

THE CUTANEOUS GLANDS OF MAN

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It has long been known that, in addition to the usual type of sweat gland, there is a special type of cutaneous gland in the axilla which some authors have described as the "axillary organ." From investigations of the anatomy of this so-called axillary organ, a generalised conception has been evolved that there are two kinds of sweat glands, the ordinary simple tubular type or epicrine gland, and the larger compound tubular type or apocrine gland. A reading of older anatomists, such as Krause for instance, would suggest that the ceruminous glands of the external auditory meatus, the tarsal glands of the eyelid, and the circumanal glands belong to the same series as the axillary organ. In the investigation of these glands, the axillary organ has received most attention and the description that follows is based upon the morphology of the glands found there.

The introduction of the term epicrine for the simple sweat gland, and apocrine for the compound tubular, seems to be due to Schiefferdecker. Several anatomists saw the interest of determining the phylogenesis of this apocrine type, but Schiefferdecker appears to have been the first to make any attempt to use the distribution of these apocrine glands as an anthropological character.

THE APOCRINE GLAND

The apocrine gland is distinguished from the ordinary sweat gland, of which it seems to be a variety, by several features. The gland occupies the centre of the axilla and measures about 50 mm. in length, about 2 mm. in width and 3-5 mm. in thickness. While other skin glands are yellowish in colour this type can be recognised by its reddish tint. Ordinary sweat glands lie entirely within the cutis while the apocrine extend more deeply and reach as far as the subcutis.

The apocrine is a compound tubular gland and thus differs from the simple tubular type of the sweat or epicrine gland. The ducts of the glands run in close association with the hair sheaths, and in fact they are found only in regions where hair occurs. The duct may open into the cavity of the sheath, or more often reaches a depression in the epidermis close to the point where the hair issues. Homma states that apocrine glands are developed from the hair root. Where the duct joins with the secretory part of the gland there is usually an abrupt enlargement, so that point of transition can easily be recognised. The secretory units are packed close together and thus become com-

pressed at the centre of the gland but assume a more spherical shape at the periphery of the gland mass. The investing capsule is thin. Trabeculae from this split the gland into lobules. The blood supply is abundant and nerves have been followed along with the blood vessel as far as the membrana basalis. They have not been seen, however, to end on the epithelium.

The individual glands are larger than those of the simple sweat glands. The lumen measures about 0.11 mm. in diameter. The apocrine gland units resemble very closely those of the sweat glands, but the convolutions are not so marked. In the literature there has been some discussion as to whether these units undergo branching. Most observers are of the opinion that they do not branch.

FINER ANATOMY

The gland cells are bounded by a basement membrane and between the cells and the basement membrane there intervenes a layer of epithelial muscle. This muscle sheet tends to form a continuous ring within the basement membrane supporting the lining cells. The latter are one layer thick and two sorts have been distinguished. In the one case the cells are cubical and the cytoplasm is clear, while in the other the cells are a prominent columnar shape and the cytoplasm full of granules. The nucleus is situated at the centre or towards the base in both. The former type is regarded as the resting, and the latter as the actively secreting cell. The act of secretion appears to be accompanied by an accumulation of granules near the surface of the cell, the cell at this point projecting far into the lumen. The secretion appears to be actually liberated into the lumen by the rupture and fragmentation of the projecting part of the cell. Herein there seems to be another marked difference between epicrine and apocrine cells. The epicrine forms its secretion by the liberation of granules, while the apocrine actually loses a volume of protoplasm.

In the secreting cells of the apocrine gland, granules of different kinds have been seen. With osmic acid granules taking a light brown stain occur. Whether this means that they are of a fatty nature or not is uncertain, since these granules do not take the ordinary fat stains and most body elements can be made to stain in some degree with osmic acid. An intracellular yellowish pigment is also present. The apocrine cells give a positive iron reaction with Turnbull's blue method. The epicrine cells do not show this reaction. The presence of iron has been largely used by Homma as a criterion for distinguishing between the two types of glands. Our own observations, as far as they go, confirm this statement of Homma.

One other point is of interest, since a good deal depends on the distribution of these apocrine glands if they are used for racial and phylogenetic purposes. Do transition forms exist between the two? In the articles available to us the existence of transition forms is either denied or the report is cast in such a way that the problem is not raised. Nevertheless, Homma would seem to regard the transitional type as common, for he remarks there are glands still

left which cannot be certainly classified by any of the tests he enumerates. Homma draws attention to one other point which our own investigations confirm. In the post-mortem material available for such an investigation as this, fixation has been so long delayed that the material can be examined only in an imperfect condition. As the result of the late fixation, desquamation of the cells lining the lumina of these secretory glands has occurred extensively. This desquamation affects in a pronounced degree the apocrine glands, while in the same section it has not occurred in the epicrine glands. This feature, together with the size, the formation of lobules, and the iron reaction has made the identification of apocrine glands fairly obvious in some cases.

