Anatomy, Histology, Physiology and Histopathology of the skin.

A. Rodin

- The skin consists of 3 parts:
- the upper one is called **epidermis**, the proper skin – **dermis** and subcutaneous –**hypodermis**

  the thickness and weight of which is strongly variable.

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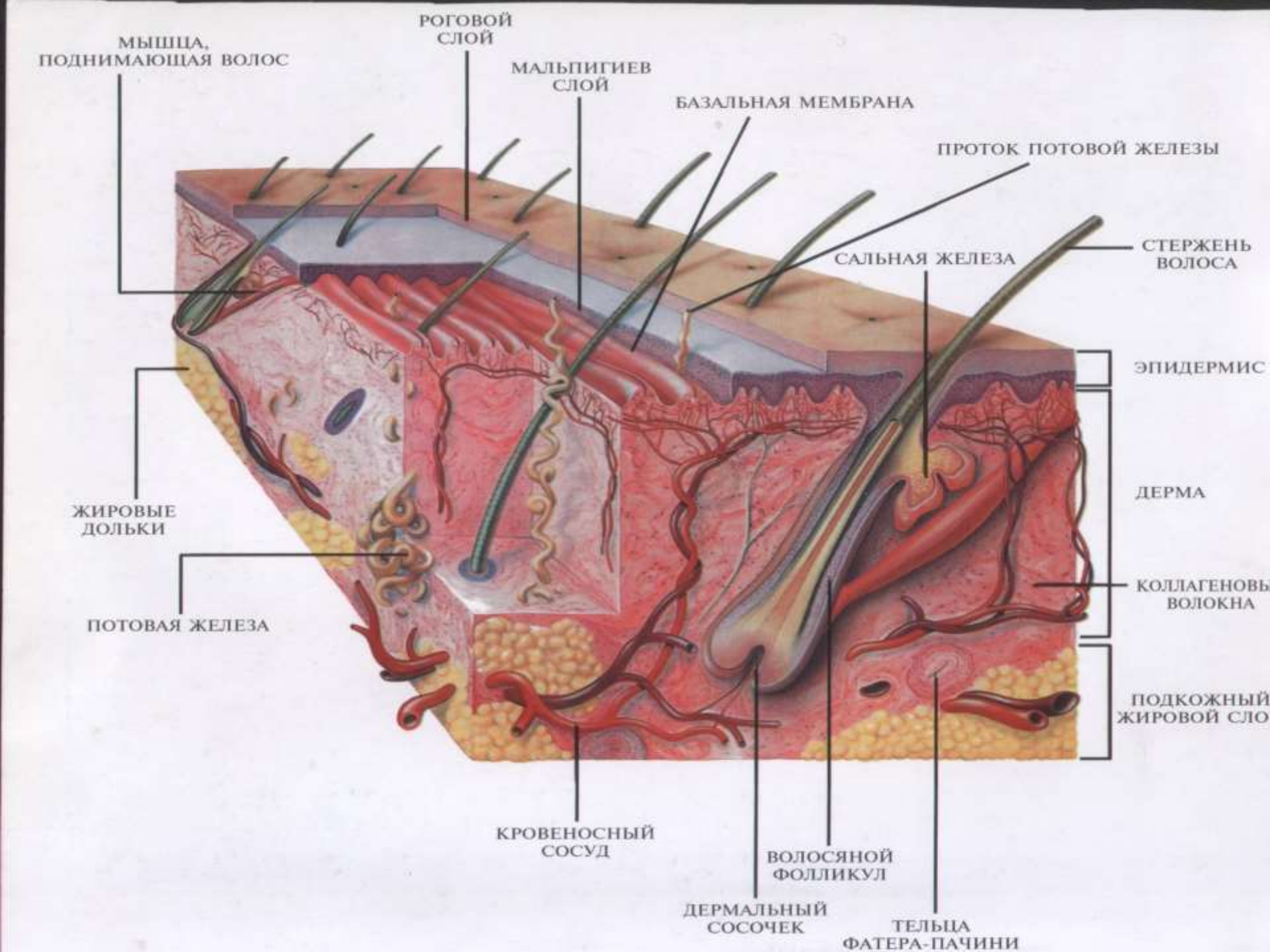
- Epidermis and it’s adventitious develop from ectoderma, a connective tissue of the skin (derma) develops from mesoderma.


МЫШЦА, ПОДНИМАЮЩАЯ ВОЛОС
РОГОВОЙ СЛОЙ
МАЛЬПИГИЕВ СЛОЙ
БАЗАЛЬНАЯ МЕМБРАНА
ПРОТОК ПОТОВОЙ ЖЕЛЕЗЫ
СТЕРЖЕНЬ ВОЛОСА
САЛЬНАЯ ЖЕЛЕЗА
ЭПИДЕРМИС
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КОЛЛАГЕНОВЫ ВОЛОКНА
ПОДКОЖНЫЙ ЖИРОВОЙ СЛО
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ДЕРМАЛЬНЫЙ СОСОЧЕК
ТЕЛЬЦА ФАТЕРА-ПАЧИНИ

EPIDERMIS.

- Consist of 5 layers each of them is different in morphology and function.
- The lower – basal layer (stratum basale) or germinative is located on a basal membrane separating epidermis from derma.
- It consists of 1-2 rows of the cylindrical cells with large nuclei rich in chromatin.

- About 90% of the cells of this row are basal keratinoblasts the aim of which is to be converted into the horn layer keratin as a result of evolution.
- The basal layer consists of the germinative cells which include a great amount of mitoses.

- **PRICKLE-LIKE LAYER (spinous) -(stratum spinozum). Consist of 5-15 rows of polygonal cells having a great number of cytoplasm appendixes along their sides which are interlaced with the same bands of the adjacent cells.**
- **Moving to the surface the prickle-like cells lose their polygonality and become flat.**
- **In this layer one can see mitoses, so both basal and prickle-like layers sometimes conjugate into the “stock” layer.**

- Partially in a basal, but generally in a prickle-like layer there are **gigantic dendric (treelike) cells of Langergans.**

  It is considered that these cells are antigen representing, that is they transmit information about the antigen staff of the irritants of foreign bodies to the lymphocytes to produce the immune response.

- **GRANULAR LAYER (stratum granulosum)** consist of 1-3 rows of spindle like cells. In cytoplasm around the nuclei there is a great amount of keratogealin - a protein substance which change in the process of keratinization.
- The nuclei in the cells gradually disintegrate.

