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ŚLADY TOCZENIA I UDERZENIA KOŚCI RYBICH O DNO NA SPĄGU PIASKOWCÓW

(Tabl. XXVII — XXX)

Sole markings produced by fish bones acting as tools

(Pl. XXVII — XXX)

Abstract: An unusual asemblage of hieroglyphs with preserved fish bones at the down-current ends of various tool-markings is described from the Menilite beds (Upper-Eocene) in Rudawka Rymanowska, Central Carpathians.

STRESZCZENIE

Na spągowej powierzchni jednej z ławic piaskowca z warstw menilitowych w Rudawce Rymanowskiej zostały odnalezione liczne przykłady hieroglifów uderzeniowych i śladów toczenia kości rybich z zachowanymi kośćmi. Przynajmniej część tych kości została wymyta przez prąd z mułu dennego już w stanie częściowo skamieniałym. Dzięki temu kości te, cięższe niż zwyczajnie toczone, były przez prąd zawiesinowy przy dnie. Autorowie przypuszczają, że wiele hieroglifów uderzeniowych w drobnoziarnistych piaskowcach krośnieńskich i menilitowych zawdzięcza swoje pochodzenie toczonym i wleczonym kawałkom szkieletów rybich. Jest to jeden z zasadniczych powodów, dla których warstwy krośnieńskie i niektóre piaskowce w warstwach menilitowych mają zespół hieroglifów uderzeniowych odmienny od zespołu w tych seriach, w których szczątki rybie są rzadsze.

INTRODUCTION

The present writers have already called attention to the fact that some inorganic markings on the undersurfaces of the Oligocene flysch sandstones might have originated through fish bones acting as tools, while carried by a turbidity current. (D ż u ł y ń s k i, Ś l ą c z k a 1958). An unusual asemblage of such markings has been recently found on a joint trip with Mr. St. C z a r n i e c k i to the exposures of the Menilite beds in Rudawka Rymanowska [1].

The examples here discussed were collected from a single sandstone bed, exposed over a distance of a few meters. The most remarkable point about this bed is the fact that almost every piece of its bottom surface contains a multitude of drag-, prod- and roll-markings which terminate abruptly with fragmentary remains of fish skeletons. The bones are commonly broken and small vertebrae are often devoid of processes. All these fish remains are very slightly attached to the bottom surface of the sandstone which otherwise is unfossiliferous.

A considerable variety of bones extends over the variety of markings produced. We have no special names for these markings and there is hardly any need for them.

Emphasis should be put on the fact, that the shape and size of fish bones correspond closely to the outline of the tool-markings [2]. This leaves any irrelevant and incidental association entirely out of question. The findings at Rudawka Rymanowska may be of assistance in deciphering the nature of tools responsible for many markings in the flysch sandstones.

It is well known that the Menilite beds contain a great number of fossil fish (see K r a m b e r g e r 1879, R y c h l i c k i 1909, B o ś n i a c k i 1911) The black shales of this series have yielded many fish skeletons in an excelent state of preservation. The fish fauna from the Menilite beds shows affinity to that from the Glarner Fischschiefern in the Alps. (B o ś n i a c k i 1911).

MARKINGS PRODUCED BY FISH VERTEBRAE

In the previous paper the present writers expressed the opinion that peculiar ring-like markings on the soles of the Oligocene Krosno beds, resulted from rolling of fish vertebrae by turbidity currents over a soft muddy bottom. This explanation is now confirmed by the finding of preserved fish vertebrae at the ends of such hieroglyphs. Pl. XXVII fig. 1, 2.

We shall not give here a detailed description of the markings in question. Few points only will be stressed.

The ring-like impressions were made alternately by anterior and posterior articular surfaces (terminal faces) of vertebrae centra. In some cases the fragmentary remains of processes have left their record in form of off-shoots, extending outward from the walls of a ring (fig. 1

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[1] The present writers wish to acknowledge with thanks the help and assistance of Mr. C z a r n i e c k i in finding and collecting the specimens and many helpful suggestions.

