

# RICKETTSIOSES

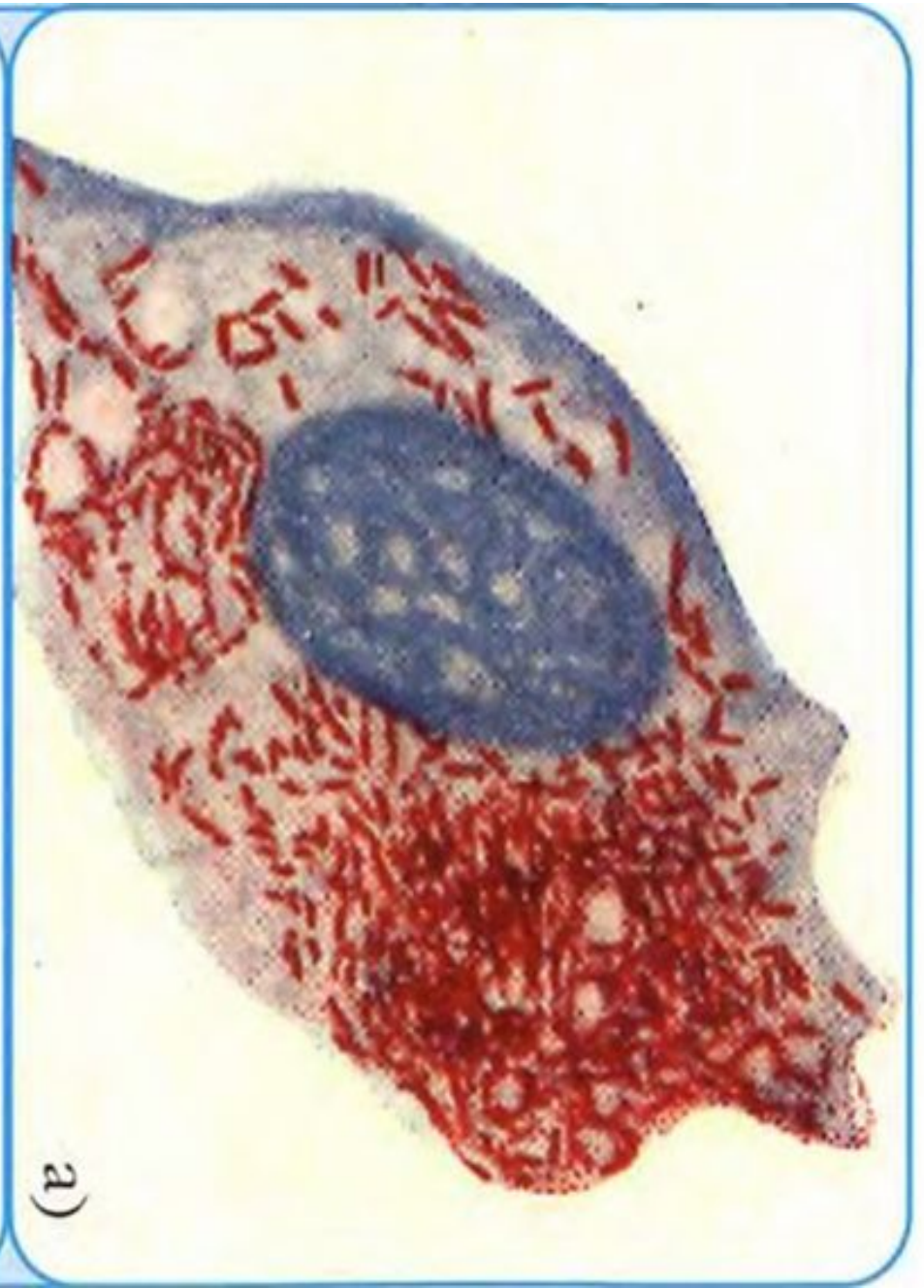
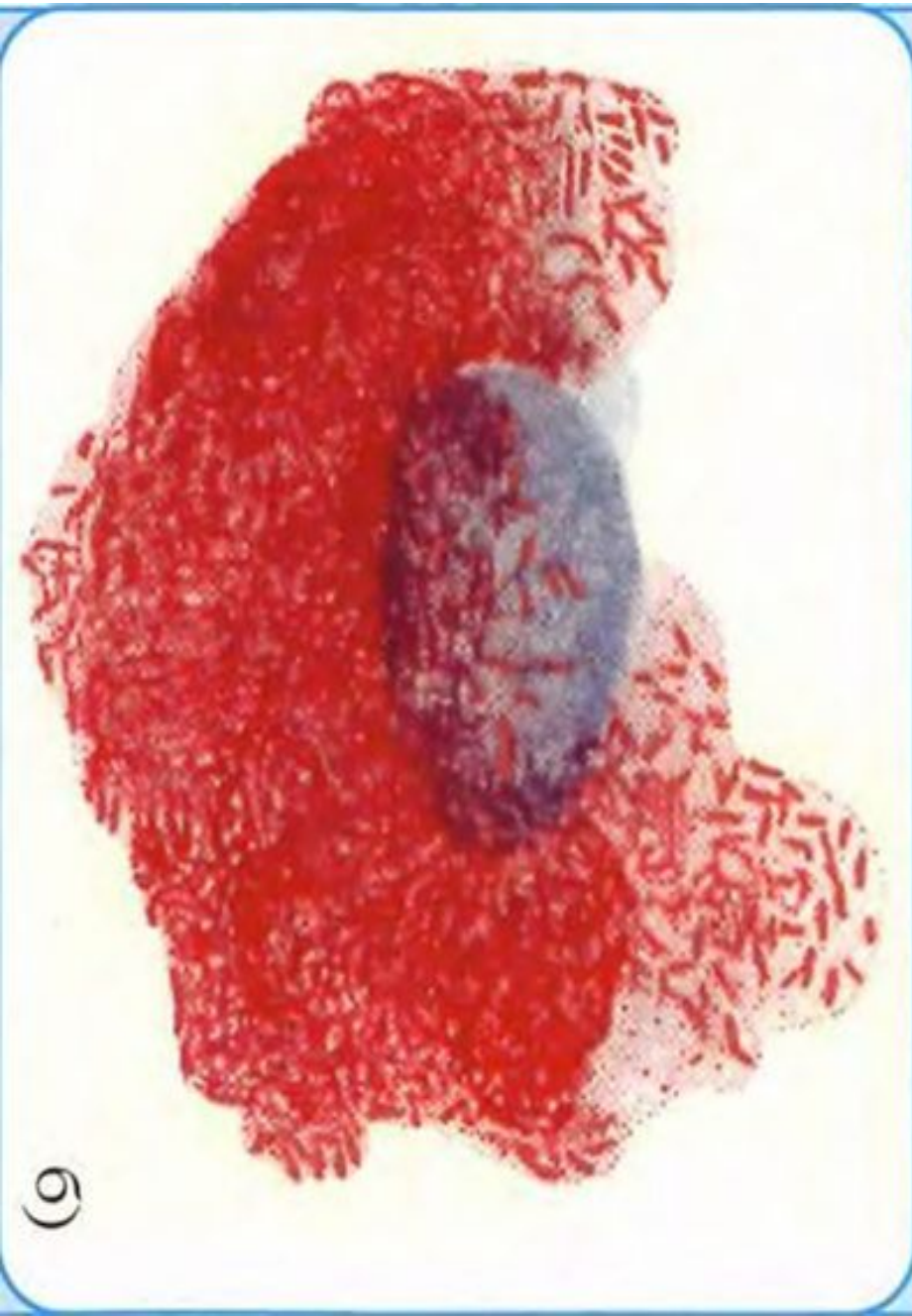
**Identification.** It's the group of **acute transmissible illnesses** of the man caused by the rickettsia and characterized by the **expressed intoxication** and generalized **panvasculitis**, which result is the lesion of the CNS, internal bodies and spotty-papular **exanthema** at majority of them.

