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THE HUMAN EPITRICHUM—ITS PHYSIOLOGICAL FUNCTIONS AND ITS ROLE IN THE CAUSATION OF SKIN DISEASE. By A. H. OHMANN-DUMESNIL, A.M., M.D., Professor of Dermatology and Syphilology in the Marion-Sims College of Medicine of St. Louis.

There is no doubt whatever that the subject of histology is far from being exhausted, and more especially in connection with development. Pathological investigations, more especially in connection with bacteriology, have, in later years, occupied so much of the attention of investigators, that they seem to have made the latter lose sight of the fact that we are not as yet thoroughly conversant with the morphology and development of normal structures, and, as a natural result, histology has not advanced with the same rapid strides as other branches of investigation connected with the art of medicine. And yet it is difficult to imagine a more fascinating study, especially when it is taken up in connection with teratology and pathology, for in it lies that of which we are always in search—an explanation for the peculiar conditions or abnormal processes observed.

*presented by the author.*

It may not be inappropriate to introduce the subject proper by a short description of the epitrichium. This layer of the skin was discovered and first described by Welcker.\* In his examinations of the embryos of the *Bradypus* or sloth he found it to consist of a continuous membrane which overlies the hairs, hence the name epitrichium from *epi* and *trichion*. This led to further investigation on his part, and he found it to exist in various mammals and in man. The presence of this curious membrane in reptiles was clearly shown by Kerbert,† whilst Jeffries‡ and Gardiner showed its presence in birds. These authors are not the only ones who have written on the subject, but it seems to have awakened but little interest among dermatologists if we are to judge from their works. So far as I know there is no systematic treatise on diseases of the skin which devotes any serious attention to this particular subject, and yet it is one of more than ordinary importance in the consideration not only of the anatomy of the skin, but in the pathogenesis, pathology and treatment, as well as prognosis, of some affections of the integument. Nearly all the work in connection with the epitrichium has been done by pathologists and embryologists. It is for this reason that I propose to devote some little time to the consideration of the anatomy of the epitrichium, such as I have found it in my investigations. I also desire to say a few words in regard to the physiological functions of the epitrichium, as this is also a subject not touched upon in the works devoted to physiology.

The epitrichium may be described, in general terms, to be a temporary epithelial layer of the skin which disappears at birth, the time when its functional necessity has disappeared. It overlies the stratum corneum of the epidermis, and is anatomically, as well as physiologically, distinct. From the investigations which have been made by competent observers, and to whom allusion has been made above, it is a structure which is not limited to mammals, but occurs in birds and reptiles as well, and doubtless it also occurs in amphibians and fishes. This constancy of occurrence is a circumstance which should certainly entitle this little-known structure to more consideration, not only at the hands of anatomists and embryologists, but especially of

\*Hant von *Bradypus*, Halle, 1864.

†Kerbert (C.), *Skin A. f. in A.*, xiii. 205-262, 1877.

‡Jeffries (J. A.), *Proc. Boston Soc. Nat. Hist.*, xxii. 203-241, 1883.

dermatologists. In this paper I propose to describe this structure in the human being only, as an attempt to do more would require too much space at this time, and is certainly deserving of separate consideration in a paper devoted to the comparative anatomy of the structure.

I do not intend to trace the development of the epidermal system in the human being, as it is much the same in all amniota. Those who are desirous of doing so can consult Bowen,\* Minot,† Lander,‡ Curtis,§ Unna,|| and others. In the human embryo the epitrichium may already be distinguished at the age of two and one-half months, and from this time on it is not difficult to demonstrate its existence. It will be found to consist of one layer of cells with well-marked nuclei overlying another layer of cells which are flatter and provided with smaller nuclei, the whole resting on Bowen's basal membrane. As the embryo grows older the cells of the epitrichium grow flatter and larger, and their contained protoplasm shrinks towards the centres of the cells.

I have had occasion to make a number of preparations of the skin of embryos of various ages, and taken from portions of the integument removed from the scalp, behind the ear, and from the groin. I have observed that at all ages, from two and one-half months up to eight months the epitrichium could be made out quite distinctly. The cells in the younger specimens are larger and fuller, whereas in the older subject they flatten, becoming fusiform in cross-section, but showing distinct nuclei which are highly refracting, and suggesting the presence of eleidin. In cross-section the stratum corneum can be made out as well as the stratum mucosum. The primitive arrangement of the cells and their grouping for the formation of the hair-buds, as well as the budding of the sebaceous glands, is very plain. In the specimens from the older embryos the formed hair and the epitrichial cells, which have been pushed aside by the growth of the former, are plainly discernible. A horizontal layer of the

\*Bowen (J. T.), *Epitrichium A. A.*, xxii. 685-882.

