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New Late Cretaceous dinosaur findings from northwestern Transylvania (Romania)

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Abstract

In 1905, Nopcsa tentatively identified a fragmentary rib from the Jibou Formation at Someş Odorhei as belonging to an ornithopod dinosaur. Therefore, he concluded that the base of this formation is Late Cretaceous, but this hypothesis was subsequently ignored or rejected by other authors. New dinosaur bones discovered in this locality by new excavations are here interpreted as belonging to the euornithopod *Zalmoxes shqiperorum* Weishampel, Jianu, Csiki and Norman, 2003. The base of the Jibou Formation can therefore be regarded as Maastrichtian, correlative to the Sânpetru Formation and to the middle member of the Densuş Ciula Formation from the Haţeg Basin, as well as the base of the Şard Formation in the southwestern Basin of Transylvania, in the Alba Iulia area. The presence of *Zalmoxes* at Someş Odorhei also confirms the northeastern extension for the 'Haţeg Island' in Transylvania. ***To cite this article: V.A. Codrea, P. Godefroit, C. R. Palevol 7 (2008).***

Résumé

Nouvelles découvertes de dinosaures du Crétacé supérieur du Nord-Ouest de la Transylvanie (Roumanie). En 1905, Nopcsa a identifié un fragment de côte, découvert dans la formation de Jibou, à Someş Odorhei, comme appartenant à un dinosaure ornithopode. Il en déduisit que la base de cette formation serait d'âge Crétacé supérieur, mais cette hypothèse fut ignorée ou rejetée par d'autres auteurs. Des ossements de dinosaures découverts dans cette même localité à l'occasion de nouvelles fouilles sont interprétés ici comme appartenant au dinosaure euornithopode *Zalmoxes shqiperorum* Weishampel, Jianu, Csiki and Norman, 2003. La base de la formation de Jibou peut dès lors être considérée comme étant d'âge Maastrichtien et peut être corrélée avec la formation de Sânpetru et le membre moyen de la formation de Densuş Ciula dans le bassin de Haţeg, ainsi qu'avec la base de la formation de Şard dans la partie sud-ouest du bassin de Transylvanie, dans la région d'Alba Iulia. La présence de *Zalmoxes* à Someş Odorhei suggère également une plus grande extension vers le nord-est pour « l'île de Haţeg », en Transylvanie. ***Pour citer cet article : V.A. Codrea, P. Godefroit, C. R. Palevol 7 (2008).***

Keywords: Romania; Transylvania; Late Cretaceous; Jibou Formation; *Zalmoxes*

Mots clés : Roumanie ; Transylvanie ; Crétacé supérieur ; Formation de Jibou ; *Zalmoxes*

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Introduction

Depuis le début du XX^{e} siècle, des dépôts continentaux datant du Crétacé terminal ont été découverts dans le Bassin de Transylvanie par le célèbre « chasseur de dinosaures », le baron von Nopcsa. Ce dernier a notamment décrit, le long du versant sud-ouest de la dépression de Transylvanie, la formation de Jibou [15,23], dont la section-type est située dans le district de Sălaj, près de la ville de Jibou [21]. Au sein de cette formation, seules les rares passées lacustres sont riches en fossiles. L'assemblage de Vertébrés découvert dans les sédiments lacustres de Cuceu–Jibou–Rona indique un âge Paléocène supérieur à Éocène inférieur pour le membre de Rona [7] de la formation de Jibou [11,12]. En revanche, les fossiles sont beaucoup plus rares dans les dépôts fluviatiles et alluviaux, qui forment la plus grande partie de la formation de Jibou. Toutefois, Nopcsa a attribué une côte, découverte sous le membre de Rona à Someş-Odorhei, au dinosaure ornithopode « *Mochlodon suessi* ». Une dent de crocodile et des ossements de tortues ont été découverts dans la même couche. En comparant ces dépôts et ces fossiles avec ceux provenant du bassin de Haţeg, il conclut que la base de la formation de Jibou serait d'âge Crétacé supérieur. Malheureusement, seul le morceau de côte a pu être retrouvé à ce jour. De plus, cet os n'est pas du tout diagnostique ; il n'est même pas certain qu'il appartienne bien à un dinosaure. Depuis la découverte de Nopcsa, personne n'a pu retrouver de restes de dinosaures dans la formation de Jibou.