**Rickettsia** ( F. Rickettsiaceae.) They were divided on three kinds: **Rickettsia, Coxiella, Rochalimea.**

Rickettsia are Gram **(-)**, rod-shaped, spherical or pleo-morphic organisms smaller than bacteria and have a size from 0.3 – 0.5 up to 3 - 4 microns.

They occupy the intermediate position between viruses and bacteria.

# Cells contain rickettsia as inclusions **Mooser**



## **PROPERTIES RICKETTSIA SIMILAR to BACTERIA:**

- one-type structure of the cells – they have: **core, cytoplasm, membrane, one-type chemical composition, metabolism, set enzymes**
- have simultaneously both **DNA** and **RNA**
- ability to derivate toxic substances
- reproduction by binary division
- sensitivity to antibiotics

## **PROPERTIES RICKETTSIA SIMILAR to VIRUSES:**

- ability to endocellular parasite
- impossibility reproduction on the synthetic mediums
- ability to derivate the filtering forms
- poor colouring by the aniline stains

## **COMMON PROPERTIES of RICKETTSIOSES:**

- transmissible mode of transmission ( via of the lice, fleas, ticks, mites )
- acute cyclic current ( except for the Q-fever)
- endemicity for the majority of them
- community of antigenic structure ( except for **R. tsutsu-gamushi** ), that results in creation of cross immunity and errors at carrying out of immunological reactions

## **Rickettsia in the environment are not enough steady:**

- at warming up to 60 d. C – are survived some minutes
- at boiling - are perished instantly
- formalinum 0.5 %, phenolum 5 %, alcohol and aether - fast inactivate their
- at temperature is lower - **20 d.C** or quick desiccation are survived from 1 to 3 years
- the rickettssia form a toxic substance with properties both **exotoxin** and **endotoxin** wich is extremely unstable and nonseparable from a cell envelope

The rickettsia have **two antigens**:

- the thermostable species **no specific** antigen (the lipo-polysaccharide-protein complex) - has high immunogenic activity
- the thermolabile species **specific** antigen. It is disposed in a cell more deeply thermostable of the antigen
- both the antigens induce formation of antitoxins, precipitins, hemagglutinins, complement-fixation of the antibodies and opsonins

## **COMMON PATHOGENESIS of RICKETTSIOSES**

1. The infiltration into the organism is more often at the sting of the insects and intensive reproduction in endothelia of hypodermic or submucous capillaries from 7 to 10 days (**incubation interval**)

2. The **primary affect** as the infiltrate with scab or without can be shaped in a place of implantation of the rickettsia.

