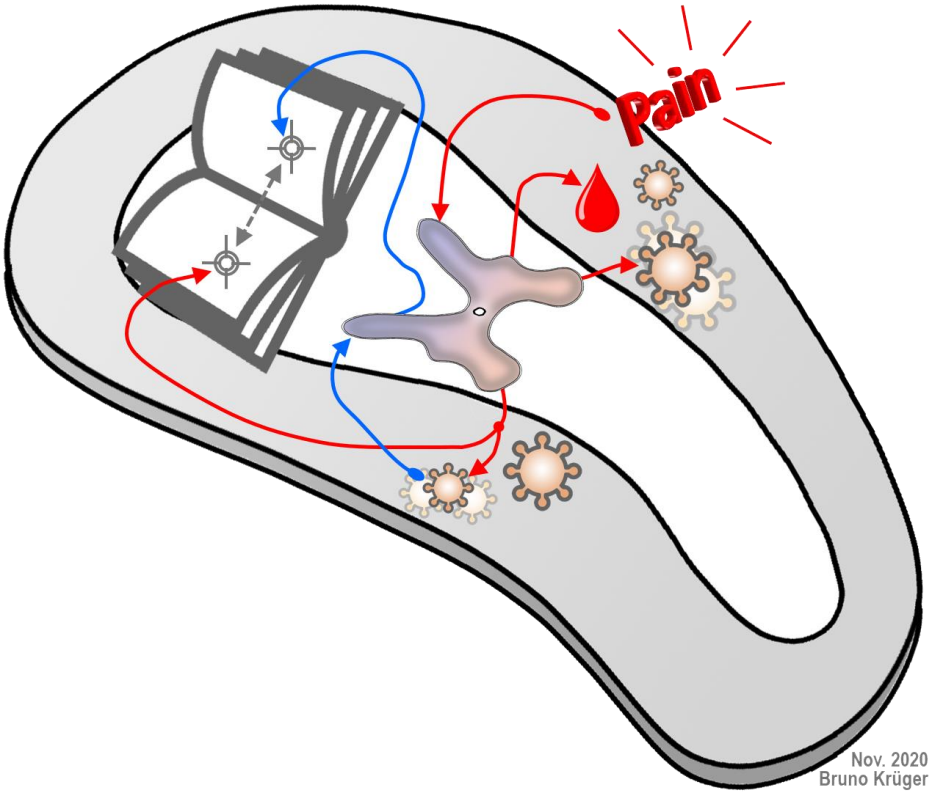
Bruno Krüger • Sours-Allee 3a • 55276 Dienheim

20.11.2020

Explanation of the Symmetry of the Bilateria

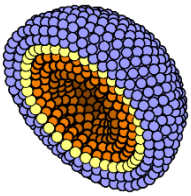
The evolution of bilateral symmetrical animals took place over 540 million years ago, when the central nervous system emerged and the Cambrian explosion of biodiversity began. The coincidence catches the eye and structural features that are also no coincidence: Each half of the brain is uniquely assigned to exactly one side of the body, both sensory and motor-wise, namely the opposite side.

Even before the Bilateria there was a cotyledon development of living beings and also a symmetrical separation into two sides. This can be explained separately elsewhere. Here the explanation for the subsequent symmetry of the Bilateria is proposed. The starting point are observations in the cotyledon stage of development, in humans around the end of the 4th week of pregnancy.

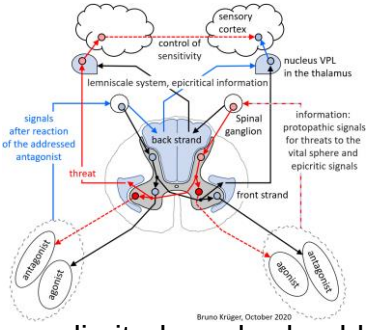


The figure shows sufficient features of the nerve connections to explain the symmetry.

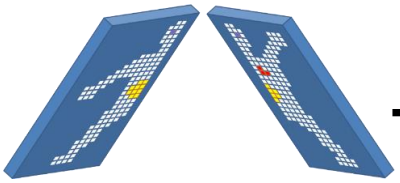
(1) CNS with brain and spinal cord,
(2) sympathetic system, blood vessel activation,
(3) peripheral nerve system for the perception of pain (red) and movement (blue),
(4) Motor skills for muscle activation separated into agonist, antagonist.



A lower cotyledon, from which food intake and supply emerges, and an upper one, from which the outer shell emerges, were already the basis for primitive forms of life. With the bilaterian anmimals, a middle cotyledon was added, from which muscles, skeleton and connective tissue emerge. A three-dimensional space grows and nutrients have to be transported away from the supply tract. In the cotyledon stage, in humans from the fourth week of pregnancy, blood capillaries and also a central heart develop.



Nutrients are limited and should increasingly arrive where they are needed. The precise location requirement is realized by nerve stimuli from the area of the body surface, which report pain and threat in later life. Activating signals use the sympathetic nervous system and cause blood vessels to contract when needed. The nerve connection between demand and contraction takes place in the spinal cord. At the same time, these threat signals trigger reflexes from muscles that have an effect at the point of pain perception. Activating neurons of the sympathetic nerve are located in the lateral horn of the spinal cord and in the vicinity of the motor neurons for the flexor muscles, which act as agonists in the logic of opposing players. The interconnection leads threat signals at the level of the spinal cord segment to the other side, where they activate extensor muscles or antagonists in the anterior horn and then continue to the brain.



The antagonists also activated on the opposite side of the body develop into opposing players of the agonists, who appear in mirror image in the symmetrical body plan and match the starting points of the threat signals. As the structures become larger and more differentiated, control at the level of the spinal cord segments is no longer sufficient. Gradually, the growth is supplemented by a control logic with higher precision. A central brain gradually participates accordingly. You can think of the brain as two mirror-image pages of a book. On each side there are nerve areas whose so-called somatotopic arrangement depicts the places in the body that the neurons represent there. The brain can assign the meaning of the locations solely on the basis of the aforementioned logic of opposing players. In the case of reflexes, bilateral movements lead to nerve stimuli in mirror-image matching locations on both sides of the book. Repetitions lead to the formation of bridges between the hemispheres of the brain as well as to learning how to connect the motor skills and meaningful nerve centers.