

COCONEIS DIATOMS INFECTED ON WHALES IN THE ANTARCTIC

TAKAHISA NEMOTO

Diatoms infected on the whales have been studied by Hart (1935), Kalcher (1940), Hustedt (1952) and Nemoto (1956), and many interesting diatom specimens are found on the skin films of whales by their works. Among them, *Cocconeis ceticola*, which is first described by Nelson in Bennett's paper (1920) is the most dominant species on whales, but it has never been found as the plankton or on any other host than whales. The next real parasitic *Cocconeis*, *C. Wheeleri* is described by Hart (1935), but Okuno (1954) considers it may be a variety of *C. ceticola*. Above two-mentioned forms and a new variety of *C. ceticola*, *C. ceticola* f. *constricta* described in the previous report (Nemoto, 1956) from sperm whales in the North Pacific are also observed among the collections from the Antarctic whales.

The study on the samples collected by the Japanese Antarctic whaling expeditions reveals that some characteristic forms of *Cocconeis* are found besides three above forms. Some of new *Cocconeis* forms seem to transform their types according to their host species or parasitic positions of whales. Diatom samples treated here are collected by the Japanese whaling expeditions from various species of whales and preserved in formalin sea water.

The preparations and the method of this examination are the same as those in the previous report (Nemoto, 1956), but Hyrax is mainly used in this study as a mounting medium. The phase-microscope is mainly used for the preexamination of species before electron-micrograph studies.

NOTE ON SPECIES

Cocconeis ceticola Nelson

C. ceticola is the most dominant diatom on whales as it has been considered up to this time. The typical form is mostly found on fin whales, sei whales and blue whales, while I have never found any typical specimens of *C. ceticola* on sperm whales as in the case of northern sperm whales. *Cocconeis* specimens found on sperm whales are all constricted forms except some vague ones.

Cocconeis ceticola form. *constricta* Nemoto

This variety form of *C. ceticola* is mainly found on sperm whales as in the North Pacific. But some specimens found on humpback whales

bear such constricted valves as those of *C. ceticola* f. *constricta*. These constricted forms, however, have wider girdles than typical *C. ceticola* f. *constricta*.

Cocconeis ceticola form. *subconstricta* form. nov.

Cells are solitary, forming patches on the skins of blue whales. Valves are rather broadly oval and constricted at only one side of the valve where the stauros of rache valve reaches. The surface structures and sizes of valves are the same as the original form of *C. ceticola*.

This form is found only on blue whales caught in the Antarctic waters among *C. ceticola*, and is considered one of the intermediate forms between *C. ceticola* form *constricta* and the original form of *C. ceticola*.

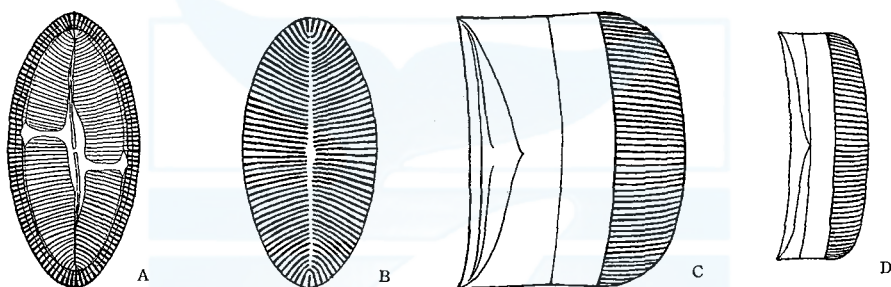


Fig. 1. *Cocconeis Wheeleri* Hart, $\times 1000$. A, rache valve. B, racheless valve. C, D, girdle views of *C. Wheeleri*.

