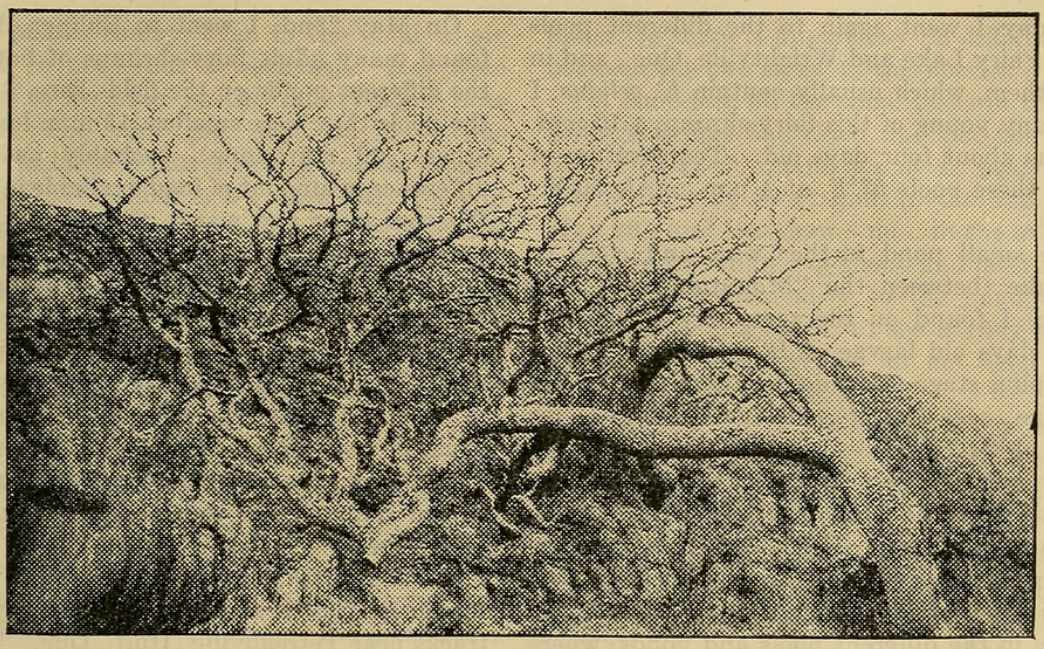

FIGURE 12.—TROPISMS OF GARRY OAKS.

Characteristic apical elongation of terminal buds toward rock masses in the neighbourhood of the tree. After attainment of the apparent objective the normal growth-form is resumed. Locality, Victoria, B.C.

APICAL ELONGATION

Rock in the environment of oak seems often to influence the direction of growth taken by the trees. There are many cases where an oak or one of its limbs bends over toward nearby rock and after attaining a certain point resumes more vertical growth. Frequently, the stems are quite procumbent for a while and these bendings are not in the direction of prevailing winds, etc. Figure No. 12 gives an illustration of one of the many phases of the characteristic. It shows a pronounced bending over of the stem and limbs of an oak till certain points in the rock close at hand have been reached. Then the branches curve sharply upward and assume the normal growth-form of the oak.

FURTHER OBSERVATIONS ON CANADIAN EUPHYLLOPODA

By FRITS JOHANSEN

EUBRANCHIPUS GELIDUS

THE TEMPERATURES around Ottawa for the first half of April, 1924, were between 26°F. and 48°F., except for the minimum of 14°F. on March 31-April 1st., and the maximum of 52°F. on April 4th. The weather was mostly clear, except for snow on April 25th; rain on the 6th, 9th and 13th, and some overcast days.

On April 13th, I looked for Phyllopods (*E. gelidus*) in all the pools and ponds between Fairy Lake and Wrightville (Hull), Que., where I found them last year; but I could discover no hatched larvae, though the pools were ice-free, and the snow had almost disappeared from the fields here. Air temperature at 4.15 p.m. 38½°F., of water in pools 44°F.; overcast, rainy and windy.

On April 16-17th, the temperatures were between 28°F. and 54°F., and the weather clear. During these two days most of the hibernating eggs of *E. gelidus* hatched in the ponds around Ottawa.

April 18-19th were rainy (particularly the 18th) and colder (38°-42°F.), thus delaying the hatching of further eggs; but the next two days, though cloudy, had a higher maximum-temperature (52°-54°F.), and a minimum-temperature of 32°F., thus facilitating the hatching of more eggs of *E. gelidus*.

