Diseases of The Skin

PART I. GENERAL

CHAPTER I

THE ANATOMY AND PHYSIOLOGY OF THE SKIN

ANATOMY

General Introduction.—From the embryological point of view, the human skin may be said to consist of only two layers, namely, the epidermis and the corium, developed respectively from the epiblastic and mesoblastic layers of the blastodermic vesicle. These differ greatly in their minute structure for whereas the epidermis is purely cellular the corium is made up mainly of fibrous tissue. Of the two the epidermis may be regarded as the more important as by means of it and its appendages certain of the main functions of the skin, such as the protective and secretory functions, are carried on. The corium acts chiefly as a support and protection to the blood-vessels which nourish the epidermis and to the nerve endings which render it sensitive.

The Subcutaneous tissue was at one time believed to belong to a different category from the corium, and to be developed from a different layer, but most observers are now agreed that it also is of mesoblastic origin, and should be regarded simply as a deeper layer of the corium in which some of the cells have become specialised by the deposition of fat within them.

The Superficial Architecture of the Skin.—The surface of the skin is everywhere traversed by ridges and furrows which vary in different situations in regularity, arrangement and size, and which to a considerable extent determine the shape of many of the elementary lesions of the skin. The existence of these ridges is dependent on three factors: (1) The arrangement of the fibrous bundles and elastic fibres of the underlying corium; (2) The direction of the movements to which the parts are subjected; and (3) The attachment of the skin by fibrous bundles to deeper structures.

There are two distinct varieties of furrows on the surface of the skin: (*a*) Fine furrows, which tend to run parallel to one another, and are best marked on the flexor aspects of the tips of the fingers and toes. There they form more or less regular patterns which differ so

markedly in each individual as to be of value for purposes of identification. (*b*) Coarse or deep furrows, which are most pronounced in the neighbourhood of joints, and are due to the fixing down of the skin by fibrous bundles to underlying structures, such as the periosteum of bone and the joint-capsules. In old age, and in wasting diseases, wrinkles or "folds of emaciation" occur, as the result of the disappearance of the subcutaneous fat.

EPIDERMIS

The epidermis is the part of the skin which is exposed to the air and which acts as a protection against injury, the harmful attacks of micro-organisms, the absorption of fluids and the baneful action of the actinic rays of the sun. In order to fulfil this purpose its outer layer has to be a highly specialised structure consisting of hard resistant horn-cells containing a fatty or waxy substance which renders the skin more or less waterproof.

For purposes of description the epidermis may be divided into five distinct layers, which are best seen in parts of the skin where the epidermis is thick, such as the sole of the foot or the palm of the hand. These layers or strata, named from within outwards, are the Stratum germinativum, the Stratum Malpighii or Rete mucosum, the Stratum granulosum, the Stratum lucidum, and the Stratum corneum. These indicate stages in the evolution of the epidermal cell from its simplest type in the Stratum germinativum till it becomes a perfect horn-cell. The epidermis as a whole is thickest on the palms and soles, and thinnest on the abdomen, elbows, forehead and cheeks. It becomes hardened and thickened from intermittent pressure, as in the soles of the feet from walking and in the palms of the hands from manual labour. (Fig. 1.)

Stratum Germinativum.—This constitutes the basal layer of the epidermis and usually consists of a single row of columnar cells with oval nuclei. These cells are arranged at right angles to the imaginary wavy line which separates the epidermis from the corium. As they are constantly dividing by mitosis and their whole function is that of reproduction, they have been named the "*mother-cells of the epidermis.*" Between and above them, smaller "daughter-cells" can be detected. These, except in pathological conditions, are not reproductive and do not exhibit mitotic figures; their function is that which is known as "differentiation," *i.e.* they are simply pushed towards the surface by the formation of new cells beneath them, and in their passage are gradually differentiated till they become horn-cells. The cells of the basal layer are not supported—as was once supposed—by a basement membrane but are united by fine protoplasmic threads or fibres which, towards the corium, are collected into tufts, giving the line of demarcation between the epidermis and the corium a denticulated appearance.

Stratum Malpighii—Rete mucosum, or Prickle-cell Layer. This layer consists of a varying number of rows of polygonal cells, which tend to become flattened towards the surface of the skin, and are built up in the form of a mosaic. They possess large, round or oval nuclei, and are united by delicate protoplasmic fibres continuous with the spongioplastic network of the cells. Owing to the presence of the intercellular protoplasmic fibres, the cells of this layer when separated present an appearance somewhat resembling a prickly pear and were