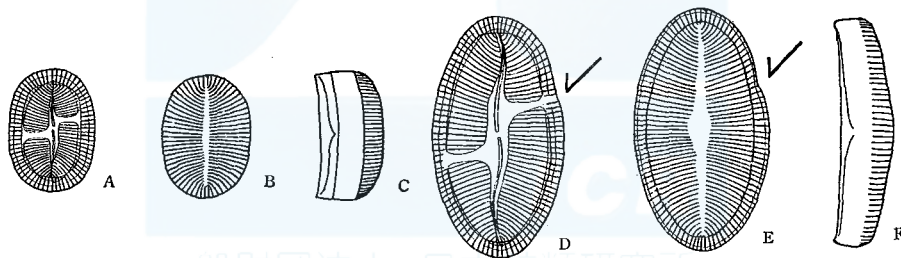


Fig. 2. A, B, C, *Cocconeis ceticola* collected from humpback whales. $\times 1000$. D, E, F, *Cocconeis ceticola* fo. *subconstricta* n. fo. $\times 1000$. Notice the broader girdles of valves illustrated in C figure. Arrows show the constricted position of the valves.

Cocconeis Wheeleri Hart

Hart (1935) describes this characteristic diatom only from Antarctic humpback whales, and I also observe it mainly on humpback whales. Many specimens collected from tail flukes of humpback whales are almost all *Wheeleri* type, and on the other hand *ceticola* type specimens are very small in number on humpback whales. (Fig. 2. A. B. C.)

The most characteristic distinctions between two above forms may be the curvature of valves and width of girdles' portion. Other distinction,

such as the size of valves is not clear enough to divide two forms as described in Okuno's report. The sizes of valves of *Wheeleri* are rather larger than *C. ceticola* as described by Hart (1935). But the largest *C. ceticola* is also as large as *C. Wheeleri* (Okuno, 1954).

In the previous paper (Nemoto, 1956) I considered *C. Wheeleri* might be one variation of *C. ceticola* as described in Okuno's report, because no specimens of *C. Wheeleri* was found on other baleen whales than humpback whales, and popular *C. ceticola* was also not observed on humpback whales. It suggests that *C. ceticola* transformed its shapes when it attached to humpback whales. However, I have not been able to derive any valid reason for above transformation of *Cocconeis* specimens after such consideration, and samples collected from a blue whale in the Antarctic are also all *Wheeleri* types. So I describe here *C. Wheeleri* again as a form different from *C. ceticola* after the description by Hart. Some discussion on this point is stated in the following chapter.

DISCUSSION

The original type of *Cocconeis ceticola* is reported by Nelson in Bennett's paper (1920). After their descriptions and successive investigations by Hart (1935), Hendey (1937), Okuno (1954) and Nemoto (1956), all typical forms of *C. ceticola* are elliptic-lanceolate in the outlines. This typical form of *C. ceticola* is mostly collected from fin whales. *Cocconeis* diatoms collected from fin whales are all this *ceticola* type. On the contrary, the constricted form *C. ceticola* f. *constricta* is only found on sperm whales as in the northern Pacific (Nemoto, 1956). The outline of the constricted form is broadly oval and constricted at the median margin of the valve and it is considered that the constricted form is one of the transformations of *C. ceticola* on sperm whales, and the constricted form has never been found on fin whales.

Ceticola form is also found on sei and blue whales, but *ceticola* form is rarely found on humpback whales, while, *C. Wheeleri* is only found on humpback whales. *Cocconeis Wheeleri*, reported by Hart from the Antarctic humpback whales, has never been found on the species of whales but a blue whale. *C. Wheeleri* resembles closely *C. ceticola* but has much greater width of the girdle and stronger curvature of the valves as described by Hart (1935). The sizes of valves are also larger than those of *C. ceticola*. But in opposition to Hart's description, Okuno (1954) considers *C. Wheeleri* may be a synonym of *C. ceticola*, because sizes and structures of valves of *C. Wheeleri* do not differ so markedly as *C. Wheeleri* is separated from *C. ceticola*.

