

An interesting case of a bicephalous *Tegenaria atrica* nymph

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Summary

An interesting case of a bicephalous *Tegenaria atrica* nymph was obtained after using thermal shocks in the form of temperatures of 14 and 32°C acting alternately on spider embryos in the first 10 days of development. An analysis of histological sections made by the paraffin method and stained with haematoxylin and eosin showed the nervous system and two poison glands in the accessory head.

Introduction

In the Invertebrate Zoology Department of the Nicolaus Copernicus University in Toruń studies are being carried out on the teratology of *Tegenaria atrica* C. L. Koch using temperature as an anabiotic factor. Earlier experiments carried out by different researchers have demonstrated that besides UV radiation, ions of heavy metals and various chemical compounds, temperature is one of the most powerful teratogenic factors affecting embryogeny (Ehn, 1963a, b; Jacuński, 1971, 1981, 1984; Mikulska & Jacuński, 1971; Seitz, 1966, 1967; Yoshikura, 1969). The most commonly observed anomalies induced experimentally by heating spider embryos are changes in the structure of appendages. They usually occur in the form of simple deformations which do not disturb the overall morphological structure of the body or the architectonics of the internal arrangements. Using this method it is also possible to induce deeper changes in the prosoma and the anterior part of the abdomen. These changes are defined as oligomely (unilateral or bilateral lack of appendages), polymely (presence of an accessory appendage), heterosymely (coadunation of appendages lying side by side but coming from different pairs) and symely (coadunation of appendages of the same pair) (Jacuński, 1971, 1984). The more drastic method of treating the embryos by exposing them to alternating temperatures (the embryos are exposed alternately to temperatures higher or lower than the optimum for the species' development, the changes being carried out rapidly every few hours, i.e. thermal shocks are used) induces, besides the deformations already mentioned, also the occurrence of bicephality and of duplication of the whole prosoma. The cause of this kind of anomaly is bifurcation of the germ band. Depending on the depth of the division of the germ band, it is possible to obtain individuals with two full and equivalent heads or with one accessory incomplete lateral head, and if the division concerns most or all metameres, siamese twins (Jacuński & Templin, 1992, 2003; Jacuński *et al.*, 2002; Templin *et al.*, 2009). Here we describe a nymph of *Tegenaria atrica* C. L. Koch

with an accessory head. It is a unique and very interesting change which we observed during our teratological experiments.

Material and methods

A very interesting bicephalic *Tegenaria atrica* larva was obtained by exposing primordia alternately to temperatures higher or lower than the optimum for the development of the species, namely 14 and 32°C. The changes of temperature occurred every 12 hours. From the moment when the first prosomal metameres appeared on the germ band the embryos were incubated at a temperature of 23°C. The bicephalous individual was cultured until the nymph II stage, then histological preparations were made and the structure of the internal organs was studied, particular notice being taken of the structure of the nervous system and the presence of poison glands. The histological sections were made by the paraffin method and stained with haematoxylin and eosin.

Results

The anomaly was as follows: the accessory cephalic part was situated on the dorsal side of the seemingly regularly formed prosoma, to the right of the fovea. It was connected to the prosoma by means of a fairly long and relatively thin pedicel, widening distally. The accessory head faced posteriorly, towards the abdomen and was directed at an angle of *c.* 140° so that it was partly lifted above the prosoma (Fig. 1). It had only one pair of appendages, which were functional chelicerae of normal size and structure. Above them on the dorsal side there was a clearly contoured eye complex, consisting of four pairs of eyes, the anterior medians and lateral eyes lying very close together (Fig. 2). On the ventral side of the accessory head there was a mouth opening encircled by lips. An analysis of a series of histological sections showed that in the accessory head there was a nervous mass probably functioning as brain innervating the chelicerae and the eye complex. It was connected to the suboesophageal nervous mass included in the spider's prosoma (Fig. 3). Moreover, in the accessory head were

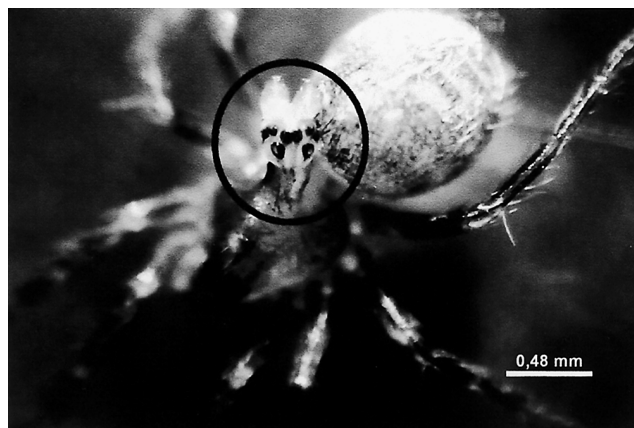


Fig. 1: Nymph of *Tegenaria atrica* C. L. Koch with accessory cephalic part, dorsal view.