[2] The term suggested for markings produced by objects striking the bottom while carried by a current (D ż u ł y ń s k i, S a n d e r s -in press).

Pl. XXX). In other cases, the processes vere effective in producing the delicate grooves.

The up-current part of a ring is usually more elevated above the bottom surface of the sandstone bed than the down-current one. Such an asymmetry prevails when rolling is involved. The centrae set to saltate may leave also hoof-like impressions pointing with their convexities the up-current direction. A different structure, however, appears when a centrum is made to prod the bottom with the border of its terminal face. The resulting structure is a prod-mark or a series of prod--marks or skip-marks [1] pointing obviously with their crescentic edges the down-current direction. Pl. XXX fig. 2.

Different markings appear, when the concave sides of centrae are in continuous contact with the bottom. The borders of terminal faces move like wheels, leaving two parallel grooves behind. Such a movement is possible only when the processes are lacking or broken off short at the point of their beginning. In the latter case the residual remnants of such processes or other forms on the sides of the centrae may leave their record in form of transverse cuts, enclosed by the parallel grooves already mentioned. Such structures can be easily reproduced by simple experiments with fish vertebrae (fig. 4, Pl. XXVIII). A similar case is afforded by the markings from the Menilite beds illustrated by fig. 1, 2, 3 Pl. XXVIII.

It may be noted that much of our ring-like markings exactly answer the description of the Engi-Matt problematicum from the Oligocene Fischschiefern in the Alps. This problematicum has been recently interpreted by Peyer (1957) as the impressions of Salpa colonies.

PROD-AND DRAG-MARKS PRODUCEND BY FISH BONES

A great number of various fish bones have been found at the down--current ends prod-and drag-markings. Pl. XXIX fig. 1, 2. Considerable variety of these markings may easily be accounted for by the variety in shape and size of fish bones. In numerous instances a continuous drag-mark passes into a series of knobs reflecting the change in the mode of transportation from sliding to rolling.

It may be noted that some drag marks do not rest upon a level surface but undulate up and down so as to remind of the behaviour of jolts or „cahots" (see V. Cornish 1914) along a path of a sledge pulled over a snow surface. This phenomenon, bearing relation to the Helmholtz waves finds its explanation in the fact that a body sliding with a moderate speed over a soft surface, seldom remains on the same level. Even small irregularities may start a slight up and down motion. This undulations should be distingushed from undulations of the bottom surfaces of sandstones which are due to the post-depositional gliding or load-casting.

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[1] For explanation of terms see Dżułyński, Książkiewicz, Kuenen 1959.

ZIGZAG ROLL-MARKINGS PRODUCED BY FISH BONES (?)

Pl. XXIX fig. 3 shows an interesting case of roll-markings which resemble organically produced hieroglyphs. There is however no satisfactory evidence to bear out the idea of the organic nature of these markings. In our opinion they could only have originated through mechanical agencies, namely by rolling of objects having a triangular outline. Here again the fish bones come to mind.

GENERAL REMARKS

The foregoing considerations have made it sufficiently clear that the fish bones may leave their record on the soles of the flysch sandstones in form of various tool-markings. Many of these markings, when devoid of the bones preserved, can in no way be distinguished from those made by other objects such as pieces of shale or wood and fragmentary remains of shells. This pertains especially to such hieroglyphs as prod-, brush-, bounce-, drag-, and chevron-markings [1]. These might or might not have been produced by fish bones. There are, however, markings, like the ring-marks described, which are highly sugestive of fish bones acting as tools, even in cases when the bones have not been preserved.

In now seems quite probable that a great number of tool-markings in the Menilite and Krosno beds were produced by fragmentary remains of fish-skeletons.

