SOME CRETACEOUS FORAMINIFERA OF SOUTH DAKOTA

The investigation on which this paper is based was begun with the purpose of determining the number and kind of Foraminifera which occur in the Greenhorn and Niobrara formations of the Cretaceous of South Dakota. Species and their relative abundance were tabulated to determine whether or not microfossils can be used to distinguish these two important formations.

Three important contributions to our knowledge of the foraminifera of the Greenhorn and Niobrara formations have been published. The first of these was published by the Minnesota Geological Survey in a report entitled "The Microscopic Fauna of the Cretaceous of Minnesota with additions from Nebraska and Illinois," by Woodward and Thomas. It contains descriptions of specimens of foraminifera from the Niobrara chalk (probably from Yankton) sent them by Dr. Bresny of Donne College in Burbank. Foraminifera from the Niobrara of South Dakota and from the Greenbore of north western Iowa were figured and described by Samuel Calvin in Volume IV of the Iowa Geological Survey under the title "Composition and Origin of Iowa Chalk." Calvin, however, did not differentiate the two formations as he believed they to be the same horizon. Niobrara foraminifera from Kansas were also described and figured by E.C. Koolurig. Most of the specimens obtained from South Dakota chalk were described and figured by these early workers.

METHODS

Two methods were used to separate the fossils from the matrix of chalk. It was found that by the use of a brush having short, stiff bristles the chalk could be readily disintegrated, brushed gently into a large beaker or other utensil of suitable size. Boiling small samples gently in beakers or test tubes in many cases has proved an effective method of disintegrating the chalk. Either method of disintegration produces a white or light colored mud or water of milky appearance resulting from the suspension of particles of considerable size range. It is desirable to remove all sizes of material larger or smaller than the shells of microfossils by washing. This was accomplished by agitation of the material in a large beaker (1000 c.c. or larger) preferably using distilled water. The material is then permitted to settle for five minutes after which the liquid is decanted or siphoned off. Washing is repeated until the liquid is clear after the settling period has elapsed. The residue is then filtered and dried.
In some cases where calcareous particles adhered to the specimens after disintegration, washing for brief periods in water made slightly acid with hydrochloric acid was an effective means of cleaning the specimens. Obviously this method is highly successful in the case of Radiolaria, whose tests are of silica (rather than of calcium carbonate).

DESCRIPTION OF FORMATION

Greenhorn Formation

This formation comprises a thin but very distinctive series of beds of hard, lustrous limestone with a thickness of about thirty feet. It consists of a basal member, eight to ten feet thick, of bluish chalky limestone, overlain by a hard lustrous, thin bedded limestone member, twelve feet thick, containing Inoceramus Labiatus in great abundance and inter-stratified with a chalky shale which is in turn overlain by a second chalky limestone member, four to six feet thick. The limits of the formation are commonly well marked, although in some places the limestone grades into the underlying Granerosus shale and overlying Carlisle shale. In many places the limestone occurs in large blocks, divided by distinct but irregular joints. Besides Inoceramus Labiatus, which occurs in great abundance, the formation contains fish teeth and scales, the latter of unusually large size. It also contains shark teeth, both of the usual form and of Psychodus. A chalk sample from the Greenhorn outcrop at Richland was the only one intensively studied but another from the Greenhorn outcrop at Stone Park in Sioux City was checked against it and the two correlated closely.

Miobrama Formation

The Miobrama formation lies above the Greenhorn with one formation, the Carlille, intervening. The most characteristic feature of the formation is the chalk stone, but possibly a considerable thickness of shale should be considered as included in the formation. The Miobrama has a total thickness of over two hundred feet. The chalk rock of the Miobrama when weathered is a white or pale yellow, and therefore is in strong contrast with the dark color of the underlying Carlisle shale. In many places where the Miobrama is unweathered, it is a moderately dark bluish grey color.

The most abundant microscopic fossils of the Miobrama formation are small, deep cup-shaped oysters (Ostrea Congesta Conrad) commonly found in colonies and often attached to fragments of Inoceramus shell. Teeth of sharks and bones of T close fish and large swimming reptiles are also found. A very small lingula is also found but is quite rare. Specimens from the outcrops at Yankeetown, Menno, Redfield, Chamberlain and Hot Springs were studied, thus making these studies fairly
representative of this formation in South Dakota.

