A Fossil Branching Structure from the Cenozoic Deposits of Wakayama Prefecture, Japan

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Recently a plant-like specimen was obtained from the Shimosato sandstone and siltstone member of the Koguchi Formation (Miocene) distributed near the tip of the Kii Peninsula, Wakayama Prefecture, Japan. The specimen is from Azumame, Kushimoto Cho and was found on the surface of a bluish gray colored tuffaceous siltstone of the Shimosato Member, and a part of the specimen was observed to be embedded in the same rock specimen. The Shimosato sandstone and siltstone member of the Koguchi Formation occupies the stratigraphic position in the geological column of the tip area of the Kii Peninsula shown in Fig. 1, according to Mizuno (1957).

This plant-like fossil shows resemblance with the genus *Isawaites* Hatai and Noda (1971, p. 1-6, pl. 1), and the genus *Buthotrephis* Hall (Häntzschel, 1962, p. 187, fig. 1a, 1b, 1c), which is now included in *Chondrites* Sternberg (Häntzschel, 1962, p. 187). This is the first record of a fossil plant-like specimen from the Shimosato Formation and also from the Cretaceous and post-Cretaceous deposits of the Kii Peninsula, Wakayama Prefecture, and therefore, seems worthy of description and illustration.

Recent deposits

..... unconformity .....

Pleistocene deposits

..... unconformity .....

Kumano acidic igneous rocks (post-Middle Miocene)

..... unconformity .....

Kumano Group (Middle Miocene)

- Mitsuno Formation
- Koguchi Formation
  - Shikiya siltstone member
  - Shimosato sandstone and siltstone member

..... unconformity .....

Kinan Group (Eoeene ?)

Fig. 1. Stratigraphic position of the Shimosato sandstone and siltstone member of the Koguchi Group in the geologial column of the tip area of the Kii Peninsula, Wakayama Prefecture. (After A. Mizuno, 1957).

The plant-like fossil, which seems to be the filling deposits originally of a tunnel-like structure, is here identified with the ichnogenus *Buthotrephis* Hall, which is said by Häntzschel (1962, p. 187) to be the larger form of the ichnogenus *Chondrites* Sternberg. The ichnogenus *Chondrites* is said (Häntzschel, 1962, p. 188) to be cosmopolitan in distribution and to range in time from the Cambrian to the Tertiary, and even probably to

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Recent, according to Chamberlain (1971, p. 234). *Chondrites* is stated to represent a tunnel system or "dwelling burrows or feeding burrows" (Häntzschel, 1962, p. 187), made probably by some kind of marine worm.

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Ichnogenus *Chondrites* Sternberg, 1833

Bandel, 1973-Paleontogr., Bd. 142, Lfg. 4-6, p. 166.
Chamberlain, 1971-Jour. Paleont., vol. 45, no. 2, p. 234.
Häntzschel, 1962-Treatise on Invert. Paleont., Pt. W, p. 187.

The genus *Chondrites* Sternberg is said to possess many synonyms, and as pointed out by Häntzschel (1962, p. 187), the following ones should be included, namely, *Fucoides* Brongniart, 1823 (partim), *Gigartinites* Brongniart, 1923 (not used as a genus), *Caulerpites* and *Sphaerococcites* Sternberg, 1833 (partim), *Buthotrephis* Hall, 1847 (the larter form of *Chondrites*), *Phymatoderma* Brongniart, 1849,? *Trevisania* Zigne, 1856, *Phycopsis* Fischer-Ooster, 1858, *Bythotrephis* Eichwald, 1860 *Nulliporites* Heer, 1865, *Chondrides* and *Leptochondrides* Schimper, 1869,? *Theobaldia* Heer (partim), *Palaeochondrites* De Saporta, 1882, *Chondropogon* Squinabol, 1890,? *Prochondrites* Fritsch, 1908, *Labyrinthochorda* Weissenbach, 1931, and, *Clematischnia* Wilson, 1948.

The genus *Chondrites* Sternberg was defined by Häntzschel (1962, p. 187) in the following way. "Very plantlike, regulary ramifying tunnel structures which neither cross each other nor anastomose ; should be interpreted as dwelling burrows or feeding burrows ; width of tunnels remain equal within a system, otherwise varying from large (e.g. *Buthotrephis*) to small (e.g., *Chondrites*) ; very common trace fossil, usually named "fucoid" ; some with transversely built-in ellipsoidal excrement pills ; surface pattern commonly very regular, effected by phobotaxis. [Probably made by marine worms]".