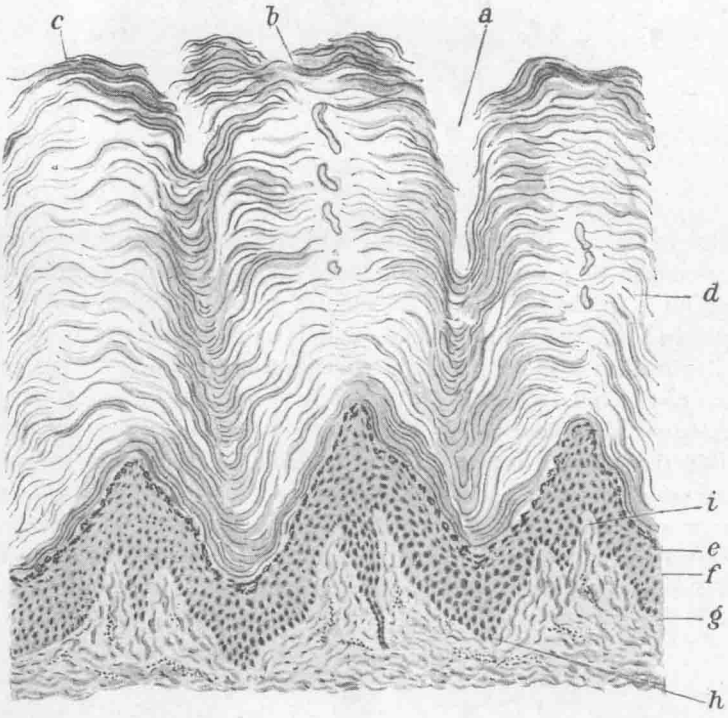

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FIG. 1.—Vertical Section of the Skin of the Sole of the Foot. (×about 150.)

a. "Fine furrow," corresponding in position to an interpapillary process. *b*. Sweat pore. *c*. Ridge corresponding in position to two papillae. *d*. Stratum corneum, showing stratification, and its great thickness in this situation. *e*. Granular layer. *f*. Malpighian layer. *g*. Germinal or basal layer. *h*. Interpapillary process. *i*. Papilla.

(From MacLeod's *Pathology of the Skin*.)

named "prickle-cells" by Max Schultze. In spite of their delicate appearance, the protoplasmic fibres are relatively resistant structures; they are unaffected by boiling water and insoluble in weak acids. Between the cells are lymphatic spaces which are bridged over by the fibres and in which are distributed the fibres of the inter-epithelial nerve plexus. Peculiar spiral fibres situated between the prickle-cells and the cells of the basal layer have been described by Herxheimer; these are generally believed to be either threads of fibrin or protoplasmic fibres passing between cells of different layers. (Plate II. 1.)

Stratum Granulosum.—Towards the surface the prickle-cell layer merges into a layer consisting of two or three rows of flattened granular cells, with shrivelled nuclei lying in spaces, and shrunken protoplasmic fibres.

The granules are most numerous in the cell-protoplasm near the nuclear spaces. They vary in shape and size from small roundish

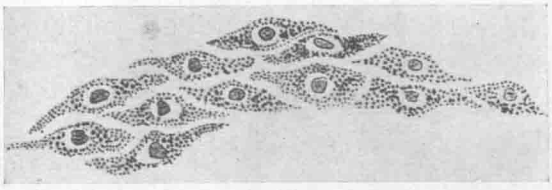

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FIG. 2.—Stratum Granulosum. (× 1000.) Shows Keratohyalin Granules in the cells.

specks to coarse irregular lumps, and are strongly light-refractive. They consist of a semi-solid substance known as keratohyalin, which is insoluble in alcohol, ether, chloroform and weak acids, is digestible in pepsin and hydrochloric acid, and is not stained by osmic acid. This substance is most probably a separation-product of the protoplasm of the cell. (Fig. 2.)

Stratum Lucidum.—This layer has been so called because in unstained sections it may be seen as a semi-transparent line resembling a narrow oily streak across a sheet of paper. It consists of one or more rows of somewhat swollen irregular cells, in which the nuclei are much shrunken and frequently replaced by a mass of debris. In these cells the keratohyalin has disappeared and been replaced by an oily substance named *eleidin*, which is present not only within but also between the cells, and which is soluble in acids and alkalies, slightly soluble in alcohol, insoluble in ether, digestible in pepsin and hydrochloric acid, and does not stain with osmic acid. It is probably a degenerative product of keratohyalin. Fat globules are also present in the cells. (Fig. 3.)

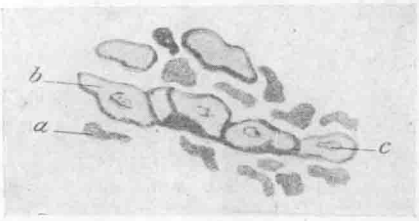

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FIG. 3.—Stratum Lucidum and Eleidin. (× 800.)

a. Eleidin around and within the cells. *b*. Protoplasm of the cells. *c*. Remains of nucleus.

Stratum Corneum.—The Stratum corneum is the most superficial layer of the skin, and is thickest on the palms and soles and thinnest on the face. It is composed of horn-cells which are most perfect in their structure next the Stratum lucidum, and towards the surface become more and more flattened and dried up until they form squames.

A horn-cell is polygonal in shape, facetted from pressure, and presents a space in the centre from which the nucleus has disappeared. The periphery has become hardened and the prickles have persisted as dried up spicules of *keratin*. Eleidin can no longer be detected within the cells, but in its place there is a waxy substance.

Keratin is a highly resistant substance, the formation of which is known as the process of cornification or keratinisation. It is indigestible in pepsin-hydrochloric acid and can withstand 50% solutions of mineral acids for a prolonged period, but is readily disintegrated by alkalies. It is a somewhat complex protein material containing a considerable proportion of sulphur and on analysis is found to have in its ash a large quantity of silicates. (Plate II. 2.)