Contexte géologique du site de Someş-Odorhei

À l'occasion de nouvelles fouilles dans la région de Jibou (Fig. 1), des fossiles ont été collectés près de Someş Odorhei (Fig. 2), là où Nopcsa a découvert la soi-disant côte de « *Mochlodon suessi* », il y a plus d'un siècle. Les ossements de dinosaures ont été trouvés dans la vallée de Bârsa, à proximité du village de Someş Odorhei. Ils proviennent d'argiles rouges, immédiatement sous la base d'un chenal fluvial (Fig. 3).

Les nouveaux ossements de dinosaures du site de Someş-Odorhei

Les quelques éléments identifiables découverts dans ce site (Fig. 4) ressemblent à ceux du dinosaure euornithopode *Zalmoxes* Weishampel, Jianu, Csiki & Norman, 2003, abondant dans le Crétacé supérieur du bassin de Haţeg. UBB SO-4 est particulièrement intéressant et diagnostique. Il s'agit de la partie proximale d'une scapula gauche, qui présente des caractères synapomorphiques de l'espèce *Zalmoxes shqiperorum* Weishampel, Jianu, Csiki & Norman, 2003 : la partie proximale de sa lame scapulaire est très étroite, et ses bords antérieurs et postérieurs sont parallèles.

Conclusions

La présence, à Someş Odorhei, d'ossements pouvant être attribués à *Zalmoxes shqiperorum* indique que la partie basale de la formation de Jibou appartient sans aucun doute au Maastrichtien, comme l'avait déjà suggéré Nopcsa. Cette succession peut dès lors être corrélée avec la formation de Sânpetru et le membre moyen de la formation de Densuş Ciula dans le bassin de Haţeg [1,13], mais aussi avec la base de la formation de Şard, dans la partie sud-ouest du bassin de Transylvanie [7].

La découverte de *Zalmoxes* à Someş Odorhei suggère également une plus grande extension de « l'île de Haţeg », un concept introduit par Nopcsa [22] afin d'expliquer la petite taille des dinosaures découverts dans le bassin de Haţeg.

1. Introduction

In Romania, Late Cretaceous formations are mainly exposed in the Eastern and Southern Carpathians [27] or had been crossed by several boreholes in the Moesian and Moldavian platforms [16]. However, these formations are of dominantly marine origins. Most of the rare Late Cretaceous continental exposures are located in the Southern and Western Carpathians [7,8,21].

Since the beginning of the last century, Latest Cretaceous continental deposits had been described in the Transylvanian Basin by the famous "dinosaur hunter", Baron von Nopcsa [21]. These formations can be followed either along the southwestern rim of the Transylvanian Depression, represented by the Şard Formation [7], or even better, along its northwestern side. The Jibou Formation, discussed in the present paper, is located in this latter area.

The type-section of the Jibou Formation is located in the Sălaj district, in the vicinity of the Jibou town (Fig. 1), where these terrigenous sediments reach their largest thickness – around 1200 m, diminishing to only 75 m in the Gilău and Preluca areas [23]. Red siltic clays, coarse to medium arenites and micro-conglomerates, of fluvial origin, dominate the lithology [12,26]. The red beds are nearly devoid of fossils. In some restricted areas, lacustrine deposits, involving freshwater limestone, marl or clay, interfinger the red clays. These freshwater episodes

