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COLUMNÆ ADIPOSÆ.

A NEWLY-DESCRIBED STRUCTURE OF
THE CUTIS VERA,

WITH ITS PATHOLOGICAL SIGNIFICANCE IN

CARBUNCLE

AND OTHER AFFECTIONS.

BY

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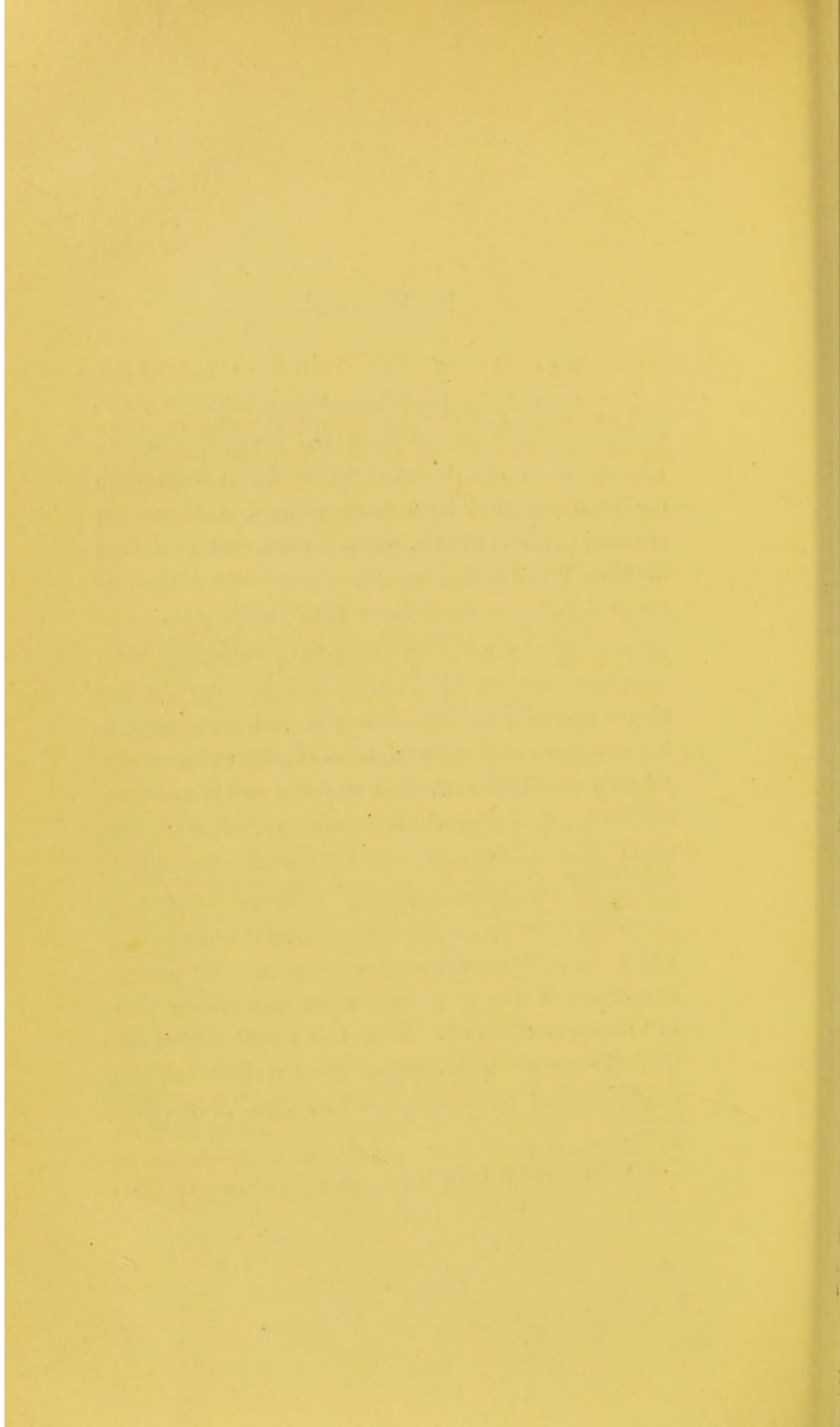
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PREFACE.

PORTIONS of this paper have been printed from time to time in the Boston Medical and Surgical Journal. The article on The Anatomy of the Thick Cutis Vera has been prepared for a work entitled A Manual of Histology, edited by Dr. Satterthwaite, and published by Wm. Wood & Co., soon to appear. They are collected together in the present form for the purpose of portraying fully and illustrating the pathological bearings of a structure which, until first described by the author several years ago, had remained unrecognized. The existence of slender columns of adipose tissue perforating the thick cutis vera was first called to his attention in examining a case of sarcoma, when the diseased elements brought into light a structure which, although hardly microscopical in its dimensions, is easily overlooked : partly because of its existence only in skin which is rarely examined, and partly also for the reason that it is only seen there when sections are made in the proper direction. That it is a well-defined anatomical structure with constant characteristics has been amply verified by observation extending over several years.

BOSTON, *January 1, 1881.*



THE ANATOMY OF THE THICK CUTIS VERA.

THE portions of the skin usually selected for histological purposes are those in which the papillæ or hairs are best shown. The glands are also carefully described, but little attention has been given to the anatomy of the cutis vera as an organ by itself; consequently those parts have not been examined where it is found in its most highly developed form.

The skin varies greatly in thickness; on the inside of the arms and thighs and on the anterior aspect of the body generally it is much thinner than behind. In the former case, particularly in delicate women, it is exceedingly soft and pliable, a thin fold being easily raised and rolled between the thumb and finger. In the latter it is exceedingly thick, in the back and shoulders of hardy adults appearing as a veritable hide, being much thicker than the skin of many pachydermatous animals. Here it measures 5.5 mm., and even more, in thickness; when tanned it resembles sole leather. This structure is composed of bundles of fibres interwoven in various directions. On the surface of these bundles lie the flat connective-tissue cells, disposed in rows and occupying the intervals, the tissue being somewhat analogous to tendon. The cutis is, in fact, a sort of tendon or aponeurosis; from its under surface it sends out fibrous prolongations of considerable size, and in some animals these are actu-

ally attached to muscles.¹ In man we find them dipping down into the subcutaneous fat, in the back forming a very dense and firm mesh-work. Fatty tumors growing in this part of the panniculus adiposus are, for this reason, extremely difficult to enucleate.

