valve a smaller number of striae may be counted. Although my opinion may not agree with that of any one of the most distinguished microscopists, I am at present inclined to the belief that the Diatomaceae, like any other organism which is produced from a germ, is born of small size, and grows as it passes through the various stages of life. And I believe that this growth may take place in various ways in different species. But as an inquiry of this kind is ultimately connected with the very thorny question of the true limits between the genera, species, and varieties of the Diatomaceae, I will reserve it for a future occasion.

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On the Structure of the Lachrymal Glands.
By Franz Boll.

Recently, in histological researches, peculiar star-shaped cells have been noticed in the acinous glands. Krause was the first man who isolated these, in the case of the parotid of a cat, by means of maceration in vinegar. He is inclined to treat them as nervous organs. Henle also describes stellate cells in the walls of the rennet glands, as well as the parotid and mammary. He also thinks that they are most likely of a nervous character, although he has never seen any connection with the nerve-fibres. Pflueger describes multipolar cells in the salivary glands of the rabbit. He holds them to be multipolar ganglion-cells, and observed on one side their connection with the fibres, and on the other side with the secretory epithelial cells. Finally, Kölliker has made closer researches concerning the cells in question in the salivary glands. He considers them to be simply forms of the covering structure of the alveolus, which seem to him to represent a kind of reticulum.

I began to give my attention to these doubtful objects whilst examining the lachrymal glands in the summer vacation of 1867, and continued in Bonn later on to do so.

The lachrymal glands of the pig, sheep, calf, and dog, also the submaxillary of the rabbit, calf, and dog, and the parotid of the cat and rabbit, served me as objects of examination. The following are the methods of isolating these cells:—Maceration in vinegar (Krause); treatment with bichromate of potash (Henle); with 33 per cent. liquor potassæ (Pflueger); and placing in a solution of iodine, later on
by twenty-four hours in chromic acid \( \frac{1}{4} \) per cent., and bichromate of potash \( \frac{1}{8} \) per cent. (Pflueger). I have found the last two methods of Pflueger the most useful, and all the results laid down herein are obtained by this process. If the glands are examined by any other method but maceration the star-like cells are only partly, or not at all, seen.

What now appears in the preparation by means of maceration in a solution of iodine is the peculiar form of epithelium, the cells of which swim about in the liquid, either singly or two or three together. I must agree with Pflueger, as against Giannuzzi, that they all show a distinct nucleus. Also, the cell itself is very rarely simply round or polygonal, but mostly breaks out into one or more projections. The projecting forms are peculiarly numerous.

Besides the epithelium here noted, all other glands that I have examined by this method have shown the star-like cells, so that I must note it as being a constant appearance. These cells show generally a granular nucleus without nucleoli, which comes out more clearly by the addition of acetic acid. The cell-substance is not true granular protoplasm, but appears to be more homogeneous, soft, pale, and shows a feeble but clear striping in the direction of the outshooting projections. Only in the substance immediately surrounding the nucleus can a fine granulation be seen. The delicate, nearly transparent, smooth projections show the longitudinal striæ the most clearly. The form and size of the real cell-body, the number of projections, and their more or less secondary division and branching, present numerous variations. I only need draw attention to fig. 2, where different forms are represented from the lachrymal gland of a calf. The species of animal in which they are found also gives
rise to differences. Thus, for instance, in the glands of
the calf the cells have large dimensions, and a distinct,
richly developed cell-substance. The projections become
prominent by gradual contraction of the cell-body, and
branch very numerously, generally at a very acute angle.
The cells of the rabbit and dog are very thin and small;
the processes, which project sharply from the cell-body,
branch much less. Between these two forms stand the
isolated cells of the lachrymal glands of the sheep.

If, now, we trace these interesting cells by means of
the above method (best in the lachrymal glands of the calf),
we soon find that they do not present themselves alone,
but form singular nets, with tree-like branched tendrils and
complicated anastomoses; it may even so happen that we obtain
one of these networks which still retains the form of the
alveolus, like a basket in which the acinus of the gland lies.
The epithelial cells adhere to the spaces in the net which
open from the periphery into the hollow enclosed by the net-
work, as by a "scaffolding" (fig. 1). By the inner connec-
tion of the surrounding cell-basket with the secreting cells
of the alveolus, it often seems as though two kinds of cells
were in direct connection. On the other hand the branched
cells of the first can easily be mistaken for those of the
alveolus—for instance, in such a case as where one or more
of the processes are knocked off.

The radiate and much branched tendrils of the cells are,
as already shown, smooth and band-like. In the rabbit and
sheep the cells themselves are so. In the glands of the calf,
and particularly in those of the dog, the parts of the net
where the nuclei lie, that is, the cell-bodies, show a distinct
thickening. Here we have, according to my idea, a perfectly
undeniable explanation of the peculiar formations, which some
time ago were described and figured by Giannuzzi from the
submaxillaries of the dog, as "mündchen" (lunula). The
crescent-shaped forms (fig. 2) are to be obtained in numbers
from the lachrymal glands of the calf by means of maceration.
They are multipolar cells, which have retained the curve of
the alveolus, and are seen in profile, their processes lying in
the plane of the profile. If one allows such a form to roll
about under the microscope, the transformation of the peculiar
crescent form into a multipolar cell takes place under one's
eyes. Fig. 2 shows two forms, which appear not unfre-
frequently, where one or more processes are disposed about the
crescent, and, coming out of the profile-plane, become visible.
If this explanation is adopted the want of the lunule in the
submaxillaries of the rabbit, where both Pflueger and Kölliker
missed them, is of no consequence. The special thinness of the multipolar cells in the rabbit does not allow the profile view to appear as a half-moon; but yet in these glands the peculiar net-like structure is found, although not nearly so strongly developed as in the calf.

