

of writers to use just such evidence to advocate the theory of a fluviatile origin for the widely distributed beds of loess in the Missouri Valley region.

By passing a quantity of the material from the shell zone over a set of sieves of different mesh, I was enabled to recover a number of very minute species, some of them, notably *Carychium exile* Lea, being quite abundant.

List of species from the government quarry near Mokane, Mo.:

<i>Polygyra albolabris</i> , (a)	<i>Pyramidula solitaria</i> , (c)
<i>Polygyra appressa</i> , (a)	<i>Pyramidula alternata</i> , (a)
<i>Polygyra appressa</i> , small var., (c)	<i>Pyramidula alternata</i> , small var., (c)
<i>Polygyra elevata</i> , (a)	<i>Gastrodonta ligera</i> , (r)
<i>Polygyra multilineata</i> , (r)	<i>Helicodiscus parallelus</i> , (c)
<i>Polygyra thyroides</i> , (c)	<i>Vallonia pulchella</i> , (a)
<i>Polygyra zaleta</i> ?, (c)	<i>Vallonia</i> sp. indet., (r)
<i>Polygyra fraterna</i> , (c)	<i>Bifidaria contracta</i> , (c)
<i>Polygyra monodon</i> , (c)	<i>Bifidaria armifera</i> , (c)
<i>Polygyra hirsuta</i> , (c)	<i>Bifidaria procera</i> ?, (r)
<i>Zonitoides arborea</i> , (r)	<i>Carychium exile</i> , (a)
<i>Zonitoides minuscula</i> , (c)	<i>Helicina occulta</i> , (c)

(a) = abundant, (c) = common, (r) = rare.

THE FEEDING HABITS OF BUSYCON.

BY SHIELDS WARREN.

Last September I made a series of observations on the feeding habits of *Busycon* at Hyannisport, Massachusetts. This place was well suited for the work, since both *B. canaliculata* and *B. carica* occur plentifully, and oysters and quahaugs are fairly numerous. All these observations were made under natural conditions.

There are two distinct stages in the feeding habits, the first when the animal is small and the shell weak, the second when the animal is grown and the shell strong. In the first stage they are incapable of attacking a large lamellibranch, and eat carrion and small univalves, such as *Nassa*, which occur abund-

antly on the flats. To get at the Nassa, they envelop the shell in the foot until it is asphyxiated, and then clean out the animal with the radula. In the second stage the quahaug and oyster are the chief articles of food, and, contrary to the general opinion, the radula is not used to bore through the shells, but the edges of the valves are chipped away against the lip of the Busycon's shell.

I was led to take up these investigations by the following facts: in examining radulae of the Busycons I noticed that they were not so worn as in the borers *Polinices* and *Urosalpinx*; the lips of their shells are almost invariably chipped: and the dead quahaug shells on the flats were not bored but chipped.

Subsequently I found that Mr. Harold S. Colton had described (*Proc. Acad. Nat. Sci., Phila.*; 1908) the feeding of *B. canaliculata* as observed in the aquarium of the University of Pennsylvania. The following statements are quoted from his summary.

"They (*canaliculata* and *carica*) open the shells of oysters by wedging their own shell between the valves and tear out the flesh with their radula. They probably treat quahaugs in the same way.

"*Sycotypus* will attack any except *Venus*."

He also states that the whelk waits until the bivalve opens and then inserts its shells between the valves.

Mr. C. W. Johnson suggested to me that the bivalves might have been weakened by life in the aquarium, and this is probably the explanation of the shells' opening their valves while gripped in the Busycon's foot. Also while *B. canaliculata* will not attack quahaugs as early in life as *B. carica*, since the lip of its shell remains almost paper-like until the animal is well grown, I found two large specimens eating quahaugs.

The Busycons I observed ate in the following manner. An oyster is held in the foot with the hinge toward the canal, while a quahaug is grasped in such a way that the hinge is toward the columella, but in both cases the edges of the bivalve are left free. In the majority of cases the Busycon rests on its foot with the canal pointing upwards at an angle of about 30°. The foot is slowly contracted, about six times a minute, and the

edge of the oyster is brought against the inner edge of the lip with considerable pressure and then drawn inward and toward the canal. A small piece is chipped from the edge of the oyster and the process repeated until a gap is made large enough to admit the radula, which then tears out the flesh. This method of getting at the animal explains not only the roughened and chipped condition of the lip of the Busycon, but also the chipped oyster and quahaug shells. Occasionally I have found a live quahaug with its edge much chipped but still intact, so the whelk does not always succeed. Usually, however, it encounters but little difficulty.

DESCRIPTIONS OF NEW SPECIES FROM THE CRETACEOUS AND
TERTIARY OF THE TESLA, PLEASANTON, SAN JOSE, AND
MT. HAMILTON QUADRANGLES, CALIFORNIA.

BY E. B. HALL AND A. W. AMBROSE.

INTRODUCTION.

During the paleontological work at Stanford University, for a folio covering the Tesla, Pleasanton, San Jose and Mt. Hamilton Quadrangles, several new forms were found. In order that the names of these might be established, the writers decided to publish the descriptions of the same. The writers' thanks are due Dr. James Perrin Smith for his assistance to the writers in this work.

HORSETOWN—MIDDLE CRETACEOUS.

PECTEN CLARKENSIS n. s. Hall and Ambrose.

Description. Shell small, two specimens found averaging 17 mm. in altitude, little higher than long, compressed, thin, sub-circular, equivalve and equilateral; ears equal, moderately small, base regularly rounded, margins smooth. Surface marked by 20 or 21 radiating nearly equal ribs, being two or three times the width of interspaces that terminate abruptly a little way from margin, also by obscure lines of growth.

Dimensions. Alt., 16 mm.; latitude, 16 mm.; longitude, 18 mm.; hinge line (restored and approximate) 9 mm.; diameter, 11 mm.



Warren, Shields. 1916. "The feeding habits of Busycon." *The Nautilus* 30, 66–68.

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