There are several theories with regard to the process of cornification. Of these the most probable is that the keratin is the result of the hardening of the protoplasmic fibres and possibly of the outer portion of the spongioplasm of the cells, and not a degenerative product resulting from the breaking down of the nuclei, nor a further stage of keratohyalin. Keratohyalin was once regarded as a precursor of keratin, but is now recognised as a degenerative product of the protoplasm of the cell and merely accessory to the process of cornification.

The presence of the waxy substance in the cells of this layer gives it the character of a waterproof coating, and the persistence of the protoplasmic fibres in the form of hard keratin spicules welding the cells together readily explains the protective power which the Stratum corneum is capable of exerting against the entrance of micro-organisms and their toxins and its great ability to resist mechanical injury.

EPIDERMAL APPENDAGES

Hairs

General Characteristics.—Hairs are present on all parts of the human skin, except the palms, soles, red portions of the lips, ungual phalanges and Glans penis. There are three types of hairs, namely :

(1) *Long hairs*, such as occur on the scalp, beard, moustache, axillae and pubes.

(2) *Stiff hairs, or bristles*, such as the eyelashes (cilia), the hairs of the nasal orifices (vibrissae) and the hairs of the auditory orifices (tragi).

(3) *Lanugo, or downy hairs.*

The long hairs and the lanugo hairs are implanted more or less obliquely in the skin ; the bristles vertically. The shape of the hair in cross-section varies in different individuals and in different races. As a rule straight hairs are circular in section, and curly hairs oval, and the beard hairs are not infrequently angular.

The colour of the hair is dependent on three factors :

(1) The pigment granules situated in and around the cells of the hair-cortex.

(2) The diffuse colour of the protoplasm of the hair-cells.

(3) The presence of air between the hair-cells.

The granules are believed to be responsible for black and brunette tints ; the diffuse colour of the protoplasm is said to produce blonde or reddish shades ; and the presence of air between the cells causes the hair to become grey or white.

In the foetus all the hairs belong to the lanugo type and are colourless except occasionally on the scalp. After birth the lanugo hairs are gradually shed, being replaced by long hairs on the scalp, and on the rest of the body by new lanugo hairs forming the downy hairs of the glabrous skin. There are cases where infants are born with long dark hair on the scalp, this is shed during the first month and replaced by lighter hair.

The shedding of the lanugo hairs towards the end of foetal life and their replacement by new hairs in the old follicles is known as the normal *hair-change*. This begins on the face and head of the foetus between the seventh and eighth month, and if it is not completed over the whole skin before birth, it is so during the first few months of extra-uterine life. The new hairs are not permanent, however, but only have a life of from two to four years, when they are shed and new ones form.

Besides the intermittent falling out of hairs, other hair-changes occur at periodic intervals. At birth or immediately after, the normal hair-change takes place and hair grows actively on the scalp. At puberty, hair appears in certain regions, such as the beard, axillae and about the genital organs. In middle life and later, stiff hairs or vibrissae grow about the nostrils and ears. In females, after the menopause there is not infrequently an increase of hairs on the face, especially about the lips. These hairs, which may be called the " periodic hairs," are usually coarse and pigmented, while those of the rest of the body retain their unpigmented condition. (Fig. 4.)

Structure of the Hair.—The hair consists of a shaft or stem which widens out at the lower end to form a bulbous swelling known as the root. The root and part of the shaft are situated in the hair-follicle, the remainder of the hair is free.

Shaft.—The greater portion of the shaft is formed by the hair-cortex, in the centre of which there is a more variable structure known as the medulla. The cortex is protected externally by a sheath or cuticle.

The cuticle consists of a single layer of flat, quadrilateral cells arranged in an imbricated manner, with their long axes directed upwards and outwards at an acute angle to the shaft.

The cortex is made up of bundles of nucleated spindle-shaped cells, which give it a fibrillated appearance. These spindles have

ridges on the surface and interlock to form a highly resistant structure. The cells contain diffuse yellowish colouring matter, pigment granules, granules of keratohyalin, and occasionally minute air bubbles.

A medulla occurs, as a rule, only in the hairs of the scalp, beard, axillae and pubes. It is best marked in the intra-follicular portion and ceases towards the points of the hairs. It is composed of rouleaux of plates, consisting of three or four flattened cells, which, near the hair-root, contain keratohyalin granules.

Root or Bulb.—The root is softer and lighter in colour than the shaft, and is composed of the same two or three layers of cells, but these are much less differentiated and more cubical in shape than in the shaft. It is indented beneath by the upgrowing vascular papilla of the hair.

The process of cornification of the hair is analogous to that of the epidermis but the details of it are not yet fully understood. Keratohyalin granules appear in the medulla and in the cortex near the bulb and these gradually disappear as the cells become cornified. In the extra-follicular portion of the hair the component cells become cornified with the formation of hair-keratin at the periphery of the cells. Towards the free end the hair becomes hard and resistant and its component cells so closely packed together as to make the tip of the hair almost homogeneous. (Fig. 5.)