- **SHINING LAYER (stratum lucidum) can be seen only on the palms and soles that is in places of physiological hyperkeratosis.**
- **Continuous process of keratinization of the protein substance cause the sharp changes of the cell, cytoplasm and the nucleus.**

- They form the entire homogenous substance resembling the glass and refracting the light.
- The layer consists of 2-3 rows of non-nuclei transparent cells rich in glicogen, eleidine, fatty acids and lipoids.

- **HORN LAYER (stratum corneum) is the top of the life activity of the whole epidermis without which the life would be impossible.**

  It serves as a barrier between the external and the internal environment.
- **The thickness of the horn layer is 0.02 mm (forearm), up to 0.5 mm on the soles and more.**
- **The cells are fully keratinized (filled with keratin) without nuclei and cellular structures.**

- So, keratinization (that is evolution of the basal cells into a horn scale) represents the most important function of the skin which provides:

1. Desquamation of the dead scales and microorganisms
2. Quick filling of the skin defects during injuries.
3. Mechanical protection and impermeability caused by high density.

- In normal condition transformation of a basal cell into a horn one needs 13 days but the full renovation of epidermis needs 28 days.

DERMA .

- As every connective tissue it consists of 3 compound parts – filamentous structures, basal substance and cellular elements of reticulohistiocytar system.
- It is conditionally divided into 2 layers: papillar and reticular.
- The boarder goes along the imaginary line passing along the lower edge of the epidermal ridges.

FILAMENTOUS STRUCTURES

are represented by collagen, elastic and reticular fibers.

- **Collagen fibers** are represented by the fibrillar threads bands and make 98% of the connective tissue.
- In a reticular layer collagen fibers and bands are thick, rough, situated in a parallel to the skin surface and form reticule (the name of the layer has are gentle), in a papillar layer - thin and are situated chaotically.

- The **elastic fibres** possess rigidity that protects the skin from the excessive distending.

- However in case of overdistending as in pregnancy the elastic fibres can rupture causing **stria**-soft linear focci of a scar atrophy on the lateral surface of the abdomen.

- **Reticular fibers** make the third system of fibers and are displayed by the silver dyeing (the second name argirofile come from this).
- In a healthy skin they develop 2 membranes: external and internal.
- The **external or basal membrane** is located between epidermis and derma, the **internal surface** surrounds the vascular walls, the appendixes of the skin.

THE BASIC SUBSTANCE

agel like mass into which all the components of the connective tissue are immersed. It forms 20% of the body weight and plays a great biological role as the internal media of the body.

It consists of acid and mucopolysaccarides which a very labial complexes constantly polymerizing and depolymerizing.

- Besides, water, albumin, inorganic salts and metabolites make the main component of the substance.

- The function of the main substance are:

1. Water metabolism in the organism. The thicker the main substance the greater it's polymerization is, the more water it keeps. So in case of depolymerization a dilation of vessels take place.
2. Trophic function. The most half of globulin does not participate in a lymph and blood circulation and concentrates in the main substance. So free protein is absorbed by the cells and serves as a material for the cellular proteins synthesis.
3. Cementing function.

- Fibroblasts participate in the synthesis of collastramine (the internal thread of collagen fibre) and probably of the main substance.
- These are little differentiated cells. So, in case of inflammation they transform into histiocytes, macrophages, lymphocytes, plasmating cells playing the main role in the cellular immunological reactions.

- So, the connective tissue cells participate in the immune reactions to eliminate antigen irritant on the place of intrusion

SKIN VASCULAR SYSTEM.

- Arteries, passing through the subcutaneous adipose layer make a **deep vascular network** on the board between it and the derma.
- This vascular layer feeds the sebaceous and sweet glands , hair. From a deep network perpendicularly arise upward thin arterioles which are divided in the papillar layer into the thinnest capillaries. **The superficial vascular network** feeds epidermis which does not have its own vessels.

SKIN INNERVATION.

- In the intracellular canals of the basal and prickle-like layer there are free nonincapsulated nerve endings, perceiving pain (they are also responsible for the development of the feeling of itching).

  The bodies of Merkel-Meisner (25-50 per/cm2), specialized ending accepting a tactile sensitivity (tactile nerves) are located in a papillar layer.

- **Krauze retorts** are located in a subpapillar layer (about 20 on 1cm2) and accept cold.
- **Ruffiny bodies** lay in a reticular layer of the derma (2-5 on 1cm2), they accept warmth.
- **Fatter-Paccini** bodies lay in a subcutaneous adipose cellulose, they accept the feeling of pressure.

SKIN APPENDIXES.

– Sweat and sebaceous glands, hair, nails belong to them.

SWEAT GLANDS. Depending on morphology, the time of the beginning their functioning and their functional specificity eccrine (merocrine) and apocrine sweat glands are distinguished.

- The **eccrine glands** derive from the epidermis and are located everywhere except the red outline of the lips, the internal leaf of the praeputium, small sex lips .

- They are especially numerous on the palm and soles (up to 500/1cm2). Sweat glands discharge water, mineral salts, urinary acid.
- **Apocrine sweat glands** are located in the armpits, in the skin of the sex organs, mammalian glands, at the anus and open into the mouth of follicules.

- Sweat of these glands is rich in volatile fatty acids and compounds giving the sweat its individual smell.
- They start functioning since the period of the sex puberosity and therefore they are accepted as additional sexual glands.
- The sweat glands function is to regulate temperature by way of persperation, excretion of metabolites.

Sweat glands pathology

- 1. Hyperhydrosis
- 2. Anhydrosis (ichtiosis)
- 3. Hydradenitis (staphylodermia)

sebaceous glands.

- They are everywhere except palms and soles.
- The cells of the glandular wall and the excretory dust area continuation of a basal layer of epidermis.
- The excretory dust fall into the upper part of the hair follicle.

- A discharge is a skin fat containing lipid acids, glyserole, soaps, protein, glycogen, phosphorous acid and so on.
- On mixing with the sweat it forms on the skin surface the thinnest water-lipid mantle – a thin film having bactericidal properties as well as softening a rough corn layer and the hair stem.

Cebaceous glands pathology

- 1. Abundance of function – seborrea (acne vulgaris)
- 2. Insufficiency of function (ichtiosis)
- 3. Staphylodermia (folliculitis, furuncule, carbuncule)

HAIR.