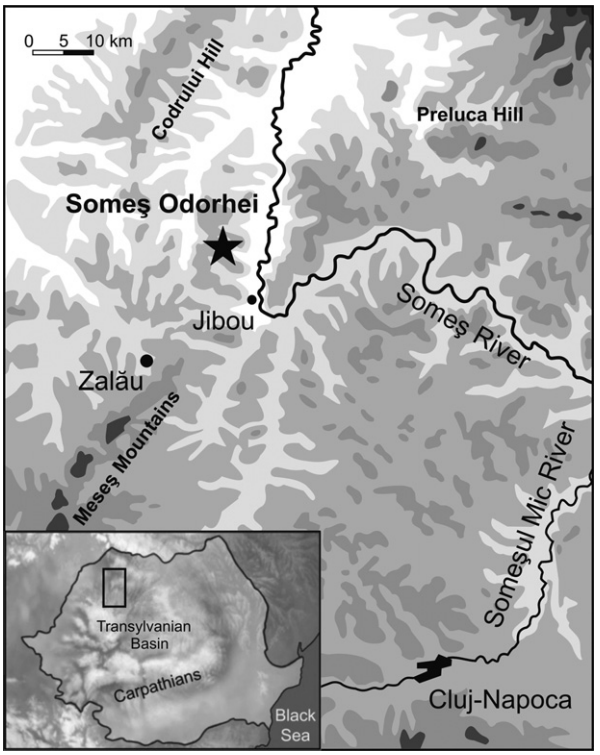

Fig. 1. Geographic location of Someş-Odorhei.
Fig. 1. Localisation géographique de Someş-Odorhei.

yielded relatively rich and diversified flora and fauna. The lake deposits only crop out at Călăţele [18], Horlacea [9,26], and Cuceu-Jibou-Rona [4,6,12,14,15,18]. In the latter locality, the sediments had been related to a distinct member of the Jibou Formation, the Rona Member (= "Rona Limestone") [6]. The fossil assemblage indicates [12] that the Rona Member is Late Paleocene (Thanetian), but it cannot be excluded that the top of this succession is Early Eocene in age. Consequently, all the above-mentioned lacustrine deposits are regarded as belonging to the Cenozoic, none being older than the Paleocene.

On the other hand, fossils are extremely rare in the red clays under or above the lake deposits. However, Nopcsa [21] described a rib fragment, tentatively assigned to the ornithopod dinosaur "*Mochlodon suessi*", a crocodile tooth and scarce turtle fragments that he found in the red beds under the Rona Member in the Bârsa Valley at Someş-Odorhei. He compared these deposits and fossils with the ones originating from the Haţeg Basin and concluded that the base of the Jibou Formation should be Latest Cretaceous in age. Nowadays, only the rib fragment described by Nopcsa could be retrieved in the Hungarian Geological Institute in Budapest (MAFI; inventory number Ob/1954, labelled in 1902 as '*Saurus rib*'). Unfortunately, this bone is not diagnostic. It is even hard to prove that this rib does belong to a dinosaur.

In the last decade, a team from Babeş-Bolyai University Cluj collected a few turtle bones from the red clays above the Rona Member at Giurtelecul Şimleului, where one can follow the westernmost exposure of the Jibou Formation, in the Şimleu Depression. These fossils belong to Testudinidae from the *Palaeochelys* (sp.l.) and *Neochelys* groups [5,19]. Therefore, the sediments in which these bones were discovered can be referred to the (?) Lower Eocene. So, one can conclude that the evolution of the fluvial system during the deposition of the Jibou Formation was therefore long and complex.

In fact, after Nopcsa's discovery, nobody has succeeded in finding dinosaur remains in the Jibou Formation, even after a century of field research. In several contributions, Nopcsa's findings from Someş-Odorhei were completely ignored, or even sometimes the age of these deposits was mistakenly interpreted (e.g., [2,10,23,24]). However, some other contributors took the putative presence of dinosaur fossils into consideration, relating the base of the Jibou Formation to the Maastrichtian [11,25].

2. Geological setting of the Someş-Odorhei site

At the occasion of several successive field missions in the Jibou area, new fossils were collected near Someş Odorhei (Fig. 2), in the same locality where Nopcsa [21] discovered the so-called dinosaur rib more than a century ago.

There, the Jibou Formation is widely exposed. Obviously, in this area, the Late Mesozoic–Cenozoic sedimentary rocks had been uplifted by the rise of a tectonic block with metamorphic basement [3], forming a SW–NE-trending ridge between Jibou, Someş Odorhei, and Benesat.

The fossil bones were found along the right slope of the Bârsa Valley, upstream from the last house of the Someş Odorhei village. Red siltic clays, microconglomerate and quartzite sand form the small outcrop. The coarse clastic rocks are the sedimentary fillings of a fluvial channel, whereas the red clays represent overbank deposits. This channel is fractured by small-amplitude faults. The dinosaur bones were found in the red clay, immediately under the base of the channel (Fig. 3).

