

limits of variation, and it is, perhaps, due to this fact that it is so universally distributed. The littoral and pelagic forms are so different that they have been considered specifically distinct.

*C. modestus* is a rare form. Thus far it has been found in only a single locality in Wisconsin.

None of the American species of *Diaptomus* is identical with those of Europe, although in some cases the relationship is very close.

*D. sicilis* is the common pelagic form of the Great Lakes, but occurs also in smaller bodies of water. *D. ashlandi* has been found only in the Great Lakes.

The most common species in the smaller lakes is *D. oregonensis*. This was described by Lilljeborg from specimens collected in Oregon, and probably is common through our northern States. *D. minutus* is common in Newfoundland, Greenland and Iceland. It occurs in some of the small lakes in northern Wisconsin and in Green Lake. It is likely that it occurs quite generally through the northern part of North America, and possibly central Wisconsin is near its southern limit.

Especial interest attaches to the fauna of Green Lake. This is about seven miles long, with a maximum depth of nearly two hundred feet. While the pelagic fauna of the Great Lakes is quite distinct from that of the smaller lakes, we find in Green Lake both sets of faunæ. *D. sicilis* and *Limnocalanus macrurus* I have not found outside the Great Lakes except in Green Lake. But besides these species the pelagic fauna of Green Lake includes *C. brevispinosus* and *C. fluviatilis*, which are the characteristic species of the smaller lakes.

A more detailed account of the Wisconsin copepoda will soon appear in the Transactions of the Wisconsin Academy.

#### THE HILLOCK AND MOUND FORMATIONS OF SOUTHERN CALIFORNIA.

BY DANIEL CLEVELAND, SAN DIEGO, CALIFORNIA.

SOME time ago, in an article upon the nest of the trap-door spider, which appeared in *Science*, I mentioned the low mounds in which these nests in many districts are so often located, as being in themselves an interesting formation. I now propose to offer an explanation of the origin of the formation.

Let me begin by saying that these mounds are not confined to this vicinity, for they extend throughout this State and elsewhere on this coast and in Texas; but they are more numerous and better defined here than elsewhere; they are, in fact, a characteristic of certain large areas of our territory. For this reason, among others, I believe this to be the best field for observing and investigating this remarkable formation.

Lying just back of the commercial portion of the city of San Diego there is a great mesa or table-land, which stretches away for a distance of from eight to ten miles to the valleys at the base of the Coast Range. It possesses a rich brown soil, holding in many places considerable aggregations of loose stones which have drifted down from the neighboring mountains and been ground into pebbles. Here for miles the surface is gently undulating, with low mounds lying as close together and as numerous, considering their size, as the ground will permit. These mounds are from one to three feet in height above their bases, and are from ten to thirty feet in diameter, separated by greatly varying areas which in their depressions in many places contain accumulations of cobble stones. An unscientific person seeing these plains for the first time might imagine that they had once been densely populated by large burrowing animals which had left these hillocks to mark their subterranean dwellings.

Several theories have been advanced to account for this formation. The most probable hypothesis is suggested by the nature of the soil and the peculiar vegetation of these plains. The soil itself is dry and hard for the six to eight months constituting the rainless season. During the time of heavy rains it is soft and mellow. During the time of drought it becomes almost as hard as stone.

Each mound, it is evident enough, marks the former home of a shrub or, as was almost always the case, of a cluster of shrubbery, to whose agency the mound in large degree owed its existence. Three shrubs—*Rhus laurina*, Nutt.; *Simmondsia Californica*, Nutt.; and *Isomeris arborea*, Nutt.—are conspicuous among the large vegetation of these plains, and have been very important factors in the formation of these mounds. Of these plants *Rhus laurina* is the largest and is much more abundant than the other two. It is an interesting fact that these three shrubs are confined to this section of California, mostly to this county, and that they were all first collected at San Diego about 1840, and were named by the eccentric naturalist Thomas Nuttall. He established the genera *Simmondsia* and *Isomeris*. The habits of these plants peculiarly fit them for their office of mound builders. They grow in small compact groups. Many stems rise from the roots, which are large and spreading. The foliage of *Rhus* and *Simmondsia* especially is dense and falls close to the ground.

Dust blown by the steady trade winds of the dry season is arrested by the shrub and accumulates with the fallen leaves at its base, making a steady accretion of material. In this way a mound gradually rises about the plant, in time covering the lower branches and in the case of the smaller shrubs—*Simmondsia* and *Isomeris*—nearly or quite enveloping the whole plant. This process of mound building can still be seen in isolated hillocks. An examination of the older mounds confirms this theory. In the lower portion of the mound the earth is compact and indurated, while the surface soil is a light loam mixed with decayed and decaying leaves. The mound is protected from washing by the rains at the summit by the overhanging branches and foliage, and at the base by a compact mass of roots. Outside of the foliage and roots the process of erosion goes on steadily, though slowly, during the rainy season, when this soil is peculiarly susceptible to the action of water, and the hollows between the mounds are then formed.

When in the course of time the plant dies from natural decay, from being smothered by the drift that environs it or from the fires that sometimes sweep over these plains, the mounds, being deprived of protection, are attacked by wind and rain and gradually worn down. The mounds are thus made shallower and broader at the base, until from this steady subsidence they sink down and flatten out almost to the general level of the plain.

The presence of living shrubs upon the more perfect mounds and of masses of roots well preserved or in process of decay in mounds in subsidence, where no large growing vegetation has been seen for many years, and in the oldest and flattest mounds the disappearance of all traces of shrubs and roots, confirm our theory of mound formation and subsidence.

What the shrubs I have named—*Rhus*, *Simmondsia* and *Isomeris*—have effected in coöperation with the wind and rain in the formation of mounds in this section, has been accomplished elsewhere by other shrubs and trees. It is a familiar fact that upon the great prairies of Texas mats of timber are generally found upon the summit of hillocks, very much larger, of course, than the mounds of southern California, as those trees are larger than our shrubs.

#### CURRENT NOTES ON ANTHROPOLOGY. — XXXI.

[Edited by D. G. Brinton, M.D., LL.D., D.Sc.]

##### The Archæology of Oaxaca.

Two or three years ago the State of Oaxaca, in Mexico, established an Archæological Museum, and placed it in charge of the very competent and enthusiastic scientist, Dr. Nicolas Leon, of Michoacan, who had already won for himself a wide reputation as curator of the Museum at Morelia. Through some unfortunate political changes the modest appropriations awarded to both these institutions have been diverted into other channels. This is a matter of great regret to all who are interested in the preservation of the ancient monuments of Mexico and the further investigations into the numerous remains there found.

The State of Oaxaca especially has an archæological importance which attaches a unique value to the investigation of its remains. From the earliest days of which tradition records the echoes, it was the home of the Zapotecs, and the profoundest researches into the pre-Columbian origin of the Aztec and Mexican civilization point, not to the fabulous "Empire of the Toltecs," but to these Zapotecs as the tribe which first spread abroad