Structure of the Hair-follicle.—The hair-follicle ensheathes and protects the growing portion of the hair ; it is a simple invagination of the epidermis enveloped by a condensed layer of the connective tissue of the corium.

It may be divided for descriptive purposes into an upper third or funnel, a middle third in connection with which are the sebaceous glands and the Arrector pili muscles, and a lower third which ensheathes the hair-root and which is indented below by the papilla. In the upper third the epidermal layers lining the follicle are the same as those of the epidermis, the continuation of the Stratum corneum being next the hair. In the lower two-thirds only the prickle-cell layer and the basal layer of the epidermis persist.

The continuation of the prickle-cell layer and basal layer is generally known as the " external root-sheath " of the follicle, and consists of several rows of polygonal prickle-cells with large round nuclei.

Between this layer and the hair there is a complicated structure named the " internal root-sheath," which is only present in the lower two-thirds of the follicle, and begins at the papilla as several layers of polygonal nucleated cells containing granules of keratohyalin. As the cells ascend in the follicle those next the external root-sheath become cornified, while in those next the hair the cornification process is much less rapid and, owing to the difference in the degree of cornification, the layer tends to split longitudinally into two layers, the inner of which is usually known as the *sheath of Huxley* and the outer as the *sheath of Henle.*

Within the internal root-sheath there is a cuticle formed of a single layer of elongated cells whose long axes are directed downwards and inwards. These fit in between the cells of the hair-cuticle. Hence it is almost impossible to epilate a hair without pulling out part of the root-sheath.

Enclosing the epidermal sheaths of the follicle there is a dense fibrous layer derived from the corium, which is known as the " connective tissue layer of the follicle." It is made up of collagenous and elastic fibres which externally are arranged longitudinally, while nearer the hair they tend to have a circular direction. Next the epidermal layer they become so condensed and homogeneous that they form a layer which has been described as the " hyalin or vitreous layer."

Papilla.—The papilla of the hair is a differentiated conical process of the corium analogous to a papilla of the papillary layer. It is composed of connective tissue fibres supporting a capillary loop and one or more medullated nerves. By means of it the root is nourished and any interference with its function through injury or disease causes a cessation of growth of the hair.

Sebaceous Glands

These are small saccular glands, usually connected with the hair-follicles, but also found independently in the skin of the borders of the lips and in the areolae of the nipples. They are generally placed on the oblique side of the hair-follicle, in the angle between it and the Arrector pili muscle. They vary considerably in size, from mere appendages to the hair-follicle to structures larger than the follicle itself, and are largest about the nose, scrotum, and areolae of the nipples. They are absent in hairless parts, such as the palm of the hand and the sole of the foot. They may consist of a single saccule, or may be composed of several saccules with a common duct which opens into the neck of the hair-follicle or, in the case of the independent glands, directly on to the surface of the skin. The Meibomian glands of the eyelids, the ceruminous glands of the ears, and the smegma glands of the penis are modified sebaceous glands.

Histologically each saccule presents a connective tissue sheath inside which there is a basal layer of flat cells surrounding a mosaic of large polygonal cells with round or oval nuclei. The latter cells have undergone a change in which their protoplasm has been converted into fat droplets and their spongioplasm into a substance almost as resistant as keratin. The duct has the same minute structure as the saccule. The central cells of the saccules and duct break up and the fat droplets become discharged and collect in the lumen of the duct as a whitish-fatty mass which mixed with epidermal debris forms the *sebum* (see page 21).

Sweat or Coil-Glands

These are single tubular glands made up of a body consisting of two or more turns forming a coil, and a duct which opens on the surface at the sweat-pore. The coil is situated in the reticular layer of the corium or in the subcutaneous tissue and opens into a duct which traverses the corium in a spiral manner and passes through the epidermis to the surface. These glands are present all over the body and are most numerous in the palm of the hand and the

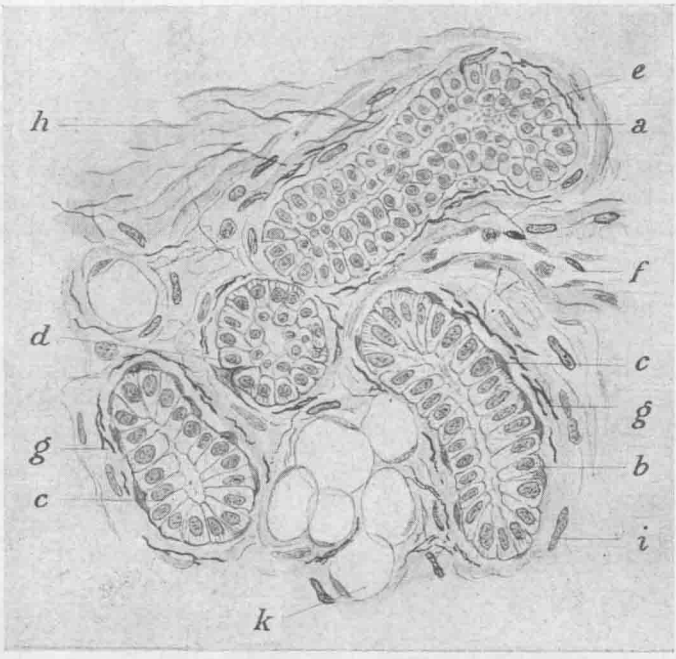

Fig. 6.—Sweat Gland. (×about 500.)

