Da die vorstehenden Auseinandersetzungen wesentlich zusammenhängen mit den Darlegungen, welche ich vor einiger Zeit über den Bau des Nervengewebes gegeben habe, so nehme ich zum Schlusse die Gelegenheit wahr auf die umfassende Monographie von Nansen über *Myzostomum* hinzuweisen, in welcher zum ersten Mal das Nervengewebe eines Wirbellosen mit Rücksicht auf meine Angaben der Durchsicht unterzogen erscheint[16].

2. The Development of the Compound Eye of Crangon.

By J. S. Kingsley, Sc. D., Malden, Mass.

eingeg. 14. September 1886.

As I hope soon to publish a detailed account of the development of the compound eye of *Crangon*, a mere outline is presented here. Numerous figures illustrating every step in the process will be given in the final article.

The first rudiments of the compound eyes appear as circular patches on either side of the egg just after the gastrula stage. Each patch is composed of a single layer of columnar cells, each cell having a smaller superficial area than those of the surrounding blastoderm. From near the centre of this circular plate an invagination takes place and a small pouch of epiblast is pushed downwards, inwards and forwards under the infero-anterior portion of the optic plate, the posterior part of which gives rise to the supra-œsophageal ganglion. The pouch itself soon becomes separated from the parent epiblast and takes an internal position, resting immediately on the yolk. By means of this invagination three cell-layers are formed, to which, for convenience names may be applied. The external layer, the unmodified epiblast is the epidermis; the outer wall of the invaginated pouch which rests against the epidermis is the retinal layer; while the inner wall of the same pouch (that resting on the yolk) is the ganglionic layer.

From this condition there is but little change until the embryo is well outlined and provided with the rudiments of seven pairs of appendages. The optic cavity (cavity of invagination) remains distinct and the cells and their nuclei retain their primitive appearance. Now change is first noticeable in the nuclei of the retinal layer. They have become more numerous and more columnar than those of the epidermis. They rapidly elongate until their major axis is three or four times as long as the minor one; the whole layer still remaining but

[16] Fridtjof Nansen, Bidrag til Myzostomernes Anatomi og Histologi. Med 9 Plancher. Bergen, 1885.

a single cell deep. At the same time the cells of the ganglionic layer, without assuming such an extreme elongation as is seen in those just mentioned begin to divide transversely, each parent cell giving rise to a row of five or six daughter cells, each row growing inwards and being directed toward the mathematical centre of the rudimentary eye, thus giving the whole a radiate appearance. The future history of these cells need not be traced here; it is sufficient to say that they give rise to the series of ganglia and fibres which lie in the stalk, of the adult eye, a union with the supra-œsophageal ganglion being effected at about the time of hatching. As will be seen from the foregoing my ganglionic layer (Anlage) corresponds, to a certain extent, to the neural layer described by Bobretzky (cit. infra) in the developing eye of *Astacus*. Up to this time the epidermal layer retains more of its primitive character. Its cells are large and flat and far less numerous than those of either of the deeper layers.

A new element now enters the eye. At the infero-posterior angle a thin band of undifferentiated mesoblast pushes its way between the ganglionic layer and the rudimentary supra-œsophageal ganglion until it reaches the point where the deeper layers of the eye separated from the parent epiblast. It now turns upwards and extends in between the ganglionic and retinal layers, thus coming to occupy the cavity of the optic invagination. Here its remains for a time unaltered, its cells being easily recognised by their slender fusiform outline.

The next important change is noticed at the time when the deposition of pigment in the eye begins. The embryo has now the same number of appendages as before, but the distinctions between maxillae and maxillipeds is well marked; the abdomen is entirely formed; the telson is bifurcate and armed with its seven pairs of setæ and the heart has begun to beat. The cells of the epiderm have undergone a rapid subdivision until now an epidermal nucleus rests directly over each one of the rows of retinal nuclei about to be described. The elongate retinal nuclei of the last stage have each been divided transversely into five nuclei and each of these sets of products of a single nucleus are arranged in a nearly straight line pointing, as did those of the ganglionic layer, to the centre of the eye. From their subsequent fate we are able to apply names to each of these cells indicated by these nuclei. The outermost is the retinophora[1] and there in regular order come the pigment cells 1, 2, 3, 4. The rows of cells are apparently arranged in sets or pairs, a considerable interval of structureless substance alternating with two rows of cells. This substance in reality is the rudiment of

[1] vide Patten, Mittheil. Neapel. 6. Bd. 1886.

the crystalline cone and is secreted by the retinophoræ on either side, and hence the closely approximate cells in reality belong to different ommatidia. The retinal cells now become greatly elongate and from the retinophorae is formed the at first slender pedicel (rhabdom, Grenacher) exactly as is claimed by Patten (l. c.) Pigment is first deposited in cells 4, next in cells 1, and later in the intervening ones which never become so deeply pigmented as the two just specified.

