A Peculiar Cone-like Specimen from the Shizukuishi Basin, Iwate Prefecture, Northeast Japan

By

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岩手県雫石盆地の特殊な円錐状構造をもつた化石標本について

多田元彦

岩手県雫石盆地に発達する新第三系の層位的ならびに堆積学的研究を行なつておる途上、岩手ポゾラン採石現場付近に発達する中新世上部の枅沢層上部から円錐形構造をもつたコンクリーション様のものを入手することができた。これは当時の堆積環境を知るうえに重要な手がかりになるものではなかろうかと考えて研究し、次のような結果を得たのでこれを報告する。

この円錐形構造をもつたものは湖成堆積物と考えられている枅沢層から発見されたが、これとよく形体が類似したクリンドリクヌスは海成堆積物から発見されている。

この円錐形構造をもつたものはさや状の外壁と内部とからなっており、さや状の外壁は褐鉄鉱よりなり、環状のふくらみをもっている以外は何も認められないし、内部は珪藻質細粒凝灰岩からできており、セプタ状の下にくぼんだラミナが発達し、褐鉄鉱のシミがついている。

これにやや類似したものにディプロクラテリオンやリゾコラリウムがあるが、内部構造、外壁の形態、軸の方向、大きさ等にそれぞれ相異がみとめられ、同一視することはできない。今までの文献にはこれと同一と考えられるものは著者の知るかぎりではみあたらないが、不完全な標本なので命名を控えておく。

生成環境は植物化石や淡水珪藻化石から湖成層であり、現在と同じ高度であつたなら今より寒冷であつたと考えられる。その生成の水深度については決定する資料を持たないが、枅沢層の上部から発見されている。

成因については、非常に困難ではあるが、枅沢層の上部に発見される植物化石や亜炭碎屑物をもたらしした樹木の幹・枝の内部が朽ちて、その後に堆積物が充填され、その外壁となる樹皮があとで褐鉄鉱によつて置換されたものと考えられるが、まだ確定的ではない。

Introduction and Acknowledgements

A peculiar cone-shaped specimen showing remote resemblance with *Kulindrichnus* (Doughty, 1965) in shape but not in size, material or in details. The present specimen is from a lacustrine deposit whereas *Kulindrichnus* is described from a marine deposit. The peculiar specimen was given to the writer by an employee of the Iwate Pozzolan Company near Shizukuishi Town.

The specimen was found in the Masuzawa Formation (Murai, 1962) exposed in a

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quarry about 1.5 km northeast of Oshuku along the Oshuku River in the Shizukuishi Basin, Iwate-gun, Iwate Prefecture. It was found in the middle part of a concretion-like oval shaped, soft, fine grained tuff in the upper part of the Masuzawa Formation. The oval shaped concretionary structure measured about one or a little more meters in longer diameter and about 50 to 60 centimeters in shorter one, being oriented with the longer diameter in vertical position. Owing to the quarrying, the original concretionary structure is no longer observable.

The specimen now under consideration is more or less of narrow cone-shape and was found in the soft tuff sediment of the concretion-like oval ball in vertical position with the larger diameter facing upwards and the smaller one directed downwards. The original length probably did not exceed that of the concretionary structure in which it was enclosed.

Since such kind of specimen has not been described from the Cenozoic or older rocks of the Japanese Islands, the writer feels that its description and illustrations may contribute to our knowledge on the concretionary and various shaped structures occurring in marine or lacustrine deposits.

At this place the writer expresses his cordial thanks to Professor Kotora Hatai and Assistant Professor Nobu Kitamura of the Institute of Geology and Paleontology, Tohoku University, for their kind instructions in the field and laboratory. Deep appreciation is expressed to Professor Sadamasa Murai of the Faculty of Technology, Iwate University, for his sincere encouragement and suggestions with regard to the writer's research. Thanks are due to Mr. Hidezo Kanki and Mr. Gensei Kamemaru of the Iwate Pozzolan Company for the permission to make geological studies of their quarry and also for donating the present specimen to the writer for study.

Stratigraphic Position of the Peculiar Specimen

As already stated above the peculiar shaped specimen was found in the Masuzawa Formation, a unit which occupies the stratigraphic position shown in Table 1 (Murai, 1962).