On April 29th, I went to the pools on the fields at Billings Bridge, Ont. The overflow from the Rideau River on the fields had now subsided, and the pools had become ice-free and mostly isolated. Many of them contained young *E. gelidus*, ranging in length from 4 to 12 mm., and in the largest ones the two sexes could already be differentiated, though apparently less than a week old. I also secured here half a dozen larvae of *Limnetis gouldii* (see below). Temperature of air 48°F., of water in the pools 56°F. (4.30 p.m.; overcast).

Next day I went again to the different pools between Fairy Lake and Wrightville, Que., and in most of them, which usually contain *E. gelidus*, I found many young of this fairy-shrimp, 4-10 mm. long, thus about four days old. Temperature of water in these pools 57°F. at 4 p.m. (Air 50°F.; overcast).

In the small pond further west and close to Fairy Lake (between the "Mountain-road" and the Lake) I found on the same day millions of only 1-2 days old larvae of *E. gelidus*, all in the metanauplius stage (for a description and figure of this stage see *Canadian Field-Naturalist* for January, 1924), and 3-4 mm. long. They had probably hatched only the day before, because this particular pond became free of ice and snow later than the others. From these observations it will be seen that even around Ottawa, the hibernating eggs of *E. gelidus* do not hatch simultaneously in the different pools and ponds, where the species occurs; but it depends upon what time each one becomes free of snow and ice. First hatch the eggs in the pools formed by the overflow of Rideau River; next the eggs in the ponds on the grassy fields, e.g., at Wrightville; while in the small ponds situated in pockets upon hillslopes they hatch still later.

During April 20-25th the temperatures were between 32° and 56° F., with mostly overcast weather, except for rain on the 22nd, and the 20th clear.

On April 27th, I again went to Billings Bridge, and the fairy-shrimps now had a length of 10-15 mm., the largest ones of both sexes being mature, the females containing ripe eggs, and the males with large claspers (2nd pair of antennae). *Limnetis gouldii* in the metanauplius-stage were also secured (see below).

The temperatures during April 26-30th, were between 38°F. and 74°F., and the weather clear, except rain on the 30th. On May 1-10th, the temperatures were between 36°F. and 60°F., with overcast weather, except for rain on the 3rd, 4th, and 10th, and the 6th clear.

On May 11th, I again went to the pools outside Wrightville. In the pools (see April 27th) on the north-side of Fairy Lake, the fairy-shrimps now had a length of about 10 mm., and both sexes mature, except for a few delayed individuals, about 7 mm. long. In the other pools nearer Wrightville, they were full-grown (15-20 mm. long) and both sexes mature, (eggs and claspers). The weather was overcast, clear and sultry.

The temperatures on May 12-21st, were between 30°F. and 68°F., but only on May 18-20th was the minimum less than 40°F. May 12-14th were overcast, with rain on May 15th and 18th; the other days clear.

On May 22nd, I went to Billings Bridge, and found many adult fairy-shrimps of both sexes in the different ponds on the fields here. In some of the pools they were smaller (15 mm. long) than in others (20 mm. long), probably owing to the difference in amount of food available in the ponds. Weather clear and warm, with an air and water temperature of about 60°F. at 4.30 p.m. Later in the day I placed some live *E. gelidus* (females with eggs) in the rock-pond at the quarry between Billings Bridge and Hogsback, to see if they will thrive here, where they have never been observed so far. This pond has a muddy bottom and rich aquatic vegetation, and if the other localities where they occur around Ottawa should be destroyed (filled in) in the future, the quarry pond may remain.

On May 25th, I examined a couple of smaller temporary pools alongside the railway and car-tracks near Tetreauville (Hull), Que. The largest ones of them was 1-2 feet deep, and its bottom is formed by the gravel used for the tracks, covered with a great mass of filamentous algae on pieces of wood, etc. I observed a number of adult (2 cm. long), female *E. gelidus* with ripe eggs swimming around here (half a dozen kept), but only a few males of the same species. A similar, but still smaller pool, next to it, probably also contained these fairy-shrimps earlier in the spring, but had now dried up. This is a new locality for *E. gelidus*, around Ottawa.

The temperatures on May 22nd to 31st were between 36°F. and 70°F., with clear weather except for May 23-27th, when it was overcast-rainy, and hail-showers on May 25th.

On May 29th I again went to Billings Bridge. Though the small pools had dried up or almost so, the others still contained living *E. gelidus* of both sexes, though males were few. Particularly was this noticed in one of the larger ponds, which contained a great many fairy-shrimps; but among the hundreds of females (with ripe eggs) there were only half a dozen males. This is the same pool in which *Limnetis gouldii* (see under this species) was noticed a week ago to be considerably larger than in the others, as was also the case to-day. Temperature of water about 60°F., of air 58°F., at 5 p.m.; clear. More live *E. gelidus* were transplanted to Brulé's quarry-pond at Hogsback to-day.