- in general a man has 5ml. of hair follicules. In this the hair part of the head contains 1ml. of them.
- They are distinguished as the **long** (the hair part of the head), the **brittle** (eyebrows, lasses, hairs of the ear shells, pubis) and **fluffy** (the surface of the body).

A part of the hair sitting in the skin is called the root, a part above the surface of the skin is called the stem.

- A nipple penetrates into the lower pole of the bulb supplying the hair with blood and nerves.
- The hair grow from a hair matrix, epithelial cells of the bulb, lying in a nipple.

Hair pathology

- 1. Lack of pigment (grey hair)
- 2. Loss (come out) of hair (alopecia)
- 3. Hereditary pathology
- 4. Lesion of fungi (mycosis)

NAIL.

- The nails consists of keratin and grow from the nail matrix located under the nail torsus. The matrix consists of epidermis without the granular layer.
- The full change of the nails on the soles takes about 90-100 days, on the hands it takes 60 days.

Nail pathology

- 1. Hereditary onichodystrophy
- 2. Acquire onichodystrophy (chronic skin disease - psoriasis, eczema and other)
- 3. Lesion of fungi (onichomycosis)

The main functions of the skin

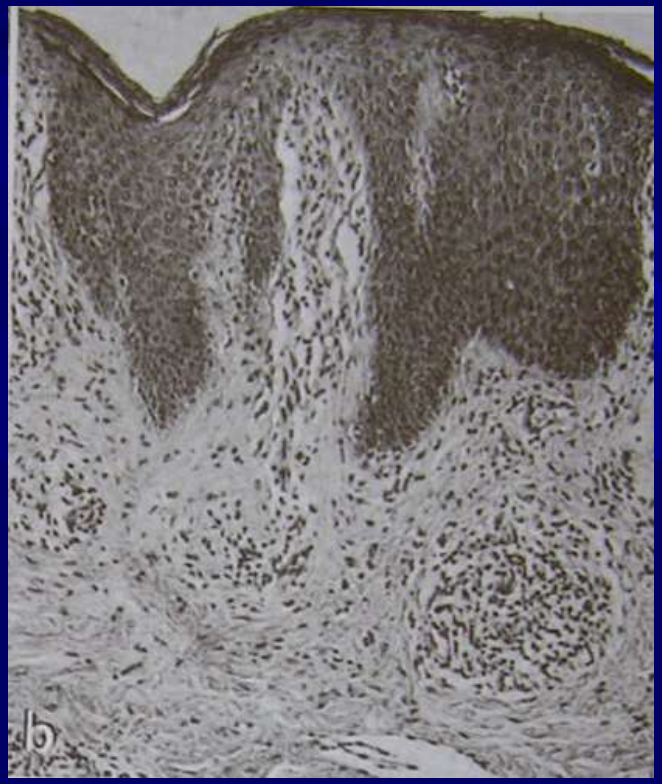
- 1. Protective function (mechanic and immune)
- 2. Exchange
- 3. Respiratory
- 4. Secretory
- 5. Synthetic
- 6. Termoregulation
- 7. Reception

Pathohystological processes

in the skin arising at different dermatozes occur due to definite hystological changes.

In epidermis the following pathomorphological changes are seen:

- **Acanthosis** – means the rising in amount of prickel- like layer cells with prolongation of epidermal ridges and dermal papillae (psoriasis)



- **Hyperkeratosis** is the thickening of the horn layer (avitaminosis of A vitamin, ichthyosis, chronic inflammatory process).

- **Parakeratosis** is not full keratinization. Under the influence of the air nuclei and cytoplasm becomes dry and causes the desquamation (psoriasis, eczema)

- **Hyperelaidosis** is a thickening of the shining layer (ichthyosis).

- **Granullosis** is the enlargement of a number of granular layer rows (lichen ruber planus)

HISTOLOGICAL MECHANISMS OF THE CAVITY ELEMENTS FORMATION

- **spongiosis is an intercellular cell edema of the spinal layer. Serous liquid in case of intercellular cell contacts widens the spaces between the cells, that causes the rupture of desmosome and formation of vesicles with many chambers (dermatitis, eczema).**

- **Vacuole degeneration is an intracellular edema of the basal cells. Vacuoles appear in their cytoplasm which move the nucleus to the periphery, in an extreme condition it is a formation of subepidermal vesicles (lupus erythematosis)**

- **Ballonizing distrofy is a sharply expressed edema of epidermocytes and degradation of intercellular bridges which results in development of a limited acantholysis with the formation of vesicles in which distrophycally changed epidermocytes swim freely (simple and herpes zoster).**

- **Acantolisis** is the loss of connection between the prickle-like cells which results in the chink and intraepidermal blisters appearing (acantolytic pemphigus)

- **Epidermolysis is the rupture of the anchor tonofilaments of the basal cells which results in the formation of subepidermal blisters (herpetiformed dermatosis of During, nonacantholytic pemphigus, toxic epidermonecrolysis of Leill).**

The following pathological processes are distinguished in derma:

- **Granuloma.**

  In chronic proliferative processes the aggravation of cells occurs (lymphatic, macrophages, monocytes and etc.).

  Granuloma may be formed in response to the invasion of different microorganisms (lepra micobacteria, spirocheta pallida, fungi) into the skin.

- **Granulous tissue** is formed in ulcers, wounds as well as in chronic inflammatory processes. It consists of a great number of newly formed collagen fibres and capillaries among which there are lots of fibroblasts.