3. The new dinosaur bones from the Someş-Odorhei site

The few identifiable dinosaur bones that have been recovered during the preliminary excavations at Someş Odorhei closely resemble the numerous specimens dis-

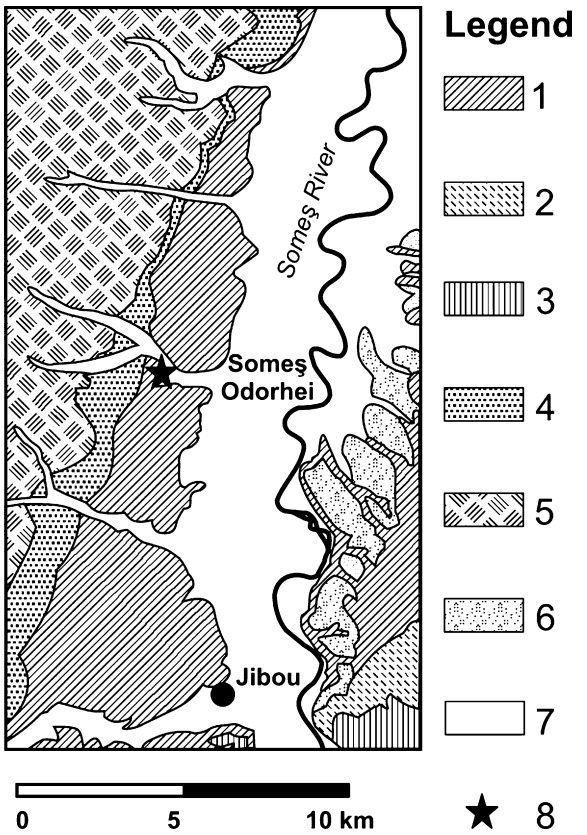

Fig. 2. Geology of the Someş-Odorhei area. (**1**) Jibou Formation (Late Maastrichtian-Lutetian); (**2**) Călata Group (Lutetian–Priabonian); (**3**) Turbuţa Formation (Priabonian); (**4**) Badenian; (**5**) Pannonian *s.s.*; (**6**) Pleistocene; (**7**) Holocene; (**8**) Fossil-bearing site.

Fig. 2. Géologie de la région de Someş-Odorhei. (**1**) Formation de Jibou (Maastrichtien supérieur–Lutétien) ; (**2**) groupe de Călata (Lutétien–Priabonien) ; (**3**) formation de Turbuţa (Priabonien) ; (**4**) Badénien ; (**5**) Pannonien *s.s.* ; (**6**) Pléistocène ; (**7**) Holocène ; (**8**) Site à fossiles.

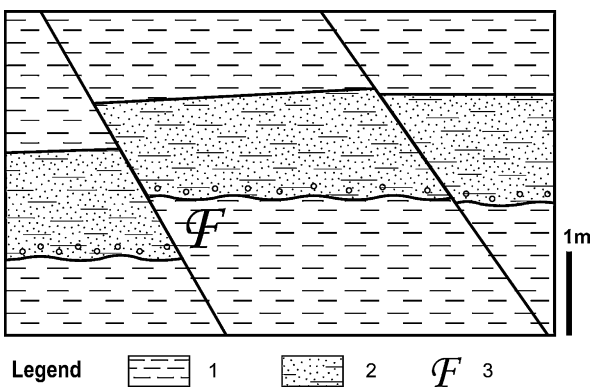

Fig. 3. Log of the Someş-Odorhei outcrop. (**1**) silt; (**2**) arenite; (**3**) fossils.

Fig. 3. L'affleurement de Someş-Odorhei. (**1**) silt ; (**2**) arrenites ; (**1**) fossiles.

covered in the Late Cretaceous from the Haţeg Basin and reported to the euornithopod *Zalmoxes* Weishampel, Jianu, Csiki and Norman, 2003.

UBB SO-1 (Figs. 4-1, 1a) and SO-2 (Fig. 4-2, 2a) are dorsal vertebrae. Their centrum is approximately as long as high, very contracted between the articular surfaces and it bears a rounded keel along its ventral surface. The articular surfaces are slightly amphicoelous to amphiplatyan and sub-circular in shape. In lateral view, the planes formed by the anterior and posterior articular surfaces converge ventrally, giving the ventral border of the centrum an arched aspect. The neural arch is shorter and narrower than the centrum. The pedicles are arched, thick and spray laterally to form a ledge at the neurocentral suture. The neural canal is circular in cross-section. The prezygapophyses face dorsally and medially. The transverse process is stout, triangular in cross-section and distinctly oriented posterodorsally.