Chondrites sp.

Chondrites Häntzschel, 1962, p. 187 ; Kennedy, 1967, p. 149, pl. 2, figs. 2, 4, pl. 5, fig. 3, pl. 9, fig. 1 ; Frey, 1970, p. 15, fig. 3 D, pl. 2, fig. 6, pl. 3, fig. 4, pl. 5, fig. 3, pl. 8, fig. 13 ; Tanaka, 1971, p. 4, pl. 2, fig. 3 ; Frey and Chowns, 1972, p. 30, fig. 2 ; J-L, pl. 2, fig. E-I.

Chondrites recurvus (Brongniart), Chamberlain, 1971, p. 236, pl. 31, fig. 10, text-fig. 6C, D.

The plantlike specimen recently obtained (Fig. 2) is identified with the *Chondrites* illustrated by Häntzschel (1962, p. 190, fig. 1 b) and seems to be very close to *Chondrites* recurvus (Brongniart) illustrated and described by Chamberlain (1971, p. 236, pl. 31, fig. 10, text-fig. 6 D, C) from the flysch facies of the Ouachita Mountains of southeastern Oklahoma (Atoka Formation and Jackford Group). The specimen at hand measures about 5 mm in

width of a single tunnel filling, and in this respect it seems to be close to Chamberlain's (Op. cit.) figured specimen.

Fig. 2. View of *Chondrites* sp., slightly enlarged. Note branching and lack of any external tube covering. Tube filling sediments rather coarse grained. This specimen is considered to be a detached part of a larger one.

Although incomplete, the present fossil is represented by three detached branches, each measuring about 5 mm in width, one forking once, one four times and another only three times. The branches are more or less rounded in profile, extending horizontally to sub-horizontally over the surface of the siltstone, and turning downward into the rock. The branches are thought to represent tunnel-fillings or burrow fillings, and being bare, it is considered that they had no calcareous or other kind of tubular ectodermal structures covering them. The original orientation of the detached branches is not known, but they are considered to have been the parts that were redeposited after having been detached from their original positions. Whether the original structures was as illustrated by Simpson (1957, p. 484, fig. 2) can not be determined by the present detached branches.

With regard to *Chondrites*, Stimpson (1957, p. 489) stated that, "In the present state of our knowledge it is doubtful whether any advantages is obtained by attempting to recognize ichnospecies within *Chondrites* and accordingly no such attempt is made here". On the other hand, Chamberlain (1971) recognized several species of the genus, namely, *Chondrites expansus* Sternberg, *Chondrites* aff. *targionii* var. *flexuosus* Sternberg, *Chondrites recurvus* (Brongniart), and, *Chondrites arbusculus* Fischer-Ooster, in his work on the trace fossils from the Mississippian-Pennsylvanian rocks of the Ouachita Mountains in Southeastern Oklahoma. Thus there seem to be two views, one to include all the species into a single one, or the lumping method, and the other, to split them into species or varieties based upon differences in width of the branches and other details, or the splitting method. Probably it would be good to use the splitting method if the recognized species are biostratigraphically, chronostratigraphically and/or palaeoecologically useful for working out different problem in geology.

It may also be added that Häntzschel (1962) recognized two forms, the small or *Chondrites* and the large or *Buthotrephis*, but actually included the latter into the synonymy of the former. Most authors follow Häntzschel in recognizing only *Chondrites*. Chamberlain (1971, p. 234) stated that he counted a total of 130 species of *Chondrites*, and Häntzschel (1962, p. 187) recognized about 20 ichnogeneric synonyms of *Chondrites*. Chamberlain (1971, p. 234-235) recognized four species of *Chondrites* from the Mississippian-Pennsylvanian rocks of the Ouachita Mountains, and these are from flysch facies "just as in the European types" according to Chamberlain (Op. cit.). And, as stated above, if distinction to the specific or lower level of the different forms of *Chondrites* is possible and if they are useful for working out different problems in geology as already mentioned, then it may be considered that they are worthy of naming, because the species or variety when named have significance as mentioned already.

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