3. A hematogenic dissimulation of the rickettsia from the primary center with lesion of the endothelium of the larger vessels with development vasculitis and perivascular mononuclear infiltrates occur through 7 - 10 days.

Affected cells may contain rickettsia as inclusions **Mooser** (e.g. Epidemic typhus)

4. At repeated dissiminations of the rickettsia, the lesion of vessels become generalized and it shows clinical:

- **enanthera** and spotty-papular **exanthera**
- wide-spread **thrombosis** with both the ischemia and necroses in perivascular tissues in many bodies

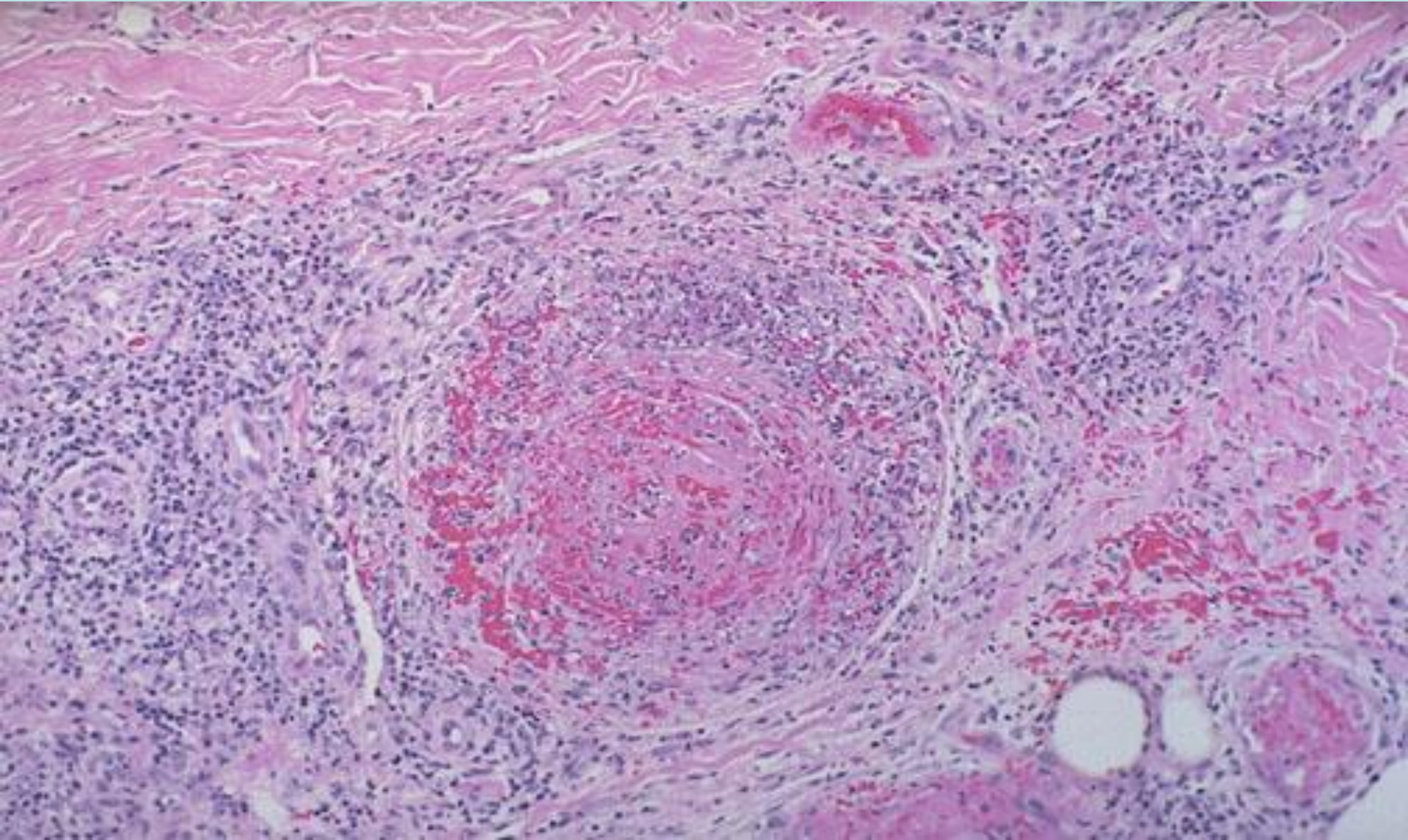


## Vasculitis and edema involving medium-sized artery in the subcutaneous fat





**The vasculitis shown here demonstrates the destruction that can accompany the acute inflammatory process and the interplay with the coagulation mechanism. The arterial wall is undergoing necrosis, and there is thrombus formation in the lumen.**



5. The generalized lesion of the endothelium results to a hyperpermeability of vessels with escaping them of water and electrolytes (appearance of edemas) and erythrocytes (appearance hemorrhage) with development of the hypo-volemic shock in severe cases.
6. The lesion of the endothelium results in activation of the coagulating system of blood with possible outcome in DIC (disseminated intravascular coagulopathy)
7. Main causes of death at rickettsioses - acute heart failure, the lesion a CNS or circulatory disturbance indirect resulting in heart failure, hypovolemic shock, DIC.