The papillæ are but imperfectly formed, and are for the most part represented by an undulating line; at short intervals are the follicles of the lanugo hairs, which penetrate only the superficial layers of the cutis, the sweep of whose fibres would be otherwise unbroken were it not for the existence of a structure, hitherto undescribed,² which connects the bases of the hair follicle with those parts in which we find the roots of the longer hairs imbedded,—the panniculus adiposus. This consists of a nearly vertical cleft or slender, columnar-shaped space, extending from the last-named structure in a somewhat oblique direction through the deeper and middle layers of the cutis, and terminating at the base of the follicle which rests upon it. This space is occupied by adipose tissue in its entire length; hence the term fat column or fat canal³ would seem to be an appropriate name. (Figure 1.) The length of this space is about four mm.; its width rather exceeds that of the hair follicle above. Its long axis is placed at a slight angle to that of the follicle, which in most cases is nearly perpendicular to the surface, and

¹ M. Renault, *Anatomie général de la Peau*, *Annales de Dermatologie et de Syphiligraphie*, tome ix., No. 5. Satterthwaite, New York Medical Journal, July, 1875.

² In the latest treatises of the skin no such structure is described. See *Die Hautkrankheiten für Aerzte und Studirende*, von Dr. Gustav Behrend, Berlin, 1879. *Pathologie und Therapie der Hautkrankheiten*, von Dr. Moriz Kaposi, Wien, 1879.

³ Note on the Anatomy and Pathology of the Skin, by J. C. Warren, Boston Medical and Surgical Journal, April 19, 1877.

is nearly parallel to that of the erector pili muscle (*b*). At about the middle of this axis are given off two horizontal prolongations, usually partially filled with fat tissue, appearing like a pair of extended arms or the remaining branches of a leafless trunk (*p*). Near this point is suspended the coil of a sweat gland (*e*), held in place by a few delicate fibres which find their insertion at the top of the canal or cleft. The duct of the gland runs to the top of this space, whence it may be traced to the side of the hair follicle, where it finds its way to the surface. (In dogs the sweat duct opens directly into the follicle a short distance from its mouth.) The fibres of the cutis appear, in vertical sections, to terminate abruptly at its edges. There does not appear to be any structure resembling a "limiting membrane." At its base there is sometimes a slight widening of the cleft, and on the side towards which its axis leans the fibres of the cutis collect to form a bundle which penetrates the subcutaneous fat. (*Cônes fibreux de la peau, k.*) The upper extremity is rounded off in somewhat dome shape. In lean subjects the fat may be entirely absent. The cleft is then seen occupied by a blood-vessel in its axis and at its top by a sweat gland, the lateral space being filled by a loose reticulum of very fine fibres and connective-tissue cells.

The erector pili muscle, taking its origin from the papillary layer of the cutis, is inserted partly into the base of the follicle, which its fibres embrace, and partly into the structures forming the apex of the fat canal. In some sections the fibres seem to penetrate this space, but probably surround it, although some fibres may be attached to those delicate bands of fibrous tissue which

traverse the column of fat cells. The muscle lies on the side corresponding with the inclination of the hair externally, and appears almost continuous in its direction with the fat column beneath it, as shown in Figure 8, where the muscle has been dissected up by disease. It probably extends some distance down the side of the column. In certain sections, on the other hand, it appears to run between the base of the follicle and the apex of the column. The sebaceous gland lies between the muscle and the follicle, at the apex of the angle made by them; a lobe is found also on the opposite side. (Figure 1; Figure 5, *c*.)

The number of these columns corresponds to the number of hairs, as they do not exist elsewhere. In some sections of skin, half an inch in length, as many as five may be counted. They are seen to best advantage in the thickest portions of the skin, but may be found on the shoulders, arms, breasts, abdomen, and lower extremities. At some points they appear as slight indentations, at others as long canals. They are well shown in the skin of an infant (Figure 5), and in a fœtus of nine months. In the pig the lower border of the cutis appears to the naked eye, when seen in section, like the teeth of a saw. Under the microscope the apex of each indentation contains the bulb of a hair. In thick hides these indentations become clefts or canals, and we find frequently a sweat gland situated at about the middle of each. The canals are oblique, as are also the hair follicles, and the axes of the two are more nearly parallel than in the human subject. In thin skin the canals are either so short as hardly to pass for such, or, if the hair root is of sufficient length to extend to the bottom of the cutis, ab-

sent. A thick skin and the existence of downy hairs are, then, the conditions necessary for the presence of this structure in its most typical form. I have not found them in the face, — although in some individuals they probably exist here, — nor in the thinner skin already alluded to. In the lip of the rat the long hairs are imbedded in a transparent mucous-like connective tissue, and their roots are surrounded by numerous bands of muscle. It is interesting to note the fact that under each root are to be found vertical rows of fat cells, arranged end on end like the beads of a rosary, but there appears to be no cleft in the surrounding tissue to inclose them.

In order to make a preparation of skin which shows these structures in their entire length, the section must be made vertical to the surface, and in a direction which corresponds with the inclination of the cleft or of the hair above the surface. This coincides with the fine folds or "grain" of the skin. Sections made in any other direction give but a fragment of the column which appears there merely as an isolated lobule of adipose tissue. Even with these precautions it is difficult to obtain a good specimen unless the razor is guided by the eye, and as in embryonic skin the canals are not large enough to be seen it is greatly a question of luck whether a good section can be obtained.