The multitude of diagnostic ring-marks, the abundance of sharp delicate roll- and saltation-markings having a definite and recurrent geometric pattern (Pl. XXX fig. 3) make the tool-markings assemblage of these strata differ from such assemblages in other units of the Carpathian flysch. When it is borne in mind that the Menilite beds contain very abundant fish remains, it is obvious that the fish bones were everywhere available for the turbidity currents to pick them up and bring into action as tools capable of grooving and scratching the bottom. It seems probable, that many of these bones were excavated from the bottom sediments by erosion of the current. This seems to be corroborated by the presence of numerous fragments of black shales scattered randomly, or imbricated in clusters within the sandstone beds. These fragments were apparently derived from the underlying shales. Many of the bones washed out from the black muds covering the bottom, might have been already partly fossilized and heavier than it is the case with the unfossilized remains of fish skeletons. This would answer the question, why the bones have been found concentrated at the base of the sandstone.

The findings at Rudawka Rymanowska give also point to the ques-

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1 „chevron-marks" (D u n b a r, R o d g e r s 1957), or „herringbone structures" (K u e n e n 1957) are closely spaced chevron-like markings. These hieroglyphs are quite common in the Carpathian flysch. They were made probably by an object brushing rapidly the bottom touching slightly the surface of the plastic mud (D ż u ł y ń s k i, S a n d e r s — in press).

tion, why in so many beds showing similar assemblages of tool-markings, the fish bones are very rare or practically absent. There appears to be no particular reason compelling us to assume some special course of diagenesis, favouring the preservation of fish bones in that particular bed. In seeking for an explanation of this phenomenon, attention should be directed to the fact that the tools brought into action by a current may leave innumerable markings before they finally come to rest.

The couple produced by the propulsive force of the current and the resistance of the bottom (Gilbert 1914), the „hydraulic lift" (Rubey 1938) to which the bigger particles are more susceptible than those of the sand grade, may prevent the permanent deposition of bones even when sedimentation of the fine sand has already begun. Another factor is the progressive fragmentation of the tools in the course of their transportation. Hence it is more likely to find markings produced by saltating objects than the objects themselves.

The present discussion should not end without a brief reference to the structure of the bed with the bones described.

The sandstone is fine-grained. Its lower part is roughly laminated, the upper one cross-stratified on a small scale with incipient convolute lamination. It should be noted that the tool-marking assemblages suggestive of fish bones acting as tools seem to be associated with fine-grained sandstones only, showing similar structures. The markings themselves, as it is commonly the case in the Carpathian flysch, are underlain by a thin layer of gray shales. No markings whatsoever have been found resting directly upon the black siliceous shale.

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EXPLANATIONS OF PLATES

OBJAŚNIENIA TABLIC

Tablica XXVII
Plate XXVII

Fig. 1, 2. Zachowane kręgi przy końcu śladów toczenia (1), kawałki łupku przy końcu drobnego śladu uderzenia (2), warstwy menilitowe. Rudawka Rymanowska

Fig. 1. Preserved fish vertebrae at the down-current end of roll-markings (1), (2) — fragment of shale at the end of a short prod-marks. Menilite beds. Rudawka Rymanowska

Fig. 2. Preserved fish centrum at the down-current end of roll-and slide-marks. Menilite beds Rudawka Rymanowska

Tablica XXVIII
Plate XXVIII

Fig. 1, 2. Ślady toczenia kręgów rybich. W czasie toczenia oś kręgu pozostawała w płaszczyźnie równoległej do dna. Warstwy Menilitowe. Rudawka Rymanowska

Fig. 3. Ślad z zachowanym kręgiem. Warstwy Menilitowe. Rudawka Rymanowska

Fig. 4. Podobne ślady uzyskane przez toczenie kręgu na miękkim podkładzie

Fig. 1, 2. Roll-markings produced by fish vertebrae. The concave sides of centrae were in continuous contact with the bottom. Menilite beds. Rudawka Rymanowska

Fig. 3. The same markings with the fish vertebra preserved. Menilite beds. Rudawka Rymanowska

Fig. 4. Similar markings reproduced by rolling of fish vertebrae over soft plasteline

Tablica XXIX
Plate XXIX

Fig. 1. Kość rybia przy końcu śladu uderzenia (1). Warstwy menilitowe. Rudawka Rymanowska

Fig. 2. Wydłużona kość rybia przy końcu śladu wleczenia (1)

Fig. 3. Zygzakowate ślady toczenia

Fig. 1. Fragment of a fish bone at the down-current end of a prod-mark. Menilite beds. Rudawka Rymanowska

Fig. 2. Elongate fish bone at the down-current end of a groove-cast (1). Menilite beds. Rudawka Rymanowska.