# BASIC GROUPS of RICKETTSIOSES:

## Organisms

## Vectors

### 1. Group of a typhus:

- epidemic typhus and illness Brill
- endemic ( murine) typhus

**R. Prowazekii** - Human body louse

**R. Mooseri** Rat flea

### 2. Group of spotty fevers:

- Fever of rocky mountains
- Marseilles fever( African tick typhus)
- North-Asian typhus
- North-Australian typhus
- Varioliform rickettsiosis (Ricketsial pox)

**R. Rickettsii**

Hard tick

**R. Conori**

Hard tick

**R. sibirica**

Hard tick

**R. Australis**

Hard tick

**R. Akari**

Mite

### 3. Group tsutsugamushi (scrub typhus)

**R. Tsutsugamusi** Trombiculid  
larval mite

### 4. Group of the Q-fever - Q-fever

**Coxiella burnetti** Hard tick

### 5. Group paroxysmal of rickettsioses:

- trench fever (volynian fever)

**Rochalimaea**

**quintana** Human body louse

**All rickettsioses are subdivided on 2 groups:**

**Anthroponoses rickettsioses:**

- epidemic typhus.
- trench fever

**Cycle of circulation of the rickettsia:**

**the sick man > human body louse > next the man**

**All other rickettsioses – zoonoses**

**Cycle of circulation of the rickettsia:**

**the sick animal > lice, fleas, ticks > next animal or the man**

## **(Louse- borne typhus, Epidemic typhus)**

### **EPIDEMIOLOGY**

**The source and reservoir – sick man**, who becomes infected before 2- 3 days prior to the beginning of illness + feverish period + 7 - 8 days convalescence)

**The mode of infection** - transmissible through damaged a skin (stings and scratching ) or mucous

**Vector – Lice:** ( **Pediculus vestimenti**) **Human body louse** (main) and (**Pediculus capitis**) **Head louse** (seldom)

Louse infects by a blood of ill. It becomes infected after bloodsucking in 4-5 days secreting rickettsia with feces up to the death ( **through 7 - 12 days**).

Rickettsia get on a skin with feces of lice, and after that at **scratching** will penetrate through bite wounds into an organism of the man.



A - **head louse** ( male)

B- **head louse** (female)