The Blood-vessels are well shown by an injection of Berlin blue in the fœtus, near full term. In each canal, as well as in the intervals between them, the arterioles which nourish the cutis ascend from the subcutaneous system of vessels, which forms a fine network in the panniculus adiposus. Those in the canals, on reaching the lateral clefts, bifurcate, giving a branch

on either side, which anastomoses sparingly through subdivisions with the adjacent arterioles in the middle layer of the cutis, and gives origin to the papillary and sub-papillary net-work of capillaries, which here can be considered as one and the same. At the point of bifurcation of the main vessel branches are given off, which ascend further in the canal and form a delicate net-work surrounding the sudoriparous gland (*Wundernetz*). The anastomosis of the vessels about the hair follicle is particularly rich and fine, and unites intimately with the superficial layer of capillaries. The hair follicle, with its subjacent fat column, thus forms the centre of a rich system of arterioles and capillaries which extends from the panniculus adiposus to the papillæ.

The Lymphatics. The following experiments were made to determine the question of the presence of lymphatics in these channels, and also to observe to what extent fluids and particles pressed up from below could be forced to the surface.

Skin was taken from the body of a lean adult within twenty-four hours after death. A small amount of the loose areolar tissue was left adherent to its lower surface. The skin being prepared by warming for a few minutes in water of about 90° F., Berlin blue was injected by means of a subcutaneous syringe into the loose areolar tissue, which was rapidly distended by the fluid. The specimen was then thrown into strong alcohol. A similar fragment of skin was stretched like a drum over the end of a brass cylinder, to which it was firmly attached by an open brass cap and screws. The cylinder being held vertically, Berlin blue was poured upon the skin, the upper surface of which

looked downward; a rubber cork perforated by a glass tube was securely fastened to the top of the cylinder, and the tube was connected with an apparatus designed to exert any atmospheric pressure required. Pressure sufficient to raise a column of mercury twenty-eight millimetres was continued for an hour and a half, the skin being pressed out with great force in dome shape at the bottom of the cylinder, which was kept during the time in blood-warm water. The specimen was then placed in alcohol. It was observed that the injection mass had gone, at one or two points to the surface, and on making vertical sections of the skin the next day the cutis was found to be penetrated by the mass in vertical blue lines, which united at various intervals by horizontal branches, occasionally so numerous as to present an almost continuous blue surface. The subcutaneous areolar tissue was uniformly colored blue. (Figure 6.)

Opinions on the character and distribution of the lymphatics of the skin seem to differ. For instance, Neumann describes them as vessels distributed through the skin in two horizontal layers, a superficial and a deep one, the vertical connection between the two being found only at comparatively rare intervals.¹ Renaut regards the skin as a lymphatic sponge, the minutest ramifications being but the spaces between the bundles of fibres, the coarser differing from these in having an endothelial lining (connective-tissue cell?), there being in neither case a true wall, which is found only in the lymphatic vessels of the subcutaneous tissue.² Vertical

¹ Zur Kenntniss der Lymphgefäße der Haut, von Isidor Neumann.

² Renaut, op cit.

sections taken from the specimens of skin injected by puncture showed a similar but not so complete an injection as was effected by the pressure method. The latter seems to possess special advantages, as a large lymph surface is exposed at one time. Figure 6 shows the route taken by the Berlin blue, which, as will be seen, ascends nearly in vertical columns through the fat canals to the base of the hair follicles, going round the sides of the sweat gland. When a slight amount only had passed into the canal a medium power of the microscope showed the blue lying in and staining the tissue accompanying the ascending blood-vessels, in the so-called "perivascular space." The lateral clefts were filled with the mass, which extended far enough to communicate with that coming from an adjacent column. From this point there is a delicate and finely anastomosing net-work marking out the spaces between the bundles of fibres of the cutis. The lateral anastomosis lower down is not so free, and in the uppermost layers, owing probably to the compression of the bundles of fibres, there is little blue to be seen. From the top of the canal the injection surrounds the base of the hair follicle; on one side ascending vertically and giving off horizontal branches, and on the other following the interval between the lower border of the erector pili muscles and the fibres of the cutis. The main route is through the canals, there being no penetration from below elsewhere. A similar method of injection of these spaces is seen in certain forms of disease. In the carbuncle (page 21) the infiltration of pus cells is traced into the papillæ through these channels. Similar instances of this infiltration were found in morbid growths. (Page 26.)

It is evident from these examples that a free communication exists between the interspaces of the fibrous bundles of the cutis and the subcutaneous tissue, and that this is effected by no system of vessels inclosed by distinct walls other than that formed by the so-called connective-tissue cells.

The special function of these canals is not evident. In addition to furnishing a route for the blood-vessels and lymphatics there would seem to be some connection with the hair and its apparatus. The constant relation which they bear to this structure and the erector pili muscle would suggest an arrangement designed to facilitate the action of the muscle. According to Biesiadecki¹ this muscle, by its contraction, raises the hair from the position which it occupies, nearly horizontal to the surface, to a more vertical one. Any movement of the root of a lanugo hair would be well-nigh impossible, imbedded in the dense tissue of the cutis, were it not for a yielding structure like that of the adipose column, an elongation of which would aid the contraction of the muscle. In specimens where the muscle is found in a state of contraction the hair follicle is bent like a bow, the root being drawn through the arc of a circle. The presence of fat near the hair bulb is made possible by this structure, a condition which is constant with all hairs. That the fat is not an incidental feature of this structure, which might be considered merely a cleft for the transmission of vessels, is rendered probable by the observation of rows of fat cells beneath each hair in the lip of the rat, where no especial channels exist, and also by the fact that

¹ Stricker's Handbuch der Lehre von den Geweben des Menschen und der Thiere.

such columns of fat do not accompany the nutrient vessels of the skin in those parts where the hairs are not seen. It seems, therefore, probable that this structure has also some bearing upon the nutrition of the hair.

Sweat glands are found not only in these canals, but elsewhere in the thick cutis. The coil of the gland is then usually situated at a level a little below the middle of the cutis vera, and not in the subcutaneous adipose tissue, as in thin skin.