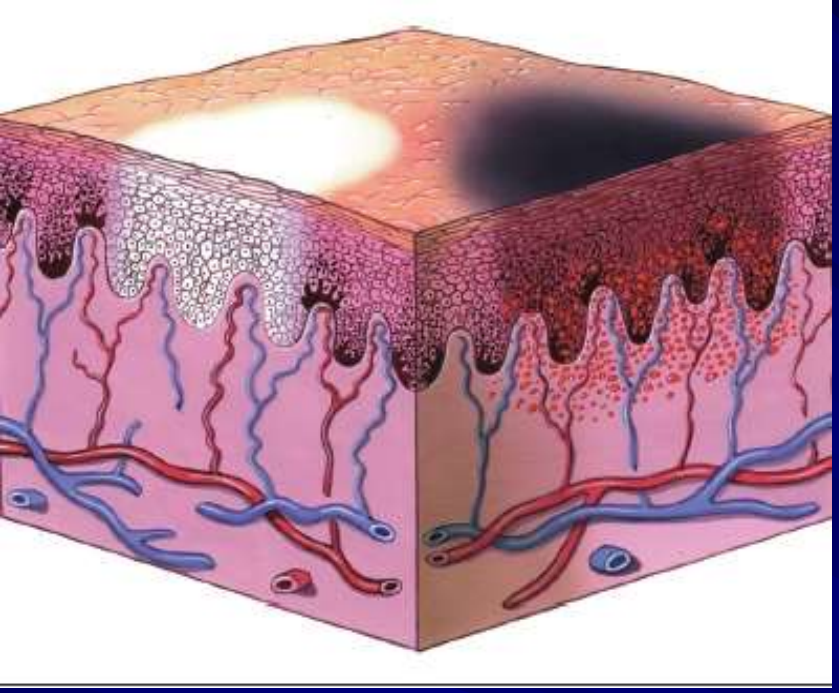
- **Inflammation.** In case of acute inflammation there is an edema, dilatation of vessels, an expressed cell infiltration. In chronic inflammation there is some thickening of epidermis, congestive edema of the derma, infiltration is lesser.

MORPHOLOGICAL ELEMENTS OF ERUPTION.

- **PRIMARY ELEMENTS.**

  Elements of eruption arising first on the unchanged skin.

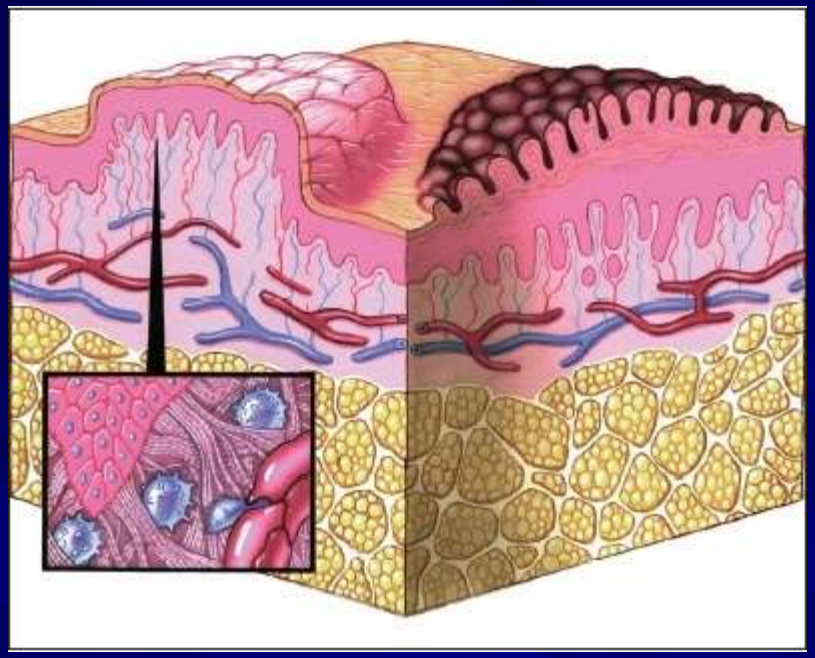
- **Infiltrative-proliferative and exudative elements are distinqished**



Infiltrative-proliferative

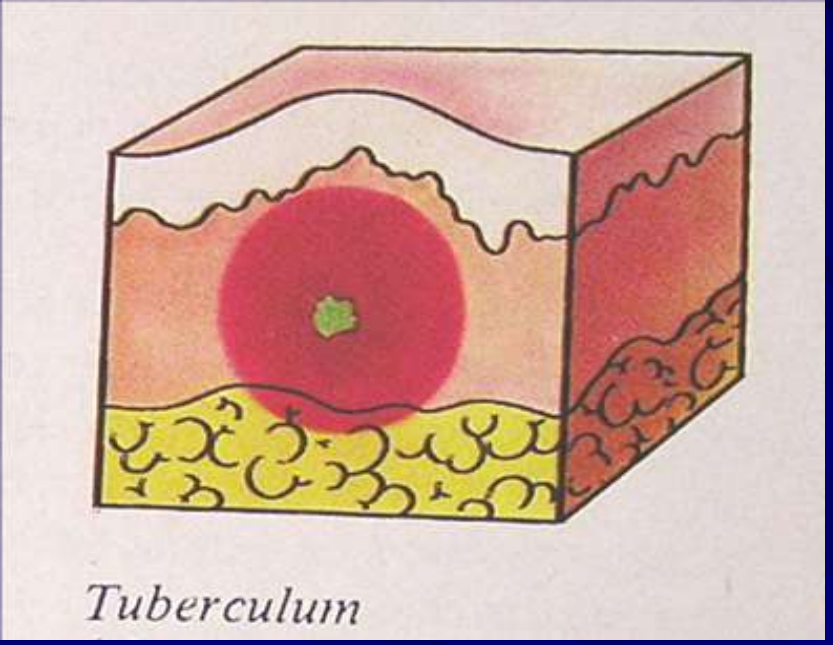
A spot (macula)

A spot is a restricted change of the skin colour due to the deposition (pigment spot-freckles) or absence of pigment (vitiligo, leucoderma etc.) due to the limited vasodilatation of the skin (vascular spots – roseole, erythema, emotional erythema), due to the exit of the forming blood elements beyond the vessels (hemorrhagic spot) , due to the artificial introduction of a pigment (tatu).



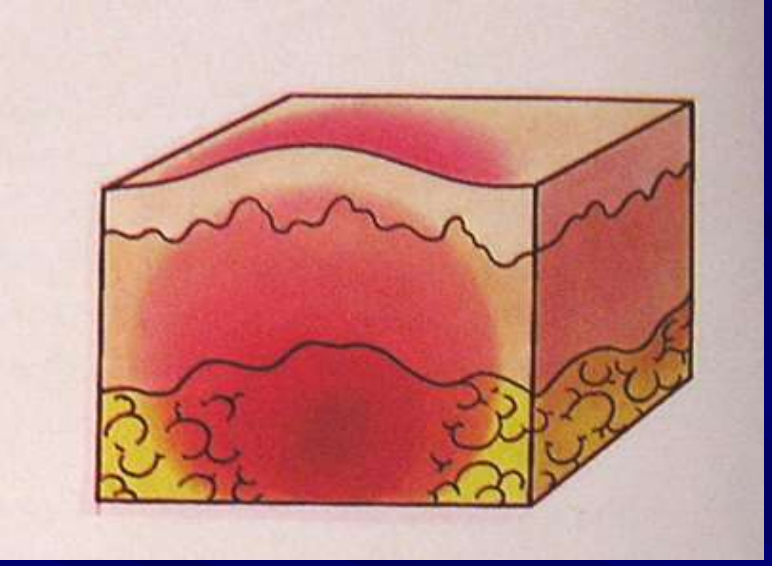
Papule (papula)