Fig. 3. Zigzag roll-markings

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Fig. 1. Pierścieniowe ślady toczenia kręgów rybich. Warstwy krośnieńskie. Rudawka Rymanowska

Fig. 2. Ślady uderzeniowe pozostawione przez kręgi uderzające o dno. Warstwy krośnieńskie. Rudawka Rymanowska

Fig. 3. Powtarzający się w zarysie ślad wśród zespołu hieroglifów uderzeniowych. Warstwy krośnieńskie. Rudawka Rymanowska

Fig. 1. Ring-like markings made by articular surfaces of fish vertebrae. Impressions of broken processes visible on the sides of markings. Krosno beds (Oligocene), Rudawka Rymanowska

Fig. 2. Prod-marks produced by fish vertebrae. Krosno beds. (Oligocene), Rudawka Rymanowska

Fig. 3. Recurrent geometric pattern amongst typical tool-markings assemblage suggestive of fish bones acting as tolls. Krosno beds. Rudawka Rymanowska

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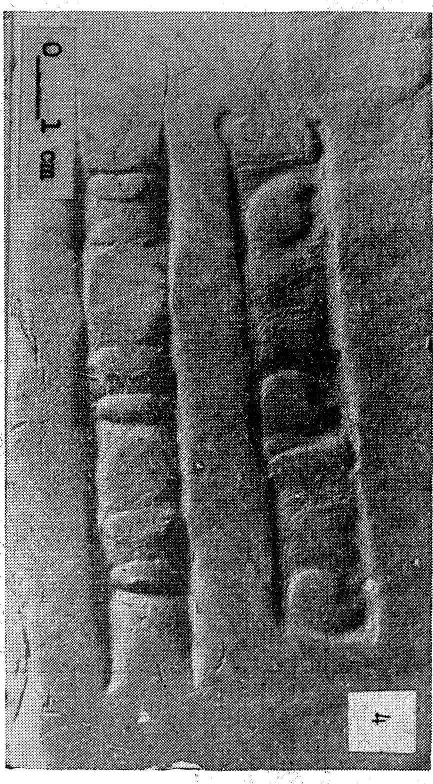

