segments only, the protocerebron and deutocerebron, both of which are provided with præœsophageal commissures. The protocerebron, which innervates the eyes, is comparable to the protocerebron of the Crustacea and Insects; it is nevertheless to be observed that in *Limulus* the pedunculate body attains truly colossal proportions. The same organ, although considerably modified, is still recognizable in the Arachnids, in which M. Saint-Rémy has described it under the name of the stratified organ ("*organe stratifié*").

In *Limulus* and the Arachnids the deutocerebron, instead of innervating olfactory antennæ, as in the Crustacea and Insects, performs the same function for the cheliceræ, which are simply tactile appendages, and so is not differentiated in view of special sensorial perceptions. The tritocerebron is wanting in *Limulus* and the Arachnids, and the first ganglionic mass which follows the deutocerebron is devoted exclusively to the innervation of the first maxillipede or mandible *.

The visceral nervous system of *Limulus* and the Arachnids is represented only by lateral ganglia, which, as in the case of the Insects, derive their roots from the deutocerebron; the median ganglia are wanting; the absence of these centres is evidently correlated to that of the tritocerebron.

Finally, we may express the differences and resemblances presented by the different types of Arthropods as regards the organization of the brain by dividing these animals into two great groups.

The first of these, comprising the Arachnida and *Limulus*, is characterized by the absence of the tritocerebron and the non-differentiation of the deutocerebron into an olfactory centre.

The second, which embraces the Crustacea, Insecta, Myriapoda, and *Peripatus*, is characterized by the presence of a tritocerebron and the differentiation of the deutocerebron into an olfactory centre.

This group may be itself subdivided into two sections, the first containing only the Crustacea, which are provided with two pairs of antennæ, the second embracing Myriapoda, Insecta, and *Peripatus*, which possess a single pair of antennæ.—*Comptes Rendus Hebdomadaires des Séances de la Société de Biologie*, n. s., t. iv. (May 6, 1892), pp. 354–357.

On the Circulation of the Blood in young Spiders.

By M. Marcel Causard.

I have examined the circulation in young spiders belonging to fifteen genera of Dipneumones, of which the following twelve have been determined by M. Eugène Simon:—*Dictyna*, *Tentana*, *Theridion*, *Epeira*, *Zilla*, *Micariosoma*, *Chiracanthium*, *Textrix*, *Clotho*,

* The rostrum of Arachnids is analogous to the labrum of Crustacea and Insects, but it belongs to the second zonite and is innervated by the deutocerebron.

Pardosa, *Phlegra*, *Heliophanus*. Three other genera examined came from eggs found under stones without the adult females.

My results differ in certain points from those obtained by Claparède for *Lycosa*. The ramifications of the aorta are indeed such as were observed by this author, but the recurrent branch arising from the cephalic arteries conducts the globules into a lacuna occupying the median portion of the upper face of the cephalothorax, and which is not, as was supposed, an actual gutter; the globules which circulate in it from the front towards the rear, returning from the ophthalmic lacunæ, form a sort of sheet spread out beneath the integument; then, overflowing at the sides without following any definite route, they unite with the currents which skirt the lateral portions of the cephalothorax. In the Saltigradæ, in which the latero-posterior eyes are very large and placed well behind the others, the globules which have circulated round these eyes arrive at the central lacuna by following real gutters. Between the median anterior eyes globules are observed to penetrate between these organs to gain the sternal face of the cephalothorax.

In young spiders which have already undergone the first ecdysis and are still transparent other ramifications of the cephalic arteries, not remarked by Claparède, may be observed in the cephalothorax. These canals, which communicate with the recurrent branch of the cephalic artery, of which mention has been made above, carry the globules back towards the posterior portion of the cephalothorax; at certain points of their course globules may even be observed as they rise from the depth of the organs. The arrangement of these canals is the same in all the genera studied, except in the Saltigradæ, where it is slightly different. The appearance of these ramifications, which do not exist immediately after the animal is hatched, is highly interesting, since it shows that if, in consequence of the exclusive study of young spiders, the arterial system of these creatures has been considered as being very slightly ramified, it is nevertheless susceptible of complication and of attaining in the adults the development which the researches of M. Blanchard, confirmed by those of M. Schneider, have demonstrated.

In the appendages the globules of the arterial current follow one another in narrow file. The venous current is broader and forms a sort of sheet beneath the integument on the extensor side; it may be temporarily subdivided by muscular masses.

In all the genera which I examined I found the sternal branches of the pedal arteries, which open into the transverse sternal lacunæ. In the median sternal lacuna the globules come from the deep parts chiefly through a sort of notch, corresponding to the interval between the second and third pairs of limbs. Of these globules some go towards the rear, and the rest towards the front, to empty themselves at last into the transverse lacunæ and rejoin the venous currents returning from the appendages upon the sides of the thorax.