DISTRIBUTION

Brinkmann appears to have been the first to investigate the so-called axillary organ or apocrine gland in the Primates. Van Gelderen confirmed the results of Brinkmann but protested against the results obtained by von Klaar. Schiefferdecker appears to have made investigations amongst the great apes also. His results have been called in question by Brinkmann. From the literature available to us it appears as if apocrine glands were widely distributed in the lower animals. Brinkmann remarks that in orders such as the Chiroptera and the Ungulates, skin glands of great complexity are found, while in the Primates such glands seldom occur. Von Klaar (quoted from van Gelderen), as the result of his investigations, concluded that in the lemurs all the cutaneous glands were of the apocrine type, there being no epicrine glands at all. Also in the Platyrrhines all the cutaneous glands are of the apocrine type. In the Catarrhines, however, both epicrine and apocrine are present. Among the anthropoids he found that only apocrine glands occur in the gibbon, the gorilla, and the chimpanzee, while in the orang, beside apocrine glands, epicrine glands are also present in small numbers. From this von Klaar proceeded to draw the conclusion that the orang and the Catarrhines stand more directly below Man than do the chimpanzee or the gorilla. This conclusion was attacked by van Gelderen who investigated the chimpanzee and concluded, as Brinkmann had already done, that von Klaar's results in the chimpanzee were in error, and that both epicrine and apocrine glands were present in the axilla of the chimpanzee. Brinkmann went further and determined the distribution of these two kinds of glands over the whole body in the chimpanzee and orang. He investigated skin sections taken from fifteen different regions of the body in these two anthropoids, and concludes that apocrine glands are more abundant in the orang, while epicrine are more abundant in the chimpanzee. This result is in harmony with the common views on the relationship of the various anthropoids to man.

One of the difficulties in this investigation is the influence of age. Apparently these glands are quite small and undeveloped before puberty. They enlarge and become actively secreting only when puberty is reached.

RACIAL DISTRIBUTION

Schiefferdecker studied the cutaneous glands in five German men and seven German women, a Chinese, two negroes from the Cameroons, and one Australian aboriginal. He concluded that the apocrine series of glands were especially abundant in the Chinese, less so in the African negroes and least of all in the German subjects. His material for the study of apocrine glands in the case of the Australian aboriginal was a piece of skin from the parotid region. He found the apocrine glands abundant in this, he inferred that their distribution elsewhere would be equally generous and so he concluded that the apocrine glands were most abundant of all in the Australian aboriginal.

On the basis of the frequency of the apocrine glands he suggested a hierarchy beginning with the Mammals generally, and followed by the Primates, the Australian aboriginal, the Chinese, the Cameroon negroes, the German women and finally the German men. Schiefferdecker, of course, realises that these glands are subserving some physiological purpose and that functional needs will play a part in determining their frequency and distribution.

Homma examined some eleven white subjects and twelve American negroes in Baltimore, U.S.A. He concluded from sections taken from the various parts of the body that the apocrine glands were three times more common in the negroes than in the whites and that in both races they were more common in women than in men.

THE PRESENT INVESTIGATION

Two bodies of mature aboriginal males became available in this department and the opportunity of investigating the cutaneous glands was taken. Large strips of skin were removed from these formalinised bodies. They were taken from the axilla, the mammary region, the pubic and the circumanal region. They were embedded in celloidin and cut in series at 25μ . Some sections were stained with haematoxylin and van Gieson, and every tenth section was stained according to Turnbull's blue method and counter-stained in paracarmine.

In general it may be said that large compound tubular glands of the apocrine type, as well as epicrine glands, were found abundantly in the axilla and in the circumanal region in both cases. In the other regions there were found no clean-cut cases of apocrine glands, though several were recorded as doubtful. A difficulty in interpretation arises here. The observers who described the apocrine glands of the axilla, the so-called axillary organ, were dealing with a large gland several centimetres in length, and if this is the type of apocrine gland then such a description is only applicable in the present instance to the cutaneous glands of the axillary and anal region. It would appear from the paper of Homma that he has applied the term to glands which are not of this large compound nature, but rather to glands somewhat larger perhaps than the simple tubular gland, with desquamated epithelium, and giving the iron

reaction. Moreover, he has included, judging from his results, glands as apocrine in which the iron reaction was absent.

A brief account of the several regions studied is as follows: In the axilla large lobulated apocrine glands are present. In the sections they are very apparent and the ducts can be followed alongside the hair sheath, and where the opening is seen it appears to be placed adjacent to the exit of the hair. Again their extension beyond the cutis into the subcutis is seen and also the fibrous investment. The iron reaction is positive. The axillary organ is similar in the two cases examined.

