QUARTERLY CHRONICLE OF MICROSCOPICAL SCIENCE.

HISTOLOGY.

Blood.—Professor Neumann, of Königsberg ('Archiv der Heilkunde,' bd. xii, p. 187, 1871), continuing his researches on the formation of blood-corpuscles, noticed in our last number, has observed coloured nucleated cells, which he regards as transitional forms between the white and red corpuscles of the blood, in several instances in the blood of new-born children (born at the full time), and concludes that the embryonal formation of blood must go on till a later period of development than has been generally supposed—certainly beyond the fifth month indicated by Paget. Further researches must show how long these embryonic forms survive after birth; they were found wanting in the case of a child who died at sixteen days (of disease). Kölliker had previously found them in the spleen and liver of new-born infants. Neumann has found the same embryonic type of blood-cell in the blood of two persons suffering from the disease known as "Leukæmia" (or in England, "Leucocythæmia"); [1] a fact well worthy the attention of physicians.

Medulla of Bones.—In the account which we lately gave of the researches of Neumann on the structure of the osseous medulla and its relation to the formation of blood, no mention was made of the parallel and independent researches of Bizzozero,[2] of Pavia. In 'Virchow's Archiv' (vol. lii, p. 156, heft. 1) a summary of Bizzozero's researches is given, to which we are indebted for the following abstract.[3] He dis-

[1] The occurrence of coloured nucleated cells in the blood of mammalia has been observed in many isolated instances. Professor Rolleston has observed them in the blood of the two-toed sloth, and has given several references to similar observations (see 'Quarterly Journal,' new series, vol. vii, p. 127, 1867), one of which, by Mr. Busk, in this 'Journal,' 1852, refers to man. Eberth found the same in a case of leukæmia ('Virch. Arch.,' xliii, 8.

[2] 'Sul Midollo delle Ossa,' studi del Dr. G. Bizzozero. Napoli, 1869.

[3] Professor Virchow remarks, in a footnote, that he himself long ago

tinguishes three kinds of osseous medulla, the *red*, the *yellow*, and the *gelatinous*. The red occupies the most important position with respect to the formation of blood. It consists of three varieties of cells.

1. Cells analogous to the white corpuscles of the blood. These are from ·005 mm. to ·010 mm. in diameter, are sometimes without a nucleus, sometimes contain a divided nucleus, or even two. Their contractility is very remarkable, and was observed by Bizzozero so long ago as 1865. He has also directly observed in four frogs multiplication of these cells by division; the actively moving cell drew itself out, became constricted in the middle, and finally separated into two parts. The obvious objection that such cells might be migrated blood cells, was met by the experiment of carefully washing out the vessels of rabbits recently killed by bleeding with solution of common salt before examination of the medulla. The number of bodies resembling leucocytes was not in any degree diminished. It was also observed that the number of such cells contained in the medulla was very far out of proportion to any that could be contained within the vessels.

2. Red nucleated cells, discovered by Neumann. These vary from ·008 mm. to ·012 mm., or more, in diameter. They show every transitional form, from the colourless nucleated cells to the red blood discs; some showing a large nucleus and colourless protoplasm, others one or more small nuclei, and a protoplasmic mass of the same colour as the red blood discs. The vanishing of the nucleus takes place by a kind of atrophy, the nucleus breaking up into granules. Elongated cells with two nuclei, one at each end, were also observed; they are either spindle-shaped or narrow in the middle, and show the process of division of red cells.

3. "Gigantic" (or myeloid) cells, with proliferating central nucleus, were observed; their size is from ·025 mm. to ·045 mm. They have an irregular round, oval, or kidney shape. They differ from the *myéloplaxes* of Robin in shape, size, and consistence, as well as in their locality.

4. White cells containing red globules were first discovered by Bizzozero himself in 1868, and are commonly, though not constantly, present. The shape of these is extremely various, in animals most round or oval; in man more often angular or spindle shaped. Their size is from

distinguished three kinds of medulla—the red, the yellow, and the gelatinous; and also pointed out the analogy of the cells of the red medulla with granulation cells, as well as the occurrence of pigmented cells in that structure.

·01 mm. to ·05 mm. The protoplasma is colourless or slightly yellowish, but contains red blood-globules and pigment-granules. The number of red blood-globules is from one to eight; or in pathological conditions even as many as thirty or fifty. Pigment-granules occur with or without the blood-discs, and are sometimes three or four times as large.

These cells Bizzozero declares without hesitation to be concerned in the destruction of blood-discs, and compares them to the similar forms described by Kölliker in the spleen.

The blood-vessels are described by Bizzozero (agreeing with Neumann) as being extremely abundant in the red medulla, and composing more than the half of its substance. He has observed *capillaries* also, which the German observer failed to find, and has both isolated them and demonstrated, by silver injections, their longitudinal spindle-cells.