a. Coil near duct, with cubical epithelium. *b*. Distal part of coil with cylindrical epithelium. *c*. Nuclei of muscle-cells. *d*. Transverse section of coil. *e*. Debris inside the lumen. *f*. Capillary. *g*. Elastic fibres. *h*. Collagen bundles. *i*. Nucleus of collagen bundle. *k*. Fat-cell.

sole of the foot, where it has been estimated that there are as many as two thousand six hundred per square inch. They are absent on the Glans penis, margin of the lips and nail-bed. In a modified form they occur in an elliptical ring around the anus (glands of Gay) and on the eyelids (glands of Moss).

Structure.—The *coil* or *body* is composed of a single layer of cylindrical cells. These have a granular appearance when the gland is actively secreting, but this disappears when the gland is at rest. A layer of involuntary muscular cells, arranged longitudinally or spirally round the coil, encloses the cylindrical cell-layer, and outside that a fibrous capsule supporting the blood-capillaries. The lumen of the

distal portion of the coil is wider than that of any other part of the gland, and is known as the "ampulla." Towards the duct the muscular coat disappears and the epithelium becomes more cubical, several layers being present. (Fig. 6.)

The *duct* in its spiral passage through the corium has a uniform calibre, and the lumen in section is stellate or forms a cleft. The tube is composed of several layers of cubical epithelium, inside which a cuticle has been described while outside there may be a connective tissue sheath, but no muscular fibres. On reaching the epidermis it passes up through an inter-papillary process, but there the duct proper may be said to end and in its further course it is represented by a spiral cleft between the prickle-cells and the horn-cells. The granular and horny layers, however, dip down into the Malpighian layer for a short distance to form a funnel for the duct. In its passage through the epidermis the sweat is mixed with the inter-epithelial lymph, which also finds exit with the sweat at the pores. A distinction is drawn by some writers between sweating and perspiring, sweat being taken to mean the secretion of the coil, and perspiration either the transudation from the blood-vessels, or the transudation and the sweat together.

Nails

The nails are inelastic, translucent, horny plates situated on the dorsum of the distal phalanges of the fingers and toes.

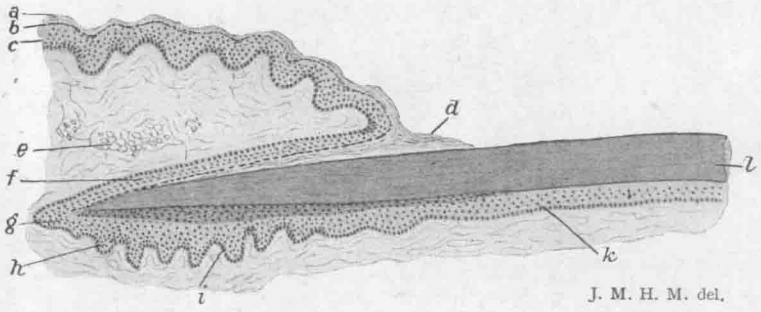

Fig. 7.—Longitudinal Section of Posterior Part of Nail and Nail-fold.

a. Stratum corneum. *b*. Stratum granulosum. *c*. Stratum Malpighii. *d*. Eponychium. *e*. Fat-lobes. *f*. Nail-fold. *g*. End of nail-fold. *h*. Nail-matrix. *i*. Granular cells. *k*. Nail-bed. *l*. Nail-plate.

(From MacLeod's *Pathology of the Skin*.)

The nail presents a posterior concave border, two almost parallel lateral borders, and a convex free edge. Its upper surface is convex transversely and to a less extent longitudinally. The whitish semilunar area occupying the posterior fifth of the nail-plate is known as the *lunule*. The nail is bounded by posterior and lateral nail-walls, and from the former a thin crescentic membrane passes for a short distance over the lunule. The lateral walls are slightly divergent, and have a rolled appearance. The nail-plate passes for a short

distance beneath the lateral walls, and for a greater distance under the posterior wall, where it is known as the nail-root, and is enclosed in a structure analogous to the hair-follicle, called the nail-fold.

The *nail-fold* is split horizontally by the root into (1) an upper portion, forming a roof composed of the various layers of the epidermis, in which the continuation of the Stratum corneum is in contact with the nail; and (2) a lower portion named the nail-matrix. (Fig. 7.)

The *nail-matrix* is an important structure, as it is from it that the nail grows. It extends from the posterior extremity of the nail-fold as far forward as the anterior margin of the lunule. It is composed of

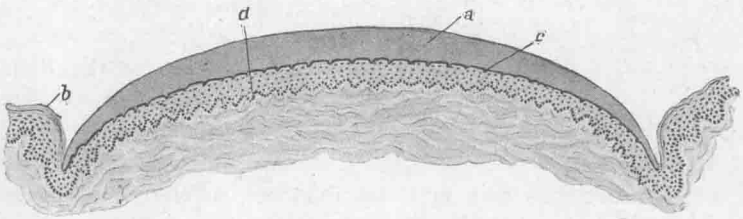

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FIG. 8.—Transverse Section of Nail-plate.

a. Nail-plate. *b*. Lateral wall. *c*. Longitudinal ridges on nail-plate. *d*. Longitudinal papillary ridges.

