ON CONJOINED EPITHELIUM.

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It does not appear that much attention has been given by English observers to the so-called "prickle and ridge" cells (*Stachel- und Riffzellen*). At all events, they have scarcely found their way into our most recent books on pathology; while the drawing in our newest textbook on minute anatomy is almost, if not quite, identical with the earliest sketch in Virchow's *Archiv*.

It is, nevertheless, twelve years since these cells were first discovered and named by Professor Max Schultze; and their distribution in fishes and amphibia has been fully described (1867) by his brother, Professor Franz Schultze. They have been subsequently noticed by Kölliker, Frey, Rindfleisch, Stricker, Cornil and Ranvier, Rollett, and others. They have been called "spinous cells", "echinate cells", "cellules dentelées", "ribbed" and "spiny and furrowed" cells; but no observer seems to have added any careful researches to the original description of Max Schultze, by whom the name was given to them of "prickle and ridge" cells. And yet there is a certain beauty and interest attaching to these structures which seem to entitle them to more detailed notice; and, while they offer problems in histogenesis of great interest to the anatomist and physiologist, they cannot but do so also in some degree to the pathologist. It is a good illustration of the old story of "eyes and no eyes", that a very remarkable structure, and not a difficult one either, in so thoroughly common a place as the borders of an epithelial cell, should have been persistently overlooked for many years, and long after high microscopic object-glasses had been brought to great perfection. No one need despair of seeing something new and important by looking with extra carefulness at what is, so to speak, straight before his face, after this fact, that the mere form of the simplest of all animal cells actually remained unnoticed until a dozen years ago.

The discovery of Max Schultze, then, was this: that in the epithelium of the mouth and conjunctiva firstly, and then in the epidermis of the skin, and indeed wherever there is true pavement or scaly epithelium in many layers, the second series upwards of cells have this peculiar character. Their surface is furnished with short projections, which are apt to appear as prickles; while sometimes there are ridges (reefs) marking portions of the cell with parallel groovings (see drawing). The lowest layer of epidermic cells consists of elongated vertical palisading-like elements, between and underneath which lie germinal masses of indeterminate form. Next above, and completing what was called "rete mucosum", is a succession of layers of spheroidal cells, becoming more and more flattened until they cohere under the form of mere scales into cuticle on the skin, or in a less firm manner in transitional situations like the mouth, conjunctiva, etc. It is these latter layers which are mostly spinous. There is some difficulty in seeing this well in thick skin. It was already noticed by Max Schultze, that the diseases involving the true skin showed the prickle-cells well; and other observers, especially Cornil and Ranvier, have followed in the same line (Fig. 1).

The anatomical structure, then, has been described thus: the cells are covered more or less with spines, which, when the cells are isolated, show as marginal prickles; and if the covering pressure chance to be *nil*, as besetting the surface. The spines are sharp-pointed, with a broadish base; and all observers, I believe, describe them as interlocking with the teeth of the next cells, thus giving the characteristic cohesion. Max Schultze compares this to the intermingled bristles of two brushes put together. Ranvier speaks of the cells as soldered by the interlocking teeth ("les dentelures au moyen desquelles elles sont engrenées et soudées"). Stricker uses the same phrase, and Rindfleisch compares their union to "a suture"; and I learn that the well known Edinburgh *préparateur* Mr. Stirling, discovering them nine years ago, thought them like "watch-wheels" (see Fig. 1).

At first sight, this all seems satisfactory enough; but it is just as to the simple nature and plan of these processes that I venture to join issue with all observers to whose works I have been able to obtain access. So long, namely, as I looked at the contact between any two of these cells as that of toothed wheels, they really seemed to interlock. I confess, however, to a rooted distrust of real processes of definite form as being projected from a cell-wall of formed material, this having no analogy with the many changes of form in germinal or bioplastic matter. As far back as 1860, when the language of, I believe, all the books was of processes sent out by cells, I ventured to dissent

from such views, and, in a paper on Connective Tissue published in Beale's *Archives*, described cell-processes as being "spun out" by a receding body. This view is now generally accepted. It seemed, therefore, to me worth inquiry, whether these prickles were really processes which interlock, or whether they were really continuous delicate