THE PATHOLOGY OF CARBUNCLE OR "ANTHRAX."¹

A GREAT deal of confusion has arisen owing to the unfortunate application of one name, anthrax, to two entirely different diseases. The existence of an inflammatory mass in the skin, in each case accompanied by gangrene and constitutional disturbance, which might terminate fatally, led many authors to confound the affections, and although at the present time the fact is well recognized that the fever of a malignant pustule is a specific one, and that of carbuncle pyæmic, septicæmic, or septic, the names are still largely common to both in most languages. Anthrax, the term originally given to the specific fever of animals, may be translated into murrain or splenic fever (English), *milzbrand* or *carbunkel* (German), and *charbon* (French). Malignant pustule is the name given to the last named disease, when occurring in man, by English and German writers, and occasionally by the French, although *charbon* covers both that in man and animals in the language of the latter. Anthrax is still used by veterinary surgeons as the scientific name for the specific fever, but it is not used in this sense by the prominent surgical writers² of to-day, who employ it to designate the local inflammation of the skin under consideration.

¹ Communicated to the Boston Society of Medical Sciences. Boston Medical and Surgical Journal, April 19, 1877.

² Gross. Ashurst. Thomas Smith (Holmes System). Korányi (von Pitha and Billroth). Nouveau Dictionnaire.

The English "carbuncle" is synonymous with "anthrax:" it is a term not employed by the French, who substitute "anthrax;" by the Germans it is used to denote either disease.

The current authority on surgical pathology¹ thus describes carbuncle: Anatomically it resembles a group of several furuncles lying close together. Its origin and first stage are the same as in furuncle; that is, the death of a small portion of the skin (perhaps a cutaneous gland) seems to be the starting-point and centre of the inflammation. "Soon a number of white points form near each other, and the swelling, redness, and pain in the periphery increase in some cases so much that the carbuncle may attain the size of a soup-dish; and while the detachment of the white plugs of skin goes on in the centre the process not unfrequently extends in the periphery. . . . After the loss of the plugs of cutis, the skin appears perforated like a sieve. . . . But even when most intense, the process is almost always limited to the skin and subcutaneous cellular tissue. . . . You will have already noticed that the process of formation of furuncles and carbuncles differs from the inflammations with which you are already acquainted by the constant and peculiar death of portions of the skin. Of course, this must be induced by an early, perhaps primary, occlusion of small arteries; possibly of the vascular net-work around the sebaceous glands. . . . This limitation to the skin and subcutaneous cellular tissue is very characteristic of fibrinous (diphtheritic) inflammations; so that on this account, as well as from the hard infiltration and necrosis of the tissue once infiltrated, I do not hesitate to consider carbuncle as a

¹ Billroth, Lectures on Surgical Pathology, American edition, page 283.

diphtheritic inflammation of the skin. . . . Kochman thinks that carbuncle as well as furuncle originally develops from a sweat gland or from several adjacent glands. J. Neumann distinguishes between carbuncles from sweat glands and from cellular tissue." In Neumann's book I find no such distinction.

In the *Nouveau Dictionnaire de Médecine et de Chirurgie* it is defined as an inflammation of the subcutaneous cellular tissue, with a tendency to mortification of the skin. The author believes that the affection begins ordinarily in the cellular tissue lying between the fascia and the skin. It differs only from a furuncle in the extent and depth of its inflammation. In Holmes's *System of Surgery* it is also described as attacking the subcutaneous tissue and involving the skin.

Mr. Ledwick¹ gives the following summary of views on the pathology of this affection: "There is much discrepancy of opinion in relation to the precise seat of this disease at its commencement. Rokitansky² believes the affection has its origin in the deep layer of the corium, involving the areolar tissue in its meshes, and subsequently extending to the subcutaneous structure. Brodie³ remarks that the disease may commence in the elongations of the cellular membrane. . . . Dupuytren⁴ believes that the dermoid prolongations of the areolar tissue, which become strangulated, are the peculiar localities of the disease, accounting thus for the cribriform suppuration of the skin and subsequent sloughing; whilst Hunter⁵ insists that its source

¹ Dublin Quarterly Journal, vol. xxii. p. 403.

² Rokitansky, *Pathological Anatomy*, vol. iii. p. 85.

³ Brodie's *Lectures on Pathology*, page 392.

⁴ Dupuytren, *Clinique chirurgicale*, t. iv. p. 111.

⁵ Hunter on *Inflammation*, page 372.

is always tegumentary, and spreads to the cellular tissue. . . . Nélaton¹ teaches that an anthrax is rather subcutaneous than cutaneous. I have not the least hesitation in affirming that the primary hardening is subcutaneous, spreading, as the disease advances, from the deep to the superficial surface of the skin, which ultimately participates in the gangrenous affection." Mr. Collis,² writing on this point, says it is essentially an inflammation of the dense fascia in which the superficial areolar tissue is implicated, as in furuncle, and also the deep, as in phlegmonoid erysipelas.

Dupuytren appears to have had the most accurate knowledge of the anatomy of the part affected, and hence the clearest views as to the seat of the disease. He defines anthrax as an inflammation of several bundles of cellular tissue contained in the areolar spaces of the skin. These spaces are formed by the interlacing of bundles of fibrous tissue, and the cellular tissue contained in them is frequently filled with "fatty fluid." They have a cone shape, the base being at the lower border of the skin and resting on a layer of cellular tissue, the apex terminating in a number of little holes directed obliquely in the skin, — easily demonstrated in a specimen which has been macerated for some time. Anthrax consists, he thinks, in an inflammation of these bundles of cellular tissue, and is found where they are most perfectly developed.

A glance at the anatomy of that portion of the skin where carbuncle most frequently occurs, namely, that of the upper dorsal region, will serve to ex-

¹ Nélaton's Clinical Surgery, page 36.