Papula is a primery infiltrative-proliferative element (without cavity) lying in the epidermis or between epidermis and derma. Evolution is an absolute or with formation of secondary pigment spot (psoriasis, dermatitis and other)



Tubercle (tuberculum)

Tubercle is a proliferative element (of a pea dimension), lying in a reticular layer of derma.
Evolution is necrotizing with formation of an ulcer and further of a scar or dissolution with formation of a scar atrophy (syphilis, leishmaniosis, lepra, tuberculosis of the skin -lupus vulgaris).

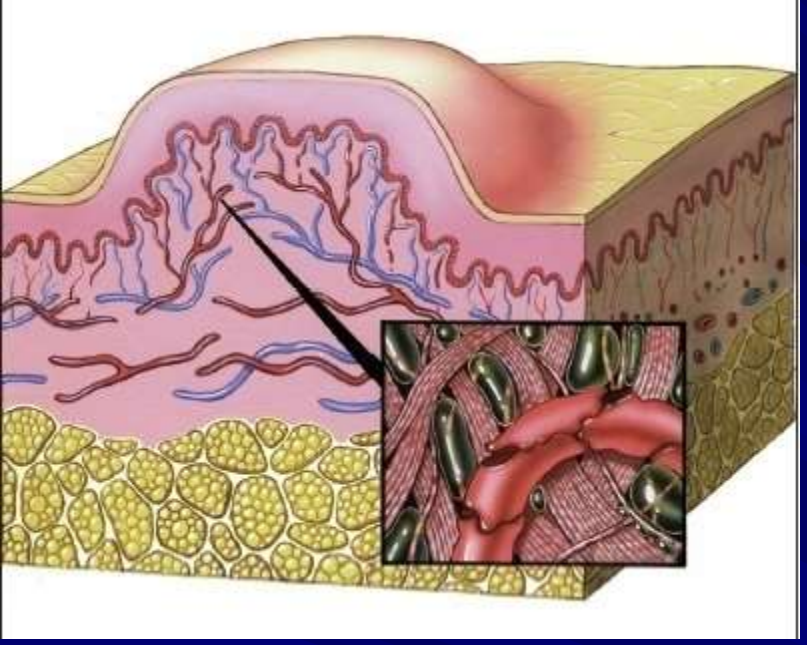


Nodus (nodus)

Nodus is a proliferative element (from a pea size to the size of a fist a even more) lying in a subcutaneus-adipose cellulose.
Evolution is similar to the tubercule (panicullitis, indurative erythema and so on).

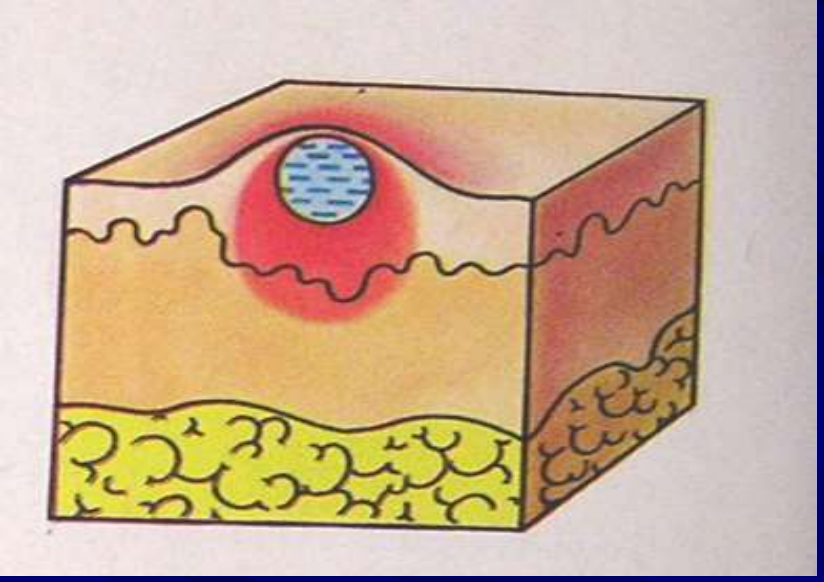
EXUDATIVE PRIMARY MORPHOLOGICAL ELEMENTS.

- Urtica (urtica)
- Vesicle (vesicula)
- Blister (bulla)
- Pustule (pustula)



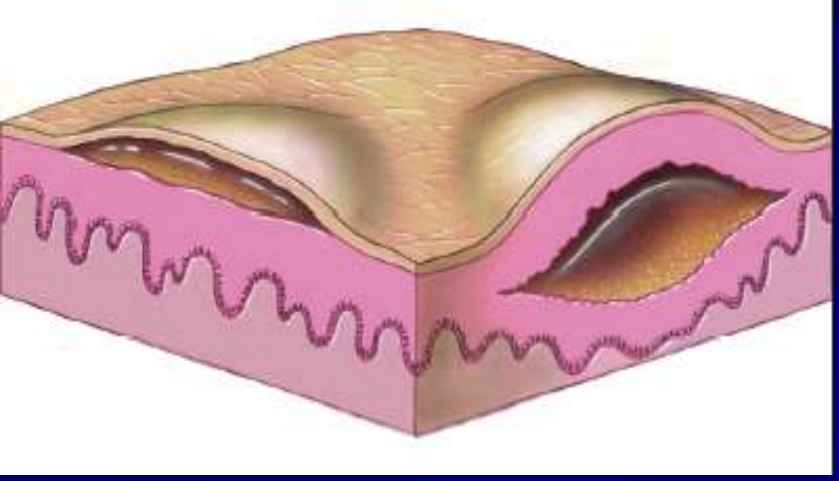
Urtica (urtica)

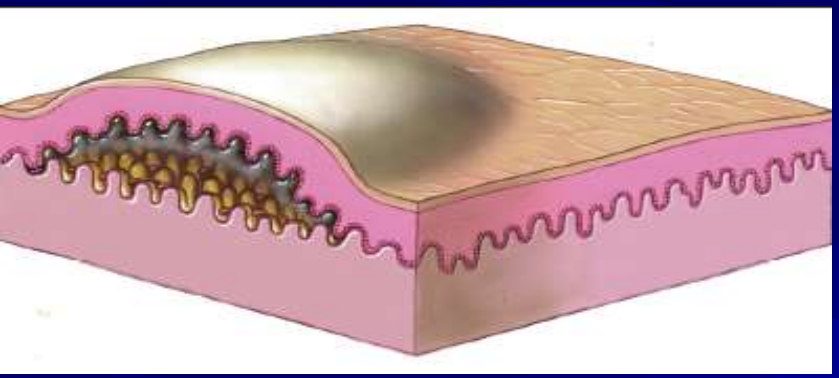
- **Urtica** represents a limited edema of the epidermis and the papilar layer of derma (without cavity): insects bites, hives and etc.
- It’s life span is from some minutes to several days, disappear without traces.



