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Explanation of Figures

- 1) Skin from the palm of an embryo 5 months old, showing strong monoamine oxidase activities, both in the ridges of the epidermis and in the supposed secretory portions of eccrine glands. $\times 100$
- 2) Alkaline phosphatase in the eccrine gland from the axilla, the cord region of the gland shows the strong and linear reaction of enzyme in the central portion of the gland. $\times 200$
- 3) Specific cholinesterase in the nerves of the skin of the palm in the 5th fetal month. A large nerve trunk in the middle portion and many nerve fibers around the eccrine glands in the lower portion are strongly reactive. $\times 110$
- 4) Section of the perianal region of an embryo 7 months old, showing the nerve fibers containing specific cholinesterase around the eccrine gland in the left-lower portion and the pseudocholinesterase containing end-organs around the hair follicle in the middle portion. $\times 200$
- 5) Cytochrome oxidase in the epidermis, the hair follicle, the immature adipose tissue, the eccrine and the apocrine gland of an embryo 7 months old. $\times 45$
- 6) Phosphorylase in the lip in the 8th fetal month, showing strong activities both in the basal cells of the eccrine gland and in the myofibrils. $\times 330$
- 7) Skin from the lip of an embryo 8 months old, treated with the phosphorylase technique. Enzymatic activities are observed in the hair follicle, the myofibril and apocrine gland, while the sebaceous gland is unreactive. $\times 100$
- 8) Skin from the perianal region of an embryo 8 months old, showing nerve fibers containing specific cholinesterase around the apocrine gland in the right-lower portion and pseudocholinesterase containing end-organs around the hair follicle in the middle portion. $\times 120$
- 9) The eccrine gland of the palm in 10th fetal month, treated with naphthol AS esterase technique. Enzymatic activities are demonstrated in the gland cells except the myoepithelial cells. $\times 430$

Histochemical investigation the skin of *Macaca fuscata fuscata*

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Preface

As one of the series of studies on the skin, the author have investigated the distribution and activity of various enzymes of the skin of *Macacus fuscata fuscata*. There are many reports which were made by Yasuds (1958,

1961), Montagna et al. (1959, 1960), concerning the histochemical approach to the skin of the human (1958), *Perodicticus potto* (1959), *Galago senegalensis* (1961), *Lemur macaco* (1962), *Loris tardigradus* (1960), *Nycticebus coucang* (1961). The author has attempted to compare the feature of *Macacus fuscata fuscata* with that of human skin and these observations mentioned above, tried to elucidate similarity and dissimilarity.

Materials and Methods

These observations were made on the skin of *Macacus fuscata fuscata*, two adult males and one female. Specimens of skin from 9 regions of the whole body, scalp, cheek, eyelid, lip, muzzle, breast and mammary gland, perianal region, genital region and tail, were removed under the anesthesia by Nembutal. Unfixed frozen sections of fresh tissues were treated with the method of Takeuchi and Kuriaki (1955) for the demonstration of phosphorylase, that of Glenner et al. (1957) for monoamine oxidase, that of Farber and Louviere (1956) for succinic dehydrogenase, and that of Burstone (1959) for cytochrome oxidase. Frozen sections of tissue fixed in chilled 10% formalin for 4 hours were treated for the demonstration of alkaline and acid phosphatase (Gomori, azo-dye method, 1952), alpha naphthol esterase (Gomori, 1952), naphthol AS esterase (Pearse, 1960), leucine aminopeptidase (Burstone and Folk, 1956), Acetylthiocholine and Butyrylthiocholine esterase (Montagna and Ellis, 1957).

Observations

Epidermis

The epidermis of the whole body surface is as thin as other primates so far studied except for palm and sole. Melanocytes are seen in the tips of the epidermal ridges in the palm, sole, vulva and perianal region. The epidermis has no alkaline phosphatase, but dendritic cells in the malpighian layer of palm is positive to alkaline phosphatase reaction. The epidermis has moderate reactions for succinic dehydrogenase, acid phosphatase, monoamine oxidase, leucine aminopeptidase and non-specific esterase.

Dermis

The dermal papilla is seen only in palm, vulva, and perianal region. The capillary loop is observed under the epidermis of palm, lip, vulva and perianal region; the endothelium of these vessels is strongly reactive for alkaline phosphatase, as in other primates. The perianal region and vulva have abundant vessels, while the other part has less blood supply. In the mid dermis of the prepuce and vulva, the nerves which are strongly reactive for acetylthiocholine esterase form tangled masses, as in *Nycticebus* and *Galago*.