THE MICROFAUNAS

In the Microfaunas of the two formations seven genera and ten species were found. Sponge spicules and rods from oyster shells occur also, and while they are not foraminifera, they are microscopic in size and of use in differentiating localities in the same formation. The list of forms includes the following:

- Textularia agglutinans d'Orbigny
- Textularia globulosa Ehrenburg
- Radiolaria (Polyocyrtidae)
- Globigerina cretacea d'Orbigny
- Globigerina bulloides d'Orbigny
- Arbulina universa d'Orbigny
- Lageno bispida Reuss
- Ammonia ammonoides Reuss
- Bolivina vickburgensis Cushman
- Sponge spicules
- Rods from oyster shells

SYSTEMATIC DESCRIPTIONS

Textulariidae

Textularia globulosa Ehrenburg

Textularia globulosa Ehrenburg (1838) Aband, Akad., Berlin, Pl. 4
Textularia globulosa Ehrenburg 1838, pp. 421, 423
* * * * Hitchcock (1845) Ass. Geol. and Nat. (1840-1842) pp. 387, pl. XV
* * * * Meek (1864) Smith, Inst. Check list
* * * * Cret. and Jur. Fossils, pl. 1
* * * * Davison (1874) Can. Nat. Vol. 7, page 253
* * * * Woodward and Thomas 1885, 13 Ann. Report, Geol. and Nat. Hist. Sur. of Minn., p. 135, pl. III, figs. 1-5

The description of Textularia globulosa is quoted from G.H. Dawson's paper on Foraminifera of the Cretaceous Rocks of Manitoba. This is much superior to the original description by Ehrenburg.

"A stout form with globose chambers, rapidly increasing in size at each addition, and sometimes even as broad as long. The primordial chamber, and those next to it, are often bent away several degrees from the axis of symmetry of the larger part of the shell. The surface of the shell is marked with extremely minute diagonal, interrupted ridges or wrinkles."
The forms found in the Greenhorn and Niobrara differed in no conspicuous detail from this description except that the Greenhorn forms have their chambers arranged in a heterogeneous manner and they are not formed in one plane.

POSITION - Niobrara, Greenhorn, Carlisle: all Cretaceous
LOCALITY - Yankton, Henno, Redfield, Richland, Hot Springs, Chamberlain.

Textularia agglutinans d'Orbigny

Textularia agglutinans d'Orbigny, Historie Physique, Politique et Naturelle de l' Ile de Cuba, Foraminiferes, p. 135, pl. 1, figs 17, 18 (1839)

" " H.O. Brady, Challenger report, Zoology, vol. 9, p. 465, pl. 45, figs 1-3 (1884)
" " Cushman U.S. Nat. Mus., Mus, Bull. 71 pt. 2, p. 9, figs. 10a (1918)
" " Cushman, U.S.O.S. Prof. Paper 129, p. 89, (1922)

Test elongate, large and stout, gradually tapering from the initial end, chambers nearly as high as wide, twisted, depressed sutures, early portion slightly compressed, test wall arenaceous with calcareous base, larger chambers rougher, tests arenaceous but roughly finished.

POSITION - Niobrara, Cretaceous
LOCALITY - Henno and Redfield

Eolivina vicksburgensis Cushman

Eolivina vicksburgensis Cushman (1922) U. S. G. S. Prof. Paper 129, p. 126, pl. 29

Test elongate, tapering, apical and bluntly pointed, gradually increasing in width for a few chambers and then the sides are nearly parallel the remainder of its length. Chambers distinct sutures deep, lower end of chambers project slightly over the chamber directly below so as to form a wavy edge. Chambers triangular, sutures sloping towards the apical end. Surface profusely punctate, punctae arranged in rows.

The type of this specimen is an Eocene form but the Cretaceous form here described shows no differences in character.

POSITION - Niobrara, Cretaceous
LOCALITY - Henno
Globigerinidae

Globigerina Cretacea d'Orbigny


Test rotaliform, much compressed, superior face convex, inferior concave, periphery obtuse. Five to seven chambers in the outer convolution. Segments relatively small, increase gradually and proportionally, punctuate.

Globigerina bulloides d'Orbigny


Test spireal, sub-triangular, superior face convex, inferior face concave, deeply sunken umbilicus, periphery rounded, lobulated, four chambers form the outer convolution. Punctuate. A rare specimen in these formations.

POSITION - Hobnra and Greenhorn, Cretaceous
LOCALITY - Yankton, Meade, Redfield, Chamberlain, Richland.

Orbulina universa d'Orbigny


Shell free, regular, spherical, hollow, perforated with a large number of very minute foramin, visible only under very high magnification. Septal orifice small, single, situated on the periphery but often invisible. Calcareous texture. Often flattened out and crumpled.

POSITION - Hobnra and Greenhorn, Cretaceous
LOCALITY - Yankton, Redfield, Meade, Chamberlain, Hot Springs

Lagenidae

Sub-family Lageniidae

Leagena, Walker and Boys

The arched or rounded part of the test is very variable in form but most commonly is nearly circular. Towards the top it is drawn out to form a thin, tubular neck which was never present in the forms from these two formations. The surface of the globular part is covered with closely spaced, irregularly spaced thoracic tubercles. These specimens are quite rare.

POSITION - Miobrara, Cretaceous
LOCALITY - Chamberlain

Sub-Family Rotalinae
Anamolina d'Orbigny.