Vesicle (vesicula)

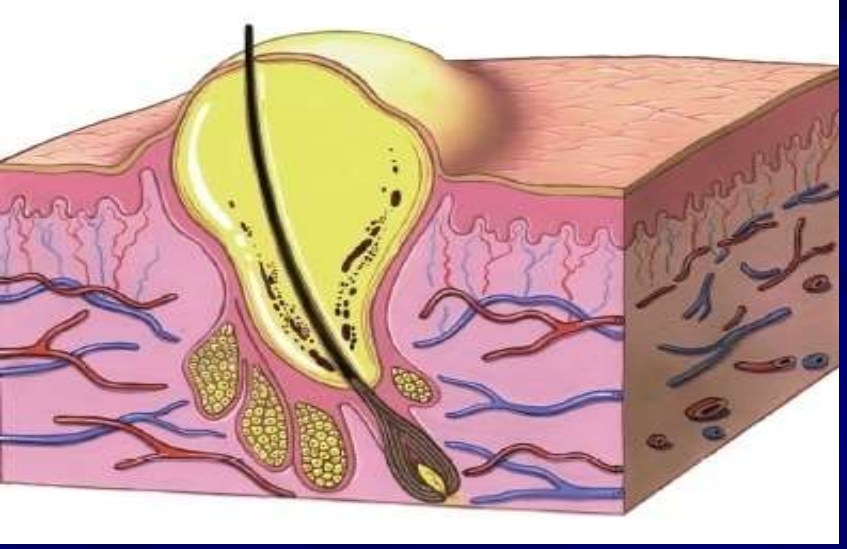
Vesicle is a cavitary element with the size of some millimeters (up to 5) having a covering, a bottom and exudate.
On opening the erosion (dermatites, ezema and so on) is produced.





Blister (bulla)

Blister differs from the vesicle by it's size (from 5 mm up to 10 cm and more) and histological mechanism of formation. It can be seen in pemphigus, During dermatosis and so on.



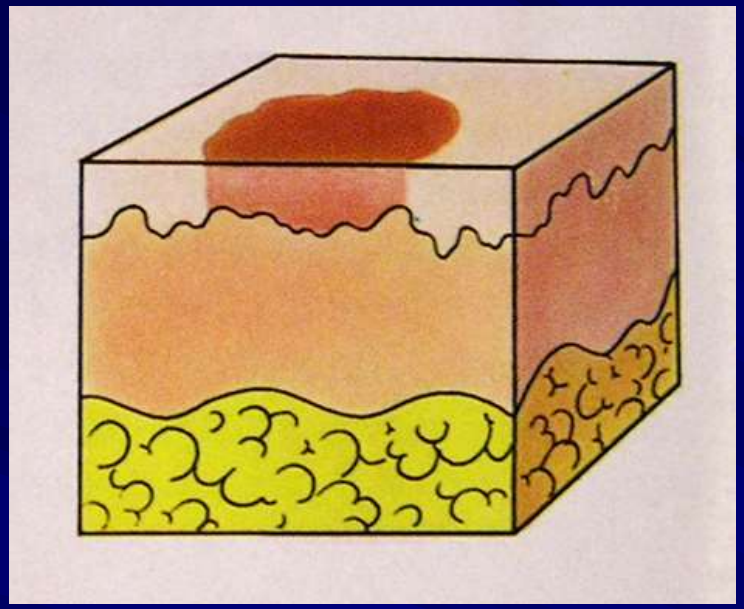
Pustule (pustula)

Pustule is a primary cavitary element with a purulent exudate. It may be superficial (pustule making in a subcorneal layer of the epidermis – streptococci phlyctaena) or deep – follicular (folliculites, furuncles and so on).
The superficial element disappears without traces or with formation of crusts, deep elements – ulser and scar

SECONDARY MORPHOLOGICAL ELEMENTS

Are formed from the primary morphological element during evolution.

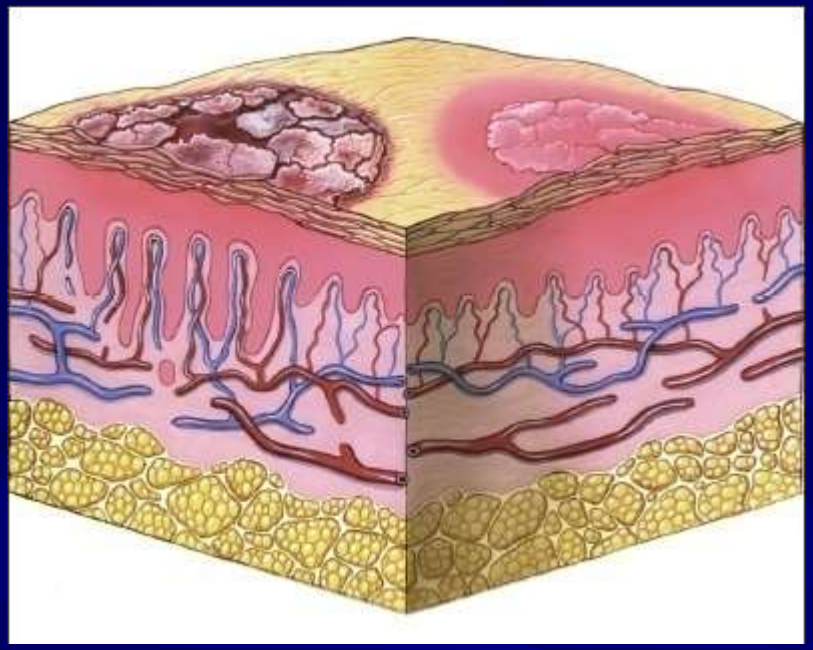
- Secondary pigmental spots
- Scales (squama)
- Ulcer
- Erosion
- Abrasion (excoriation)
- Crack
- Crust
- Scar (cicatrix)
- Lichenification
- Vegetation