The arteries and veins form a kind of framework, in the interstices of which are contained the proper elements of the medulla. While Neumann finds the red blood-cells always within the vessels, Bizzozero observed his cells containing red blood-globules always outside the vessels. The medullary cells are scattered in a quite disorderly manner in the meshes of the vascular network; the "gigantic" cells occur at intervals, and separated by more or less considerable masses of medullary cells. The connective tissue-cells, with their prolongations, form a sort of network, which is demonstrated very clearly on teazing out sections of the medulla hardened in potassium bichromate, or, better, in osmic acid.

The gelatinous medulla differs from the red by its abundant intercellular substance. While in the red medulla the spaces between the vessels are almost filled with cellular elements, there is in the gelatinous a large quantity of amorphous, translucent, colourless, or faint yellowish substance, which coagulates with dilute acetic acid, and dissolves in an excess of that reagent. Moreover, the nucleated blood-cells, and especially the cells containing blood-globules or pigment, are rare.

The *yellow* medulla is distinguished by its richness in fat-cells from both the others. Various transitional forms between these three varieties of medulla may be met with.

These facts of structure, as well as the variations met with in pathological conditions, illustrate the great analogy of the medulla with the spleen.

Some experiments were made to determine the effect of starvation on the medulla. In a healthy, well-fed rabbit the leg was amputated, and the medulla of the tibia found to be of a grey colour below, and greyish-red in the upper part, while the microscope detected a large number of fat-cells. In starved rabbits the corresponding structure was found of a dark red colour, and highly vascular. The microscope showed enormous dilatation of the vessels; the veins in some parts touching one another, and leaving hardly any space for the proper medullary tissue. Where there was any interval, it was found occupied by amorphous matter, or else by nothing but medullary cells.

Development of Fatty Tissue. — Flemming, in 'Max Schultze's Archiv,' vol. vii, p. 32, in a paper entitled "Ueber Bildung und Rückbildung der Fettzelle im Bindegewebe," discusses the formation of adipose tissue, its relation to connective tissue, and its retrogression into the condition of the latter. His observations were made on embryoes and newly born animals, and also on animals artificially fattened, in order to make sure that the fatty tissue should be in the condition of increase; also on animals in a state of progressive emaciation. He is in agreement with most of the physiological and pathological observers on the point that fatty tissue is nothing but a modified connective tissue. The only observer who had previously investigated the subject by artificial fattening was Czajewicz, with whom Flemming does not always agree. Flemming finds that the development of fat is always dependent on vessels. The first deposit of fat takes place in the *tunica adventitia* of the blood-vessels, so that adipose tissue might in fact be called a loosely spread adventitious coat of the vessels. Moreover, the fat does not accumulate round newly-formed outgrowths of vessels, but rather round those which are completely formed and comparatively thick. The mesentery, which has been studied by previous observers, was found to be an unsuitable object. The subcutaneous tissue of mammalia was preferred. The advantages of observing mammalia are, that by artificial fattening an unquestionable production of fat can be secured. Rabbits, on account of their numerous parasitic diseases, are unsuitable. Guinea pigs and puppies are better. Young mammalia, still sucking, or shortly before birth, show the same fat-generating process as artificially fattened animals. The production of fat takes place only in isolated foci, round certain vessels of the fatty lobule, while other quite similar vessels show nothing of the kind. The fat does not appear at first, as observed by Czajewicz, in the periphery of the lobules, nor is it contained, as has been asserted by other observers, in special, smaller cells. A certain quantity is accumulated in the wall of the larger, completed fat-cells, and a small number of fatty molecules are seen free, perhaps in consequence of the mode of preparation; but most is seen in what are believed to be fixed connective-tissue-cells. Migratory cells are seen in great abundance, but are not different from the white corpuscles of the blood, and do not contain fat. The genuine young fat-cells have no membrane, and look at first sight like a heap of fatty molecules varying in size; they are angular or spindle-shaped or polygonal, and only occasionally, when they contain several larger drops of fat, are they round. The smallest of them hardly exceed in size the normal fixed connective-tissue-corpuscles. Although it might seem natural to suppose that the migratory cells should be the early stages of fat-cells, no evidence of this could be found. The fat-containing cells never show spontaneous movements; pigments introduced into the blood pass into the migratory cells, but never into the fat-containing cells.