Anamolina Ammonoids Reuss (1845) Vörstein. bollm. Kreid., pt. 1, p. 35, pl. XII, fig. 28. pl. VIII, fig. 5

Tests much compressed and nearly equally convex on both sides. The peripheral edge is nearly round and the aperture is in the center of the median line. Early convolution visible on both dorsal and ventral sides. Coarsely punctuate. Very thin test wall.

POSITION - Miobrara, Cretaceous
LOCALITY - Boatno, Redfield

Radiolaria
Radiolaria, Müller.

Polycystinae

An order of the Rhizopods which have a siliceous test. Tests gradually increase uniformly in size. Sutures excavated. Apical angle quite small. No surface markings.

POSITION - Miobrara, Cretaceous
LOCALITY - Yankton

IDENTIFICATION OF FORMATIONS.

There are several striking differences in the faunas of the Greenhorn and Miobrara chalks.

1. The relative abundance of Orbulina. These foraminifera were much more abundant in the samples from the Greenhorn than in those from the Miobrara.
In the Greenhorn specimens from Richland and the specimen from Iowa, the Orbilocoides made up about 40% of the total content of the foraminifera. In none of the Niobrara specimens did the Orbilocoides exceed ten percent and often there is only a trace present. About five or six specimens out of a hundred would be the average of the Orbilocoides in the Niobrara chalk.

2. Another method of separating the two formations is on the type of the Textularia globulosa specimens. The Greenhorn specimens are twisted and poorly symmetrical and usually quite small while the Niobrara specimens are very symmetrical. Textularia globulosa is the most abundant Niobrara species.

3. The relative abundance of species common to both formations as shown in the diagram of faunal analysis which follow appears to be a reliable criterion. These diagrams represent abundance as ascertained by counts of specimens in representative slides from different localities. The most abundant form of the Niobrara formation as brought out in the analyses is Textularia globulosa, whereas Orbilocida universalis is significantly abundant in the Greenhorn.
Neural Analysis

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Slide No. I
Positio-n: Niobroze
Locality: Yankton

Notes: This chalk is a drab color which becomes darker when wet. It has a distinct,apy odor and very fine texture. Under magnification of 61.5 Ciphers it was still a drab gray but looked finely granular and porous.

Date: April 25, 1950
Harvey W. Anderson, Analyst
### Fossil Analysis

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Slide No. II
Position- Miobrara
Locality- Chamberlain

Notes: This is another specimen of Miobrara chalk. It is a very dark grey, almost black in color. This chalk is quite hard and has small pieces of harder material in it. The foraminifers are very difficult to separate from their matrix, and even when separated with the aid of chemicals, still have calcareous particles adhering to them.

Date- April 25, 1920  
Harvey E. Anderson, Analyst
### Yeomal Analysis

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**Slice No. III**

**Position:** Micrbara

**Locality:** Yennan

**Notes:** This chalk came from Yennan and belongs to the Micrbara formation. It is a very light gray, almost white. It has a very distinct clay odor when wet. Under magnification of 51.5 it looked like a good grade of table salt, both in color and texture. Copseum crystals were also seen in this chalk while it was under the microscope.

**Date:** April 25, 1929

Harvey W. Anderson, Analyst
<table>
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Slice No. IV

Position-Hiobrara

Locality-Hedfield

Notes-This chalk is Hiobrara. It has a peculiar thin bedded cleavage that is almost as thin as the cleavage of shale. It has a tan color and no distinct odor. The microscopic fossils from this locality are hard to separate from the chalk due to the large amount of finely divided material in it.

Date-April 25, 1920 Harvey W. Anderson, Analyst
Found Analysis

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Slide No.-V
Position-Mobbyara
Locality-Hot Springs

Notes: This chalk comes from the Mobbyara formation where it is exposed in the Black Hills. It is a very white chalk and is composed of some colloidal material. It has a faint clay odor, becomes slightly darker when wet.

Date-April 25, 1930
Harvey W. Anderson, Analyst
### Faunal Analysis

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Slide No. VI

Position: Greenhorn

Locality: Richland

**Notes:** This chalk constitutes the chalk member of the Greenhorn Limestone. This chalk is thin bedded and is coarse and granular. It is a dark tan-gray in color and has a pronounced clay odor.

Date: April 25, 1930

Harvey W. Anderson, Analyst
Radiolaria sp.

Globigerina cretacea d'Orbigny

Textularia globulosa Ehrenberg

Textularia esculenta d'Orbigny

Sponge spicule
Textularia globulosa Ehrenburg

Aramolina ammonoides Reuss

Bolivina tuckerensis Cushman
Textularia globulosa Thrombg

Anomalina ammonoides Reuss

Orbulina universa d'Orbigny
Globigerina cretacea d'Orbigny

Lagenia hispida Reuss

Orbulina universa d'Orbigny

Textularia globulosa Ehrenberg

Textularia globulosa Ehrenberg

Scale in mm: 40 5 2