Art. LXII.—*On the Thoracic Legs of Triarthrus;* by C. E. Beecher.*

The first conclusive evidence of the presence of legs and gills in the *Trilobita* was given in 1876 by C. D. Walcott,† who by means of translucent sections was enabled to demonstrate their existence in four genera, and to indicate several important points in their structure. The genera shown to possess legs were *Ceraurus*, *Calymene*, *Asaphus*, and *Acidaspis*. Various announcements of the discovery of the legs of trilobites had been made previously, but, with the exception of a specimen described by Billings in 1870, these proved to be erroneous determinations. Walcott has since made further studies, and brought together his conclusions in a paper published in 1881.‡ Until 1893, no additions of note have been made beyond those confirming the fact that these animals possessed jointed legs. The specimens investigated by Walcott consisted chiefly of coiled individuals in which the body cavity was filled with calcite and clayey matter. There was no actual mineralization of the appendages, but the fillings of the cavities left by the decay of these organs served to show their general form. On account of their enrolled condition, considerable difficulty was experienced, and there was also a liability to error in attempting to determine the precise characters of the organs observed. Notwithstanding these drawbacks, some of the main points in the ventral anatomy of these animals were established.

The occurrence of *Triarthrus Becki* Green, in an exceptionally perfect state of preservation, from the Utica Slate near Rome, N. Y., has already been noticed in this Journal.§ In their present condition, the specimens contain very little calcareous matter, and nearly the entire calcareous and chitinous portions of the animal are represented by a thin film of iron pyrite. To this kind of fossilization is doubtless due the preservation of delicate organs and structures which otherwise would have been destroyed. For, as is well known, pyrite may replace such organic tissues as chitine or even soft dermal structures, the change occurring by the slow decomposition of

* Abstract of a paper "On the Structure and Development of Trilobites" read before the National Academy of Sciences, November 8, 1893.

† Preliminary Notice of the Discovery of the remains of natatory and branchial appendages of Trilobites. 28th Ann. Rept. N. Y. State Museum of Natural History, published in advance, December, 1876.

‡ The Trilobite: new and old evidence relating to its organization. Bulletin of the Museum of Comparative Zoology, vol. viii, No. 10, 1881.

§ Vol. xlvi, pp. 121–125. 378–379, August and November, 1893.

these tissues in the presence of iron sulphate in solution, or from the action of hydrogen sulphide as a result of decomposition in a chalybeate water.

It was apparent that specimens preserving organs so delicate as antennæ ought to show in addition other anatomical features of great interest. This expectation has been fully realized in the study and preparation of the collection belonging to the Yale University Museum, but at present it is proposed to give only a preliminary description, and to figure some of the details of the thoracic legs.

No essential differences have been observed in the series of legs attached to the segments of the thorax. Each segment bears a pair of biramous appendages originating at the sides of the axis (Walcott). The anterior legs are the longest and the others gradually become shorter towards the pygidium. Those which are here taken for description are the legs of the second and third free thoracic segments. The entire length of the legs has been exposed, from the dorsal side, by removing the overlying pleuræ of the thorax which concealed nearly half their length. Each limb consists of two nearly equal members, one of which was evidently used for crawling and the other for swimming. These two members and their joints may be correlated with certain typical forms of Crustacean legs among the *Schizopoda*, *Cumacea*, and *Decapoda*, and may be described in the same terms. Therefore, each limb is composed of a stem, or shaft, with an outer branch (exopodite), and an inner branch (endopodite). Figure 3 shows the joints of the stem (6, 7), the exopodite (*ex*, 1 and 2), and the endopodite (*en*, 1–5). The precise details of the coxal joint of the stem (coxopodite) have not yet clearly been made out. It is followed by a broad joint about twice as long as wide, which may be referred to the protopodite.

The endopodite was the member used for crawling, as in the *Schizopoda*. The three proximal joints, the ischiopodite (5), meropodite (4), and carpopodite (3), are similar in form to the protopodite (6), and taper gradually outwards. The distal portion is completed by two shorter cylindrical joints, the propodite (2) and the dactylopodite (1), the latter bearing at its extremity short setæ, or bristles, of which three are commonly to be seen.