² Dublin Quarterly Journal, vol. xlvii. p. 76.

plain many of the striking peculiarities of this affection. In the first place, the skin is extremely thick; probably thicker than at any other portion of the body. It forms a solid mass of dense fibrous tissue, well calculated to sustain burdens or to protect a comparatively defenseless portion of the body. The great bulk of the cutis vera necessitates certain important modifications of contained and contiguous structures. The hair follicles, being those supporting downy hair only, and therefore shallow, project but a short distance into the uppermost layers of this mass of fibre; and there would be no communication with the subcutaneous adipose tissue were it not for oblique columns of fat which extend from below to their bases. These fat columns, or *columnæ adiposæ*, which I have described elsewhere,¹ are found beneath each hair follicle, are of about the same width, — perhaps a little broader, — and contain, besides loose connective-tissue fat cells and vessels, the coil of a sweat gland suspended midway in the shaft. (Figure 1, *e*.) There are generally two horizontal branches to this cleft (*p*) in the skin, and I have already shown how an injection mass forced in from below may ramify through the whole thickness of the cutis, forming quite a delicate net-work, and marking out the anastomosing system of lymphatic channels. At the point where these columns open into the parts immediately below this dense sheet of cutis we find a broad band of fibrous tissue (*k*) given off from one side and extending down obliquely into the subcutaneous structures, to be attached finally (tendon like) to the fascia, beneath which lie the muscles. These fibrous bands interlace one another in

¹ Boston Medical and Surgical Journal, April 19, 1877.

various directions; are very different in character from the delicate "cellular tissue" underlying other portions of the skin, and form a dense net-work, which holds firmly in place the tough hide to which it is attached. (Figure 4.) In the interstices there is the usual loose connective tissue, which is largely occupied by fat cells. Dissecting students are familiar with the toughness of this subcutaneous layer, as also any surgeon who has once attacked a lipoma in this region with the vain hope that it was going to "shell out" easily (*g*). It will be observed that the alveoli formed in the mesh work, although having a comparatively limited communication with the neighboring subcutaneous structures, have a tolerably direct, though narrow, medium of communication with the surface through the fat columns, which chimney like are placed directly above them. These columns are evidently none other than the "holes" alluded to by Dupuytren, who, so far as I am aware, is the only observer who has in any way suspected their existence.

The characteristic features of the carbuncular swelling are its broad, flat, indurated base, the cribriform surface of the skin, and the honey-combed appearance of the subsequent crater. These appearances I have had an opportunity of explaining by the microscopical examination of large sections of skin and subcutaneous tissue removed from the borders of several specimens of carbuncle.

The earliest changes seen at the extreme periphery are scattered collections of wandering cells in the subcutaneous adipose tissue, and as we approach the centre we find clusters of these cells in the *columnæ*

adiposæ. These cells appear to follow some of the numerous natural channels of the tissue in their progress, probably the lymphatics. There is nowhere any well-defined boundary to the inflammatory tissue. As we proceed inwards the cells become more numerous, until the entire subcutaneous tissue is occupied by them; at this point the columns of the skin are already filled at their bases with the round cells, while a few rows of cells extend to the apex. When we come to the point where the columns are entirely filled with cells we begin to observe an infiltration of other portions of the skin, which are reached through the lateral horizontal clefts branching on either side from the columns midway from base to apex. (Figure 2.) In these clefts we usually see a blood-vessel, around which lie the cells in abundance; by finer subdivision of the clefts (*p*) the cells penetrate interstices of the fibrous tissue both upward and downward, until the whole of the deeper portions of the cutis vera is completely infiltrated (*m*). A thin, superficial layer still remains intact.¹ Meanwhile the inflammatory cells, having reached the apex of the column, are brought to a momentary halt, but soon find their way to the superjacent papillæ around the edges of the hair follicles and along the borders of the erector pili muscle. By this time the column has been much distended and elongated, the whole cutis having become swollen. The adipose tissue has entirely disappeared, (*m*) and later also the hair follicle and muscle, all that is left being the hair shaft, which is

¹ In making injections of Prussian blue by pressure from below against the under surface of a portion of normal skin, I found great difficulty in forcing the mass into the upper fourth of the cutis, although the injection ran well below.

now seen projecting and forming a prominent pustule. It is at this point, therefore, that the pus first appears upon the surface. (Figure 2, *h*; Figure 4, *h, m*.)

At this stage of development of the carbuncle the papillæ of the skin covering the tumor present appearances which deserve special attention. (Figure 3.) At those points where cell infiltration is most abundant a change of shape is occasionally noticed, the upper part of the cone becoming greatly distended so that the narrowest portion of the papilla is its base, the cone being converted into a balloon-shaped figure (*l*). A more minute observation shows that papillæ thus affected contain a number of wandering cells, and that the meshes of their loose tissue are distended with fluid; they have the appearance of being œdematous. The adjacent layers of the rete mucosum are greatly compressed by this swelling, and in some instances the interjacent projections of the deep layers of the rete are nearly obliterated, several neighboring papillæ thus becoming united to form a single large one. Usually, however, we find that the number of cell elements in the papillæ gradually increase, until it becomes packed solid with small round cells, which obscure all other structures. The blood-vessels, if seen, are filled with red blood corpuscles, which are also found at times in considerable numbers in other parts of the papilla. At this stage we find that the fundus of the polypoid structure presents itself above the level of the surface, the epidermis forming but a thin layer above, or being represented by a few adherent crusts and scales. The final stage in the development of this series of changes is an actual giving way of the epidermal covering, and an escape of the contents of the papilla. Should the

epidermal covering continue firm the contents of the papilla undergo retrograde changes, and we find, in fact, many containing a shrunken mass of detritus, the anatomical structures of the part having been completely destroyed. In short, we have here an example of the mode of development of the minuter form of pustule which is found scattered in such profusion over the surface of the carbuncle. The cutis beneath these pustules is unusually well supplied with wandering cells, and in specimens treated with picrocarmine we find also most perfect examples of the division of the fixed or the epithelial cells of the connective tissue. (Figure 3, *f*.) Indeed, in no other tissue can the various stages of the inflammatory changes of connective tissue be studied to better advantage. So far as I am aware no such description of the development of certain forms of pustules has ever been given, but the appearances described are too constant and correspond too accurately with the pustules seen on the surface of the specimens examined to admit of other interpretation. In the ordinary acceptation of the term, it may be objected that these collections of pus in the papillæ should be regarded as genuine pustules, as they are not the result of a purely isolated and local process, but are merely the terminal points at which pus makes its escape from the skin through which it has forced its way from below, as in the case of the channels already described. That many so-called pustules in other localities may, however, be formed in this way will be a point for future investigations to determine.