While two (27th and 30th) of the last days of May were cooler (maximum temperature 56°F.), the five first days of June had temperatures between 42°F. and 72°F., the maximum temperature being 70°-72°F. on all five days (all warm and mostly clear).

On June 5th I again went to Billings Bridge, but in spite of careful search I was unable to find a

single *E. gelidus* to-day, even in the pond where they were so numerous a week ago. Nor were there any to be seen in the quarry-pond near Hogsback. The very last days of May thus represent the latest occurrence of *E. gelidus* around Ottawa, in 1924, which is 3-4 days later than in the preceding year (see *Canadian Field-Naturalist* for January, 1924). This is probably owing to the comparatively late (middle of April) hatching of the eggs in 1924, around Ottawa; and the cool weather during the spring this year, which made the season for this fairy-shrimp a little longer than in other years.

LIMNETIS GOULDII (*L. brachyurus*).

The finding, on April 20th, of the first larvae of this clam-shrimp in a pool on the fields at Billings Bridge, together with young fairy-shrimps, has been mentioned above, under *E. gelidus*. I secured six nauplii, ½ mm. long, of the clam-shrimp, all with the appearance typical for this species ("turtle-shell", etc.; see *Canadian Field-Naturalist* for January, 1923). The four of these nauplii moulted and transformed into metanauplii (double "clam shell", etc.) before preservation the same evening. The (hibernating) eggs of *L. gouldii* thus began hatching to-day, a week earlier than last year, while most of the eggs of *E. gelidus* hatched in 1924 three or four days earlier than in 1923.

A week later (April 27th) I secured at Billings Bridge a number of metanauplii of *L. gouldii*, in the same pools, by using a pipette and standing out in the water. They were between ¼ and ½ mm. in diameter, the smallest ones having apparently just transformed from the nauplius-stage. Temperature of air and water in the pools was about 60°F. at 4 p.m. (Clear).

On April 26th, and 27th, the maximum temperature went above 60°F., and they were the first real warm days this spring, thus speeding up the hatching of the eggs of *L. gouldii*.

I again examined the pools at Billings Bridge for clam-shrimps on May 22. The smaller pools had now almost dried up; but even these contained *L. gouldii*, which were present in all the pools in millions and had a size of about 2 mm. in diameter, except in one pool, where they were larger (3-4 mm.), though not yet with eggs.

A week later (May 29), *L. gouldii* was still present in these ponds in millions, even in the almost dried-up pools. They were from 2 to 4 mm. in diameter, the largest ones being found in one of the largest pools (see May 22). Both sexes were present and seen in copulation; the females carried eggs. I noticed that some of the smallest individuals were females, some of the largest ones males, so there is apparently no difference in size between the two sexes, in this species.

On June 5th, all the small pools in the fields at Billings Bridge had dried up; but the others all contained great quantities of *L. gouldii*, with a size of from 2½ to 4½ mm. in the one pond (see May 29), and less than 3 mm. in the other ponds. I collected a number of them, and later in the day transplanted them alive to the pond at Brulé's quarry near Hogsback, to see if they will thrive here, where they have so far not been observed. Weather clear and warm.

On June 15th, I visited the pond at Tenaga, Que. (see *Canadian Field-Naturalist* for January, 1924), and found that it still contained a few *L. gouldii*, though they were not nearly so numerous as earlier in the month. I secured only eight specimens in all, half of which were females with eggs, half of them males; and these represented both large and small specimens of the two sexes. The weather was sultry, with weak sun. No *E. gelidus* were seen.

Six days later I again went to the pools at Billings Bridge. Only the two largest ponds contained any water now; but there were still quite a few *L. gouldii* in them. The clam-shrimps had a size of from 2½ to 4 mm., and were mostly of a brownish colour, only a few orange-colored. The females carried eggs, and the two sexes were often seen in copulation.

The weather during June and the first week of July, 1924, was warm, with temperatures between 42° and 88°F.; mostly clear, with rainshowers of short duration on June 2, 6, 12, 13, 14, 26, 28 and July 3rd.

Finally, on July 6th, I paid the last visit to the pools at Billings Bridge. They had now all dried up, except the largest pond, the deeper parts of which still had pools of water. By wading out into these and standing here, I secured, by stirring up the water, in the course of half an hour, two dozen *L. gouldii*. Both sexes were represented, and copulating freely; except a couple orange colored ones they all had a brownish coloration. I kept them alive, and the last two of these died four days later.