It seems, moreover, that the route followed by the globules of the

blood in the various cephalothoracic lacunæ may be slightly variable.

At the point where it divides to give off the pedal arteries each trunk of the aorta emits a short branch towards the sternal face; the two sanguineous currents thus formed encircle the sucking stomach, and, uniting forthwith, travel below the œsophagus and come into view beneath the integument, pouring numerous globules into the median sternal lacuna. This is probably the first of the anastomoses described by M. Schneider, that which gives off the *subœsophageal* vessel.

Though the abdomen is but slightly transparent the heart is generally quite visible, as also the two anterior pairs of its orifices (*pylocardia* of Schneider). The posterior pair is usually very difficult to observe. The blood which returns from the lungs into the pericardium enters the heart partly by the anterior and partly by the median orifices. In the posterior portion of the pericardium the globules circulate *from behind forwards*, to arrive at the median and posterior orifices. The blood which, penetrating into the anterior portion of the heart, is not sent into the aorta, circulates in this organ *from in front backwards*. I have nevertheless once seen in the anterior region of the heart the sanguineous current produced *from behind forwards*, because the greater portion of the blood returning from the lung gained the median instead of the anterior orifices of the heart.

I have not been able to directly observe globules issuing from the heart by the lateral arteries of M. Schneider; but in young specimens of *Heliophanus* I have succeeded in seeing in the posterior portion of the body a sanguineous current recede from the heart and branch off to lose itself in the liver. In young individuals of *Dictyna* and *Chiracanthium* I have perceived at the sides of the abdomen a current of globules proceeding towards the ventral face, which probably belonged to one of these arteries.

The blood which escapes from the posterior portion of the heart passes into the pygidial lacuna, which surrounds the anus and the spinnerets. It divides into two currents, which reach the ventral face; a few globules separate from the rest to circulate in the spinnerets before rejoining the common route. These two currents flow forwards, following the longitudinal ventral muscles, and mingle with those which have come from the cephalothorax, in the interval which separates the two lungs. The globules disappear behind the respiratory lamellæ, to reappear on the outer side and be swallowed up in eddies by the corresponding pulmonary vein, which conducts them to the pericardium opposite the anterior orifices.

The whole of the blood which reaches the heart has not previously passed through the lungs. As a matter of fact globules may be observed at the sides of the abdomen, which, issuing probably from the mass of the liver, appear beneath the integument and there circulate until they reach the pericardium, whence they penetrate

into the heart. In young specimens of *Pardosa* I have seen globules leave the two abdominal currents, some near the spinnerets and the others towards the middle of the ventral face, pass round the sides of the abdomen and fall directly into the pericardium. Finally, in some young individuals of *Pardosa* and *Heliophanus* globules, instead of penetrating into the lung, skirted its external border, and then, circulating beneath the integument, passed directly into the pericardium.

In conclusion : the vascular system, which is very little ramified in newly hatched spiders, becomes complicated later on ; the venous blood circulates in a very extensive series of lacunæ. The whole of the venous blood of the cephalothorax is arterialized before reaching the heart ; a portion of that of the abdomen returns directly to the pericardium, and from thence to the heart, without passing through the lungs.—*Comptes Rendus*, t. cxiv. no. 18 (May 2, 1892), pp. 1035–1038.

A Contribution to the Knowledge of the Anatomical Structure of the Sexual Organs in the Galeodidæ. By A. Birula, of the Zootomical Institute of the University of St. Petersburg. (Provisional Communication.)

The chief results of my investigations into the anatomico-histological structure of the genital organs in the Galeodidæ are the following.

My studies were conducted upon :—

a. *Galeodes araneoides*, Pall. (♂ & ♀);
b. *Galeodes ater*, Bir. (♀).

The male genital organs are constructed as follows :—

1. The external genital aperture is represented by a longitudinal slit in the protuberance of the posterior margin of the first abdominal segment ;

2. Aciniform (so-called accessory) glands, with a chitinized intima, open into the uterus masculinus, which is clothed with chitin ;

3. Each of the seminal ducts (vasa deferentia) divides in the third abdominal segment into two rami, which, suddenly narrowing, pass into the filiform testes ;

4. In the walls of each vas deferens, at their opening into the uterus masculinus, lie aciniform accessory glands, with columnar epithelium, but without an intima ;

5. At the period of the maturity of the sexual products the end of each ramus of the vasa deferentia, which is histologically indistinguishable, swells up into a vesicle and functions as a vesicula seminalis ;

6. The testes consist of four thin and very long coiled tubes, which,