

GY 112L Earth History

Lab 6

Biostratigraphy and Foraminifera

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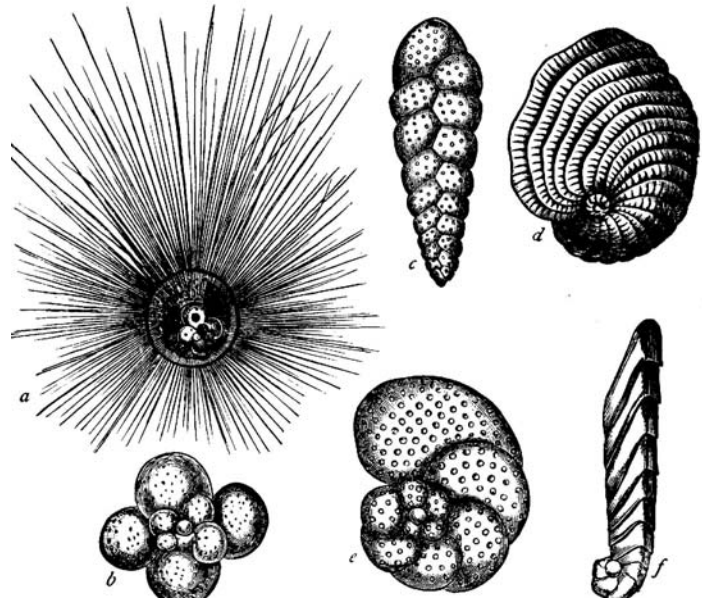
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This manual is constantly being updated and occasionally, even improved. Typos, grammatical errors and sections that make no sense whatsoever may, or may not, be intentional. If you find an error, show it to your instructor. You may get bonus points. More likely you will be told to go away

The recipes that are included in some sections are intended to prove that you can eat anything as long as you serve it with plenty of ketchup. Neither Haywick, nor the Connors are responsible for any food poisoning that might occur if you actually try them.

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Lab Six

Biostratigraphy

Background: We have spent considerable time discussing the importance of fossils in unraveling Earth history and you should recall that they are particularly useful in establishing stratigraphic relationships between rocks in different areas. This component of geology is known as **biostratigraphy**. Many fossils can be used in biostratigraphy, but one of the most important groups is the **foraminifera**. Commonly referred to as “**forams**”, these beasties are usually tiny (frequently smaller than 0.1 mm) and hence, can really only be studied with the aid of a microscope. For this reason, they are considered to be **microfossils**.

Whether you use microfossils or **macrofossils** or even **nannofossils** (really tiny beasties best studied with an electron microscope), the procedures required to establish biostratigraphic relationships are relatively straight-forward. You must first identify the types and names of beasties (usually down to genus and species levels) that are contained in the rocks. Then you need to determine the age range of each of those beasties. Unless the fossil(s) you identify are new species, there is a good chance that someone has already determined when they lived and they preferred environment. For example, the large gastropod *Struthiolaria frazeri* (Figure 6-1), has been studied by many different paleontologists and they have determined that it lived

¹ Figure shows tests of living (Modern) foraminifera. From Le Conte, J., 1905. Elements of Geology. D. Appleton & Co. New York, 667p.

from the late Pliocene to the early Pleistocene in sandy marine environments less than 50 m deep. Since its age and environment of deposition is rather restricted, you can be pretty certain that if you find strata containing *Struthiolaria frazeri*, the strata must be late Pliocene-early Pleistocene in age and must have been deposited in a shallow ocean. If you find a new fossil, there is a bit more work required to resolve its age and paleoenvironment, but at least you get to name the beastie.

In most cases, one fossil is insufficient to accurately age a particular sedimentary layer. If a sandstone contained *Struthiolaria frazeri*, all you can safely conclude is that the sandstone formed sometime between the late Pliocene and early Pleistocene. What you really need is a bunch of fossils with overlapping age ranges. If you are lucky, you will be able to establish the age of strata within a very narrow time range (e.g., upper Pliocene, lower Miocene etc.).