Observations were also made on fishes, which in the spring, when their nutrition is active, give excellent objects. A small portion of the parietal peritoneum is carefully stripped off and laid on a glass in iodized serum; if surrounded by a ring of oil and covered with thin glass it preserves its appearance, and even the mobility of its cells for as long as half a day. Migratory cells are seen in great abundance, and also young fat-cells, but these structures seem to be perfectly distinct from one another; the migratory cells never containing fat, and the fat-containing cells having the closest resemblance to the fixed connective-tissue-cells. Besides these forms, however, there are others, which have previously been noticed by Leydig as "mulberry-shaped fat-cells," which appear to be nothing else than ready-formed fat-cells, which increase in size by the accumulation of fatty granules in their periphery. These forms are met with rather on the outside of a fatty lobule. Neither in the mesentery nor in the medullary tissue of bone could Flemming find any evidence that the production of fat begins, as has been supposed, in any special round cells, but always in ready-formed connective-tissue-cells. In embryoes (of the rat, &c.), the fat production seemed to take place in cells of all kinds, among which were round embryonic cells.

In his observations on the wasting or absorption of fat, Flemming comes to the conclusion that the fat-cells become ultimately converted, not into a "serous fat-cell," as has been said, but simply into the ordinary flattened connective-tissue-cell; in fact, that the process is precisely the converse of that seen in the production of fat. The cells left after the fat has vanished have no membrane; and Flemming even asserts that the perfectly formed fat-cell has, in some cases, for instance in *amphibia*, no true membrane, the drop of fat being encircled by a ring of homogeneous protoplasm.

The general results are summed up as showing that fat-cells are formed out of the ordinary fixed elements of connective tissue, and can, by the loss of their fat, return to the condition of such connective-tissue-cells again. That there is no special preliminary tissue, and that the name adipose or fatty tissue is accordingly superfluous. The "mucous tissue" of Virchow has no special relation to fat; it has merely the characters of all embryonic connective tissue.

The passage of fat into the fixed connective-tissue-cells is not to be explained by its transmission through plasmatic channels communicating with connective-tissue-corpuscles; the existence of these channels Flemming does not admit; but he proposes the hypothesis that fat circulates in, and passes out from, the vessels in a liquid form, and then, being absorbed by the connective-tissue-cells, is precipitated in their substance.

The remarkable localisation of the production of fat, he thinks, depends upon the dilatation of the vessels at particular points, and sees another evidence of this dilatation in the large number of migratory (extravasated) cells at these points.

In an introduction, Flemming discusses the general structure of the connective tissue, especially in relation to the views of Ranvier, with which he expresses a general concurrence, rejecting altogether the notion of *hollow* corpuscles communicating by a system of plasmatic channels. His methods were principally the same as those of Ranvier; producing an artificial œdema of the connective tissue, with injections of size, mixed with silver solution, which coloured the tissues, and on cooling produced a mass sufficiently firm to cut fine sections. For tinting, he especially recommends the picrocarminate of ammonia solution of Ranvier, made by *precisely* neutralising an ammoniacal solution of carmine with a pure, concentrated, and filtered solution of picric acid.

Lymphatics in connection with Cerebral Arteries.—'Virchow's Archiv der Pathologischen Anatomie' (Vol. li, p. 568, Dec. 1870) contains an abstract of a paper, not yet published in full, by Dr. Golgi, of Pavia, on the "perivascular spaces" of His. The author holds (with Kölliker and others in opposition to His) that these spaces are true canals limited on the outside by the *adventitia*, on the inner side by the vascular wall. He has arrived at this opinion by investigations conducted on the vessels of fresh brain substance, as well as on specimens hardened in osmic acid, and in bichromate of potassium. His results were also confirmed by injected preparations, made by injecting a solution of Prussian blue under very gentle pressure into the subarachnoid spaces; which not only filled very beautifully the meningeal perivascular spaces, but penetrated into the cortical part of the brain along the vessels, and along the inner, not the outer, wall of the lymphatic sheaths.

The size of these channels was found to vary with the age of the individual, the particular part of the brain, and the diameter of the adjacent vessel. They are, on the average, wider in children than in adults; and larger in the cerebral hemispheres than in any other part of the brain. From more than a thousand measurements the author finds the average diameter to be—in adults 62μ;[1] in children 70μ. The following table shows the average diameters in different parts of the brain:

	ADULTS.	CHILDREN.
Cerebral hemispheres	99 μ	81
Corpora striata	77	75
Thalami optici	76	54
Cerebellum	56	
Pons varolii	38	

Very careful comparative measurements also established the fact that the lymphatics are not filled from the adjacent vessels, but that their distension holds a converse relation to the fulness of the blood vessels. Hence in rapid hyperæmia of the brain the lymphatics are compressed; when the blood-pressure diminishes they dilate, and so on. These relations were well illustrated by measurements taken from brains in several morbid states; all those in which there was hyperæmia showing the lymphatics small, while in anæmia they were larger.

Many interesting details are given respecting pathological conditions of the lymphatics, which we cannot further enter into.