(From MacLeod's *Pathology of the Skin*.)

a prickle-cell layer continuous behind with that of the roof of the nail-fold and in front with that of the nail-bed. Above the prickle-cell layer there is a layer of several rows of flat granular cells with shrivelled nuclei, above which the true nail-cells begin to appear. It is the presence of these granular cells which gives the whitish opaque appearance to the lunule. Beneath the prickle-cell layer of the matrix there is a well-developed papillary layer in which the papillae are arranged on parallel ridges suggesting cockscombs. (Fig. 8.)

The *nail-bed* extends from the matrix almost as far as the free edge of the nail, and on it the nail-plate rests, but there is no organic connection between them. It is composed of a prickle-cell layer, beneath which is a papillary layer consisting of about sixty ridges parallel to the long axis of the nail. Under this there is a rich sub-papillary vascular plexus in which large venous sinuses are present, lined with endothelium, and forming an erectile tissue. (Fig. 9.)

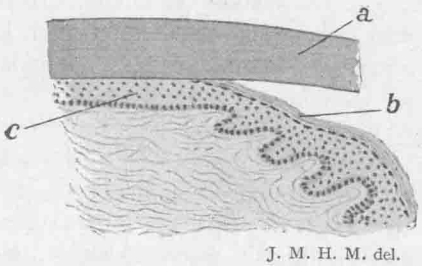

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FIG. 9.—Longitudinal Section of Free Border of Nail.

a. Nail-plate. *b*. Stratum corneum and granular layer. *c*. End of Nail-bed.

(From MacLeod's *Pathology of the Skin*.)

The *nail-plate*, though not in organic connection with the nail-bed, is in close contact with it, since on its under surface there is a series of

parallel ridges which fit in between those of the nail-bed and so bind the two structures together. It is made up of flat cornified cells which differ from those of the Stratum corneum in that the nuclei persist. These cells are arranged in superimposed lamellae, which can only be distinguished near the nail-matrix, since further forward they become knit together to form an almost homogeneous plate. (Fig. 10.)

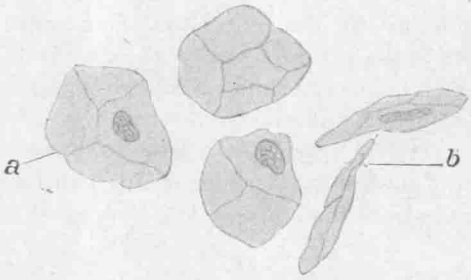

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FIG. 10.—Nail-cells. (× about 1000.) From a piece of nail soaked for a week in Liquor Potassae.

a. Cells, showing facets, seen from the surface.
b. Cells seen from the side.
(From MacLeod's *Pathology of the Skin*.)

Growth of the Nail.—If left uncut the nail does not grow indefinitely, but at a variable distance beyond the finger it becomes thin and desquamates, so that a natural free border is formed. As a rule the matrix only produces one nail, which during life is constantly growing at about the rate of 0.8 mm. in twenty-four hours on the fingers, and 0.4 mm. on the toes. It takes roughly about 100 days for a finger nail to grow.

CORIUM

The corium, or Cutis vera as it was once called, is the dense fibrous layer of the skin which gives it strength and elasticity. It supports and protects the hair-follicles, glands, nerves and blood-vessels. Structurally it is built up chiefly of white fibrous tissue and a variable amount of yellow elastic tissue, in the interstices of which are certain well recognised cellular elements. It is customary to divide the corium into a superficial and a deep layer, known respectively as the papillary and the reticular layer. In the papillary layer the white fibrous bundles are thin, loosely packed together, and tend to have a vertical direction, while in the reticular layer they are coarse and form a dense complicated network, the meshes of which tend to be arranged horizontally.

The papillae are conical projections of the corium into the overlying epidermis, in which are found the terminal capillary loops and certain nerve-endings ; according as they support the former or the latter they are known respectively as vascular or nerve-papillae. They are situated on ridges of varying height, arranged more or less parallel to each other. The papillae may be single or more rarely compound, are longest on the flexor aspects of the finger-tips and toes, and are specially numerous about the areolae of the nipples.

Cellular Elements.—The cellular elements in the healthy corium consist of migratory cells and fixed cells. The *migratory cells* are the

leucocytes which are specially noticeable near the blood-vessels and in the papillary layer.

The fixed cells constitute the more important group. They are not all absolutely fixed to fibrous structures, as some are unattached and may be carried about in the lymph stream, but their movements are purely passive. There are three distinct types of fixed cells in the corium namely :

(1) *Ordinary connective tissue cells* which, as a rule, are spindle-shaped, but may be polygonal. These have usually long processes, tapering to fine threads, which in young connective tissue frequently unite with those of neighbouring cells to form a meshwork. The nuclei vary according to the shape of the cells, some being oval, others round, and a few polygonal. These nuclei are peculiar in having a coarse intra-nuclear network with unusually open meshes, producing a " vesicular " appearance. (Fig. 11.)