The Masuzawa Formation is distributed throughout the Shizukuishi Basin and is composed of, according to Murai (1962), "tuff and tuffaceous shale frequently with pumiceous tuff and conglomerate intercalated. The tuff and sandy tuff are often with banded stratification or with intercalated thin layers of shaly tuff or tuffaceous shale." The formation has yielded fossils of brackish and freshwater shells (*Anodonta* sp., cfr. *A. lauta* Martens), freshwater diatoms (*Epithemia zebra* var., *E. turgida* var., *E. sorex* var., *Melosira granulata*, *Eunotia zebrium*, *E. zebrium* var., *Orephora Martyi* var., *Rhoicosphenia curvata*), and abundant fossil plants which are called the Gosho Flora by Murai (1962). The fossils, especially the plants point to that the geological age of the formation is late Miocene.

Description of the Specimen

A single cylindrical cone-like specimen measuring 110×130 mm in diameter at preserved upper or wider part, 84×95 mm in diameter at preserved lower part, about 165 mm in height as preserved (would be much longer if complete), and with external wall or sheath attaining 4-7 mm in thickness. The specimen is broken at both upper and lower parts, thus its original length is unknown. Its shape as noticed from the measurements, is not perfectly round in cross-section, but was probably a long more or less conical cylinder narrowing towards the lower end, which may have been bluntly rounded. The external surface of the specimen has broadly rounded convex annulations, separated from one another

Table 1. Stratigraphic Sequence of the Formations in the Western, Eastern, Central and Southern Parts of the Shizukuishi Basin, Iwate Prefecture (After Murai, 1962).

		Western Part	Southern and Central Parts		Eastern Part
Neogene Tertiary	Plio-cene		Takamatsuzawa Formation		
	Miocene	Hashiba Formation	Hashiba Formation	Aonokimori Formation	
		Masuzawa Formation	Masuzawa Formation		Masuzawa Formation
			Yabitsu Formation		Yabitsu Formation
		Sakamotogawa Formation	Osuke Formation		Osuke Formation
		Koshitomaezawa Formation			
		Ryukawa Formation	Ryukawa Formation		Shimosaruta Formation ?
		Kunimitoge Formation			
		Rentak Formation			Ioka Formation
	Pre-Tertiary	Metamorphosed Paleozoics and Granitic Rocks			Metamorphosed Paleozoics

by narrow but well rounded shallow concave valleys. Both annulations and valleys are not uniform in their development. The largest and most expanded annulation occurs near the preserved uppermost part of the cylinder. No external sculpture except for the annulations and valleys are recognized. The external wall or sheath is firm, 4-7 mm in thickness and its outer part or external surface is dark brown as if limonitic, stained irregularly at places, its inner surface is of fine grained tuff and stained darker as mottles or banded. The external surface of the specimen brownish yellow in color and stained here and there as mot-

Explanation of Plate

All figures reduced to one half natural size. Photo: K. Kumagai

- Figs. 1, 2. External views of the specimen to show the annulations, stained portions, concave layers, limonitic sheath, and general shape.
 Figs. 3, 4. Top (fig. 3) and bottom (fig. 4) views of Figs. 1 and 2 respectively. Fig. 3 shows the concave surface of the uppermost layer and fig. 4 the plugged nature of the sediments. The sheath of limonitic material is well displayed.
 Figs. 5, 6. Longitudinal views to show the concave shaped layers extending throughout the specimen, the development of limonitic material of the sheath, and gradual downward narrowing sides.

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bles with some banding. The material filling the cone-like specimen consists of diatomaceous (*Melosira islandica* O. Müller, *M. distans* (Ehr.) Kütz., *Stephanodiscus astrea* var. *minutula* (Kütz.) Gnow., *Cyclotella* sp., *Fragilaria* sp., *Melosira* sp. : these were identified by Mr. Itaru Koizumi, graduate student in Institute of Geology and Paleontology, Tohoku University, to whom the writer takes this opportunity to express his deep thanks), fine grained tuff. The diatomaceous fine grained tuff deposited in the cylinder is of concave form like the septa of orthocones. Each concave septa-like layer is about 7–10 mm in thickness and consists of many laminae, from very thin paper thickness to rather thick lamina of about 1 mm.

In longitudinal section, it was found that the concave septa-like layers extended from top to bottom of the preserved part of the cylindrical structure, with no change in the degree of curvature of the concavity, development of the layers and their laminae. However, the upper nearly 33 mm thick part of the cylinder, or the rather widely expanded part is filled with fine grained tuff of whitish yellow color whereas the part below is colored more deeply yellowish and stained bands are developed. The limnic part of the sheath extends from top to bottom of the cone-like cylinder as now preserved.