Finally, as the inflammatory process continues, the spaces between the bundles of fibres of the cutis are much

enlarged, and the fibres themselves seem to be partially absorbed; the tissue becomes so brittle that it crumbles readily under the razor. By this time the plug of cells occupying the column has softened to a semi-fluid mass, and is retained in place only by a thin layer of cuticle, which still forms a covering to what has now become a large pustule. (Figure 4, *h, m.*) In the subcutaneous tissue the cell infiltration has spread from one alveolar space to another, while the tendon-like bands of fibrous tissue appear to be but slightly affected (*m*); in fact, the cells do not penetrate them at all, but when the surrounding parts are melted into pus they form the undetached masses of sloughing tissue which hold down at first the integument, and favor spreading in a lateral direction, and at a later stage give to the crater its honey-combed appearance.

In specimens of carbuncle of the lip, sections taken from various portions showed the same tendency to a diffused cell infiltration of the structures.

The papillæ in this case, also, are worthy of notice. Although naturally diverse in shape and size, and crowded between large hair follicles, their alteration by the inflammatory process is evident. In some cases the papillæ are distended by a mass of small, round cells, and where this cell infiltration is most marked we find extensive ecchymoses at the apices of the papillæ, showing that considerable disorganization of the tissue at that point has taken place.

The possibility of other diseased products finding their way from below to the surface through these channels is illustrated in the cases of some morbid growths.

In the light of these observations it seems unavoidable

to abandon the old view that a carbuncular inflammation is one originating or developing itself in a number of adjacent foci, and to conclude that we have a more or less rapidly spreading phlegmonous inflammation of the subcutaneous cellular tissue, we might say a *purulent infiltration*, the characteristic appearances being produced by the anatomical peculiarities of the part affected. In confirmation of this view, attention may be called to the fact that the more distantly removed from the region where the structures described exist in their most highly developed form, the less typical is the appearance of the disease. When seated upon the anterior aspect of the body there is little to remind one of its striking characteristic. On the other hand, when an abscess, that is, a circumscribed collection of pus, forms in the dorsal region, a protective barrier of cells is thrown around the accumulating pus, there is no infiltration of the tissue, and the pus reaches the surface by pressure upon the superjacent integument, which, softened by inflammatory changes, melts slowly away before it. There is in such a case no injection of certain structures with pus, as in carbuncle, and the characteristic appearances of the latter affection fail to show themselves. The cribriform appearance is also not typically developed where the skin is thin and the columns do not exist, as in carbuncle of the lip. The pus then leaks through, so to speak, only at one or more accidentally less-resisting spots, taking as a route one of the lymph spaces of the cutis, and reaching the surface through a papilla.

I have said that the fever accompanying carbuncle was not specific in character. In mild cases it may be absent. In the early stages it may be simply inflam-

matory, but in severe cases from the beginning and in typical cases in the sloughing stage, the fever is septic. Pyæmia and septicæmia occasionally occur.

SARCOMA.

The mode of purulent infiltration of the skin just described was closely imitated in a case of round-cell sarcoma which, arising in the tissue beneath the skin of the back, had begun to involve the superjacent cutis at the time of its removal. A vertical section through the specimen (Figure 7) showed the skin, which was quite thick, to be pierced by several slender parallel columns of sarcoma tissue equidistant from one another, reaching the epidermis at points where the dimples made by the opening of the hair follicles were to be seen. Cross-sections showed these masses of cells to be cylindrical in shape. Under the microscope the hair follicle and sweat gland could be found surrounded by the cell growth, which penetrated the lateral clefts and infiltrated the skin as far as the papillary layer. In those specimens retained for examination this layer had not been invaded by the disease. The cutis was, however, much swollen, presenting on section a very considerable thickness. (Figure 7, *f*.) It was the very striking peculiarities of this specimen which first called my attention to a structure in the skin which had not hitherto been described.

In a case of melanotic sarcoma of the skin of the back situated superficially, a number of sections were made to observe the progress downward of the disease through the thick skin. Although the adipose columns were numerous, the disease had not reached a

sufficient depth to enable me to determine to what extent its further progress might have been modified by these structures. In those directly beneath the tumor a small round-cell infiltration was observed in one or two instances.

NÆVUS.

This growth, usually congenital, originates in the subcutaneous adipose tissue, and works its way to the surface soon after birth. We find the panniculus adiposus much more extensively affected than the upper layers of the skin, particularly in the early stages of development. Where the skin is thin at this tender age the growth has little difficulty in displacing the superjacent parts, so that we see the red coils of blood-vessels "marking" the skin. But on the back the skin is already of considerable thickness (Figure 5). The *columnæ adiposæ*, presenting the points of least resistance, offer a passage for the growth to the surface. This was illustrated in the case of a rapidly spreading nævus excised from the shoulder of an infant. A vertical section through the specimen showed the lobulated vascular tissue occupying the place of the subcutaneous adipose tissue. At the point where the invasion of the skin began (Figure 8), elongated masses of the disease could be observed, even with the naked eye, and easily with a hand lens, to extend nearly to the surface. These prolongations were nearly vertical and parallel (*n*), and a higher power showed that they communicated freely with one another by horizontal coils of the vascular structure until the development of the disease reached a point where the cutis vera could no longer be found. This method of invasion is shown in Figure 8, where that portion of the true skin involved ap-

pears in detached islets surrounded by coils of blood-vessels. The erector pili muscle (*b*) of one of the canals invaded is still seen, but has been unusually elongated. This is probably partly due to the fact that the development of the disease has raised the surface of the skin at this point considerably above its natural level, and has thus put everything upon the stretch; but it is also possible that disease has in this case acted the part of dissector, and has thus demonstrated the fact that the muscle in reality extends further down the side of the adipose column than in an ordinary normal section it appears to. The lobulated character of the vascular tissue peculiar to nævi is given at the bottom of the drawing. No attempt has been made to show the structure of the new growth, as the magnifying power is too low for that purpose.

The great similarity of the routes taken by the different diseased structures to reach the surface as well as that selected by the injection mass indicates a constancy in their presence in the cutis vera. It shows the existence of a richer net-work of channels throughout this dense tissue, containing blood and lymphatic vessels, than would otherwise have been suspected. It proves also that this system has a well-defined anatomical character, which is but slightly modified by age or individual peculiarity.

