

In studying these mollusks it is necessary to remember that the different species often have an almost identical series of color variations, so that if one is guided chiefly by color, there is a liability to put together mutations belonging to different species. There is little doubt that food greatly influences and directly changes both the color and texture of the outer layers of the shell, while the form is directly related to the situs of the individual.

An interesting fact in the distribution of these animals is the evidence they give in favor of the probability of the former existence of an elevated ridge or range roughly parallel with the coast of California and the peninsula, and of which the Santa Barbara Islands, Guadalupe, and Socorro are the only supermarine indications at the present day. It looks as if there was a second gulf or inlet between this range and that of Lower California, so that the cool-temperate species were able to extend as far south as Socorro on the western coast of the western range, while the more tropical forms were able to reach far to the North in the warmer waters of the inner area between the outer range and the continent to the east of it, including what is now the Gulf of California.

POSTPLIOCENE SHELLS OF PROVIDENCE AND LUPUS, MISSOURI.

BY F. A. SAMPSON.

Several trips to these two places have given many specimens. Providence, Boone County, is on the north side of the Missouri river, a place now of only a few houses, but formerly, in the days of steamboat travel on the river, a large town and important shipping point. The grading for the Missouri, Kansas and Texas railroad along the river cut into the bluffs, and uncovered the deposits containing great numbers of postpliocene land shells. The deposit is of later period than the Kansas loess, and is not the fine silt of the loess, but is of clay intermixed with stones of various sizes.

Lupus is almost opposite on the other side of this river, in Moniteau County, where the grading for the river route of the Missouri Pacific railroad uncovered the beds with the fossil shells. A mile above Lupus was the former town and steamboat landing of Mt. Vernon, a town of which no trace now remains. On both sides of the river the rocky bluffs are of Chouteau limestone, resting on beds

of Devonian, and capped by Upper Burlington limestone. The Chouteau fossils, especially the crinoids, are interesting, and the type specimen of one species came from Mt. Vernon, while Providence has given the types of many fossils.

The most of the shells found at both places are now found living in the neighborhood, while others have not been found in any nearby county. The following species have been collected :

Polygyra profunda Say. The largest of the Providence shells are of 31 mm. diameter, but the Lupus shells up to 34 mm. averaging smaller size, but more plentiful and some preserving the color band. So far this has not been found living in the state except at Courtney, in Jackson County, near Kansas City.

Polygyra albolabris alleni Weth. At both places fine shells from 26 to 32½ mm. diameter are common, and more plentiful at Lupus. The living shells have been found in the neighborhood to about the same size, but from a rock pile in an open field near Columbia they were only 23 to 25 mm. and very similar to the still smaller ones found in a cemetery at Kansas City.

Polygyra thyroides Say. Of fifty shells picked up at Providence thirty-six were *thyroides edentata*, and of thirty-seven at Lupus twenty-five were the same.

Polygyra elevata Say. Not much variation in size, somewhat smaller at Lupus, and all similar to the living ones found on both sides of the river. Some that seemed to have been entirely mature were edentate.

Polygyra clausa Say. Scarce at both places.

Polygyra pennsylvanica Green. This is rather uncommon at both places. A walk of three miles along the railroad, during which many thousand shells were picked up or seen, gave but a single one of this species. It is not now found living in this part of the State.

Polygyra appressa Say. These are of the three-tooth variety found rather plentifully in many places in Missouri. On both sides of the river the shells vary much in size, many being larger than those now living in the neighborhood. It is the most plentiful shell at Providence, but scarce at Lupus. The shells varied in size from 15 to 22 mm., and many of the smaller ones have only a trace of lip teeth.

Polygyra inflecta Say. Sparingly found at both places, but sometimes uncertain as to whether fossil, or simply dead shells that had dropped from higher parts of the bluff.

Polygyra fraterna Say. The same may be said of this as of the last. From both places.

Polygyra monodon Rack. From both places.

Polygyra hirsuta Say. Sparingly at both places. The ordinary size is of 7 mm. diameter, but one from Providence is of 9 mm. and somewhat differing from the smaller ones in other respects.

Succinea ovalis Say. A single one found at Lupus.

Gastrodonta ligera Say. A single one was found at Lupus. At some places in Boone county the living ones are plenty.

Helicina occulta Say. In my report of the Shells of Missouri this was given as *Helicina orbiculata tropica*. It is rather scarce on both sides of the river, and has never been found living in the State.

Vitrea indentata Say. From Lupus.

Vitrea hammonis Strom. Some young shells from Lupus were probably of this species.

Zonitoides minusculus Binne. From Lupus.

Zonitoides milium. From Lupus.

Bifidaria armifera Say. At Lupus.

Bifidaria contracta Say. These and other minute shells were not found imbedded in the dirt, but in clearing the larger *Polygyra* of the dirt that filled them a number of small shells were found. These and some smaller *Pupillidæ* that have not been identified, were found at Lupus.

Pyramidula solitaria Say. This at Providence is perhaps as abundant as *P. appressa*, but at Lupus it is rare and somewhat smaller.

Pyramidula alternata Say. At Providence they are of good size and not plenty; at Lupus rare and smaller.

Pyramidula perspectiva Say. A single specimen was found at each place.

Helicodiscus parallelus Say. From Lupus.

Carychium exile H. C. Lea. From Lupus.

An idea of the comparative number of the species may be had from the results of a walk along the railroad for three miles on the Providence side, during which hundreds of shells were picked up or seen, among which were only four *profunda*, one *pennsylvanica*, one *clausa*, and one *alternata*, while *soltitaria* and *appressa* were abundant, and *elevata* next in abundance.



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