Researches on the Normal and Pathological Anatomy of the Frog's Skin—By Carl Jos. Eberth, Professor of Pathological Anatomy in Zurich; with three plates (Untersuchungen, &c. Engelmann, Leipzig).

Professor Eberth's researches were made on *Rana escu-*

[1] μ = one thousandth of a millimètre.

lenta, R. temporaria, and *Hyla arborea.* His work forms the most complete account of the frog's skin which has been published, which is thus carefully worked out with a view to further studying it under pathological conditions. Amongst the more remarkable facts recorded are—1st. The round openings or pores between the cells of the epidermis, also found passing *through* the actual substance of epidermic-cells, sometimes three through one cell, already observed by F. E. Schulze, most of which are the openings of underlying unicellular goblet-shaped glands. Eberth regards some as mere pores, and suspects the presence of very much finer pores in immense numbers. 2nd. The similarly placed openings of the proper cutaneous glands, which have a curious shape, formed by three converging lines like the bite of a leech. 3rd. The structure of the cutaneous glands, the smooth muscle-fibres of which, the areolar tunica propria, and the nerve-supply, are described and figured. Of this we have given some account below. 4th. The well-known swellings which appear on the thumbs of male frogs are carefully examined. Eberth cannot find touch-corpuscles nor multipolar ganglion-cells in these organs, as some have described. He finds peculiar cells, like white blood-corpuscles, with large round nuclei, but does not consider these as nervous organs. The cells taken by Ciaccio for multipolar ganglion-cells he regards as connective tissue-corpuscles. 5th. The pigment-cells of the cutis are specially examined. Eberth confirms Wittich, as against Brücke, in the conclusion that the green colour in the green skin of the back of frogs is caused by the covering over of the black pigment-cells by *yellow* pigment-cells, and is not an "interference-colour," and hence there is not the difference between Hyla and Chameleon which Brücke had maintained, for in the former, as in the latter, the granules in the pigment-cells which appear bluish and yellowish-green by incident light, are few and subordinate in effect to the super- and juxta-position of the yellow and black pigment-cells. 6th. The fibres in the small papillæ of the cutis, described by Ciaccio as nerves, are shown by Eberth to be smooth muscle-fibres, which run perpendicularly and spirally into the papilla. The connection of nerve-endings with these muscle-cells is described. Instead of ending in connection with the nucleus or in its neighbourhood, as recently described by Krause for other smooth muscles, in these the muscle-cell tapers away to a very long and fine process below, and the nerve-fibre joins this long process of the muscle-cell. When the medulla oblongata of a frog is cut through there often comes on, after a few seconds or a few minutes, a very obvious wrinkling of the skin, a true *cutis anserina*. 7th. The nerves of the skin are not very favorably studied in the frog, especially their endings.

Eberth, after several attempts, was obliged to give up the attempt to follow the nerves into the epidermis, and confine himself to those of the cutis, which he studied in Hyla. We may refer to Eberth's previous papers on the ending of nerves in the tadpole's tail, and also to some observations made by Dr. Klein, of Vienna, in which gold chloride was used, showing a remarkably fine network of nerves in the epidermis. Eberth describes fine networks of nerves in the cutis of Hyla, but insists that these cannot be regarded as terminal. Stellate connective tissue corpuscles, remarkably like those in the frog's cornea, and having the same apparent relation to the nerves, are described and figured; but Eberth does not find himself able to confirm his previous views as to the termination of the nerves in such corpuscles, which he advanced in his paper on the tadpole's tail ('Archiv für Mikros. Anat.,' Bd. ii). At the same time, though the cutis of *Hyla* does not confirm the existence of such a relation, Eberth cannot, in the face of repeated observation, deny the connection in the case of the tadpole's tail.

Researches on the Olfactory Mucous Membrane of the Frog. By Dr. Sigmuud Exner, Assistant in the Physiological Institute, Vienna (' Sitz. der R. Akad. der Wissench.,' vol. lxiii, part 1. Read December 15th, 1870).

The author divides the nasal mucous membrane of the frog into three layers—1st. The epithelial layer. 2nd. The subepithelial network. 3rd. The connective tissue layer, with its nerves and vessels. In the fresh condition the cells of the first layer are very soft and elastic, and like blood-corpuscles. They present, on their outer surface, hairs, the longer of which are immovable, whilst the smaller give from forty-nine to sixty strokes in the second. The movement was not affected by the electric induction current, but the cells appear to stretch and return again to their original form. The fresh cells were examined in humor aqueus.