†Minot (Charles Sedgwick), *Skin Am. Nat.*, 575-578; *Human Embryology*, 548-554, 1894.

‡Lander (R.), "Nails," *His. Arch.*, 103-143, 1884; "Nails," *His. Arch.*, 273-306, 1886;

§Cornification," *His. Arch.*, 51-96, 1888.

||Curtis (F.), "Nails," *Jour. de l'Anat. et Physiol.*, xxv. 125-186.

Unna (P. G.), "Anatomy and Development of the Skin," *Ziemssen's Cyclopaedia* 1885.

integument, separated by maceration, shows very plainly the presence of the epitrighial layer overlying that of the stratum corneum. At first the cells of the former are distinguished from those of the latter with difficulty, but, as development progresses, the epitrighial cells assume a more distinctly polygonal shape, the nucleus is more indistinct, and the protoplasm concentrates, as it were, at its centre. A certain amount of shrinking also takes place, so that the cell is actually flattened despite the fact that the protoplasm has all gathered about one point. It is by no means a difficult matter to demonstrate the difference between these cells in integument derived from a fetus from six to eight and one-half months old. One prominent feature is that the cells of the epitrighial layer are much larger than those of the underlying structure, and this disparity increases with the progress of development.

An interesting question arises as to whether the epitrighium finally merges into the horny layer or not. This idea has been advanced by some very competent authorities, but it is open to serious objections. If it becomes part of the horny layer, it should certainly be so already at the time the hair emerges from the skin, and yet it is not. It is raised up by the growing hair. Furthermore, the cells of the epitrighium never become perfectly flattened like those of the horny layer, and are essentially of a different nature, both morphologically, histologically and chemically. Moreover, it can be separated from the horny layer at any period, and this separation occurs at or about the time of birth, so that a consolidation of the two seems hardly probable.

To attempt an explanation of the physiological functions of the epitrighium is by no means an easy task, and that it possesses such there can be no question or doubt. It may be argued that it is simply a persistence of type, but this is simply an explanation which is no explanation, and which does not explain, for even if it be such in man it must have some function in animals. In the *Bradypus* it is much more developed, and is separated from the embryo, thus constituting another amnion it is claimed. But, it may be asked, of what utility would such another amnion be? From an examination of this peculiar membrane it would seem that it is impermeable to water—at least it does not take up aqueous stains very readily, and from this the conclusion might be drawn that its function is to protect the skin from

maceration through the action of the liquor amnii. And if death of the embryo supervene, maceration of the embryo will take place, although more slowly than when denuded skin is placed in water. Of course, this prevention of maceration is aided by another condition, viz.: the retention of sebum upon the surface of the skin, and this is effected by the limiting action of the epitrichium which overlies the sebum or vernix caseosa which has formed. If this fat be carefully removed from the skin of a new-born infant, and its covering membrane be carefully mounted, it will be found to consist of a single layer of cells having all the characteristics of the epitrichium, which naturally leads to the conclusion that a complementary function is to retain the sebum, and thus act further in preventing maceration.

A question which naturally suggests itself in connection with the epitrichium is in regard to the length of time it persists, and as to whether it is cast off, and if so, at what period of fetal life does this occur. As the embryo increases in age the cells of the epitrichium become flattened, and in this process the outlines become polygonal and the edges closely adherent to one another. This change takes place at those parts and at the time that the hairs and sebaceous glands assume form and the cells composing their first buds group themselves in a definite manner. As is well known, the development of the hairs and fat-glands is rapid, so that by the time the shafts of the former emerge and the secretion of the latter finds its way to the surface, the epitrichium has become a single continuous, definite membrane, composed of one layer of flat epithelial pavement cells, rather large, but quite resistant. In the locality where the hair development is strongest, such as the scalp, the epitrichium is first raised, and in those places where the secretion of fat is most active it is raised to the greatest degree. Where neither hairs grow nor sebum is secreted, there is apt to be no separation at all, and this is best exemplified in the case of the nails. The eponychium, from *epi* and *onyx*, as Unna has denominated it, is analogous to the epitrichium, and may be found in earlier fetal life. Later on it disappears, having, in all probability, been cast off in the course of the growth of the nails. The fact that the epitrichium is found over the entire integument in earlier fetal life, and that it becomes gradually separated in the later

life of the embryo, is evidence of the fact that it is finally cast off at that period when it is no longer physiologically necessary. Furthermore, the fact that even at birth it may be found overlying the accumulated secretion of sebum is further evidence that the final casting off is a comparatively late process.