I also considered that *C. Wheeleri* might be a fixed variety form of

C. ceticola in my previous report, because *C. Wheeleri* is found only on humpback whales and few *ceticola* type is found on humpback. It suggests that *C. ceticola*, which is very common on other whales, is transformed by any causes of humpback whales' skins when it attached to the whales. But the further observations after above suggestion, reveals that, though *C. ceticola* has many variety forms, it is best to consider

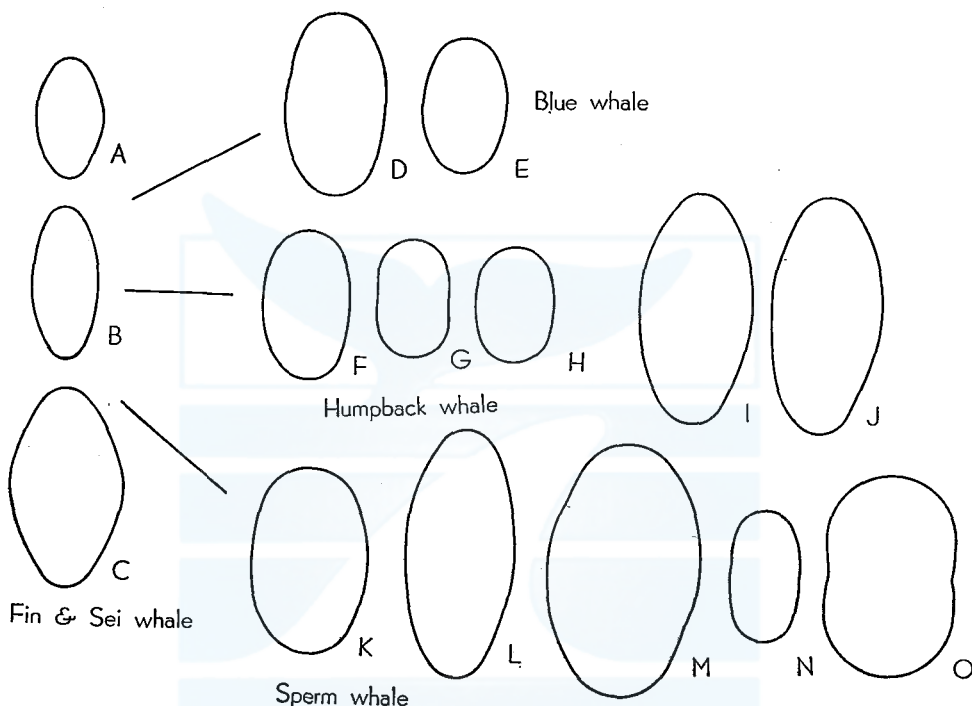


Fig. 3. A, B, C, *Cocconeis ceticola* Hart collected from fin and sei whales. D, *C. ceticola* f. *subconstricta* collected from a blue whale. E, *C. ceticola* collected from the same blue whale. F, G, H, *C. ceticola* & *ceticola* f. *constricta* collected from humpback whales. I, J, *C. Wheeleri* collected from humpback whales. K, L, Ambiguous *C. ceticola* collected from sperm whales. M, N, O, *C. ceticola* f. *constricta* collected from sperm whales.

C. Wheeleri is the fixed species on humpback whales though it is possible that further information on structures, etc., may cause me to revise my present opinion. These variety forms and *Cocconeis Wheeleri* are listed in figure 3. As shown in figures, various forms of *Cocconeis ceticola* are found on each whale. Especially, it is an interesting fact that the outlines of valves differ in each whale species as partly described in above descriptions. The types A, B and C are collected from fin and sei whales in the North Pacific and the Antarctic. They are all typical *ceticola* forms, and these host whales are mostly related to each other.

The next figures D and E are found on a blue whale caught in the Antarctic waters. The characteristic point of the former specimens is a constriction on only one side of the valves. This constriction is usually found on the marginal position where the stauros of rache valves reaches alike *constricta* form which has two constrictions on both sides. The latter oval form is found on the same blue whale and it closely resembles some specimens collected on humpback whales. This oval form is not the typical elliptic lanceolate *ceticola* form, and this type is also observed on sperm whales as shown in K illustration. The oval form is considered as the first transformation of *C. ceticola* on other whales than fin whales.