To what extent certain forms of vesicles or papules, in a cutaneous eruption, conform in their distribution to that of these channels in the skin is a question which invites inquiry.

FIG 1.

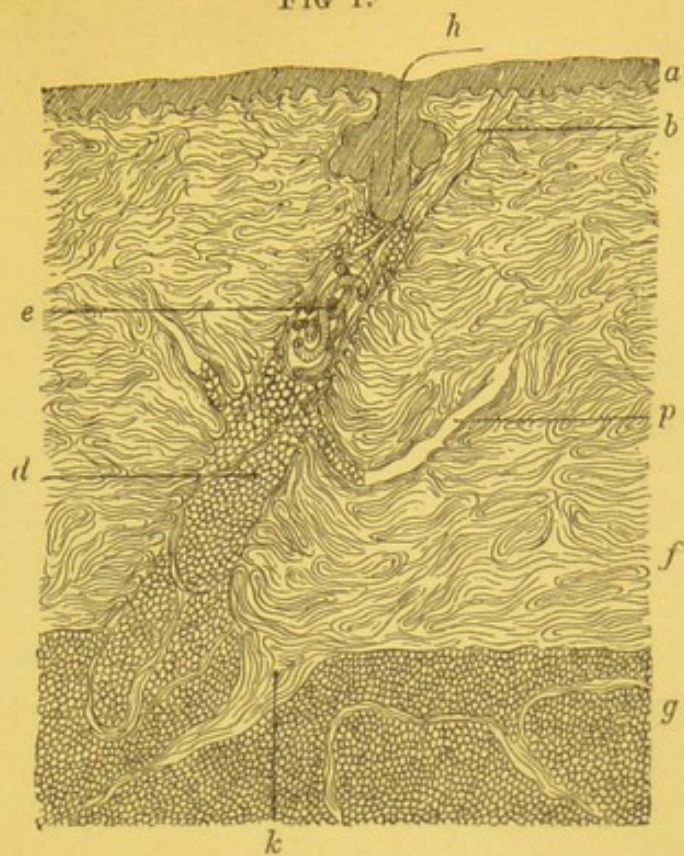


FIG. 2.

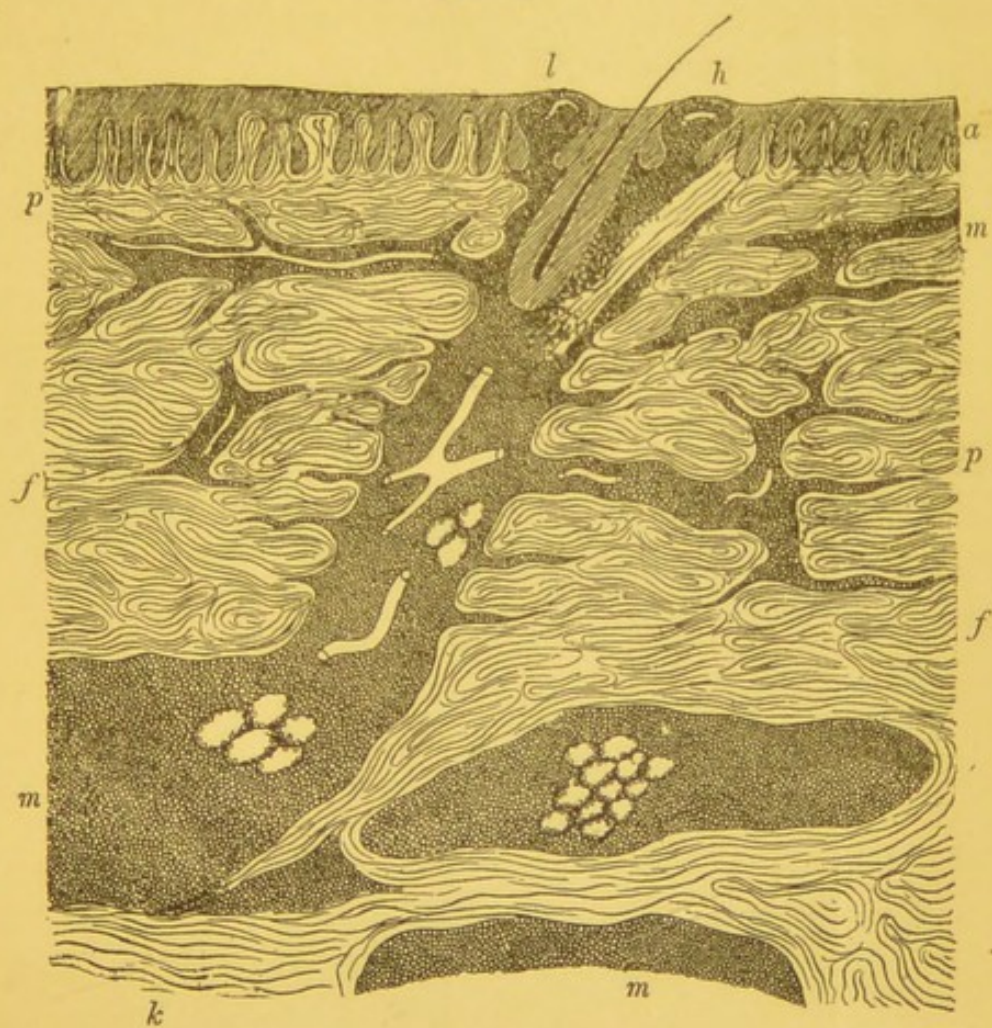




FIG. 3.