UBB SO-3 (Fig. 4-3, 3a) is a proximal caudal vertebra. It is approximately as long as wide and high. Its articular surfaces are amphiplatyan and broadly heart-shaped. Ventrally, the hemapophyseal facets are not developed on the proximal and distal margins and the longitudinal keel is very rounded. In lateral view, the articular surfaces are nearly parallel and inclined distally. The distal articular surface is somewhat higher than the proximal surface and the ventral border is very concave. The neural arch is much shorter and narrower than the centrum. The neural canal appears relatively smaller than on the dorsal vertebrae. The prezygapophyses extend at the base of the neural arch and their articular facets are nearly vertical. The cervical ribs are rather robust and they are fused to the sides of the centrum along the neurocentral suture.

UBB SO-4 (Fig. 4-4, 4a, 4b) is the proximal portion of a left scapula. The narrow and strap-like proximal part of the scapular blade closely resembles that of *Zalmoxes shqiperorum* Weishampel, Jianu, Csiki and Norman, 2003. At this level, the anterior and posterior margins of the blade are parallel. The blade is roughly triangular in cross-section, with a convex lateral surface and a flat medial surface. In *Z. robustus* (Nopcsa, 1902), on the other hand, the proximal part of the scapular blade is distinctly wider, with divergent anterior and posterior margins: the anterior margin is straight, whereas the posterior margin is concave. The cross-section of the proximal part of the blade is proportionally more compressed mediolaterally in *Z. robustus*. As in both species of *Zalmoxes*, the proximal head of the scapula is well expanded and the posteroproximal angle of UBB JBZ-4 forms a robust dorsal buttress above the humeral glenoid.