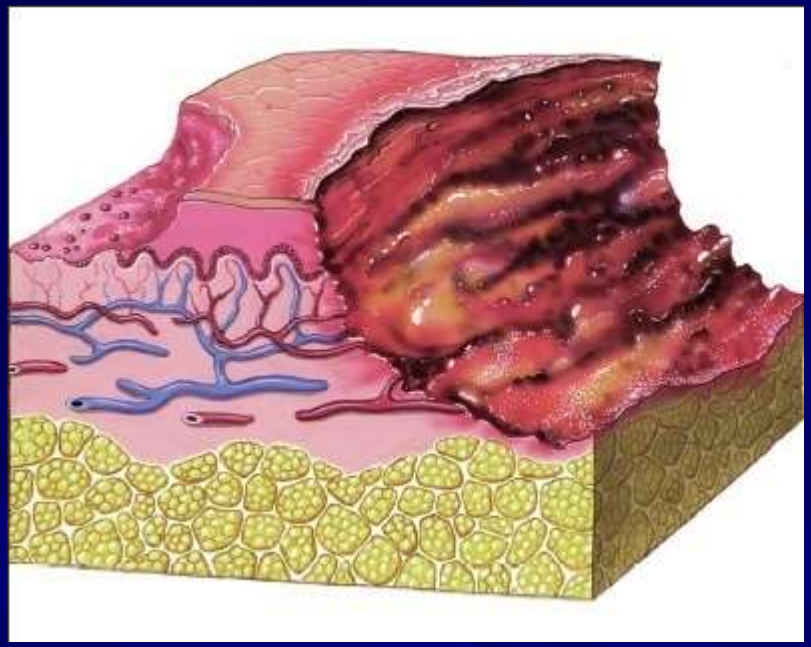
Secondary pigmental spots

The secondary pigmental spots is the outcome of papula, erosions, haemorrhages and etc.

Scales (squama)

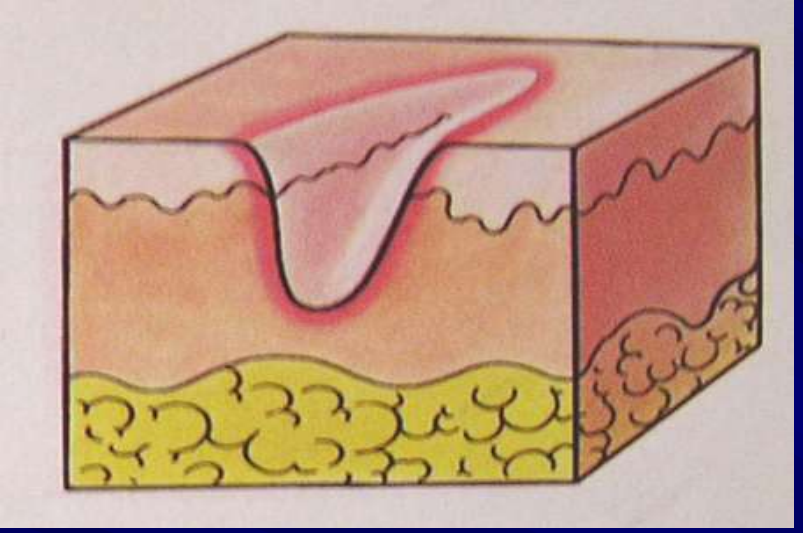


Scales are sticking out of corn plate. The size of it stipulates a definite type of desquamation (psoriasis, atopic dermatitis and other).



Ulcer is a defect of the skin in the area of derma or subcutaneous-adipose cellulose. It is formed as a result of the deep pustule incisions (furuncle, carbuncle, ecthyma and so on) or as a result of deep prolipherative primary elements necrosis (tubercules, nodus) - tertiary syphilis, lepra and so on). The outcome – a scar.

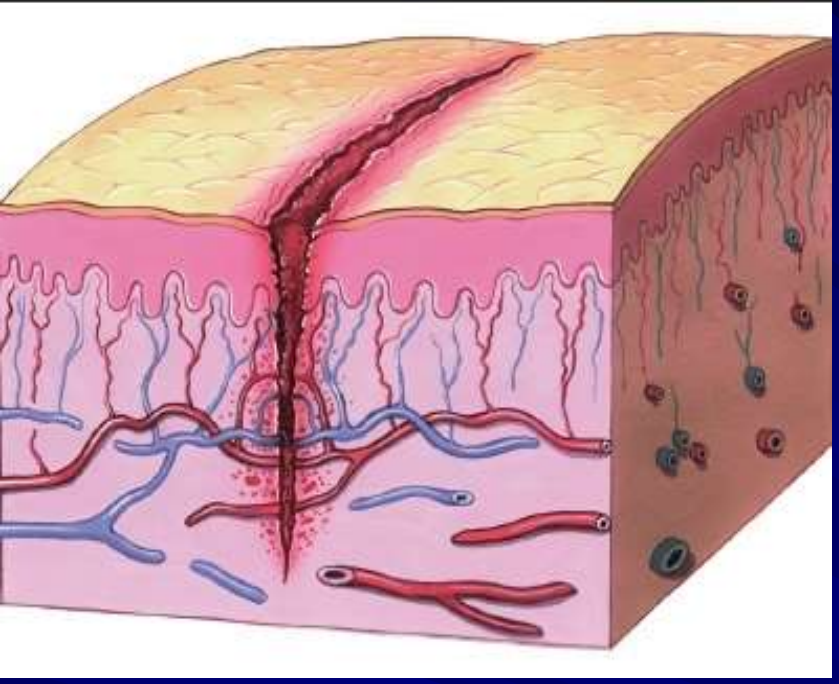
- **Erosion is a skin defect of epidermis arising on the place of cavitary elements (vesicle, blister) or mechanical injury on the background of maceration (moist erosive papules of the secondary syphilis, impetigo etc.). Evolution – traceless disappearance or formation of a temporary secondary pigmental spot.**



Abrasion (excoriation)

Abrasion (excoriation) is a linear defect of the skin due to a mechanical injury, scratches. Depending on the depth of injury the outcome of excoriations may be scars or traceless disappearance.

