ON THE OCCURRENCE OF *CRUZIANA* (*BILOBITES*) IN YUNNAN AND SZECHUAN.

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Cruziana-localities in China.

The fossil animal trails known as *Bilobites* have been found for the first time in China by A. F. Legendre in 1910 at the surface of a sandstone formation near the village Tapishan, NE of Paimakou (白馬口), Luchuanhsien (祿勸縣), Yunnan. The specimens were described by P. Lemoine under the name of *Cruziana* cf. *monspelliensis* (Saporta).[1]

Two years ago Messrs. H. C. T'an and C. Y. Li had the opportunity to collect two remarkable specimens of *Bilobites* in Washan or Wawushan (瓦屋山) on the northern bank of T'ungho (通 河), Jungchinghsien (榮經縣), SW Szechuan. As they are not found *in situ*, the exact locality is unknown. By a comparison of the lithological characters of the specimens with the known rocks of the region, Messrs. T'an and Li suppose that they might come from the Cambrian sandstone of Omeishan (峨眉山) which is situated about 80 li north from Wawushan.

Last year Mr. Y. L. Wang reported some new materials of this kind from three localities of Yunnan, namely:

Loc. Y 327. Tienmashan (天馬山), 10 li SE of Fuminhsien (富民縣);

Loc. Y 347. 20 li E of Luchuanhsien;

Loc. Y 351. 8 li W of Hsiaotsang (小倉), Luchuanhsien.

The most complete specimen was collected in a gully of Tienmashan while others came from the two localities of Luchuanhsien; only the latter ones were found *in situ* in a yellow sandstone which Mr. Wang inclines to consider as more probably of Silurian than of Ordovician age.

1. Legendre, A. F. and P. Lemoine, 1916. Massif Sino-Thibétain—Provinces du Setchouen, du Yunnan et Marches Thibétaines, p. 145, p. 231, pl. XI, figs. 1, 2.

I am glad to express thanks to Messrs. T'an, Li and Wang through whose kindness I am able to examine these specimens.

Description

Most of the collected specimens can be referred to *Cruziana*, a generic name given by A. d'Orbigny in 1842 to a problematic object from the Lower Palæozoic of Venezuella.[1] It has subsequently been found in the Ordovician sandstones and quartzites in France, Spain, Portugal, Anatoly, etc.

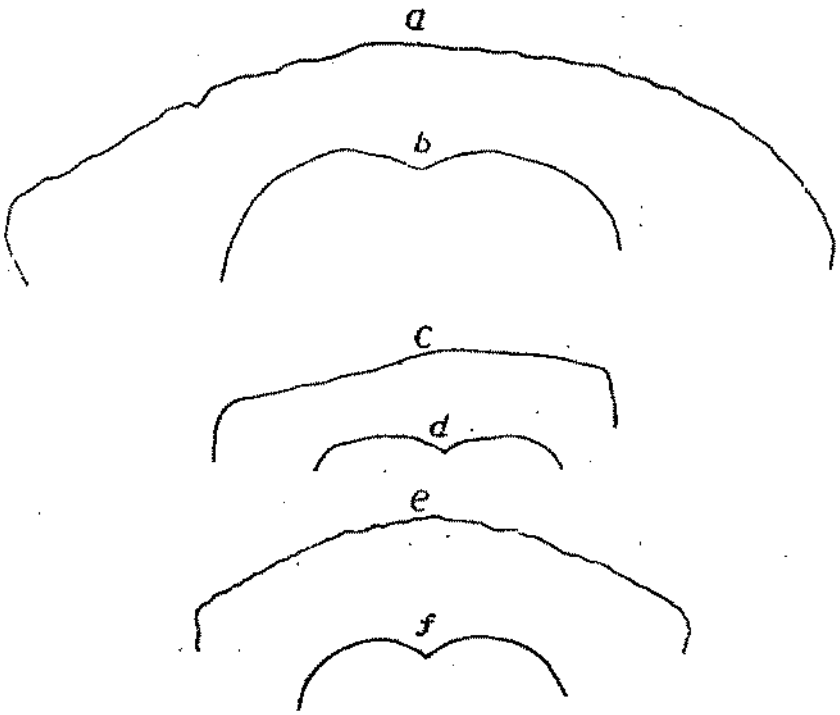

Fig. 1. Profile and transversal section of *Cruziana*. a, c, e, Profile of the specimens A, B, C respectively; b, d, f, transversal section of the same.

1. d'Orbigny, A., 1842. Voyage dans l'Amérique Méridionale, tome III. 4e partie, Paléontologie.

In the following description specific names are not given to the different forms on account of the fact that we do not know what animals had produced these trails.

Cruziana A—Pl. I, Fig. 1.

This specimen came from Wawushan and is the largest one. It measures about 30 cm. long and 12 cm. wide, with a strongly convex profile (Fig. 1, a). A median longitudinal furrow irregularly zigzagging, divides the surface into two equal lobes, the transverse section of which is also convex (Fig. 1, b). The principal lateral ridges which are thick and obtuse extend from the median furrow to the edge of each lobe. On the lower part of the lobes (which occupies about ¼ of the total length) they are more or less perpendicular to the furrow; those on the remaining parts of the lobes make an angle of 60°-80° with the furrow and are somewhat less developed. The secondary ridges or arêtes which are very acute may be either continuous from the furrow to the edge or cut into small segments meeting each other at different angles. Some of them are bifurcated.

Cruziana B—Pl. I, Fig. 2.