The pilary system

Five to 6 hair follicles grow in islands that are surrounded by glabrous skin. The hair follicles on the muzzle, lip and lid grow singly and are not

clustered in group. The hair follicles of tail show more stronger activity than those of the other regions for phosphorylase, succinic dehydrogenase and monoamine oxidase. Alkaline phosphatase reactive nerve end observed in Galago and Lemur was not found.

The sebaceous gland

In general, the sebaceous glands are small except that in tail. Every gland has no reaction for phosphorylase, with the exception of weak activity in the peripheral region of the sebaceous glands in tail. There are some differences of the distribution pattern of enzymes among region, for monoamine oxidase, succinic dehydrogenase, acid phosphatase and aminopeptidase. The most remarkable regional differences have been observed on the distribution of alkaline phosphatase. The sebaceous glands in the prepuce, vulva and lip abound in enzyme activity, those of the perianal region, muzzle and eyelid are weakly reactive, and those of the scalp, cheek and tail are free from activity.

The eccrine sweat glands

The eccrine sweat glands are distributed almost over the surface of the whole body besides the palm and sole as in man. The secretory portion is differentiated into clear and dark cells, and duct opens directly to the surface of the skin. Both secretory segment and duct are strongly reactive for phosphorylase, but the myoepithelial cells are not reactive. The regional differences have not been seen in phosphorylase reaction. Both secretory coil and duct have a moderate amount of monoamine oxidase, succinic dehydrogenase, cytochrome oxidase, acid phosphatase and non-specific esterase, being unreactive in the myoepithelial cells. On the contrary, the secretory segment and duct is not reactive for alkaline phosphatase at any region, while myoepithelial cells abound in activity. The eccrine sweat glands are surrounded by thick networks of the nerve fibers which have acetylcholine esterase.

The apocrine sweat glands

The apocrine sweat glands, with a slightly coiled secretory portion, have been found in cheek, scalp, lid, lip, breast, perianal region, prepuce, vulva and tail, and the duct opens to the hair follicle. The myoepithelial cells are large, and the secretory epithelium have wide range of variation in form and size. Though most of the secretory portion and myoepithelial cells are not reactive for phosphorylase, the duct is weakly reactive. While the myoepithelial cells in tail have a intense reaction for phosphorylase. In the prepuce and perianal region, the non-typical cells have been found frequently; these cells are strongly reactive for phosphorylase. This kind of regional differences have been also found in the distribution of alkaline phosphatase. The apocrine glands are surrounded by a scant nerve fibers reacted for acetylcholine esterase.

Summary

1. The epidermis has no alkaline phosphatase except the alkaline phosphatase-

Fig. 1 Alkaline phosphatase activity is invisible in the secretory cells of the apocrine gland. The myoepithelial cells have a moderate amount of alkaline phosphatase. $\times 75$.

Fig. 2 The side view of apocrine secretory segment in perianal region. Phosphorylase activity is seen only in the non-typical cells (Nc) and excretory duct (Ed). $\times 116$.

rich cells.

2. The hair follicles have no end-organ reacted for alkaline phosphatase, alphanaphthol esterase and cholinesterase.
3. The sebaceous glands are not reactive for alkaline phosphatase and phosphorylase, but the distribution of these enzyme is different from one place to another.
4. The eccrine secretory segment and duct contain activity of monoamine oxidase, succinic dehydrogenase, cytochrome oxidase and phosphorylase, though other primates so far studied have no reaction of these enzyme in ducts. The eccrine glands are distributed over the surface of the whole body.
5. The apocrine glands open to the hair follicle. The glands are not reactive for phosphorylase both in the secretory segment and myoepithelial cell. But the distribution of this enzyme also shows regional difference.
6. From these findings as mentioned above, it is concluded that the skin of *Macacus fuscata fuscata* is histochemically different from that of *Nycticebus*, *Galago* and *Lemur*, and resembles to that of man. But, it is also different from the human skin at the following points, the every apocrine gland has nerve fibers containing acetylcholine esterase, the sebaceous glands have no reaction for phosphorylase, the epidermis has no alkaline phosphatase except alkaline phosphatase-rich dendritic cells, the eccrine sweat duct has reaction for naphthol AS esterase.

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