Krause has described anal glands as occurring about 15 mm. from the anal margin where they form an oval ring of about the same width. The individual glands are about three times the size of those in the case of simple sweat glands. The gland mass has a strongly developed adventitia and muscularis.

It is apparently these glands that have been observed in the sections of the circumanal region of the two aboriginal males. In such sections gland lobes of considerable size have been encountered extending throughout sections 2.5 cm. wide. The lobes are the same size as those described forming the axillary organ. The resemblance is not confined to that of size, but the individual glands are of the same dimensions and their lumina are filled with coagulated material and desquamated cells. Moreover, they react with the same intensity to the iron stain, blue granules occurring in the cells and in the lumina. One might speak of an anal organ as others have spoken of an axillary organ.

These glands, then, are in every way identical with those special apocrine glands found in the axilla, and at first it was considered that they might form a series of glands in the anal region peculiar to the Australian aboriginal. On reflection, however, this seems improbable, and it is more likely that these are nothing else than the glands described and referred to as the circumanal glands in all the standard text-books of anatomy (Cunningham, for instance). The former idea was aroused by the results obtained by Homma in the study of the circumanal skin of 11 whites at Baltimore. In this series, which included both males and females, a study of the sections of the area in question revealed apocrine glands only in 9 out of a total of 129 sections examined. From this it must be concluded either that such glands as we have met in the aboriginal do not occur in whites in Baltimore, or that they have been missed. In view of the precise description given by Krause and repeated by later anatomists, it is concluded that Homma missed them in the whites.

In the study of 179 circumanal sections from 12 negroes of both sexes, Homma states that he saw apocrine glands in 96 sections. He makes no remark on their abundance in individual sections and does not discuss their similarity with the axillary glands. He speaks of the axillary glands as densely arranged so that many of them can be examined in a single section. In the opening lines of his paper he refers to the apocrine glands of the anal region as being widely scattered.

In the mammary region the total number of sections examined in the present series was 104. Of these, 57 from one subject showed an apocrine gland once, while in the 47 from the other subject 8 were regarded as possible apocrine glands. Homma found none in 139 sections from whites and 6 in 120 sections from negroes. The apocrine glands from this region (the same applies to the pubic region) are totally unlike the massive series met with in the axilla or the anal region. Occasionally a group of glands is met with in which the lumen is slightly larger than in the case of the simple glands. In such glands the lumen may be filled with coagulated material and desquamated cells. In some cases they give a positive iron reaction. Furthermore, glands have been encountered which are clearly part of a complex of simple sweat glands, belonging to the same duct and invested by the same sheath, but are distinguished by a positive iron reaction from the rest of the gland mass. All these have been counted as examples of apocrine glands, but nevertheless some hesitation was felt in doing so. The slightly greater frequency in the Australian aboriginal of apocrine glands in the mammary region does not seem very significant. In addition to the difficulties of deciding what should be called an apocrine gland, sections taken at random from what is vaguely called the mammary region, and moreover sections unequal in area, are likely to give results which could only have value when the differences were either very great morphologically or numerically.

It is presumed that what Homma calls the *mons veneris* region is the equivalent of the pubic region in the males. The remarks made on the apocrine glands in the mammary region apply equally to this region. Homma's results give a percentage of 31.5 per cent. in the whites, 65 per cent. in the negroes; my own in the Australian aboriginals, 12 per cent. based on 104 sections. The comments made on the significance of these numbers in the mammary region are applicable also in the pubic region. Even if they are regarded as significant they do not arrange the races mentioned in an order which corresponds to that implied in the term primitive.

In general I would conclude that an analysis of the relative proportions of the apocrine and epicrine glands in existing varieties of man would furnish an anthropological character of very doubtful value. In fact, from my present experience I would say that it does not present a character of any anthropological value and that the Australian aboriginal has much the same variety and distribution of cutaneous glands as appears to be found in European races.

SUMMARY

1. An attempt, following on the work of Homma and others, has been made to analyse the frequency with which apocrine and epicrine glands occur in the skin of the Australian aboriginal.
2. The percentage of apocrine glands in the mammary and pubic regions show variations whose directions do not mutually accord.

3. The method used has too many sources of error to make the numerical values of much importance. In the pubic region, where the differences are greatest, the racial order so derived would advance the Australian aboriginals in front of the whites.

4. The large circumanal glands in Australian aboriginals are regarded as the equivalent of the circumanal glands of European anatomy.

5. If circumanal glands are few and scattered in the white and if they are of the same type though more frequent in the negro, then the large circumanal glands of the Australian aboriginal may be a character of some racial importance. This latter conclusion is rejected.

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