The majority of this lab is designed to introduce you to the principles of biostratigraphy and biostratigraphic correlation using a fictitious series of stratigraphic sections. Be warned; this component of the lab frequently causes problems for students.

Since some of the correlations you will be doing involve foraminifera, we thought that it would be a good idea to introduce you to this group of beasties during this lab. Important background information about the forams follows. From this lab exercise onward, every GY 112 lab will include important new fossil groups.

Phylum Protozoa

Foraminifera belong to the phylum **Protozoa** and all protozoans share one common characteristic. They are all organisms that consist of only a single cell. That one cell performs all of the necessary bodily functions including locomotion, digestion and reproduction. Protozoans are generally very small (they are after all, single-celled), and most require a powerful hand lens if you are going to study them (I hope you brought yours today!). Some are so small that electron microscopes are necessary in order to effectively study them.

There are four **classes** of Protozoa and they are distinguished from one another based upon modes of locomotion. The most important Protozoans in geology belong to the class **Sarcodina** which consist of beasties that move and feed via long thread-like extensions called **pseudopodia**. Two **orders**, Foraminifera and **Radiolaria** belong to the class Sarcodina. Both are characterized by beautiful **tests** (a kind of

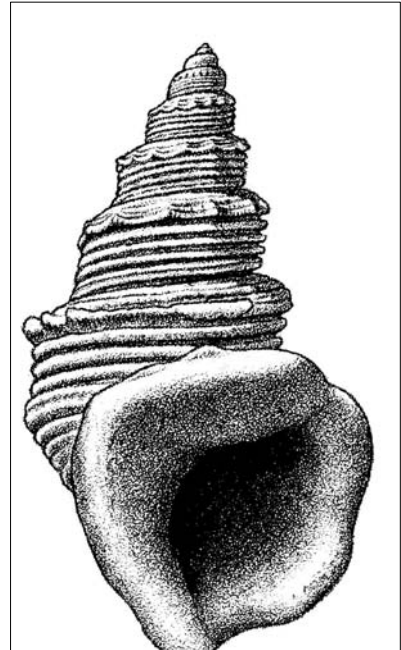


Figure 6-1: *Struthiolaria frazeri* (approximately 6 cm long).

From Beu and Maxwell, 1990.
Cenozoic Mollusca of New Zealand.
NZGS Paleo. Bull. 58

exoskeleton; see inset figure on the first page of this weeks lab) composed of either calcium carbonate (the forams) or opaline silica (radiolarians). The former are important components of **chalk**. The latter, of deep sea **chert**.

In GY 112L, we do not examine radiolarians. They are exceptionally small nannofossils and hence, hard to study in a class room setting. However, some foraminifera (including the **Family** Fusulinidae) were huge, some up to 1 cm across! (remember, foraminifera are single-celled organisms). You will get to see an example of **fusulinid** foraminifera in this week's lab exercise.

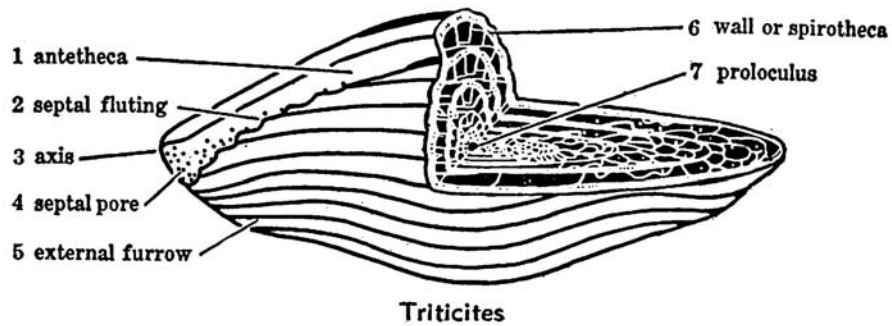


Figure 6-2: Diagram of a fusulinid foraminifera showing important structural features. From, Moore R..C., Lalicker, C.G. and Fischer, A.G., 1952. Invertebrate Fossils., McGraw-Hill, New York, p60.