Fig. 1.—Epidermic "Prickle and Ridge" Cells; or "Spinous", "Furrowed", or "Echinate".—*a*. Papillary Tumour of Tongue. *b*. Human Epidermis (Max Schultze). *c*. Ext. Layer, Middle Cells—Cornea of Pig: Stricker and Rollett. *d*. Cellules dentelées of Cylindroma: Cornil and Ranvier (1869).

bands uniting cell to cell. In an epithelioma of the lip, and in a section of a hard preputial chancre, I found instances of a rich development of the prickle-cell. Probably, just as on a nasal polypus the ciliated epithelium often becomes monstrous, many fine examples of these cells may be encountered where there is unusual setting free of formative force.

In the example (Fig. 2), the cell (*a*) is incontestably united by bands to its neighbours, and the decisive experiment has been made; for, where these bands have broken across, the remaining stumps have become prickles; but where (two cells touching) the teeth seem to have strongly dark ends (Fig. 2, *b*), I believe this effect is universally an optical illusion, and that the dark spot is the cavern between bands (*b*). On the other hand, where (two cells touching) the ordinary light spines seem to be so truncated, a very careful view will show that the light track may be followed from one cell to the next, if I may use the illustration, like walking across on a plank. In some cases, however, pointed teeth may be seen at touching cell-margins, as in Max Schultze's original plate. But it is an illusion, in my opinion, to see in this appearance a true second set of interlocking teeth, the outlines of which correspond precisely with the first. Rather let it be granted that prickles are broken bands of union in all cases, as we know they are in (*e.g.*, *a*, Fig. 2), and then the whole thing becomes intelligible. In a microscopic preparation thin enough to be seen well with 1,000 diameters, most cells are partly isolated, and, consequently, broken bands, *i.e.*, prickles, abound, and those near the outer margin of the cells lie as detached teeth touching from each cell-wall, or even interlocking in some instances. Meanwhile, the cell-margins of real contact deeper down are united by unbroken bands.

So much for the prickles; and next as to the "furrows", "reefs", "ribs", or "ridges" (see Fig. 1, *a*, and Fig. 2, *c*). I confess that at present the only explanation which occurs to me is founded on an

insufficient number of observations. As a conjecture supported by some instances, I would suggest that these are *stretched bands* often broken off at one end, and lying parallel on the cell-wall. They are beautifully seen with careful oblique illumination under high powers.

This peculiar cell-structure which we have been describing may, then, be supposed to originate in this sort of way. In the lowest cell-layer of epithelium, there are found the newly grown, long, vertically placed

Fig. 2. —Conjoined Epithelium.—1,000 Diameters.

cells, side by side in contact. When these have a somewhat permanent character, as in many fishes, the next layer of cells consists of spheroidal cell-forms which have resulted from division or budding, and consequent "fissiparous" multiplication or budding of a *new* progeny. In all this there is a tendency of dividing cells to remain, at points, united by threads of formed material of hard cell-wall; e. g., amongst these very layers are often found large and branched pigment-cells united by long delicate threads. Thus I imagine the cells of rete mucosum, in multiplying originally by subdivision, retain numerous points of incomplete severance, and these points of cohesion are dragged out and become the uniting bands. These, when severed by any accident, assume the characteristic form of "prickles". In the normal ascending series, these cells, becoming older and flatter, lose all surface-connection, and in the cuticle are simple polyhedral horny blocks. The uniting agency of these cells is a firm one; for in a scraping from a tumour-section, as noticed by Ranvier, they almost always hold together strongly in groups. It is a firmer union than I should expect from any interlocking teeth, but of course one which would naturally result from uniting bands.