The specimen B came from the same locality as the preceding one but belongs surely to a different type of animal trail. It has not only a smaller size but also shows a quite simpler design on the surface. The profile is slightly convex (Fig. 1, c), much less than it is in the specimen A, but the transverse section of the lobes is the same (Fig. 1, d). The median furrow though not straight does not form a zigzagging line. The obtuse ridges, if they exist, are not very apparent. The secondary ridges or arêtes make an acute angle with the median furrow, describing a loose-lobed S.

Cruziana C—Pl. I, Fig. 3.

The third specimen was collected from Tienmashan. It resembles closely the specimen A by its very convex profile (Fig. 1, e), zigzagging median furrow, oblique principal ridges and more or less bifurcated, intercrossing secondary arêtes. It differs from the first specimen only by the smaller size.

Some other specimens collected by Mr. Wang from Yunnan are more fragmentary. Two of them seem to belong to *Cruziana* while two others are trails which were produced by two different animals.

TERMINOLOGY AND INTERPRETATION.

"The name *Bilobites*, proposed by Dekay in 1823, was, as Newberry has shown (Science, Vol. V, No. 124, 1885, p. 508), originally applied not to objects of this kind, but to casts of certain bivalve shells. It was therefore dropped in America; but it has been revived and has gained currency in Europe, as a term including various forms of markings referred to differnt genera. The dominant characters are a band, or an oval mass with a median longitudinal furrow or ridge, and marked with transverse or oblique furrows or striæ, and with or without a marginal ridge.[1]"

Before Dekay the name *Bilobites* had already been used by Linné for a Silurian Brachiopod. So far as animal trails are concerned it is therefore preferable to substitute to this term the generic names such as *Cruziana*, *Fraena*, *Crossochorda*, *Rusichnites*, etc, although it is still used in Europe as a collective name of the Palæozoic bilobed trails.

Fig. 2. Transversal section of the original trail subsequently filled up with sands.

Cruziana occur mostly in the Ordovician sandstones or quartzites, rarely in Cambrian or Silurian formations. It was known to geologists more than one hundred years ago, but the true nature of these enigmatic objects has given rise to a long polemic. It had been held that they were remains of algæ, a hypothesis still supported by de Saporta[2], Delgado[3] and Schimper and Schenk[4]

1. Dawson, J. W. 1890. On burrows and tracks of invertebrate animals in Palæozoic rocks and other markings. Quarterly Journal of Geological Society of London, Vol. XLVI, pp. 595-618.
2. Saporta, G. de 1882. A propos des algues fossiles. Paris, Masson.
3. Delgado, J. N. 1886. Stude sur les Bilobites et autres fossiles des quartzites de la base du systeme silurique du Portugal. Lisbonne. (not seen).
4. Schimper W. P. and A. Schenk. 1890. Handbuch der Palæontolggie, II Abteilung, Palæophytologie, p. 52.

fourty years ago. It was the Swedish palæobotanist Nathorst who has shown that they are molds of animal trails. He first considered that they were produced by Trilobites but afterwards he held that it was some unknown Crustacean.[1]

Cruziana occur mostly in Ordovician sandstones or quartzites. When found *in situ* they are always on the lower surface of the sandstone layer which is just in contact with shales or other fine rocks. This naturally leads us to consider the original trail as consisting of two parallel grooves separated by a median ridge (Fig. 2). It was subsequently filled by sands which, when hardened, give us solid molds in relief. According to Nathorst the animal

Fig. 3. Probable section of the Crustacean having produced *Cruziana* (after A. G. Nathorst).

which had produced this kind of trails should have a carapace and a bilobed body in the lower surface (Fig. 3).

What kind of Crustaceans could produce these trails? Were there in the lower Palæozoic faunas Crustaceans which had such size, form and organisation so as to leave exactly the "bi-grooved" trails? We have not yet any positive answer.[2]

The writer has just received Delgado's Monograph on the Bilobites of Portugal when the proof reading is entirely done and the paper is ready for printing.

1. Nathorst, A. G. 1886. Nouvelles observations sur des traces d'animaux et autres phénomènes d'origine purement mécanique decrits comme algues fossiles. Kongl. Svenska Vetenskaps-Akademiens Handlingar, Bandet 21, No. 14.
2. Professor Grabau suggests that it might be some continental animals which hazarded in the muddy beach of the Palæozoic sea.

A comparison with Delgado's illustrations enables us to refer *Cruziana* A described above to *Cr. prevosti* Rouault[1] from the Ordovician of France, Spain and Portugal, this species being characterized by the presence of strong transverse costæ (ridges) and by a complicate system of striæ. *Cruziana* B belong no doubt to *Cr. monspelliensis* Saporta[2], a species which was already found in Yunnan (See ante). *Cruziana* C is also closely allied with *Cr. prevosti*, but it is not so typical as the specimen A because of the fact that the transverse costæ are less well defined.

1. Delgado, *Op. cit.*, p. 48, pl. X, fig. 1; pl. XI, figs. 2,3.
2. Delgado, Op. cit., p. 42, pl. XIII; pl. XIV, figs. 2, 3.

Explanation of Plate I.

EXPLANATION OF PLATE I

Fig. 1. *Cruziana* A. ½ natural size. Wawushan, Jungchinghsien, Szechuan. Collected by H. C. T'an and C. Y. Li.

Fig. 2. *Cruziana* B. ½ natural size. Wawushan, Jungchinghsien, Szechuan Collected by H. C. T'an and C. Y. Li.

Fig. 3. *Cruziana* C. ½ natural size. Tienmashan, Fuminhsien, Yunnan. Collected by Y. L. Wang.


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