All the above-named glands were examined also as to their nerve-endings by means of the capital method of Pflueger, that is, by the use of very diluted chromic acid. Concerning this method, I need only to mention the writing of Pflueger, and again repeat the advice not to overlook any of the precautions given by him.

In the preparations kept by means of this method the cells which lie close to one another within the alveolus appear irregularly polygonal, and, as Pflueger says, nearly of the same size. If not at first sight, at least by different focusing, all show sometimes a simply round, but generally an excen-trically placed nucleus, which often sends out a pointed projection. We see no trace of the multipolar cells, and it is only in the glands of the calf and dog that we see peculiar crescent-shaped forms, which generally are disposed about the blind end of the alveolus.

The alveoli appear to be surrounded by connective tissue. In the rabbit this is scarest and the fibrils finest, and attaches itself very loosely to the alveoli. In old rabbits it is more mixed with stronger fibrils and elastic tissue, and more solid, and is with difficulty detached from the alveolus. It is the carrier of the blood-vessels and nerves. As a peculiarity of the lachrymal glands of the sheep, I may here mention the enormous abundance of stellate pigment-cells which accompany the nerve-branches.

We will now direct our attention to the examination of the course and endings of the nerve-fibres. I will begin with the lachrymal glands, where the relations are simpler, because one nerve, namely the n. lachrymalis, has the whole care of the glands, whilst in the salivary glands the nerves which rule the secretion are difficult to be seen by naked-eye anatomical preparation.

If one examines quite freshly-prepared n. lachrymalis in a solution of iodine, serum, or chromic acid, it will be found that by far the greater portion of the nerve-fibres (in my opinion four fifths) are medullary nerve-fibres. It is worth remarking that all sizes lie close to one another, from the rudest to the finest. Besides these fibres there are also others. Their diameter is very changeable. They consist of a very soft, very easily burst, connective-tissue-like covering, in which granuli are often to be seen, and of a peculiarly
weak, shining, and finely granulated contents. In the inside of the covering it appears finely granulated, pale, or in some places striped with peculiarly fine longitudinal markings. If, however, it should have burst, as may be the case by a careless placing of the covering-glass, it forms peculiar dark balls and shapes, which are to be distinguished from the characteristic pipe-like forms of the nerve-tubes through their more finely granulated character, and therefore more clouded appearance, as well as through the want of double outline.

It is well known that Pflueger saw that in the salivary glands the nerve-fibres approached the alveolus, entered the same, branched out between the single cells, and at last came into connection with the epithelium. I can only endorse these statements of Pflueger. Some of my figures are taken from the lachrymal glands of the sheep. In some, exactly as in the plates of Pflueger (taf i, 1—4), are to be seen the fibres, already known, which come from the stem of the lachrymal nerve, and enter the blunt end of the alveolus, where they pass into an obscure mass, which is not clearly separated from the neighbouring epithelium. Whilst some of these fibres do not show any further difference, and are, therefore, not to be separated from the common fibres of Remak, as M. Schultze has pictured them from the spleen-nerves of the ox, there are others which have the peculiar property of containing, buried in their inside, two and even four peculiar, shiny, soft fibres, which are certainly to be considered as axis-cylinders. Cases such as Pflueger pictures in table i, figs. 5—9, are comparatively seldom seen in the lachrymal glands of the sheep and calf. Nevertheless, I have twice undoubtedly observed the entrance of a large medullary nerve into the alveolus, and have been able to convince myself of the frequent appearance of these forms in the submaxillaries of the rabbit, which certainly, of all glands, is the best for the study of nerve-endings. Oftener, however, forms are to be seen in the lachrymal glands of the sheep, as in fig. 3, where an undoubted fine medullary nerve enters the alveolus, and branches off amongst the epithelial cells. To follow the continuation of the axis-cylinder, which is enclosed in the fibres of Remak, through the finely granulated mass of the place of entrance, is very difficult, although some of my preparations show undoubtedly a soft fibre which branches out amongst the epithelial cells, but whose connection with the axis-cylinder at the place of entrance is not proved with certainty.

Lastly, I must shortly mention the peculiar organs which
Pflueger discovered, and to which, in the submaxillaries, he has given the name of salivary canals (Speichelröhren). These are clothed with cylinder epithelium, and must by no means be mistaken for the excretory ducts of the salivary glands, which are covered with pavement epithelium. They appear to me to be forms of a very high functional importance, because in the submaxillaries of the rabbit, where, after treatment with 1 per cent. hyperosmic acid, they come out beautifully, they take up a fourth of the volume of the whole gland. That they do not act only as a conducting apparatus, that is, as passages for the secreted saliva, is seen from the fact that some end blindly. By the above-mentioned method one can see very plainly, at the end of the cylinder epithelium, when it is turned to the light, a striping, which might be the indication of a fine system of fibres, or fibrillation. "Lachrymal canals" also appear in the lachrymal glands of the animals examined, but by no means in such numbers as the canals in the submaxillaries of the rabbit.