This is ten days later than *L. goudlii* was observed around Ottawa in 1923, and the latest record of them from this vicinity so far.

The different, outward conditions causing the disappearance of *E. gelidus* and *L. gouldii* in the summer, around Ottawa, is thus both striking and interesting. In the case of the fairy-shrimp it is the advent of summer-weather, which makes it disappear suddenly in the middle or end of May, though there is still plenty of water and food in the pools in which they occur. The clam-shrimp, however, apparently does not disappear entire\

until all the pools in which it occurs have dried up completely; and the observation given above, under July 6, 1924, shows that they are very tenacious to life and able to thrive, even if only a square foot of water or two remains of the pool or pond in which they are found. The observation also shows that at least in certain years (e.g. 1924) the season around Ottawa for *L. gouldii* is as long as two and a half months, from the time the (hibernating) eggs hatch in the spring, to the dying off of the last adults in July.

It would be interesting to know more about the life-history of this clam-shrimp on the prairies of western Canada, where it seems to be found (at least in certain ponds) even in August, judging from a Saskatchewan record (see *Canadian Field-Naturalist* for May, 1921). In Eastern Canada there is only one record (see above, July 6, 1924), of it, later than June; but it has been recorded (A. S. Pearse, in *Occas. Pap. Mus. Zool., Univ. of Mich, No. 1*, December 20th, 1913), as abundant on July 4th, 1912, in a pond in Massachusetts, and in the northwestern part of this continent it has also been collected in July (see *Canadian Field-Naturalist* for May, 1921, postscript).

*INTEGUMENT OF CHASMOSAURUS BELLI**

By C. M. STERNBERG

IN THE early days of Palæontology there was little expectation of securing complete skeletons of extinct animals and much less of ever gaining an adequate idea of the integument of land-dwelling forms. Since then our knowledge of the dinosaurs has advanced to such a stage that to-day we not only know every bone of the skeleton of many of the forms but have a fairly accurate idea of the musculature and the external covering of the body. Even the eggs of one form have been found.

The integument of the *Hadrosauridæ* has been known for a number of years from field observation and small specimens of the impression in some museums; but it was left for my father, C. H. Sternberg, to collect the first skeleton of a dinosaur in which the impression of the greater part of the external covering is preserved. I refer to the skeleton of *Thespesius annectens* (*Trachodon annectens*), which was collected from the lance formation of Niobrara County, Wyoming, and is now in the American Museum of Natural History, New York, known as the Mummy dinosaur. Since that time several specimens of hardosaurs have been collected from the Upper Cretaceous strata, in which more or less of the integument is preserved as impressions on the sand or clay, so that to-day there is practically no part of the body of which the integument is unknown.

In the case of members of the other families of dinosaurs much less is known of their external covering. For years it was thought that the horned dinosaurs had been covered with dermal scutes or bony plates in the epidermis because dermal scutes were found in more or less close association with the bones of horned dinosaurs. We now know that these dermal scutes are from the armored dinosaurs and there is no evidence of the presence of such scutes in the *Ceratopsia*.

The integument of a horned dinosaur was first described by L. M. Lambe, F.R.S.C., in the *Ottawa Naturalist* for January, 1914, from a specimen of *Chasmosaurus* (*Protorosaurus*) *belli* collected by C. H. Sternberg in 1913 from the Belly River formation of Red Deer river, Alberta. At that time Mr. Lambe had only fragments of the rock bearing the impressions, as the large section showing the pattern over a considerable area was not prepared until after his death.

The object of the present article is to describe more fully and illustrate the pattern or arrangement of the large, round plate-like and the smaller polygonal tubercle-like scales rather than go into a detailed description of the scales themselves, which were so admirably described by Mr. Lambe. The integument here described is from the same individual as were Lambe's fragments, Cat. No. 2245, Victoria Memorial Museum, and consists of a section about 1½ feet by 3 feet, from above the pelvic arch and the right flank. The median line is not recognizable, though it is thought to have been not far beyond the part preserved. Due to the fragility of the rock bearing the impressions and the necessity of removing the underlying bones, it was possible to save only parts of the impressions. Before they were disturbed, however, a photograph and plaster mould were taken of those parts best preserved.

As in the hadrosaurs there is no evidence of bony plates in the skin but the tubercles were much larger and somewhat thicker than in that family, although the animal was smaller. There is great variation in the size of the tubercles and even over a small area there seems to be no uniformity though the tubercles on the upper part of the body seem to be much larger than those on the under parts. Examination of the larger area does not bear out Lambe's belief that "The plates

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