Lastly, as to the pathological anatomy. The primary meaning of the presence of these cells is an abnormal formative activity of the lower cells in the rete mucosum; and the occurrence of rib and prickles may be taken as indicative of this structure having become involved. In epithelioma occurring in connection with *flattened* epithelium, both lobular and tubular, they mostly occur. Their development seems to be in direct ratio to the vigour of growth present, and accordingly they were very large in granulations snipped from a perineal fistula. Papilloma and rodent ulcer afford fine specimens; and probably always the best occur in diseases of the transitional epithe-

lium extending from the lips to the cardiac orifice, and on the conjunctival, anal, or preputial epidermis. I have found them unusually fine in a section of preputial chancre. I believe it to be the opinion of Professor Lister, who discovered these cells independently, and named them "echinate", that rodent ulcer, when they are present in it, should be considered as allied to, if not identical with, epithelioma. The presence of prickles-cells in cylindroma leads me strongly to doubt the origin of that form of cancer from the sudariparous glands, according to the received notion. But, as I indicated at first, the real meaning, for medicine and surgery, of these curious cells, remains to be investigated; and it is necessary that some one should do that for their origin, varied forms, monstrosities, and pathological distribution which has been so laboriously accomplished for their anatomy in fishes and amphibia by Professor F. Schultze. My present attempt has been, so far, merely to see more of the true character of their intimate structure, and, if possible, to determine the true mode in which they are united together.*

ON THE STRUCTURE OF THE OVARY IN RELATION TO CERTAIN FORMS OF DISEASE OF THE ORGAN.†

By JAMES FOULIS, M.D., Edinburgh.

IN 1872, Waldeyer published at Leipsic his beautiful work on the development of the ovary. Waldeyer described the ovary as arising in connection with the Wolffian body on its median side. He showed that the Wolffian body at an early stage of its development is invested by a layer of columnar epithelium. Very soon there appears a thickening of this columnar epithelium on the median side of the Wolffian body, and in a short time a small outgrowth rich in cells projects from the interstitial tissue of the Wolffian body beneath the thickened epithelium. The thickened epithelium investing this outgrowth gradually forms the rudiments of the Graafian follicles and ova, and of the subsequently appearing epithelium of the ovary, whilst the outgrowth itself is destined to furnish the vascular stroma of the ovary.

The thickened epithelium he called the *germ-epithelium*.

According to Waldeyer, the further development of the ovary depends upon a peculiar mode of growth of the germ-epithelium on the one hand, and of the subjacent vascularised stroma on the other. Certain more or less delicate processes of connective tissue from the stroma now shoot forth, whilst at the same time the epithelium increases by the continued production of new cells. The processes then penetrate between the epithelial cells, enclosing a variable number of them, which thus by degrees come to be more and more embedded in the vascular stroma. The connective tissue stroma between the embedded masses of epithelial cells constantly undergoes increase. As to the development of the ova and Graafian follicles, Waldeyer goes on to state: "Some, and sometimes very many, among the embedded cells become conspicuous by their size and the size of their nuclei, while other cells remain of small size, and surround the larger cells as a kind of epithelium. Connective tissue of the stroma then grows in between the larger egg-cells, enclosing them with their epithelial investment in separate capsules or meshes of the stroma. In this manner, each mass or ball of the embedded germ epithelial cells is divided by these ingrowing processes of vascular stroma into as many follicles as it contains large egg-cells. These last formed meshes are the primordial Graafian follicles." In describing the development of Graafian follicles from the Valentin-Pflüger tubes, Waldeyer remarks, "in the case of new-born children, one sees long branching structures in the form of tubes anastomosing with each other, as Valentin first described, and lying separate from each other at considerable distances. Upwards they pass with narrow mouth openings into the germ-epithelium, and appear as direct tubular gland-like processes of it".

"Follicles are formed from the tubes directly through the growth of interstitial tissue. At the lower end of the tubes, interstitial tissue grows, as may be well explained from the absence of a *membrana propria* in the tube, into the epithelial groups in the tubes, and encloses individual egg-cells along with a portion of the not fully developed epithelial cells which surround them as a kind of epithelium; and in this way primordial follicles are produced."

In concluding his remarks on the development of the ovary and ova,

* Four situations may be recommended specially to those who wish to study these cells. 1. The lip of the sturgeon. 2. The cornea of the pig. 3. Preputial chancre. 4. Epithelioma of the lip.

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