The other member, the exopodite, lies over the endopodite. It apparently articulates with the protopodite, but may spring from what is here referred to the coxopodite, as its basal portion is very broad and originates close to the articulation of protopodite with the coxal joint. The proximal joint of the exopodite (2) is somewhat arched and tapers rapidly. It extends to the ends of the pleuræ, and is the longest joint of

either branch. The posterior edge is finely denticulate, and carries a row of long setæ. The distal portion (1) is multiarticulate, being composed of ten or more joints. In general form, it is slightly crescentic, with the margins thickened, the anterior one being strongly crenulated. Long setæ extend posteriorly from the crenulations on the dorsal side of the leg, making a conspicuous fringe along the distal half of the exopodite.

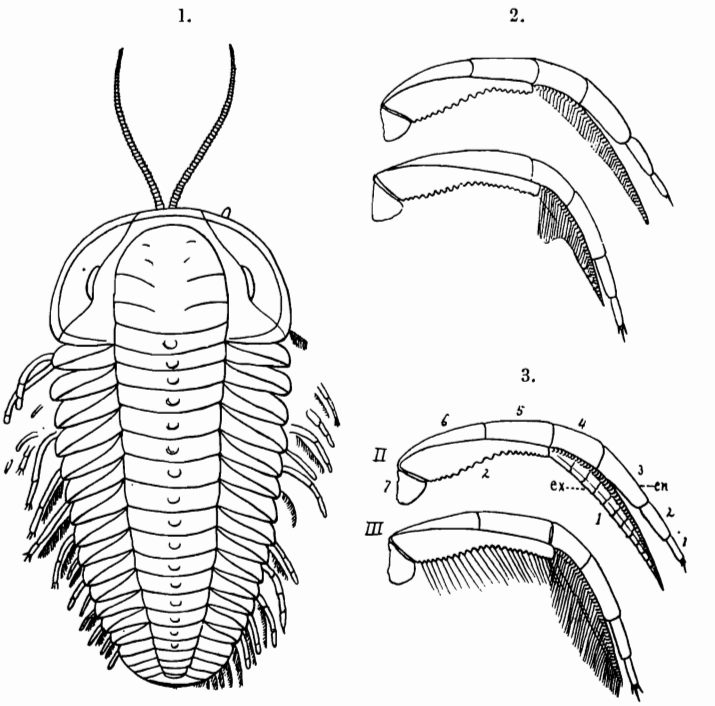

FIGURE 1.—*Triarthrus Becki* Green; dorsal view; showing antennæ and paired crawling and swimming thoracic legs × 3. (The antennæ and legs on right side are from one specimen × 3. and the legs of the right side are drawn from a smaller individual × 6).

FIGURE 2.—*Triarthrus Becki* Green; dorsal view of right legs of second and third free thoracic segments. × 12.

FIGURE 3.—The same. with setæ omitted from II, to show details of structure; *ex*, exopodite; *en*, endopodite. The setæ are represented on III. × 12

Figure 1 represents a dorsal view of *Triarthrus Becki*, showing the antennæ and the exposed portions of the appendages. The antennæ and legs on the right side are drawn from one specimen, and the legs on the left side are as shown in

another individual. The biramous character of the entire series of thoracic legs is very evident, as is also the distinction between the crawling and swimming members. Figure 2 shows the right second and third legs of the free thoracic segments. In figure 3, the upper exopodite is represented without setæ, so as to bring out the structure in greater detail. On the lower leg the setæ are shown.

It is not proposed at this time to make any extensive comparisons or homologies with other groups of Crustacea, as the appendages of the head and pygidium still require further description and illustration, and will be the subject of a future contribution. It is evident, however, that the relations of the trilobites are with the *Entomostraca* and *Malacostraca*. Moreover, like the *Leptostraca* (*Nebalia*), the *Trilobita* probably constitute an intermediate type having affinities with the *Entomostraca* chiefly in the irregular segmentation, and with the lower forms of the *Malacostraca* (as the *Schizopoda*, *Cumacea*, and *Anisopoda*) in the detailed structure of the limbs.