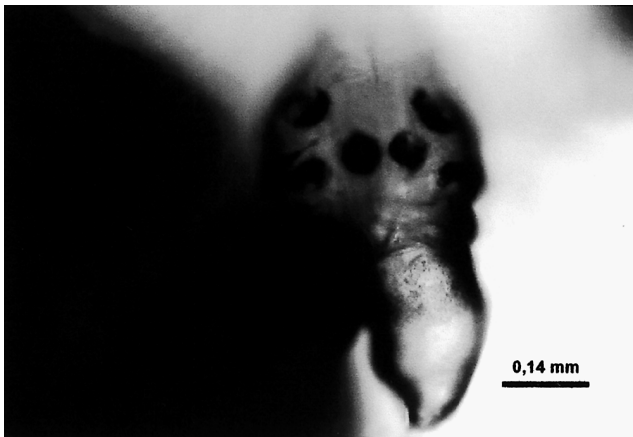


Fig. 2: Accessory head with chelicerae and four pairs of eyes.

found two poison glands with outlets on the chelicerae (Fig. 4). The oesophagus of the incomplete head was found to be connected to that of the “main” head.

Discussion

In the above case the exposure of the embryo to the teratogene in very early embryogeny resulted in a specific division of the anterior part of the germ band including part of the cephalic metameres, and the development of two brains, two pairs of poison glands and two oesophagi as a consequence of that process. This case is in agreement with the results of earlier studies on the anatomy of bicephalous spiders, in which the same organs were present in each of the “equivalent” heads, i.e. similarly equipped with appendages serving the mouth opening (Jacuński & Templin, 1992). The above-described case of bicephality is not the first obtained in our teratological studies. Two similar disturbances in the morphogeny of the cephalic part of *Tegenaria atrica* were found earlier, but the anomaly was lethal in character. The accessory heads were attached to the prosoma with pedicels that were so thin that in the course of casting off the egg membranes they broke off the prosoma.

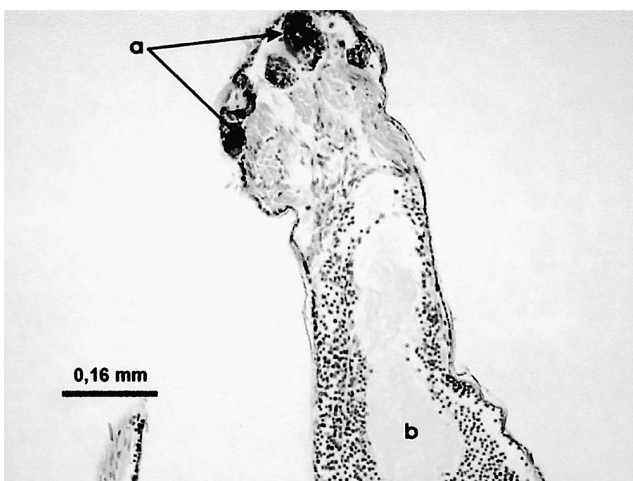


Fig. 3: Section through the accessory head: a=eyes, b=nervous mass.

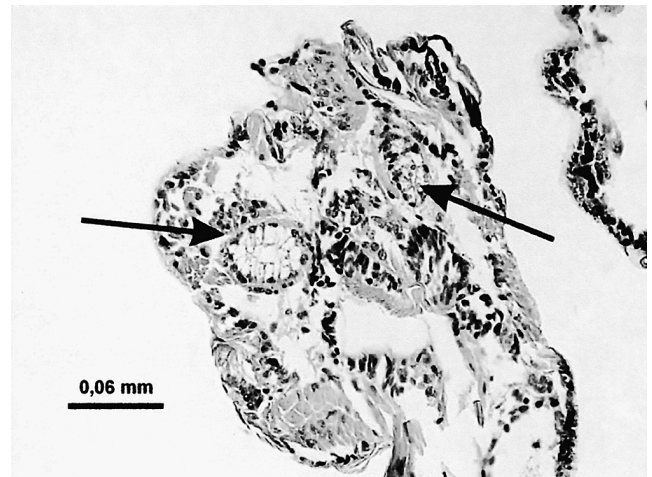


Fig. 4: Section through the accessory head. Arrows point to poison glands.

There are grounds to suggest that temperature as an abiotic factor occurring in nature can in extreme cases induce very serious disturbances in embryonic development leading to irreversible, usually lethal, anomalies in spiders.

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