F illustration is collected among the ventral grooves of humpback whales in the Antarctic. The next G illustration is collected from the same whales. The following figures, H, I and J illustrations are obtained also from humpback whales. But, these specimens are collected from the tail flukes of humpback whales. The latter two specimens are apparently *Wheeleri* types. *Cocconeis Wheeleri* has been found only on humpback whales by Hart (1935) and also by my examinations on Japanese collections in 1954 and 1957, but in 1958 I found *C. wheeleri* on a blue whale in the Antarctic. The typical *Wheeleri* specimens are mostly collected from the tail flukes of humpback whales. On the contrary to this fact, there is no dominant patch of typical *Wheeleri* among the ventral groove specimens in 1957. And the ventral groove specimens are almost all rather small oval forms or sometimes constricted form like *C. ceticola* f. *constricta*. This phenomenon suggests that, though the materials are few in number, the parasitic positions on whales may have some effect to the transformation of the form of *C. ceticola* or the related forms.

From the girdle view of above *Cocconeis* specimens, some interesting features are also observed. The subconstricted form, D and E illustrations have narrow girdles as *ceticola* form shown in figure 2. But oval and constricted form collected from humpback whales among ventral grooves have the wider girdles like *Wheeleri*, though they never bear the stronger curvature of valves such as *Wheeleri*. So from the girdle view, it resembles *C. Wheeleri* more than *C. ceticola*. The microstructure of the girdles of the specimens is now under close examination and it will be discussed in the next report.

The deformation of *C. ceticola* on sperm whales is also very characteristic. In the lower series, these typical variety forms on sperm whales are illustrated. K illustration shows the first deformation, which is mostly related to the original type and mostly related to Karcher's photographs in 1940. L illustration is as large as *C. Wheeleri*, but this

specimen bears slight curvature of valves like that of *ceticola* form. M, N and O illustrations are all constricted forms, though some differences are observed among these forms. M specimen is large and the constricted positions are not situated at the median portions of outlines. N specimen is generally of moderate size, and rather slender than other *constricta* forms. This type is also shown in figures 11 and 12 in plate II. The constriction of the type is not sometimes so distinct as oval *constricta* form. O illustration is the most typical *constricta* forms, and no typical difference is observed in surface structures, from the constricted forms of *C. ceticola* f. *constricta* from humpback whales but the sizes of valves.

SUMMARY

Cocconeis diatoms infected on the Antarctic whales are examined. *Cocconeis ceticola* is mostly common on fin, sei and blue whales, but it is found on humpback and sperm whales in rare cases. *Cocconeis Wheeleri* Hart is the dominant species on humpback whales and *Cocconeis ceticola* f. *constricta* Nemoto is the dominant species on sperm whales.

One new form, a variety form of *C. ceticola*, *Cocconeis ceticola* f. *subconstricta* is described from blue whales in the Antarctic.

Some specific differences among host whales, and transformations of *Cocconeis* diatoms are suggested.

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EXPLANATION OF PLATES

All photomicrographs have been taken by electronmicroscope. The materials are boiled with hydro-chloric acid to remove the organic contents before the photographing.

PLATE I

Fig. 1. Rache valve of *Cocconeis ceticola* f. *constricta* Nemoto collected from a sperm whale in the Antarctic. × 4000.

Fig. 2. Rache valve of *Cocconeis ceticola* collected from a humpback whale in the Antarctic. $\times 4000$.

Fig. 3. Racheless valve of *Cocconeis ceticola* f. *subconstricta* n. fo. collected from a blue whale in the Antarctic. $\times 4000$.

PLATE II

Figs. 1 & 2. *Cocconeis ceticola* f. *subconstricta* n. fo. collected from a blue whale in the Antarctic.

Figs. 3 & 4. *Cocconeis ceticola* f. *constricta* collected from a humpback whale in the Antarctic.

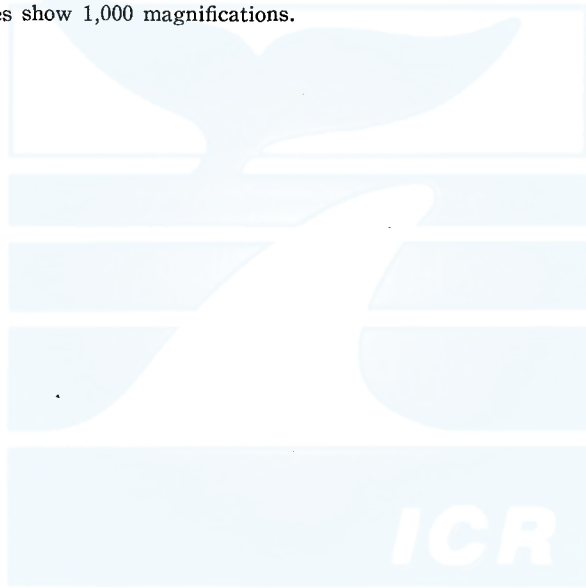
Figs. 5. & 6. *Cocconeis ceticola* collected from a humpback whale in the Antarctic.