C -nit of the **head louse**

1- egg of the nit

2- cover of the egg

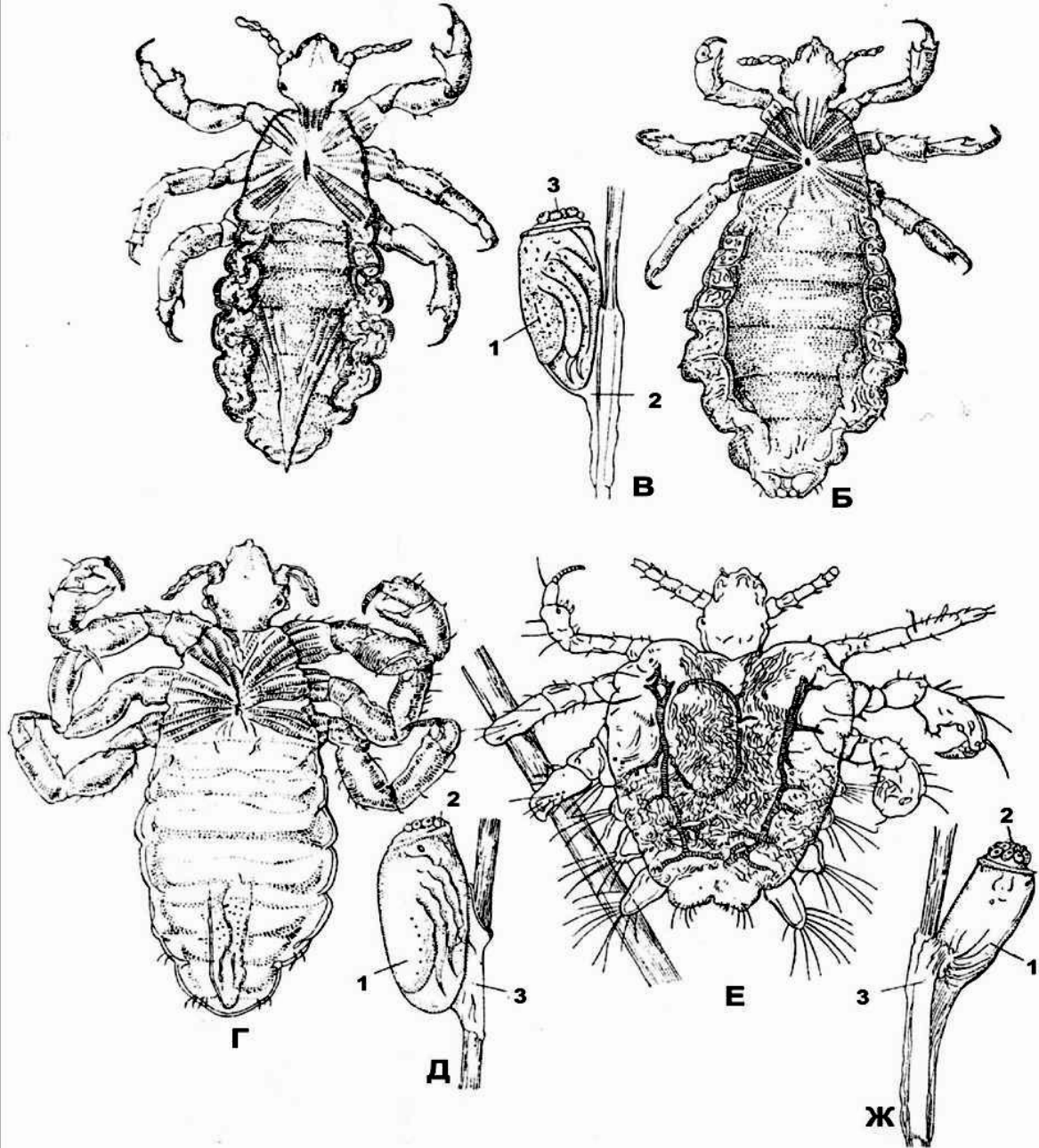
3- sticky substance

D - **body louse** ( male)

E - nit of the **body louse**

F - pubic **louse** ( female)

G - nit of the **pubis louse**



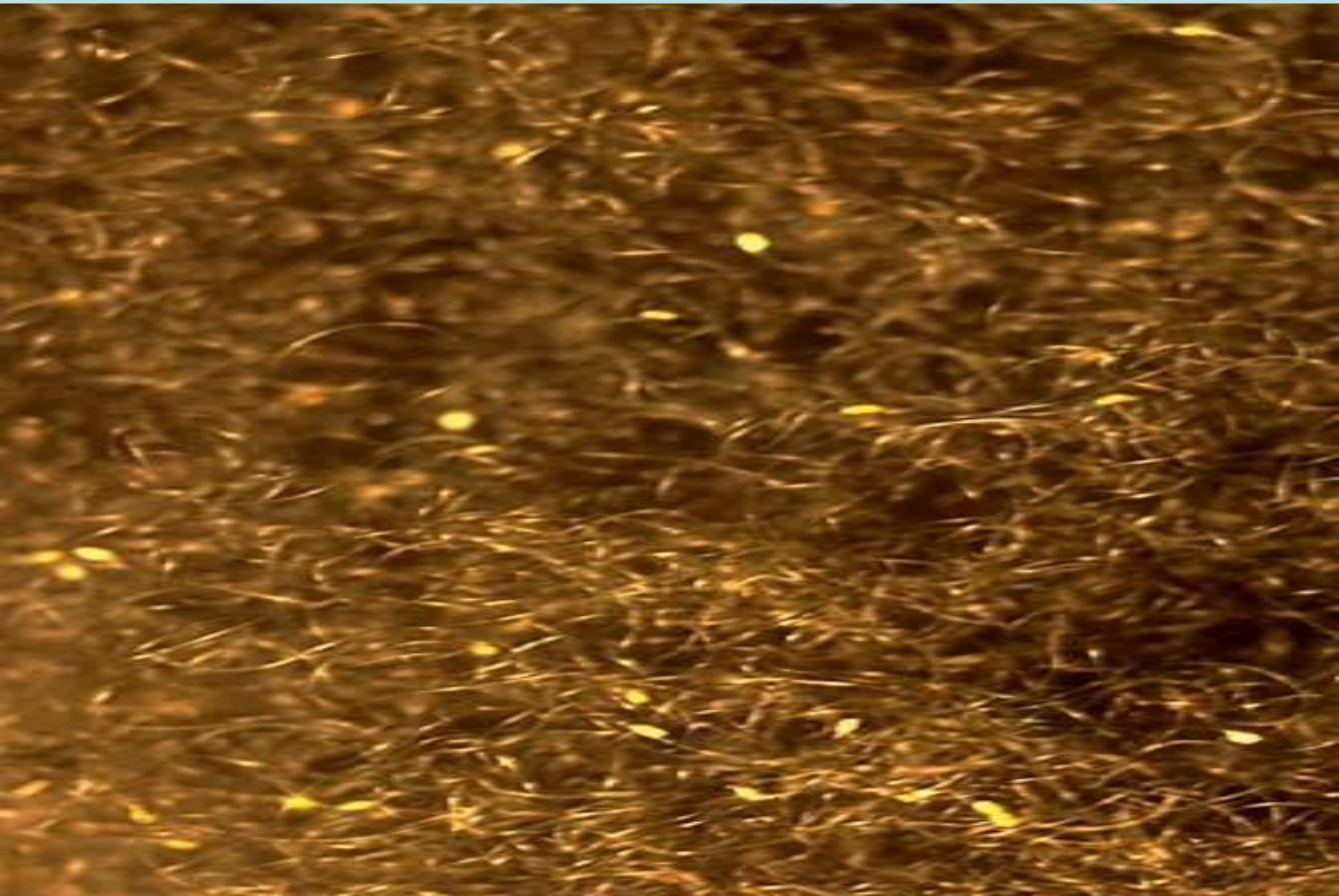
**Вши человека:**

А—головная вошь (самец); Б—головная вошь (самка); В—гнида головной вши;  
Г—платяная вошь (самец); Д—гнида платяной вши; Е—лобковая вошь;  
Ж—гнида лобковой вши; 1—яйцо; 2—крышечка; 3—приклеивающее вещество  
(по Е. Н. Павловскому)





**They are nits of the Human head lice**





The **Human head louse**, *Pediculus humanus capitis*, has an elongated body and narrow anterior mouthparts. **Human body louse** look similar but lay their eggs (nits) on clothing fibers instead of hair fibers.



