"On the Development of the Layers of the Retina in the Chick after the Formation of the Optic Cup." By JOHN CAMERON, M.B., Ch.B. (Edin.). Communicated by Professor McINTOSH, F.R.S. Received February 6,—Read March 20, 1902.

(Abstract.)

The inner wall of the retinal cup in a 4th-day chick has exactly the same structure as the wall of the embryonic cerebral vesicles or spinal cord at the same stage of development. Thus all the structures which His has described in the wall of the embryonic spinal cord can be also recognised in the inner wall of the retinal cup, and may therefore receive similar names. (1.) A network (the myelospongium), which is produced by the union of the processes of cells called spongioblasts. The outer and inner extremities of the myelospongium network fuse to form the external and internal limiting membranes respectively (the external limiting membrane of the retina corresponds to the internal limiting membrane of the embryonic spinal cord or cerebral vesicle as it is next to the cavity of the original optic vesicle).

(2.) In the meshes of the myelospongium are two kinds of cells—1st, germinal cells, which are found only under the external limiting membrane; 2nd, neuroblasts, which are formed from division of the germinal cells and give rise to the ganglion cells and the cells of the inner and outer nuclear layers (the cells of the outer nuclear layer are the youngest cells of the retina).

Up to the 8th day, the inner wall of the retinal cup grows greatly both in thickness and surface area. On the 8th day of incubation the internal molecular layer appears, and on the 9th day the external molecular layer. These two layers first show themselves in the central point of the retinal cup, and extend forwards in all directions towards the anterior margin of the cup. The outer and inner molecular layers do not extend into the anterior one-fourth of the retinal cup, and this portion shows the simple arrangement seen before the 8th day; but in the posterior three-quarters, the external and internal nuclear layers and the ganglion cell layer are mapped out by the two molecular layers.

During the 8th day a rearrangement of the myelospongium occurs, and consists in the lateral offshoots of the fibres being absorbed for the most part in the region of the future internal nuclear layer; but in the region of the internal molecular layer the network becomes finer and much denser, and thus pushes the cells away on either side of it. The internal molecular layer appears before any processes from the ganglion cells or the internal nuclear layer have grown into it, and

therefore its first appearance is not due to the growth of the processes from these cells into it. The three streaks which develop in the internal molecular layer are due to a denser texture of the myelospongium at these places, on either side of which the fine arborisations from the cells in the ganglion layer and internal nuclear layer tend to accumulate.

The first appearance of the external molecular layer is explained as follows:—The myelospongium fibres bifurcate near their outer ends and neighbouring branches fuse with one another, so that the external molecular layer has at first an irregular outline. Later on, when the retinal wall becomes thinner, then this layer has a straighter outline. The persisting radial fibres of the myelospongium become the fibres of Müller.

In the internal nuclear layer, three kinds of cells can be distinguished at the 12th day of incubation: 1st, a single row of cells with clear nuclei, which lie next to the external molecular layer (basal cells); 2nd, several layers of small bipolar cells with external and internal processes passing into the external and internal molecular layers respectively; 3rd, a set of cells, usually arranged in three rows and giving off processes into the internal molecular layer (amacrine cells). From the 10th to the 12th day the ganglion cells spread out to form one layer, and the bipolar cells of the internal nuclear layer also spread out so that the retina becomes thinner. At the 10th day two kinds of cells can be recognised in the external nuclear layer—1st, cells which extend from the external limiting membrane to the external molecular layer, and are of the same breadth throughout (the rod cells); 2nd, cells which taper towards the external molecular layer (the cone cells). The rods and cones develop on the 12th day as outgrowths from these cells. The rods, however, appear a little earlier than the cones, and form globular projections which soon become flask-shaped. One cone-element appears usually between two flask-shaped rod-elements, and are therefore forced to assume a cone shape, but from them a fine filament is forced between the rod-elements and forms a minute spherical swelling immediately beyond. In most of the rod and cone cells a spherical body can be seen lying between the nucleus and the external limiting membrane on the 14th day. The rods and cones increase in length, due to protrusion of more and more protoplasm from the rod and cone cells, and this spherical body (the rod and cone ellipsoid) is borne along with the later protrusions of protoplasm and comes to occupy the inner segments of the rods and cones. Thus the outer segments of the rods and cones are the first to be protruded and lastly the inner segments. The oil globule develops in the protruded portion of the cone-element on the 15th day, and becomes coloured red or yellow on the 17th or 18th day. When first developed the rods about equal the cones in number, whereas

in the adult bird the cones are most numerous. Some of the bipolar cells from the internal nuclear layer emigrate through the external molecular layer, and develop into young cones. These investigations on the retina led to an inquiry as to what relationship there might be between the rod and cone cells, and the ciliated epithelium of the cerebral ventricles, and it is found that these are homologous structures. The germinal cells which line the cavities of the cerebral vesicles remain there after they cease to divide, and from them cilia develop. The inner ends of the myelospongium fibres do not develop cilia as is usually described.

The processes of the hexagonal pigment cells appear on the same date and at the same spot as the rods and cones and do not at first contain pigment granules. They resemble pseudopodia in their mode of development, and also, after full development, they behave like pseudopodia, for they elongate and retract under the influence of light and carry the pigment granules with them (the granules having no inherent power of movement).

The inner wall of the retinal cup has been seen to have the same structure as the wall of the cerebral vesicle in the early stages, and even later (as at the 8th day) some resemblance can still be drawn between them.

"The Classification of the Elements." By HENRY E. ARMSTRONG, V.P.R.S. Received March 5,—Read March 20, 1902.

Although no direct evidence acceptable to chemists has been adduced which in any way justifies the belief that the elements are decomposible, it is impossible to resist the conclusion that they are genetically related—so closely in many respects do they resemble a series of related compounds, especially when regarded from the point of view of the organic chemist. The generalisation known as the *Periodic Law* is in itself a justification of this view: the manner in which interrelationship becomes manifest when they are classified in accordance with its canons, being probably the strongest of all the arguments which can be cited as tending to show that the elements are compounds—but compounds very different from those with which we are accustomed to deal. Even in the form in which it was put forward by Mendeleeff, however, the periodic generalisation is but a first approximation: and the great Russian has himself pointed out that it needs improvement and development.* As chemists are beginning to recognise this,† I venture to submit a scheme of classification which I have been led to draw up in

* Faraday Lecture, 'Trans. Chem. Soc.,' 1889, p. 656.

† Comp. Biltz, 'Deut. chem. Ges. Ber.,' 1902, p. 562.