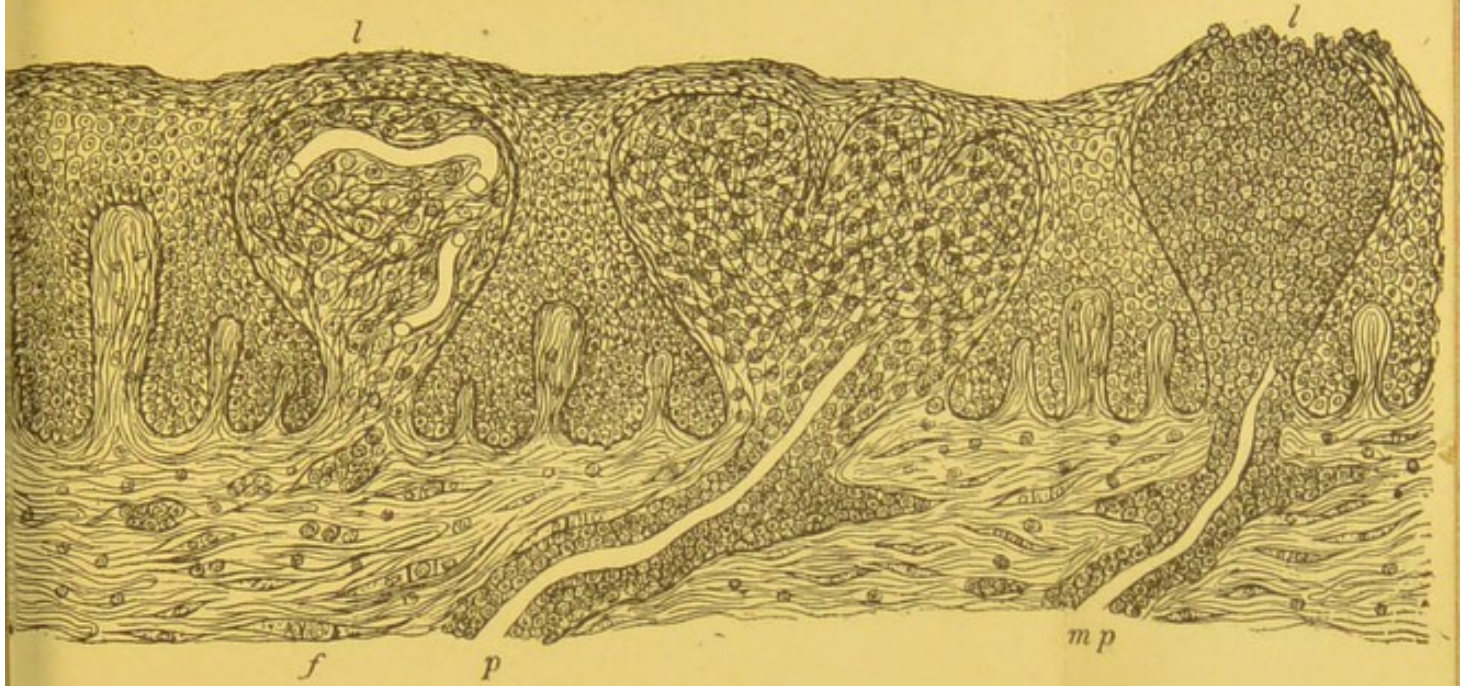


FIG. 4.

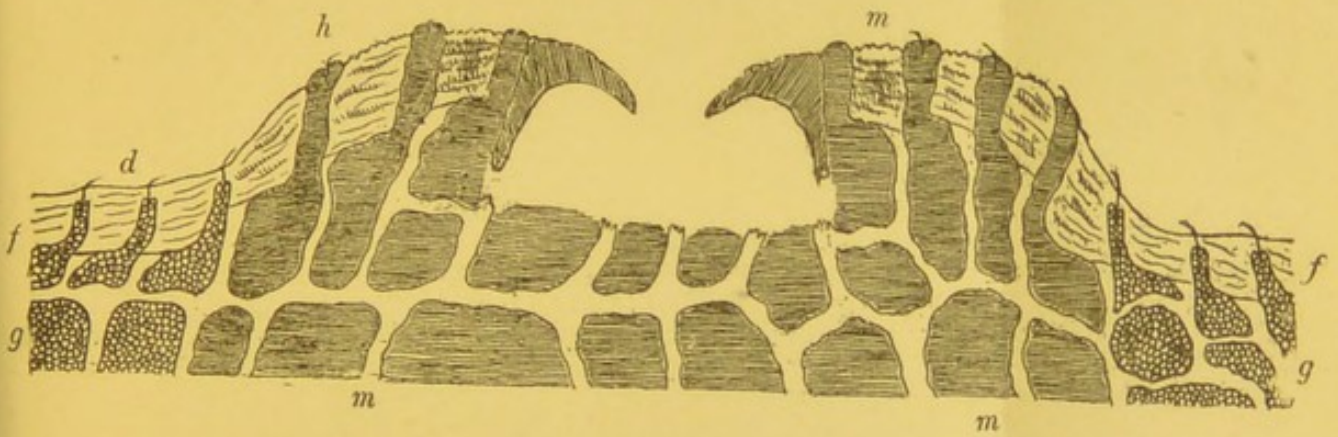




FIG. 5.

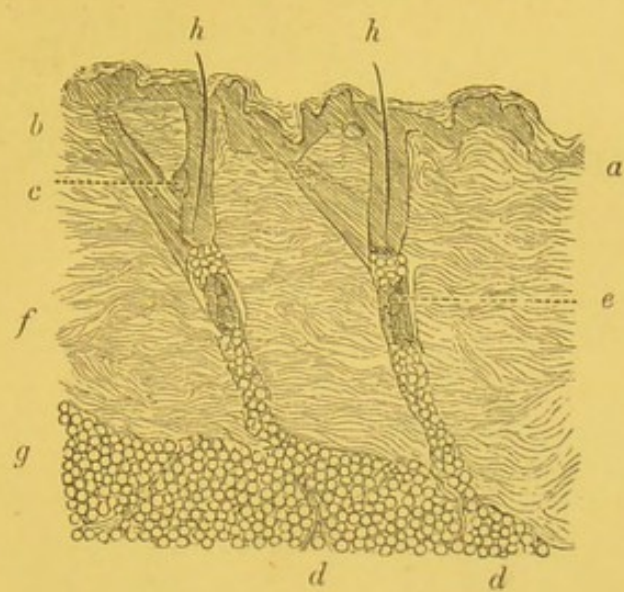


FIG. 6.