*P. humanus capitis*  
Dirk M. Ebston M.D.

**Aerborne** mode of transmission is possible - as in dry feces of the lice rickettsia can survive about **1 year!**

**The patient without lice is not dangerous** for contact ,  
though for him in a blood rickettsia are present!

**Susceptibility general !**

The case rate is enlarged in January - March

Has no true endemic of the centers (**as against other rickettsioses**), but more often meets in the countries in the South and North of Africa, central and South America

**Wars and the disasters - rise a case rate**

Outside of epidemics - the sporadic case rate supports for the endemic **illness Brill- Zinsser.**

The mortality in cases, nontreated by antibiotics, makes  
**10 - 60 %!!!**

## CLINIC

Can proceed typically : as **mild**, **middle-severe**, **severe**  
and **fulminant** forms.

But can proceed atypically: as **asymptotically**, **abortical**,  
the **erased** forms

### Periods of illness:

**Incubation** - 12 - 14 days ( **from 6 to 23 days**)

**Initial** (4 - 5 days) - **from a beginning of a fever - up to the exanthema**

**Peak** (4 - 10 days)- **from an exanthema - up to normal temperature**

**Convalescence** - 2 - 3 weeks

### Initial period:

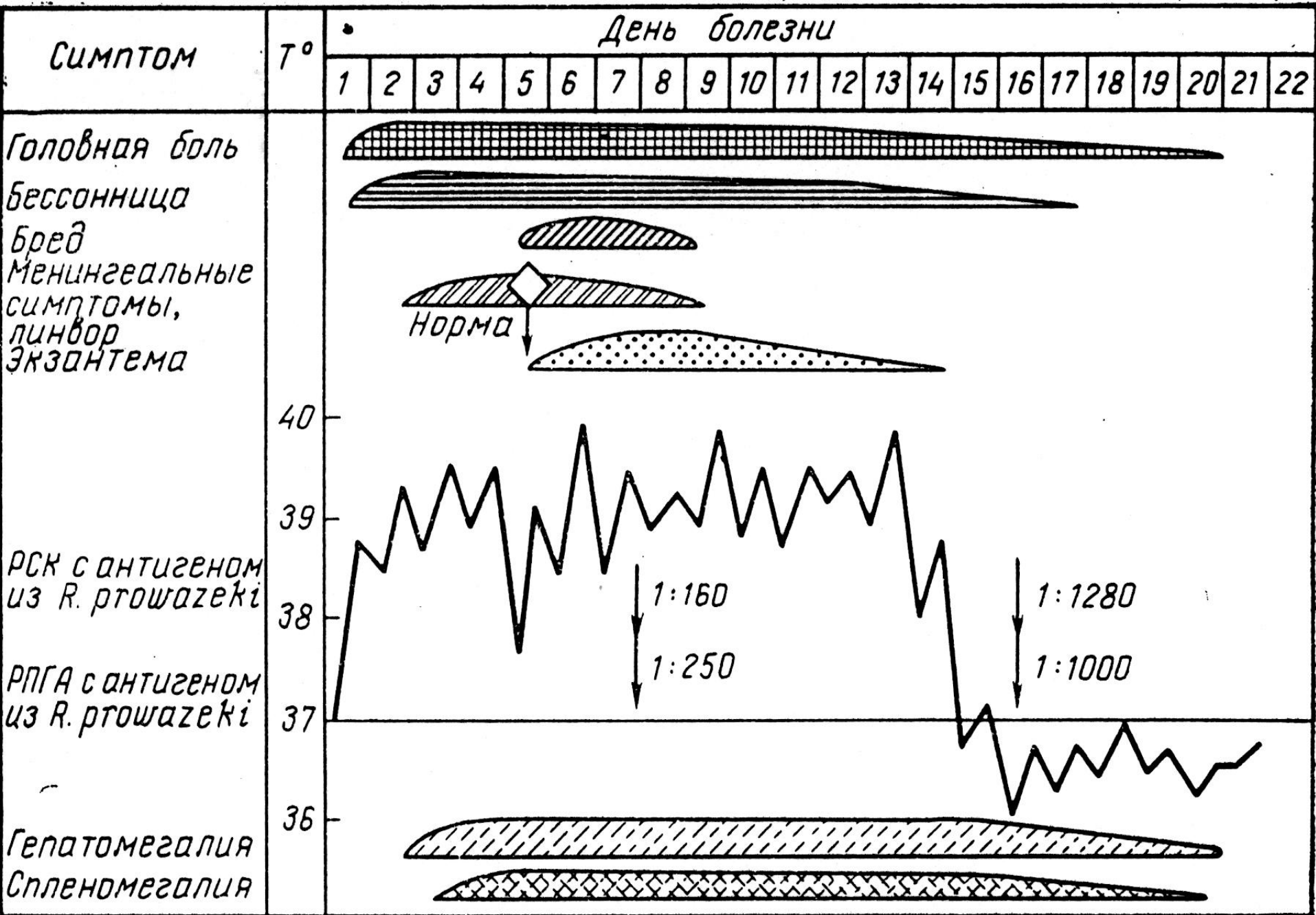
- acute beginning with **fast rise** of the temperature up to 39-40 d.C
- obstinate **headache**, myalgia, arthralgia, **insomnia**