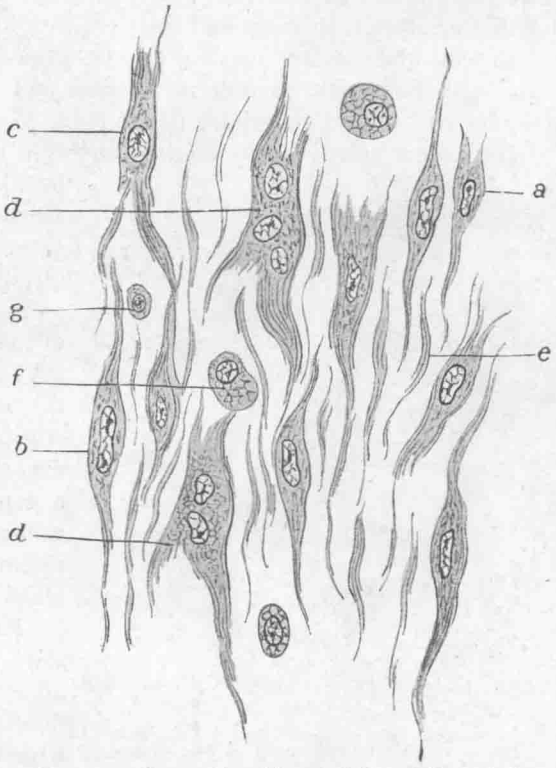

FIG. 11.—Connective Tissue Cells of Granulation Tissue.

a. Spindle-shaped Connective Tissue cell. *b*. Longer Spindle-cell with protoplasm becoming fibrous. *c*. Branching and early fibrous formation. *d*. Large Connective Tissue cells with several nuclei. *e*. Fine fibrils between the cells, probably parts of cells not shown. *f*. Connective Tissue cell with a vacuolated appearance. *g*. Spindle-cell in transverse section.

Frequently only the nuclei of the cells can be detected, and even with the most careful staining no protoplasm can be recognised around them. As a rule the cells or nuclei are found flattened between the fibrous bundles of the corium, and at times their processes may surround bundles and may line the lymphatic spaces between them like an endothelium.

(2) *Vacuolated Cells.*—These differ from the ordinary type of connective tissue cell. They have no processes, and the meshes of their spongioplasm are unusually large and rounded, giving them a vacuolated appearance. The nuclei of the cells are " vesicular " in character, and mitotic figures may occasionally be detected within them. It is

just possible that these cells are the "mother-cells" of the corium, their function being exclusively that of reproduction, and that they bear the same relation to the corium as the cells of the basal layer to the epidermis. (Fig. 12.)

(3) *Mast-cells.*—This type of cell is distinguished by the presence in its protoplasm of numerous coarse granules with a marked affinity for alkaline dyes. In shape and size they vary like ordinary connective tissue cells, and may be round or spindle-shaped. Their nuclei do not stain well, frequently present no nucleoli and are generally more or less obscured by the granules. (Plate II. 3.)

They occur chiefly in the neighbourhood of the blood-vessels, hair-follicles, and sebaceous glands, and are found in greatest number in the skin of pigmented regions, such as the scrotum and areolae of the nipples.

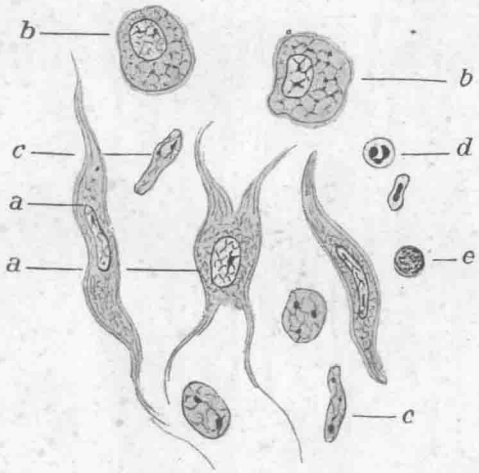

FIG. 12.—Connective Tissue Cells of the Corium.

a. Ordinary Connective Tissue cells. *b*. Vacuolated cells. *c*. Connective Tissue nuclei. *d*. Polymorphonuclear leucocyte. *e*. Lymphocyte.

The nature and origin of the mast-cell granules are still undecided. A possible explanation is that they are a separation- or degeneration-product of the protoplasm of the cells, somewhat allied to mucin.

Fibrous Elements.—(1) *White fibrous bundles* which are composed of numerous fibres about the breadth of a red blood corpuscle, united by a semi-fluid material. These fibres readily split up into fine fibrils of a substance known as collagen and are incapable of branching. The bundles are flexible, slightly extensible, and when seen longitudinally present a wavy appearance which disappears when the skin is stretched.

Collagen is an albuminoid substance and is probably the anhydride of gelatine.

There are two opposing views regarding the origin of the white fibrous bundles, namely, (1) that they are the result of the direct transformation of the protoplasm of the connective tissue cells, and (2) that they are formed by the deposition of fibres in an intercellular substance secreted by the cells. Of the two the former seems to be the more probable.