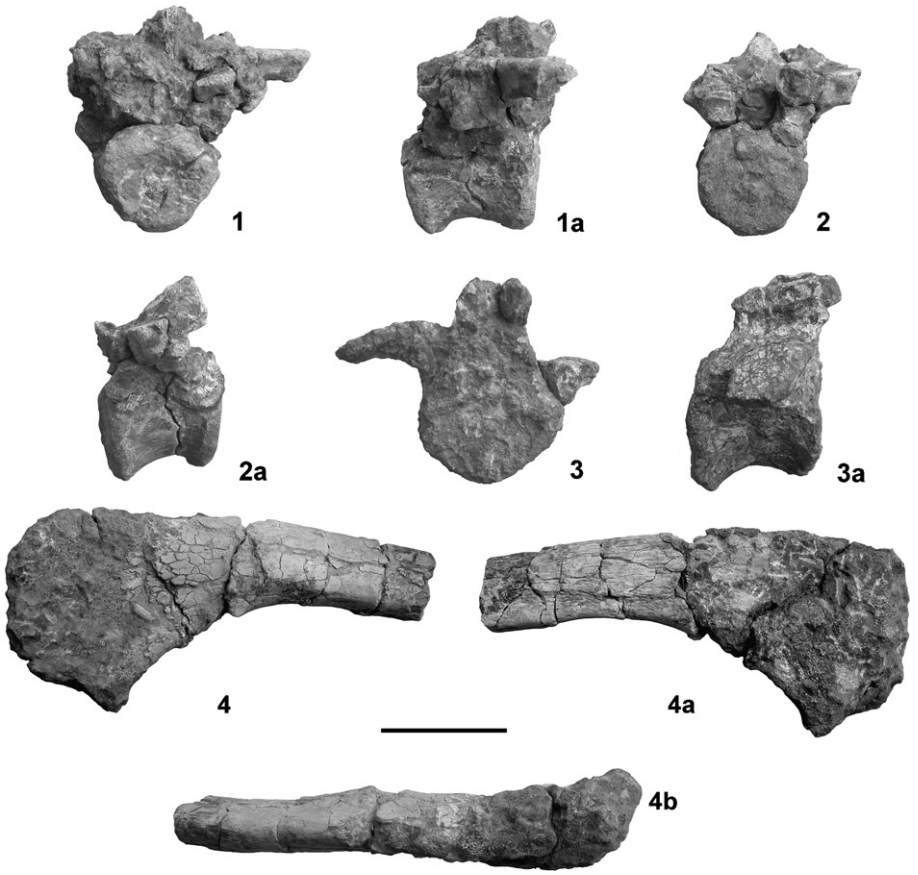

Fig. 4. (**1**) UBB SO-1, dorsal vertebra of *Zalmoxes shqiperorum* in anterior view; (**1a**) UBB SO-1, dorsal vertebra of *Zalmoxes shqiperorum* in left lateral view; (**2**) UBB SO-2, dorsal vertebra of *Zalmoxes shqiperorum* in anterior view; (**2a**) UBB SO-2, dorsal vertebra of *Zalmoxes shqiperorum* in left lateral view; (**3**) UBB SO-3, proximal caudal vertebra of *Zalmoxes shqiperorum* in anterior view; (**3a**) UBB SO-3, proximal caudal vertebra of *Zalmoxes shqiperorum* in left lateral view; (**4**) UBB SO-4, *Zalmoxes shqiperorum* left scapula in lateral (**4**) medial (**4a**) and anterior (**4b**) views. Scale bar: 50 mm.

Fig. 4. (**1**) UBB SO-1, vertèbre dorsale de *Zalmoxes shqiperorum*, vue antérieure ; (**1a**) UBB SO-1, vertèbre dorsale de *Zalmoxes shqiperorum*, vue latérale gauche ; (**2**) UBB SO-2, vertèbre dorsale de *Zalmoxes shqiperorum*, vue antérieure ; (**2a**) UBB SO-2, vertèbre dorsale de *Zalmoxes shqiperorum*, vue latérale gauche ; (**3**) UBB SO-3, vertèbre caudale proximale de *Zalmoxes shqiperorum*, vue antérieure ; (**3a**) UBB SO-3, vertèbre caudale proximale de *Zalmoxes shqiperorum*, vue latérale gauche ; (**4**) UBB SO-4, scapula gauche de *Zalmoxes shqiperorum*, vue latérale (**4**) médiale (**4a**) et antérieure (**4b**). Échelle : 50 mm.

4. Conclusions

Although they are extremely scarce and fragmentary, the dinosaur bones from the Jibou Formation at Someş Odorhei may tentatively be attributed to *Zalmoxes shqiperorum*, because the proximal part of the scapula is narrow and strap-like, an autapomorphic character for this species [29].

As the new fossils do not expose any reworking sign, one can consider that the basal part of the Jibou Formation doubtless belongs to the Maastrichtian, as previously mentioned by Nopcsa [21]. This succession can be considered as correlative to the Sânpetru Formation and to the middle member of the Densuş Ciula Formation from the Haţeg Basin [13], as well as to the base of the Şard Formation in the southwestern Basin of Transylvania, in the Alba Iulia area [7].

The presence of *Zalmoxes* at Someş Odorhei also suggests the northeastern extension of the "Haţeg Island". Nopcsa [22] introduced this concept in order to explain the apparent dwarfing of dinosaur taxa discovered in the Haţeg Basin as the consequence of insularity. The Haţeg Basin would have emerged after the Laramide tectogenesis, which erected the last folded structures in the western and southern Carpathians, in Romania [28], and probably covered the area comprised between Poiana Ruscă and Apuseni Mountains, as well as large areas now belonging to the present Transyl-

vanian Depression too. Eastward, this land gradually passed into a marine realm, as documented by the post-tectonic cover of the Ceahlău Nappe [20]. Unfortunately, the westward extension of the "Haţeg Island" is less clear, because erosion probably removed large piles of Upper Cretaceous sediments during the Cenozoic [27]. For that reason, an accurate palaeogeographic reconstruction of this emerged land cannot be proposed in the current state of our knowledge. As a matter of fact, other hypotheses have been proposed to explain the dwarfism of Transylvanian dinosaurs. Jianu and Boekschoten [17] argued for a continental setting, where dinosaurs and other vertebrates evolved in an outpost separated from the continent by a mountain range.

In these circumstances, each element – like the Someş-Odorhei outcrops – allowing a better understanding of the Late Cretaceous palaeogeography in Transylvania is worth being balanced in order to estimate a correct evolutionary pattern.

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