From the fact that, in early fetal life the epitrichium can be easily demonstrated in the embryo, and furthermore that it is a distinct structure composed of a different sort of cells from those which form the outermost layer of the stratum corneum, we must conclude that it has functions of its own. In early developmental life it is closely adherent to the underlying layer of cells, but later on it separates in the manner which has just been given. But, should there be an arrest of development of the hairs and sebaceous glands, the raising of the epitrichium does not occur, and this membrane adheres to that overlying the stratum corneum, and it does not become separated from it for a period of time, almost, if not, coincident with birth. In the meantime the developmental impulse which should have expended itself upon the hairs and sebaceous glands is diverted to the horny layer, and it undergoes a rapid and marked multiplication of cells, making it thicker and assuming a horny appearance. That the epitrichium does not become a component part of the stratum corneum may be easily demonstrated by means of selective stains which will decolorize in the cells of the epitrichium and will not in those of the stratum corneum. A question which suggests itself in this connection is as to whether the thickening of the horny layer is due to a persistent adherence of the overlying membrane of which we are speaking. It is evidently not, but depends rather upon the arrest in development of the hair and sebaceous glands, and this arrest is possibly dependent upon pressure exercised from without, which condition would also act as an important factor in producing an adhesion between the epitrichium and the stratum corneum.

When the process is one which is generalized the thickening of the horny layer is so also, and in consequence we have the different varieties of ichthyosis known as xerosis, ichthyosis simplex and ichthyosis congenita, or so-called harlequin fetus. These are simply different varieties of the same process, whereas ichthyosis hystrix and ichthyosis sebacea are somewhat analogous, but have superadded an exaggerated secretion of sebum. But

it must certainly be true that the ichthyotic process owes its origin to the same cause that the other forms do, and there is added thereto a certain development of the sebaceous glands, whose functions not only continue, but are exaggerated by the stimulation exerted by the pressure due to the thickening of the stratum corneum. In all of the former ichthyotic conditions there is evident lack of development of the sebaceous glands, and in all forms of ichthyosis there is a deficiency in the number as well as size of all the lanugo hairs. The skin is harsh and dry, or rugous and spinous, and it persists in this condition despite the best directed treatment, which can only mitigate it at best.

Should the epitrichium be adherent in localized areas only we have as a result a localized and limited ichthyosis which does not extend beyond its primary limits. A peculiarity observed in connection with localized ichthyosis is the fact that it partakes of the nature of the portion of integument which is affected. If it be in the palms and soles the thickening is much greater than if it occur upon a flexor surface, and upon this latter it is never as well marked as upon the extensor portions of the integument, as is daily shown by observation. A peculiarity which has been noted in connection with both localized and generalized ichthyosis is the fact that it rarely if ever affects the face and axillæ. This is explainable by the further fact that in these localities the sebaceous glands develop early and rapidly and attain a comparatively large size, as they also do in connection with the hair of the scalp, this latter being also singularly free from the ichthyotic process.

From an anatomical examination of the epitrichium in its different stages, and from a critical examination of the various points involved in a consideration of the question, it seems to me that there can be no doubt whatever that the epitrichium plays an important rôle in connection with the development of the human integument. It not only does this, but it also plays a by no means insignificant part in the production of some keratogenous skin diseases, and it is far from improbable that lichen pilaris is in some way indebted to the same structure for its origin. There are other processes of a similar pathological nature which certainly should be investigated more closely. Like ichthyosis, they are of frequent occurrence and much more

common than is usually supposed, so that the investigations of a thorough and convincing nature could be easily made. No attempt to include any considerations of this kind would be in order at this time in this paper, as it is the intention of the writer to deal with general considerations only, special ones requiring more space than could be given at this time.

An explanation for the existence of the diseases of the skin which have been alluded to has been attempted by various authors, but it is one in which no satisfaction can be found. It is that ichthyosis is hereditary, and this assumption is based upon observations of one ichthyotic parent having one or more children similarly affected; or, the condition being seen through several successive generations in members of the same family. It may be possible that an anatomical peculiarity is transmitted from parents to children, but that a pathological process may be is a proposition repugnant to reason. If we assume that an anatomical peculiarity is transmissible from parent to child we can readily understand that an arrested or incomplete development or an exaggerated development may occur, and, in connection with the subject under consideration, there could occur a transmission of the developmental peculiarity in the sebaceous glands whereby they would not attain their proper form, size and secretory functions, thereby permitting the epitrichium to adhere to the stratum corneum, and this, in turn, act as the active cause of ichthyosis and allied conditions. This might be taken as a partial explanation, but the subject is so extensive that each portion of it, from its very nature, should be taken up separately and thoroughly discussed.