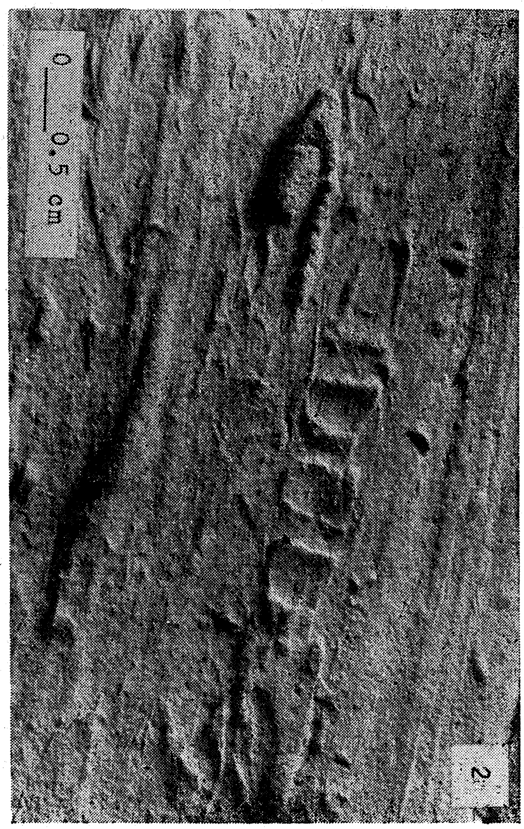

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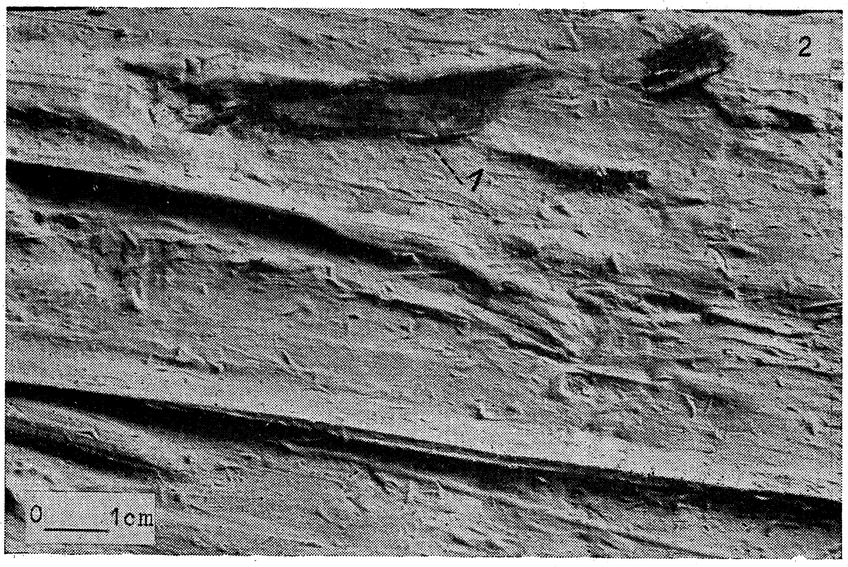

