Highly specialized in some respects, in both Protopterus and Lepidosiren, this specialization is largely due to a change of habit, and that, undoudtedly, these two types are, genericly, very distinct.

In conclusion, I may simply add that this classical work will, in the future, prove to be one of the very greatest value to all students of the morphology of the Amphibia and of Pisces, as it will be indispensible to the general biologist.

OBSERVATIONS ON A CYCLONE NEAR WILLIAMSTOWN, KANSAS.

BY E. H. S. BAILEY, UNIVERSITY OF KANSAS, LAWRENCE, KAN.

A SEVERE and fatal cyclone visited a small area of country in the Kaw valley, in Jefferson County, on June 21, at about six o'clock in the evening, and the peculiar topography of the country gave an opportunity to make some observations that may be of scientific interest. The valley at this point is about two miles in width, the river running nearly east. On the south side it is bounded by bluffs about a hundred feet in height, and on the north side there is a strip of level meadow, something over a mile in width, before one reaches the bluffs, which are of about the same height as those on the south side.

The general trend of the broad valley is east, but at a point a mile or so beyond where the cyclone lifted the river runs toward the southeast for perhaps a mile. On the particular afternoon in question the weather had been extremely hot and sultry, the mercury ranging between 90° and 95° F. The weather had been warm and dry, with only one local shower for about two weeks. About two hours before the cyclone burst upon the valley there was a gathering of clouds in the northwest, with thunder and lightning. A short time before the storm burst an ominous stillness was noted, and a sudden darkening of the sky. During the heaviest of the storm a peculiar green tint of the sky was noticed in the locality.

As the storm came from the west, it seemed to settle near the ground at the base of the bluff, and, wherever the bluff was not broken by lateral valleys, its path was about one-half on the side of the hill and the other half on the sloping meadow to the south.

Wherever the cyclone crossed the course of lateral ravines, even if they were quite narrow, it dipped down into them and destroyed trees and buildings. It was not swerved from its general eastward course even at one point where a broader valley joined that of the Kaw. At this point, as the country was heavily timbered, there was a special opportunity to observe the action of the wind. Elm and walnut trees, two or three feet in diameter, were either torn up by the roots, laid prostrate, or twisted off fifteen or twenty feet from the ground. Here the track of the cyclone, where it did appreciable damage, was a little less than 600 yards in width. There were, occasionally, wrecked chimneys and slightly injured roofs on the outer edges of this path. All along the course of the storm the debris was deposited in the peculiar way that is characteristic of these furious whirlwinds. The material north of the centre of the track was deposited in lines from northwest to southeast, and that on the south side of the centre in lines running from southwest to northeast. In the centre of the track there was a tendency to distribute the material in an east and west direction. A line of telephone poles on the south side were laid in parallel lines, thus, ////. Fields of grass and wheat were beaten to the ground and the stalks laid in the directions above noted: W. \\\\\\ / / / / / / → E. The wires of the telephone line and of the barb-wire fence were lifted into the tree-tops about fifty feet north of their original position. There was a little debris deposited on the west side of some of the buildings demolished, but most of it was carried along the track and thoroughly pulverized. Strong, new farm wagons were wrenched to pieces, and the spokes were even broken off near the hub, before they were deposited half a mile away.

The terrible force of the wind could be seen in the beheading of the wheat, the uncovering of potatoes in the hills, the transportation of grave-stones 300 yards, and the picking of all the feathers from the chickens

One of the most interesting effects that was noticed was upon the trees that were left standing or laid prostrate and bereft of every vestige of foliage and of nearly all the bark. All the wood on the west side of these trees, often being exposed by having the bark torn off, was roughened as if by a sand blast; while that on the east side was smooth. This roughness was uniform, showing that it was not produced by occasional missiles hurled through the air. This roughening, if not produced by the actual friction of the air, must have been produced by the sand and gravel in the air, or by the rain that beat against the surface.

Some who witnessed the storm saw the clouds of dust that accompanied the wind, so the sand-blast theory is no doubt the correct explanation.

The most serious work of destruction was accomplished just before the cyclone lifted. Here the valley broadened out towards the north, and the bluff for a distance of a mile or more disappeared. With one last sweeping blow the storm lifted, and the only other evidence of its work was a partially demolished barn. Just at the point where the intensity seemed concentrated, the path was much narrower than farther west. The strip of land devastated was about five miles in length. From the manner in which it followed the base of the bluff, one would infer that had it not been for this obstruction the storm would have passed off towards the northeast instead of pursuing, as it did, a direction a little south of east.

NOTES ON THE COPEPODA OF WISCONSIN.

BY C. DWIGHT MARSH, RIPON, WISCONSIN.

In the waters of Wisconsin and in the adjacent lakes are found the following twenty-one species of free-swimming copepods: *Diaptomus sanguineus*, Forbes; *D. leptopus*, Forbes; *D. pallidus*, Herrick; *D. sicilis*, Forbes; *D. ashlandi sp. nov*; *D. minutus*, Lillj.; *D. oregonensis*, Lillj.; *Epischura lacustris*, Forbes; *Limnocalanus macrurus*, Sars; *Cyclops americanus, sp. nov.*; *C. brevispinosus*, Herrick; *C. pulchellus*, Koch; *C. navus*, Herrick; *C. parcus*, Herrick; *C. leucarti*, Sars; *C. signatus*, Koch; *C. modestus*, Herrick; *C. fluviatilis*, Herrick; *C. serrulatus*, Fischer; *C. phaleratus*, Koch; *C fimbriatus*, Fischer.

Although two of these, *D. ashlandi* and *C. americanus*, are new species, it is not probable that they are peculiar to the Wisconsin fauna. The copepods of America have thus far received very little attention, the only important publications on the subject being by three men, Professor Cragin, Professor Herrick and Professor Forbes. If more were known of our copepods it is probable that it would be found that there are few local differences in the faunæ of our northern States. The copepods are readily transported from one body of water to another and, without change of structure, seem to endure great changes in their environment In fact, half of our species of cyclops are not only widely distributed in America, but are identical with those of Europe. Those that may be considered distinctly American are closely allied to well-known European forms.

C. leucarti is found in nearly all parts of the world where collections have been made and, so far as can be inferred from the published descriptions, varies but little, even in the minute details of its structure.

C. americanus closely resembles *C. viridis*, and is probably the species which has by other American authors been identified with *viridis*. Although there seems to be good reason for separating it from the European species, the similarity of the two forms is so great that it is only by a close examination that the structural differences become apparent.

It is very possible that *C. brevispinosus* should be considered a pelagic variety of *C. americanus*, thus reducing by one the number of species peculiar to America. There is some reason, too, for supposing that *C. navus* is not specifically distinct from *C. pulchellus*.

C. pulchellus is the common pelagic form of the Great Lakes. Although found in smaller lakes, it is more commonly replaced by *C. brevispinosus*, which is a species of wide distribution.

C. navus is found only in stagnant pools.

The most common of all our species is *C. serrulatus*. Rarely is a collection without this form, which seems to adapt itself easily to very different surroundings. It has, however, wide

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