Chromic acid, of 0·5 per cent., and, in other cases, osmic acid in saturated solution, were used for the observing the form of these cells. In concordance with Max Schultze's observations, made on the same subject, Exner finds two kinds of cells, the one (epithelial-cells) having the front portion of the elongated cell-body of about the same width as the nucleus, and the hinder portion passing off into a narrower, but still tolerably thick prolongation; whilst the other sort (smelling-cells) have an anterior portion much narrower than the nucleus, and an excessively fine long thread-like prolongation from the deeper surface, which passes towards the connective tissue layer Exner, however, cannot confirm Max Schultze as to the essential differences between these two forms, and is, accordingly, not prepared to assign them distinct functions, as that histologist has done. He denies that the nuclei differ in the two forms, but finds that the nucleus exhibits some variation in form and optical character in both. He also states that the difference in the thickness of the portion of the cell in front of the nucleus is of no importance, since he has most carefully and amply observed forms of intermediate thickness. Pigment-drops also occur in the thin anterior piece of the smelling-cells, as well as in the broad epithelial-cells. Schultze pointed out a difference between the two kinds of cells in the presence of hair-like projections on the "smelling-cells." But Exner finds these on the epithelial-cells too. He attributes the absence of them, which is commonly remarked, to their getting detached; such portions of epithelial-cells, *e.g.* in the case of the striated piece on the cells of the intestinal villi, not unfrequently becoming broken away under the influence of reagents.

Exner says he has been very careful not to confuse the proper epithelial-cells of the olfactory region with the ciliated epithelium of the surrounding parts, and gives drawings of two or three undeniable cases in support of his statement, the best of which were obtained by the osmic acid method. That there should be two forms of cells which equally have claims to be regarded as "smelling-cells" is of interest, in conjunction with the fact that two forms of nerve-endings, the rods and the cones, occur in the eye. It would be worth inquiring whether any transition forms between rods and cones occur in the retina as here, between "epithelial-" and "smelling"-cells, and whether, in either case, the transitional forms indicate an actual metamorphosis of the one form into the other—points of which Dr. Exner does not profess to treat. The parallel is striking between the very delicate "centrale Forssatz" of the "smelling-cells" and the similarly delicate thread coming from the "rods," on the one hand, and the thicker corresponding parts of both so-called epithelial cells and the cones.

The *subepithelial network* is a nervous structure, which has been more or less clearly seen by previous observers, and which is very exactly represented in the tongue of the frog, as described both by Axel Key, and more recently by Engelmann (in Stricker's 'Handbuch,' Heft iv), in direct connection with which the forked taste-cells are placed. Exner describes a perfectly clear and simple connection of the "epithelial"-cells with this nervous network, and figures their continuity. Max Schultze had described these cells as passing to the deeper lying connective tissue layer, to which they appeared connected by a three-cornered enlargement. This network, now pointed out by Exner, appears to consist of a protoplasmic mass, with numerous meshes in it containing nuclei, which nuclei are like those of the "smelling-cells." With very thin sections, prepared in osmic acid, and teazed out, it was possible to observe the direct connection of the cells with this network. Max Schultze describes a network in the olfactory mucous membrane of the Plagiostomi, which agrees very closely with this, and he also appears to have seen, though not fully to have described and figured, Exner's network in the frog.

The olfactory nerve forms a plexus in the connective tissue beneath Exner's network, and the branches from this plexus pass straight up directly into the overlying network, such a branch occupying the space between two of the nucleus-containing meshes. Here the branches gradually lose their characteristic fibrillar aspect, and pass by degrees into the protoplasmic matter of Exner's meshwork, thus completing the connection of the nerve with the cells. This connection is fully illustrated in nature-true drawings in the paper, and rests on observation, not on hypothesis.

Exner doubts whether the fine fibrillar structure often to be seen in branches of the olfactory nerve, when they have been torn so as to present a jagged end, is a living or a post-mortems tructure. Max Schultze has regarded these very fine fibrillæ, with their intermittent swellings, as continuous with the identical fine fibrillæ, one of which comes from each "smelling-cell" (so also with the rods of the retina). The course of the fine fibril coming from each "smelling-cell" appears to be quite impossible to follow; it may, and probably does, end in the protoplasmic substance of Exner's meshwork, but is so fine that it would be apparently impossible to trace it further. Two folding plates illustrate Dr. Exner's paper.

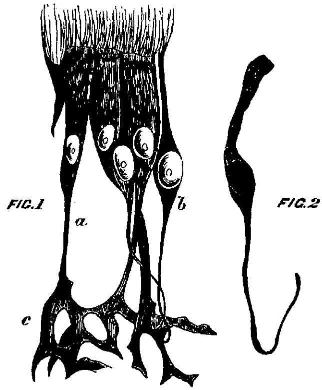


Fig. 1.—*a*. Epithelial, and *b*, Smelling-cells in continuity with Exner's network, *c*.
Fig. 2.—A transition form of the olfactory cells:—the hair-like fringe is broken away.

