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or combination of layers into which they are intruded, and not to the prolongations of these growth planes further out in these layers.

The classification of ribbing and related structures used here is based mainly on morphology, in part also on deduced genesis, and is as follows:

1. Non-additive ribbing, with the shell margin deformed into plications, lobations, or both.
2. Additive ribbing, with structures that appear added onto the shell surface.
3. Composite ribbing, with components of both previous types, comprising a non-additive framework on which are secreted additive structures, whose position is directly related to and in most cases apparently determined by that of the non-additive components.

## Introduction

This paper is essentially a condensed version of a thesis written for the University of California nine years ago<sup>1</sup>. It concerns the various layers found in pelecypod shells, their classification, arrangement, and hence the distribution of the various microstructures contained in these layers, including tubules; an attempted classification of pelecypods based on structure; and the various types of ribbing, together with the modifications they bring about in the structural arrangements within the pelecypod shell. Most of the species observed came from the collection of the University of California and originated from the West Coast of the United States. Some specimens were obtained from the Collection of the Museum of Natural History in Berne and were of European and Asiatic origin.

## Acknowledgments

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<sup>1</sup> A short abstract of the thesis was published at that time by the author (OBERLING, 1955).

of California at Berkeley for the present study. Dr. ARNOLD is responsible for many of the photographs. Miss J. SISCHO drafted the drawings.

In Berne, Director Dr. W. KÜENZI kindly allowed the use of specimens from the Naturhistorisches Museum for the sections done here and made possible the publication of the work in Switzerland. Dr. W. HUBER helped greatly with the plates and Drs. H. ADRIAN and W. HUBER furnished advice and suggestions in preparing the text. Miss V. GERBER helped much in getting the work ready for publication. Many thanks are due to all these persons from the Museum.

### Technique

Three types of sections were used:

1. Rough sections produced by breaking shells for examination by reflected light.
2. Polished sections obtained by cutting shells with a diamond wheel and polishing the cut surfaces with fine carborundum abrasive. These were also examined by reflected light.
3. Thin sections were made by cutting and then grinding parts of shells until they transmitted light<sup>1</sup>.

Rough and polished sections were examined with a binocular microscope under 12, 36 and 96 powers by reflected light. Thin sections were examined with a biological microscope under 120 and sometimes 480 powers with transmitted light.

As the present work deals with gross morphological features, with the arrangement and distribution of the microstructures rather than with a close examination of these microstructures themselves, a petrographic microscope was not used, and, in general, low powers of magnification were found to be adequate for these studies.

<sup>1</sup> An attempt was also made to use a plastic (parlodion) peel method for getting better photographs of some sections. The results however have not been generally too satisfactory.