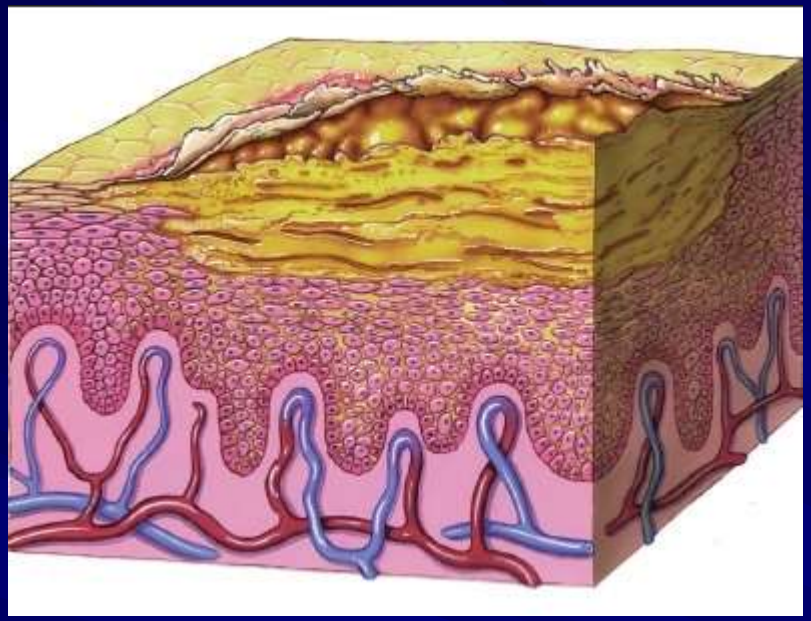
(itching dermatosis: scabies, atopic dermatitis, eczema and other)



Crack

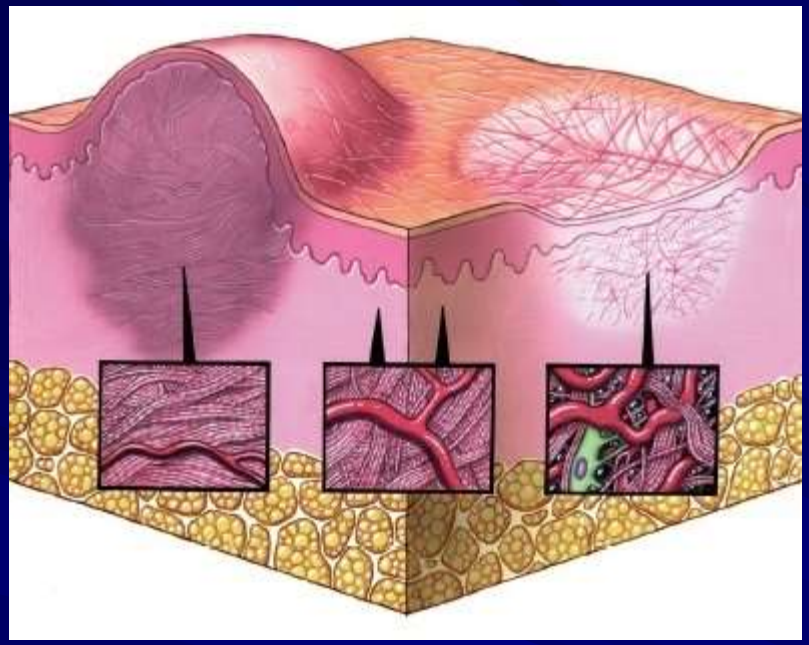
Crack is a linear skin defect formed due to the loss of skin elasticity on the background of dryness (ichthiosis, chronic eczema etc.) or on the background of maceration (soles mycosis, folds candidosis, benign pemphigus and so on).

Crust



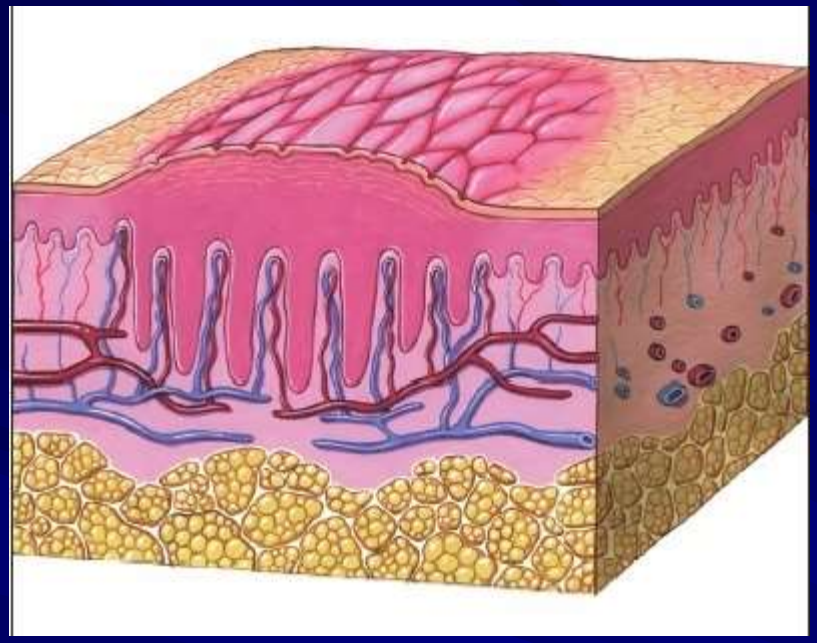
Crust represents a dryed exudate of the cavitary elements or erosive-ulceric defects. In this connection the crusts may be purulent, serous or haemorrhagic.

Scar (cicatrix)



Scar is a newly formed connective tissue acting for a deep skin defect (ulcerative as rule).

Depending on its correlation with the surface of the healthy skin they distinguish **normotrophic scars** (which do not rise above the skin surface), **athrophic** (falling down), **hyperthrophic** (kelloidal – arising).



Lichenification

Lichenification is roughness, thickening of all the skin layers developing due to a prolonged mechanical injury by scratches (atopic dermatitis) or excessive keratinization (ichthiosis and so on).

Vegetation

Vegetation is the epidermis and papillar layer of derma growing (plus tissue) due to the irritation of the erosive areas or in dermatosis of the pemphigus, viral condilomas and so on.