The Nature of the Influence of Nerves on Gland-cells, as illustrated by the Cutaneous Glands of the Frog.—Two papers have recently appeared of considerable physiological interest in relation to the 'gland and nerve' question, one is by Engelmann, of Utrecht, in Pflüger's 'Archiv.' The other a separate work on the 'Skin of the Frog,' is by Professor Eberth, of Zurich (see above). It has long been known that some of the cutaneous glands of the frog are contractile, and their structure has been very carefully studied with not quite concordant results by Stieda, Ciaccio, Szczesny, Leydig, and Hensche. Engelmann finds that if the foot of Rana esculenta be spread out so that the small glands in the swimming membrane are observable, and the sciatic nerve in the thigh be then irritated by the induction-current, a contraction of the glands is at once observed, the lumen almost disappearing and the cells of the gland altering their form.

Engelmann found that the administration of curare does not affect this phenomenon, so that the experiment may be very easily made on curarized frogs.[1] He seems to have

[1] I have repeated Engelmann's observations, obtaining a very sudden contraction of the gland so that the secretion is sharply spurted out.—E. R. L.

been inclined to ascribe the contraction of the gland to a direct action of the nerve on the proper gland-cells. In the larger cutaneous glands of the frog, smooth muscle-fibres have been described by Szczesny and Ciaccio, also in the smaller ones surrounding the gland-cells and enclosed by the tunica propria of the gland, which tunica appears to be of an areolar character. Eberth in the paper above noticed figures the smooth muscle-cells as seen in sections of the glands, but remarks curiously enough that he has failed to detect them in the glands occurring in the swimming membrane of the foot. There can, however, be little doubt that they are represented there, and it is through the contraction of these proper contractile elements that the change in the dimensions of the glands is effected. Engelmann has, it is said, more recently observed elongated cells in the cutaneous glands of the foot, to which he attributes the contractile property, and which, doubtless, correspond to the previously described smooth muscular fibres. Szczesny says that some of these muscular fibres exhibit cross-striping, but Eberth cannot confirm him in this; such markings are due to plications and not to differentiation of the cell-substance.

The nerves of the cutaneous glands first mentioned by Ciaccio are described and figured in Eberth's paper. A very fine network of nerves is described by him lying close round the gland-cells, the points of intersection of the fibres having often spindle-shaped nuclei. From this fine net-work, which is not due to any deceptive appearance of the intermediate substance of the gland-cell, since it is brought to view by dilute acetic acid, which shrinks up the gland-cells, proceed still finer fibres which appear to pass to the gland-cells, whether entering into direct connection with them or not Eberth does not say. Here, again, the histologist is baffled in attempting to determine the connection of nerve- and gland-elements. It is, however, clear that Eberth's thoroughly trustworthy observations do not tend to confirm the view of an abrupt junction of nerve- and gland-element as maintained by Pflüger for the liver and salivary glands.

Retina.—Landolt (M. Schultze's 'Archiv,' Bd. vii, 81) has studied the retina of the frog on preparations made with the help of osmic acid, especially of the stützgewebe.

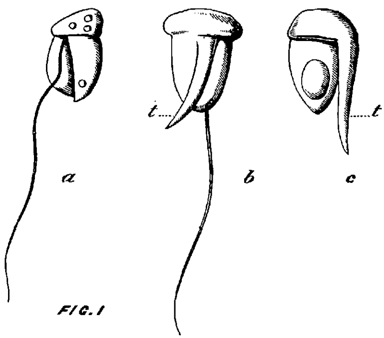
He confirms generally the observations of M. Schultze (in his 'Archiv,' Bd. ii, s. 267).

Another research on the retina of the frog appears in Reichert and Dubois-Reymond's 'Archiv,' 1870, p. 642, by Dr. Merkel, who worked independently of Landolt, but finds himself in the most important points in agreement with that observer.

EMBRYOLOGY.—Oellacher ('Die organischen Veranderungen des unbefruchteten Hühner-Eies, Zeitschrift des natur. med. Vereins in Innsbruck,' 1870; Centralblatt, May 27th, 1871) has observed the remarkable fact that even in warm-blooded vertebrata, the first act of embryonic development, namely, segmentation, may take place independently of impregnation by male semen. The author found in unimpregnated fowls' eggs, the yellow spot composed to external observation of three zones, namely, of an outer homogeneous ring, an inner spotted one, and a central homogeneous spot. The two first are only condensed portions of the white outer layer of the yolk which here, going under the central spot, passes into the central process of the yolk. The central spot alone is the true germ, and this has the form of a biconvex body. Microscopical examination now shows the germ to be composed of small roundish angular elements arranged in several layers, and each with a yellow nuclear spot, as after impregnation. When seen as a flat object, the appearance is also very much like what Coste has described as that of segmentation in impregnated fowls' eggs, namely, a mosaic of cells in the centre and radiating grooves passing to the circumference. On incubating eggs of this kind, the author first saw the elements of the uppermost layer multiply, and those of the under layer become larger and finely granular; but then solution of the cells gradually took place. Such eggs are accordingly incapable of further development. Nevertheless the process described constitutes the first step, though an abortive one, to parthenogenetic development. Attempts at parthenogenesis and partial embryonic cell-formation in unimpregnated eggs have, however, been already observed. The author draws attention to the observations of Hensen on the eggs of rabbits, which unimpregnated, and within closed cysts, developed themselves into poly-nucleated protoplasmatic masses and fibres; and further to the memoir of Kupffer on Ascidia canina, in which creature there arises in the egg, before impregnation, a peripheral layer of epithelium, which later on, after impregnation, becomes the external covering of the animal.