Notes

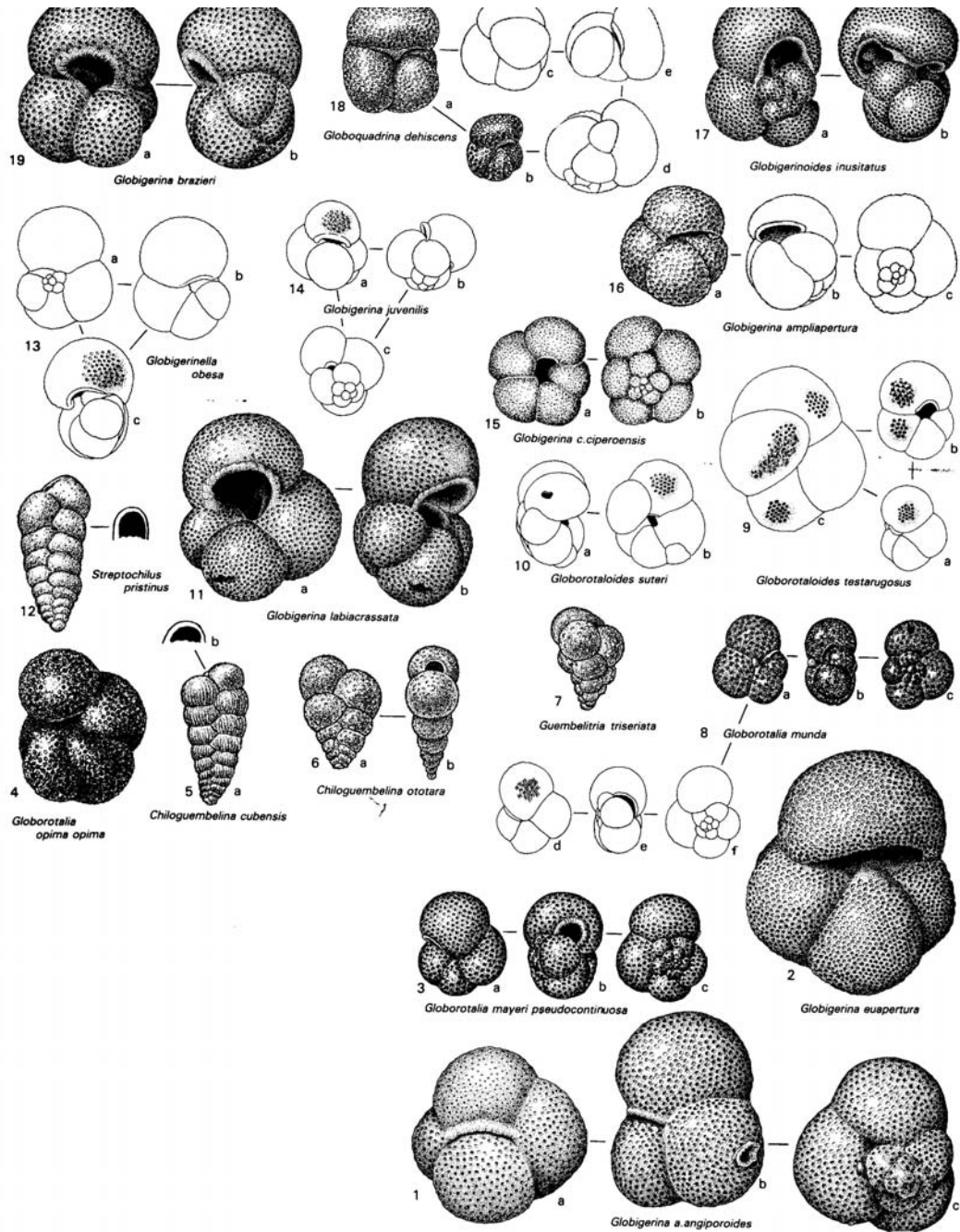


Figure 6-3: Some important planktonic foraminifera. From, Hornibrook, N.de, Brazier, R.C. and Strong, C.P., 1989. *Manual of New Zealand Permian to Pleistocene Foraminiferal Biostratigraphy*. NZGS Palaeontological Bulletin 56., 175p.