- thirst, anorexia, weakness, giddiness
- common **anxiety**, **euphoria**, irritability, the **verbiage**
- acoustical, visual, tactile **hypersensivite**

### OBJECTIVE:

- the red, edematic face, **scleritis** – s-m **Kjary - Aucyne**
- **enanthema** on a soft palate, tongue – s- m of **Rosenberg**
- raised fragility of capillaries
- tachycardia (more than 130 -140 in minutes - **poor**  
**forecast!!**)
- dull of cardiac sounds, hypotonia
- tongue **dry, impose by white fur**
- the temperature curve has of the **constant type**





Temperature sheet of ill ( **Epidemic typhus** )

## PEAK PERIOD of ILLNESS:

- short-term lowering of temperature ( on some clocks ) for the 4<sup>th</sup> – 5<sup>th</sup> days of illness (appearance of the exanthema) and on the 9<sup>th</sup> – 10<sup>th</sup> day (disappearance of the exanthema)
- appearance plentiful, roseolous or petechial of the exanthema on a skin of a breast, back, abdomen, thighs, arms. Exanthema appearance only once, does not rise above the level of the skin
- intensifying of the headache and intoxication, transition from a stage of excitation in "the typhous status " ( 6 - 8 days of illness) with appearance of hallucinations frightening character and development of a psychosis

- **tachycardia**, arrhythmia, falling B/P (**70/40 mm Hg.**)
- signs of a **meningocephalitis**, s- ms: **Kerniga, Govorov-Godejae**, dysarthria, dysphagia, convulsive seizures - have been revealed. **CSF**- clear, with normal dynamics and chemical constituents Coma and muscular rigidity may occur.

**The lesion peripheral NS** – as neuritises, neuralgia, polyradiculoneurites, plexites with subsequent by violation of the trophicity of the tissues as necroses and ulcers of the skin and the mucous

**The lesion ANS ( autonomic nervous system)** appears by change: **hyperemia** of the face on his **pallor**, **tachy-cardia** on a **bradycardia**, **red** dermographism on **white** etc.

**The lesion of kidneys** - glomerulonephritis, **ischuria paradoxa**, involuntary emiction, oliguria, anuria, azotemia (commonly occurs in the seriously or critically ill patients)

- May be enlarged of the spleen and the liver (since 4-6 days of illness), **but jaundice is unusual**, the hypoproteinemia with reduction in the albumin fraction.
- violation in a liver keratin of exchange (appearance icterus only of the skin of palms and soles - **s-m of Filippovich**)

### **Respiratory tract:**

- rhinites, laryngitises, tracheites, localized pneumonitis.

The fever has of a **constant** type is replaced on **remittent** and since 12- 14 days is reduced **critically** or **lytic**

## **STAGE of CONVALESCENCE:**

- temperature is normalized during 2 - 3 weeks
- the intoxication and signs of the lesion NS disappears
- the liver and lien diminution
- the hypotension and asthenic syndrome is durably saved
- the mental activity is normalized after all