MICROZOOLOGY.—'On the production of Swarm-spores in Noctiluca miliaris,' by Prof. C. L. Cienkowski. With two plates. (Max Schultze's 'Archiv,' 2nd part, 1871).

The developmental history of the Noctiluca is very imperfectly known up to the present time; the multiplication by division and production of internal buds is nearly all the knowledge we possess upon this matter. Baddeley in this Journal ('Q. J. Mic. Sci.,' 1857, p. 189), fully described the process of division. On the other hand, the supposition of Busch that the youngest stage of Noctiluca proceed, from internal germ-bodies is not proved. Gosse ('Rambles on the Devonshire Coast, 1853') endeavours to establish a reproduction by internal budding. Busch observed round, transparent discs, of the same size, consistence, and optical properties as the Noctilucæ, often occurring among these. Their contents were nearly homogeneous, except at one spot where several yellow processes were remarked. Busch could not determine what relation these bodies bore to the *Noctilucæ*. It is such bodies as these which Prof. Cienkowski has studied during April and May, 1870, at the Island of Prinkipo, off Constantinople. He has succeeded in tracing the formation of spores (drawn in the woodcut), similar in appearance to those of some fungi, and swimming round about like algæ-zoospores.



Swarm-spores of Noctiluca.

The process of formation was inferred first from the observation of different specimens, and then traced by direct observation step by step in the same individual through some important stages, though it was not possible to do so throughout. It is exceedingly difficult to keep the same Noctilucæ during a length of time for observation. Prof. Cienkowski found that placing them in a drop of water on a thin glass cover which was placed over a *moist chamber* so as to exclude all access of dry air to the water in which the animals are living, succeeded best. In this way he kept specimens twelve hours. The stages observed are—1st. Noctiluca-like bodies, but without mouth or lash, and having a doubly spherical or so-called biscuit form, each partial sphere having a granular protoplasmic mass with fine branching rays, the two masses being connected more or less. 2nd. The protoplasm collects so as to form a disc on one pole of the irregular double spheroid, which gradually becomes spherical, exhibiting three or four depressions at one pole. 3rd. The protoplasmic disc sends out stumpy processes which project from the surface of the spheroid and exhibit peculiar wriggling movements. 4th. The mass commences to divide into smaller pieces, the vesicle being now quite spherical. The commencement of this division was not directly observed, but later stages, in which clumps of protoplasmic matter were seen arranged at first in groups of eight; these, then, were followed carefully through their division into groups of sixteen irregular, oblong particles. These products of division appear like denser, sharply-defined masses or nuclei, lying in a less dense surrounding granular plasma. 5th. The next stage was one of the first and most commonly observed, in which the protoplasmic disc, formed as above described, has become entirely split up into small oval bodies, each ·016 millimèter long. The aggregated mass of these oval spores sometimes appears as a disc at one pole of a Noctiluca-like vesicle, or as a girdle passing round it. 6th. By high powers each oval particle is seen to have a terminal cilium, and whilst under observation many were seen to separate from the disc and swim about as free swarm-spores: such as that drawn in woodcut fig. 1 *a*; fig. 1*b*, and *c*, are later stages of the free development of the swarm-spores. The large development of the process *t* is very interesting. Professor Cienkowski thinks it not improbable that this becomes the "tooth" of the adult *Noctiluca*. The further development of these spores was unfortunately not traceable, and there are some difficulties in attempting to harmonise their appearance with young Noctilucæ, as described by previous authors.