(2) *Elastic fibres* which are arranged parallel or obliquely to the collagenous bundles and are most numerous in the reticular layer. Unlike the collagenous fibres they are capable of branching and of uniting with neighbouring fibres to form a meshwork. They envelop

the coil and ducts of the sweat-glands and are present around the hair-follicles, sebaceous glands and Arrectores pilorum. The distribution of these fibres is so universal that they form a skeleton supporting the various elements of the corium. Their elasticity is not nearly so great as was at one time supposed, and is considerably less than that possessed by the collagenous fibres. In section they are angular in outline and tend to curl up on being broken across. They are composed of an albuminoid substance called *elastin*, which is more resistant to the action of weak acids and alkalies than collagen. The origin of the elastic fibres is undecided, and they have not been definitely proved to be capable of regeneration. (Fig. 13.)

Subcutaneous Tissue

This structure may be regarded as the deepest layer of the corium, the cells of which have become infiltrated with fat. This layer serves four important purposes :

(1) It forms a pad which protects the delicate underlying structures from being harmed by injuries to the skin.

(2) It is a bad conductor of heat.

(3) It prevents too great a loss of heat by radiation and evaporation.

(4) It forms a supporting framework for various delicate structures, such as the Pacinian bodies, nerve-trunks, coil-glands, and blood-vessels.

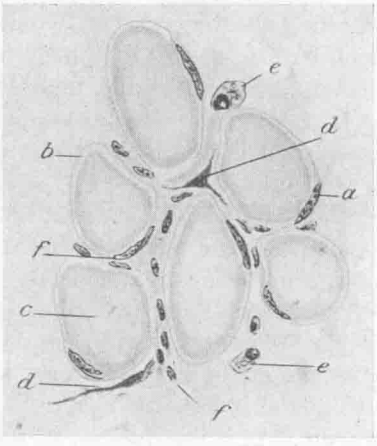

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Fig. 14.—Fat-Cells. (× 800.)

a. Fat-cell with "mantle" and nucleus. *b*. "Mantle" formed by protoplasm. *c*. Fat-globule. *d.s*. Connective tissue corpuscle. *f*. Capillary and leucocytes.

It is especially thick on the palms and soles, and thin on the face. It consists of a coarse fibrous meshwork enclosing large groups of fat-cells, known as fat-lobes. The fibrous walls separating the lobes are named "trabeculae." The lobes are broken up by fibrous septa into lobules. The lobes, lobules and individual fat-cells are richly supplied with blood-vessels and lymphatics, which are distributed in the trabeculae and septa and form a capillary meshwork between the cells. Fat-columns (Columnae adiposae) have also been described, which pass vertically along the larger vessels from the fat-lobules to the coil-glands in the corium.

The individual fat-cells are large, oval, round, or polygonal bodies, consisting of a globule of fat encapsuled in a homogeneous mantle, the

remains of the protoplasm of the cells, at one side of which a flattened nucleus is generally present. These cells are due to a fatty infiltration of the connective tissue cells and are not the result of a degenerative process. (Fig. 14.)

The *origin of the skin-fat* has been a fruitful source of controversy. The leading theories regarding it are :

1. That the skin-fat is a product of degeneration of the cell-protoplasm.
2. That it is a product of secretion of the cell-protoplasm.
3. That the subcutaneous fat, and that which occurs in the lymphatics of the skin, is derived from the coil-glands.
4. That the epithelial fat comes from the sebaceous glands.

It is generally conceded that the fat of the sebaceous glands and that which occurs in the Stratum corneum is a separation or degeneration product of the protoplasm of the cell ; this explanation does not apply to the subcutaneous fat, however, for in the latter situation the cells are not degenerated and the fat is of the nature of an infiltration. The presence of fat in the coil-glands and ducts has been noted by a large number of observers, and Unna has strongly advocated the view that the subcutaneous fat is derived from that source. The lymph which bathes the coil is said by him to be loaded with fat and to be taken up, as a rule, by the small venules, and in the process filtered and the fat deposited. The fat accumulates in columns around the blood-vessels, and is eventually taken up by the connective tissue cells of the subcutaneous tissue.

Other Situations in the Skin where Fat is found.—Small fat granules or globules occur in the epithelial cells of the sweat-apparatus and in the lumen of the sweat-coil and duct. They are present also in the lymphatic spaces of the corium, in the walls of the vessels and in the medullae of nerves.

In the epidermis, fat occurs in the nuclear spaces of the prickle-cells, in the inter-epithelial lymphatics and in the cells of the Stratum corneum. It is also present in the epidermal cells of the hair-follicles.

Blood-Vessels

The following systems of blood-vessels in the skin begin in the subcutaneous tissue and pass towards the surface :

Blood-Vessels of the Subcutaneous Tissue.—Small arteries are present in the trabeculae between the fat-lobes ; certain branches from these course in the septa between the lobules and end in capillaries between the fat-cells, while others pass up more or less vertically into the corium. Veins and venous capillaries correspond to these arteries.

Blood-vessels of the Corium.—Two somewhat horizontal vascular plexuses are generally described in the corium ; a deep one situated next the subcutaneous tissue and a superficial one in the sub-papillary