All of the important parts of the eye are now outlined and the subsequent development is quite regular. With the increase in size of the crystalline cone the nuclei of the retinophorae and the corresponding ones of the epidermis (which secrete the cuticular lenses) are forced to a position on the ends of the cone, while by the same process the pigment cells are forced backward and form a sheath around the style and pedicel of their respective ommatidia. From the ganglionic layer nerves grow outward and penetrate the retinal elements, proceeding even into the crystalline cone. In short my studies so far as they go confirm the observations of Patten as to the structure of the eye of the adult Decapod and warrant his criticisms on the account of Grenacher. It merely needs to be said that I have not traced the fine nerve terminations described by Patten as existing in the crystalline cone. After hatching, the mesoblast in the optic cavity becomes developed into a thick layer of connective tissue in which there is an abundant deposition of pigment.

There is nothing in the development of the eye which warrants the assumption that it or its stalk is an appendage homodynamous with the other arthropod appendages; and further, the development of a compound eye from a single invaginated pit shows that it is not to be regarded as derived from a coalescence of ocelli.

Whether vali dor not the comparison instituted by Locy[2] between the eyes of Arthropods and those of Vertebrates is extremely interesting, and the studies of Patten on the nerve terminations make them ever more so. In the light of the facts here presented they do not appear so absurd as they would have seemed a year ago. In both, the retinal elements, with regard to their origin have exactly the same relation to direction of the light; there is an analogy in the nerve supply while Patten's investigations on the nerve terminations show still another point of similarity. I hope later, to show that the analogies (homologies?) are even closer than the foregoing would indicate.

As to a question of priority. Bobretzky was the first to describe

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[2] Bulletin Mus. Comp. Zool. XII, p. 94, 1886.
[3] Зап. Кіев. Об. Ест., III, T. I., 1873.

the development of a compound eye[3] and apparently he saw the same invaginated pit without recognising it. Reichenbach[4] also saw it, but interpreted it as an ‚anlage' of the optic portion of the supra-œsophageal ganglion. Sedgwick[5] definitely states that in *Peripatus* the eye is formed by an invagination and von Kennel (teste Carrière) confirms him. Locy was, however, the first[6] to indicate the steps in the process; and I regard the close similarity which exists between his results and those of my own outlined above as largely confirmative of the thesis I endeavored to maintain in my »Notes on the Embryology of *Limulus*«[7] viz. that the spiders are far more closely related to the *Crustacea* than either are to the Hexapods and that the group »Tracheata« is not a valid one. Carrière's recent studies[8] on the development of the ocelli in Hymenoptera do not in the least invalidate this position.

Malden, August 31st 1886.

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[4] Zeitschr. f. wiss. Zool. 19. Bd. 1877.
[5] Quart. Journ. Microsc. Sc., XXV., p. 461, 1885.
[6] l. c. p. 85—89, Pl. X. 1886.
[7] Quart. Journ. Microsc. Sc., XXV., Oct. 1885.
[8] Zool. Anz. 9. Jahrg. No. 230. p. 496—500. 1886.

IV. Personal-Notizen.

Utrecht. Herr Dr. A. C. Oudemans ist am 1. Mai zum Director des Zoologischen Gartens im Haag und an seiner Stelle Herr C. H. van Herwerden am 1. October zum Conservator des zoologischen Museums ernannt worden.

Necrolog.

Am 1. Mai starb in Bern Dr. Gustav Haller, ein um die Kenntnis der Milben verdienter Zoolog.

Am 10. August starb in London Mr. George Busk im 78. Jahre. Autorität auf dem Gebiete der Bryozoen, bekannt als Anthropolog und Palaeontolog, unvergeßlich als allezeit zuverlässiger, liebenswürdiger Freund.

Im August starb plötzlich in Lion-sur-mer während seines Ferienaufenthalts Maurice Girard, der bekannte französische Entomolog, 64 Jahre alt.

Am 1. August starb in München Baron Edgar von Harold, einer der Herausgeber des Catalogus Coleopterorum, einer der vorzüglichsten Käferkenner.

Berichtigung.

In No. 232 p. 547 (Über die Metamorphose der Süßwasserbryozoen von A. Ostroumoff) muß es Z. 10 von unten (Text) heißen: »aus dem aufsteigenden« anstatt »aus welchem«.

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