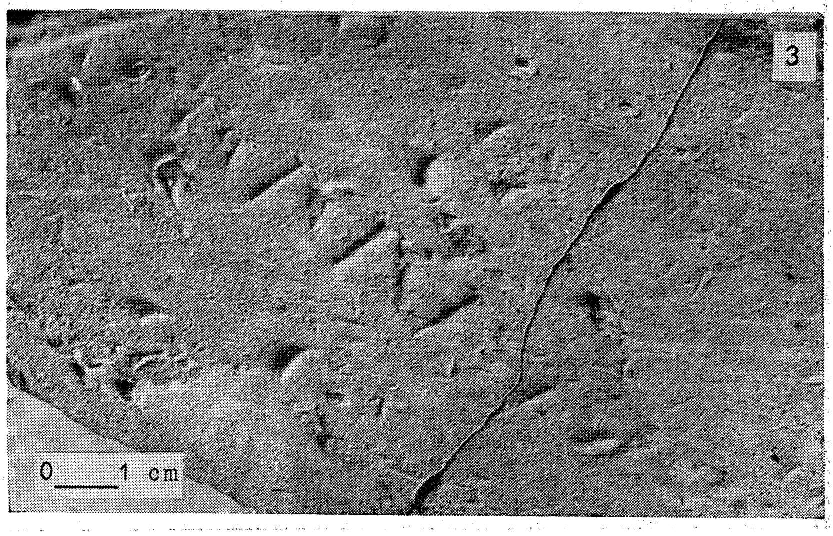

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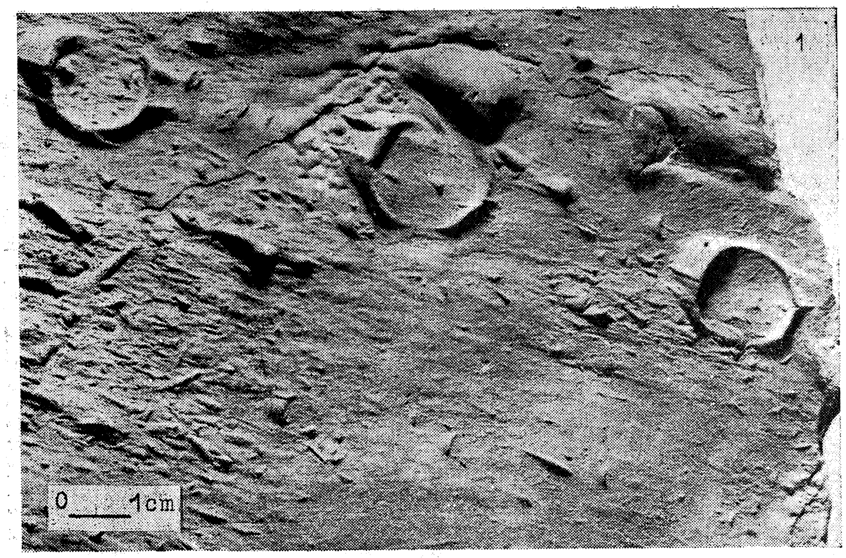

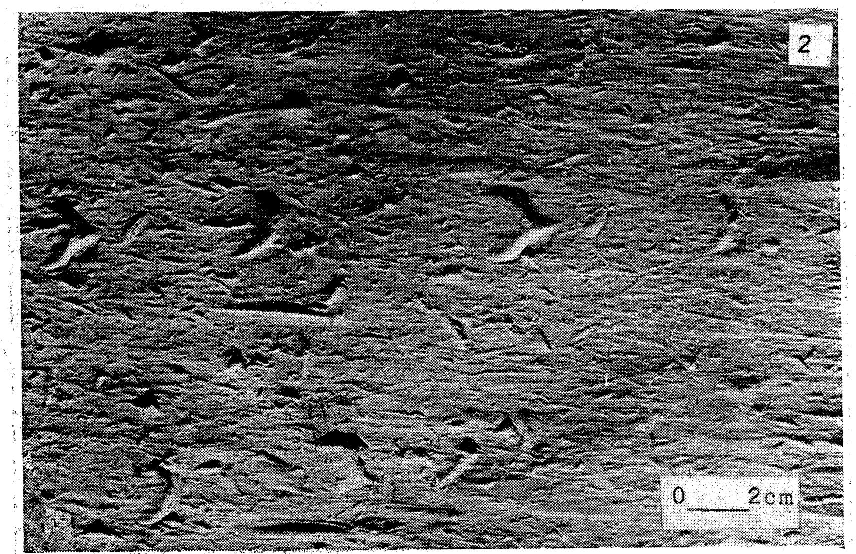

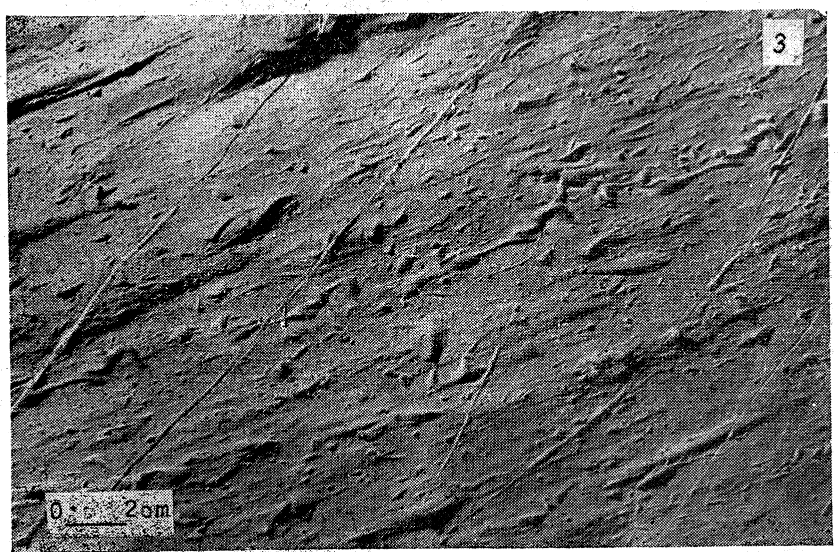

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