A further point, however, of much importance, is established by Cienkowski. He has succeeded in observing, step for step on the stage of the microscope, the copulation of the two Noctilucæ. The two animals place themselves with the two so-called "oral apertures" close to one another, and through these a protoplasmic bridge is formed, which unites the nuclei of the two individuals. Later, at the points of contact, the outlines of the two Noctiluca-vesicles fuse, and thus the double spheroid or biscuit-shaped bladders are formed. By further fusion the pinching in of the vesicle disappears from one side, so that the vesicle becomes more nearly spherical. Meanwhile the two nuclei become completely fused into one, retaining, however, their radiating threads and network, as in normal individuals. The cross-striped "lashes" and the "teeth" of the two fused Noctilucæ also disappear. All trace of the double origin of these "copulated Noctilucæ" may pass away by the disappearance of the fold on the surface, near to which the nucleus lies, and thus a Noctiluca vesicle is formed, which is always larger than the normal Noctiluca, and seems identical with the bodies noticed by Busch, and also very probably identical with the biscuit-shaped and spherical Noctiluca vesicles in which Cienkowski has traced the formation of the swarm-spores. A direct observation of the formation of swarm-spores in the copulated forms Cienkowski was not able obtain.

Ciliary Movement.—In the 'Biologische Studien,' his latest contribution to scientific literature, Professor Haeckel gives the result of some highly important observations on the nature of ciliary movement. The most recent investigations on this subject, viz. those of Dr. W. Engelmann ('Jenaische Zeitschrift,' 1868, vol. iv, p. 321), as also the earlier ones of Dr. M. Roth ('Virchow's Archiv.,' Bd. 37, p. 184), have shown that physiologically the ciliary is much more nearly related to the amœboid movement than to the muscular. Professor Haeckel's observations show that the ciliary movement is merely a modification of the amœboid movement of protoplasm. Ciliated cells are of two kinds. In the one kind (epithelium flagellatum) each cell is provided with a single long flagellum or lash—sponges possess only this kind; in the other (epithelium ciliatum), numerous hair-like appendages take the place of the flagellum. This is the kind found in most of the higher animals. The old notion, that in ciliated cells the cilia are attached to the outside of the cell membrane, must now be considered as entirely set aside. Many, probably most, ciliated cells are destitute of a membrane, and the appendages, whether flagella or cilia, are direct processes of the protoplasm of the cell. Professor Haeckel's observations on lower organisms during the last year have led him to the conclusion that ciliated cells arise directly by the transmutation of amœboid cells. This transmutation he has observed in the case of the motus flagellaris, in Monera, such as *Protomyxa anurantiaca* and *Protomonas*

Huxleyi. The swarm spores of these species, when they leave the parent cyst, are pear-shaped, with a single long hair-like flagellum, by the lashing movement of which they swim about. After a time they settle, whereupon the flagellum becomes an amœboid process. These are merely cytods, but the same phenomenon has been observed in the case of swarm spores with a nucleus, *i.e.* real cells, and described by De Bary, in his monograph of the Myxomycetæ. The same thing was seen in the epithelial cells of sponges of the order Leucosclearia by Professor Haeckel, whilst at Bergen, in Norway, in August and September, 1869. But by far the most interesting observations of the Professor on this subject are those made in the Canary Island Sanzerote. Here he has been able to observe the direct origin of the motus ciliaris from amœboid protoplasmic movement, first, in the spherical masses arising from the division of the egg in the Siphonophora; secondly, in a new and very remarkable form which he has discovered, and which he calls *Magosphæra Planula,* and considers to represent a new and separate group of the kingdom Protistæ. This creature has a ball-like body, consisting of pear-shaped cells, bedecked with many cilia. These ciliated cells not only can be seen to develop out of amœboid cells, but also subsequently to resume that condition. For after the ciliated ball has swum about for some time, its component ciliated cells separate from one another, and gradually pass into an amœba form. These observations of Professor Haeckel are not only of importance as confirming physiological results, but also of classificatory value, as showing that their possession of cilia, as opposed to the exhibition of an amœboid movement, must not any longer be considered as a ground for placing the Infusoria in a separate group.—*Academy.*

Histological Classification.—Rollet has published ['Untersuchungen aus dem Institute für Physiologie in Graz,' 1871, 2tes Heft, p. 111; 'Centralblatt,' No. 20, 1871, p. 308] a valuable paper on the discrimination of elementary parts and tissues. In the first part Rollet opposes the rigid distinction lately introduced by E. Häckel between cells and cytods, as well as the theory of the same writer relative to the homogeneousness of protoplasma. In the second part he develops the principles which should be made the basis of a scientific classification of tissues, and criticises the systems of Henle, Frey, Beale, Kölliker, Leydig, and Häckel. Rollet's own system claims to be founded upon physiological experience. He adopts the views of His relative to the distinction of epithelia and endothelia, and shows the fallacy of certain objections which have been made to this distinction, viz. the supposed occurrence of ciliated epithelium upon serous surfaces. Waldeyer had already shown that the presence of cilia on the peritoneum is dependent upon the peculiar connection of the female sexual apparatus with this cavity; but several observers had thought they had detected cilia on the pericardium of the frog. Rollet shows that this is an error, part of the peritoneum having been removed with the pericardium.