Remarks on the Specimen

It was already mentioned above that the present specimen shows remote resemblance to *Kulindrichnus*. The general shape of *Kulindrichnus langi* Hallam, 1960, described and figured by Doughty (1965, p. 146, fig. 1) from the Lower Lias "Limestone beds of the Bucklandi Zone extending along the Frondingham Ironstone escarpment from Messingham, 3 miles south of Scunthorpe, to Whitton, on the Humber, in the northwest of the country" shows a more or less remote resemblance to the present specimen. The orientation of the apex or narrower part directed downward and the cylindrical or conical shape of the Lias specimens are quite the same in the Japanese specimen, except for the size and mode of occurrence. *Kulindrichnus* is said to be normally of "indurated small shells and shell fragments and a sheath of phosphatic rock is sometimes found around the specimens". In the present specimen a limonitic sheath forms the external wall and no shells or fragments of any kind are found adhered.

From the just described features it is evident that the present specimen cannot be referred to the genus *Kulindrichnus*, or to any previously described and formally named one, so far as the writer is aware.

Although it may be advisable to propose a generic name for the peculiar specimen described in this article for the sake of convenience in its use in stratigraphy, correlation and problems related with paleoenvironment, the writer refrains at present from such procedure because the specimen is not a complete one and more should be studied.

Diplocraterion parallelum (Torell) figured by Hallam (1963, p. 562, fig. 4, a and b) shows some resemblance to the present one in having plugged tubes, but differs in the tubes not being U-shaped, of small size or parallel straight walls as in that genus. However, the convex structure of the sediments filling the tube seem to be analogous even though *Diplocraterion* is of marine origin and the present one of lacustrine environment.

Rhizocorallium jenense Zenker figured by Hallam (1963, p. 562, fig. 4c) is stated to be of much larger size than *Diplocraterion parallelum* and with curved axis which is oriented more or less parallel to the bedding whereas the latter named one is vertical in position.

Literature on concretions and concretionary structures are abundant, but so far as the

writer has been able to find, there are none with which the present one can be identified.

For the reasons mentioned above it is difficult to explain the process by which the present specimen developed. However, from the fossil flora (Murai, 1962) and the fresh-water diatom flora identified by Koizumi (from sediments scraped off the present specimen) as well as those listed by Murai (1962), it seems evident that the lacustrine sediments were deposited under a climatic condition cooler than at the present day at the same altitude and latitude, because the original lake may have occupied a higher altitude and or the temperature may have been lower. There is no evidence by which the depth of deposition of the sediments in which the specimen was found can be determined, except that it was found in the upper part of the Masuzawa Formation. On the other hand there is no evidence to show that the depth of the lake water was great.

It is assumed that the specimen was made on a lake bottom influenced with cool water, at a moderate depth, not subjected to agitation or bottom currents (ripple-marks, cross-bedding and other water make structures have not been observed), but under tranquil conditions. Whether the production of the specimen was associated with or related with the sedimentary structure produced by subaqueous slumping remains to be settled. However, even it was related therewith the explanation of the limonitic sheath is difficult to interpret.

Although plant leaves and lignitic materials have been found from upper part of the Masuzawa Formation, whether the endoderm of some water plant or the external covering of some submerged land plant root, stem or trunk could have been responsible for the making of the limonitic sheath, and the decayed and hollow inner part later filled from above by depositing sediments is another problem to be considered. At present it is considered that the limonitic sheath of the specimen was originally part of a plant, later decayed and transformed into limonite, and the inner parts were also decayed to form a hollow tube which was latter filled by sediments deposited from above.

References

- Doughty, P. S. (1965): Trace Fossils of the Liassic Rocks of Northwest Lincolnshire. *Mercian Geologist*, Vol. 1, No. 2, p. 143-152, 1 table, pl. 6, 7.
- Hallam, A. (1960): *Kulindrichnus langi*, A New Trace Fossil from the Lias. *Paleont.*, Vol. 3, p. 64-68, pl. 15, text-fig. 1.
- Katto, J. (1965): A Note on Some Concretions from the Muroto Formation (Eocene) of Kochi Prefecture, Shikoku, Japan. *Kochi Univ., Res. Rep.*, Vol. 14, Nat. Sci., 1, No. 2, p. 7-28, 1 table, pl. 1-3 (with bibliography).
- Murai, S. (1962): Geology and Paleobotany of the Shizukuishi Basin, Iwate Prefecture, Japan. (Part 1.). *Iwate Univ., Rep. Tech.*, Vol. 15, No. 1, p. 131-193, 10 tables, 3 figs.