of the same order of magnitude (EF = 2.63 cm; EA = 0.94 cm, and IF = 2.0 cm; IA=0.78 cm respectively), the ratio E/I being 2.8 for the trace fossil and 2.6 for the contemporary trace;
b) the prints for both traces are of bifide type, positioned parallel to the median line;
c) both traces are characterized by a simple no series track rows type;
d) the distance between steps (R) and the ratio E/R are considerably close: 0.96 cm for the trace fossil and 1.0 cm for the contemporary trace; E/R = 2.7 for the trace fossil and 1.9 for the contemporary trace, respectively, the subunitary difference between those being due

to the heterogenous distribution of the measuring points for this parameter along the contemporary trace, which is longer than the fossil, as shown in the variation of RA values in Fig. 2;

e) both traces differ in the display of the print in relation to the median line (opposite symmetry for the trace fossil, and alternate symmetry for the contemporary trace, respectivelly) and the trace trajectory (straight for the trace fossil and meandered for the contemporary trace, respectivelly).

Fig. 2 Diagram for E, I and R (N=8) parameters of the trace fossil (F) and the contemporary trace (A)

The considerable dimensions of the trace indicate the activity of a large insect, probably a Coleopteran belonging to the Hydrophilidae family, large size genera between 13-18 mm (*Hydrophilus*) and 32-40 mm (*Hydrous*) (Ionescu, 1962).

The data mentioned above allows for the classification of the trace fossil from Vrancea as a large Coleopteran, probably belonging to the genus *Hydrous*. The morphological characteristics and the numerical values strongly support this hypothesis.

DISCUSSION AND CONCLUSIONS

Originating in Permian, Coleopterans diversify strongly in Tertiary with more than 3,000 known genera (Laurentiaux, 1953).

Constituting a large part of the activity traces of terrestrial invertebrates, Coleopterans are insects, which build shelter tunnels, built homes and cells and/or pupal nests in wet depositional environments (fluviatile, lacustrine) and dry (beaches, dunes), but especially in paleosoils (Hasiotis & Brown, 1992).

In Romania, examples of the Fam. Hidrophiliae are known in the Pucioasa Oligocene lithofacies (e.g. *Hydrophilus geticus* – Protescu, 1938), and the Lower Miocene deposits (Cornu Beds), contain very frequently pyritized Coleopterans of small sizes, very particular (Voicu, 1953). An interesting structure of gravitational collapse, due to the activity of the *Cicindella* Coleopteran was recently noticed (Brustur, 2001) in the Sf. Gheorghe beach sand (Danube Delta).

Freshwater Coleopterans (fam. Hydrophilidae and fam. Dytiscidae) and their larva show various adaptations to the aquatic life, containing pairs of flat appendices (adjusted for swimming) and the capacity to retain air under wings. They are carnivorous insects, the larva consuming even fish in lakes and rivers (Panin, 1951).

The noticing of a locomotion trace (repichnia) in the Red Formation in Vrancea, attributed to a Coleopteran, completes the ichnological inventory of the Bozului Brook Paleontological Reservation. The presence of insects in the flooded fiel deposits of the Vrancea molasses offers the possibility of the identification of other types of animal activity organic structures, due to the known capacity of many insects to produce significant bioturbations on the surface and/or the interior of the layer (Ratcliffe & Fagerstorm, 1980).

Some Coleopteran structures (e.g. pupal nests), common to other insect groups (hymenopterans, termites, etc.), along with meniscus tunnels, the cavities produced by mammals and rhizoids make up the ichnofacies along with *Coprinisphaera*, which

Table 2 Numerical values for the trace fossil parameters (Vrancea) and the contemporary trace (Sulina)

Trace	Parameter (mm)			E/I	E/R
	E	I	R		
Trace fossil (Vrancea)	25	12	12	**2.8**	**2.7**
	27	11	14		
	29	9	10		
	25	11	9		
	25	8	11		
	26	7	8		
	26	9	6		
	28	8	7		
Mean	**26.3**	**9.4**	**9.6**		
Contemporary trace (Sulina)	23.5	5.0	15.3	**2.6**	**1.9**
	22.3	8.94	17.6		
	21.8	11.7	8.23		
	17.6	8.23	7.05		
	18.8	7.52	16.5		
	18.8	7.5	7.05		
	18.8	7.29	5.88		
	19.05	6.12	3.53		
Mean	**20.08**	**7.78**	**10.14**		

characterizes the paleosoils developed in the paleoecosystems of the herbal communities in the Triassic-Upper Pleistocene (Mangao & Buatois, 2000).

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