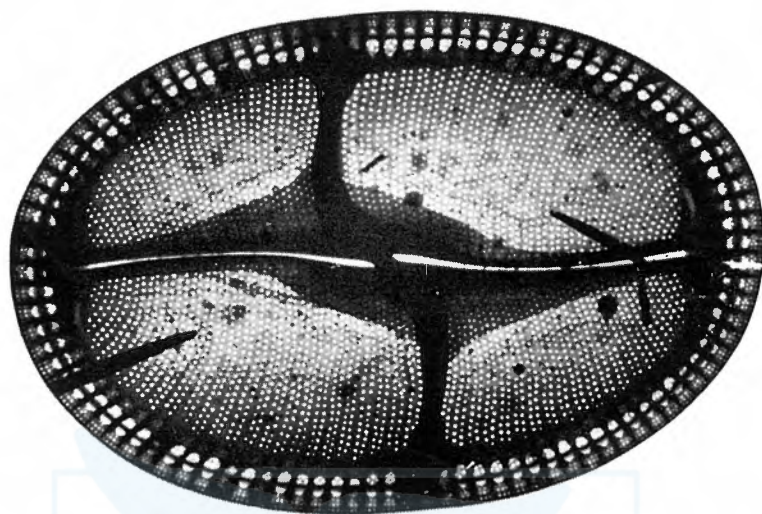
Figs. 7-9. *Cocconeis Wheeleri* Hart collected from humpback whales in the Antarctic.

Fig. 10. Ambiguous *Cocconeis ceticola* Nelson collected from a sperm whale in the Antarctic.

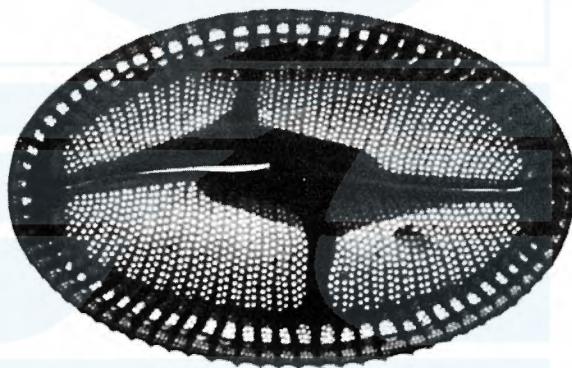
Figs. 11-15. Various forms of *Cocconeis ceticola* f. *constricta* Nemoto collected from sperm whales in the Antarctic.

All photographs show 1,000 magnifications.

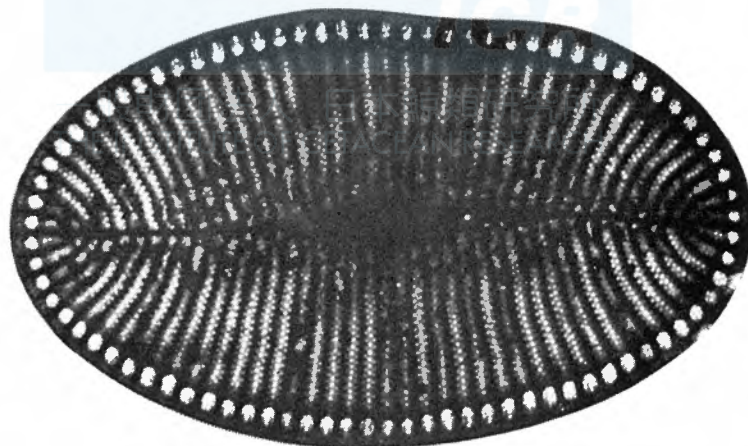




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