## **Complications** of a louse- born typhus:

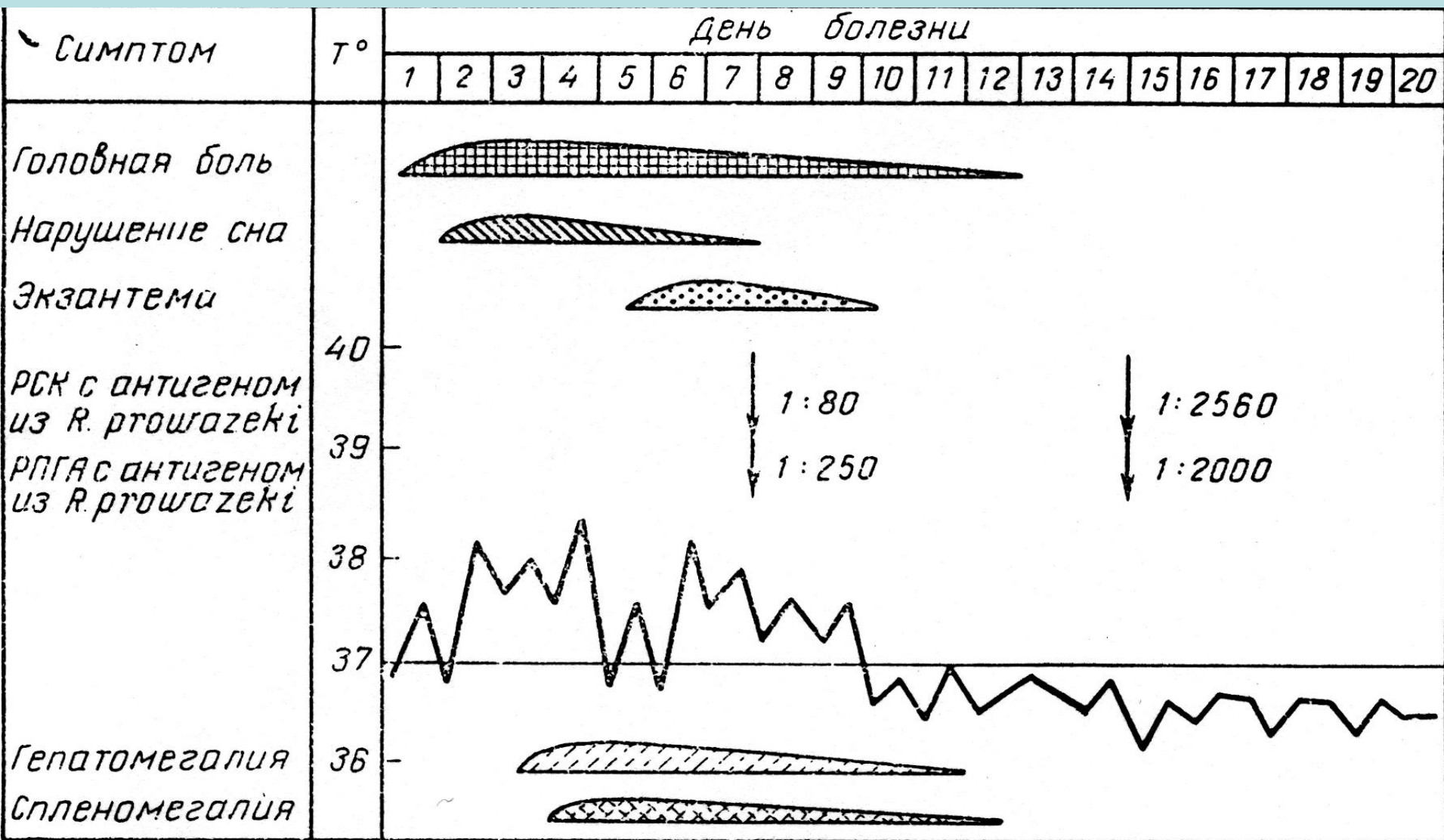
- cardiovascular unsufficiency, myocardites, endocardites, myocardiosclerosis
- tromboses, thromboembolism, thrombophlebites
- pneumonia, otites, mumps, stomatites
- decubitus, gangrene of the extremities, phlegmon hypodermic fats etc.

## ILLNESS Brill- Zinsser (Recurrent typhus fever)

- the **absence** of lice in clothes and hair of ill patient
- **senior** age of the patients, which have **transferred earlier louse-born typhus !!**
- **less** expressed **fever** (in limits 38 - 39 rp. C) and intoxication
- enanthema only for 20 % of the patients
- **scanty** exanthema for 60 - 90 % of the patients
- Increase of a liver and spleen - nonconstant s-m!!
- damage NS corresponds mild or middle severe forms of the louse-born typhus
- Complication - thromboses of surface veins, pneumonia



# Temperature sheet of ill ( **Endemic typhus - ILLNESS Brill** )



Б

Схема температурной кривой и развития основных симптомов у больного эпидемическим сыпным тифом (А) и болезнью Брилла—Цинссера (Б)

## **SPECIFIC DIAGNOSIS:**

- **CFT (+)** with 5 -7 days of illness for **40 - 50 %** of the patients, but over 2-3 weeks of illness for **100 %** diagnostic titer **1:160**  
(**In a titer 1:10 - 1:20 many years can be saved!!**)
- **HAT (+)** with 5-7 days for the majority of the patients, and about 2 weeks for 100 % (diagnostic titer **1:40 - 1:80**)
- **PHAT(+)** with 3 - 4 days of illness (diagnostic titer **1:1000 1:2000**)
- **IFA** - at a louse-born typhus at once occur in a blood **IgM**, and at Brill in a blood it are found out **IgG and IgM**, and the titer **CFT** raises up to considerable values (**1: 10240**)
- **Weil-Felix reaction** with an antigene **Proteus OX-19**, but it occurs only since the second week, gives a decussation of response with other rickettsioses.

## DIFFERENTIAL DIAGNOSIS:

**In initial period** - influenza and ARVD, pneumonia, meningococcal infection, hemorrhagic fevers

**In peak of disease** - other typhoids and rickettsioses, measles, ornithosis, mononucleosis, sepsis, trichinosis, canicola fever, a phlebotomus fever, medicinal illness, lues

## TREATMENT:

**Hospitalization after a disinfection** (**except for Brill**)

**Diet, bed rest regimen, maintenance behind a skin and mucous**

**Anti-infectious therapy- the primary drugs:**

tetracyclini	5 - 8 mg/kg	PO in q6h
doxycyclini	1,5 mg/kg	PO in q12h
metacyclini	4 - 8 mg/kg	PO in q12h
oletetrini	5 – 8 mg/kg	PO in q4h

The **alternative drugs** –laevomycetin, erythromycin, ciprofloxacin, rifampicin but they are less effective!!

**Duration of treatment** - all period of a fever + 2 - 3 days!

- Desintoxication
- Antiferment drugs
- Anticoagulants
- Antioxidants
- Glucocorticoids
- Cardiac glycosides, antipyretics
- Sedative etc.

### **PROPHYLAXIS:**

- Isolation both disinfestation of the patient and his clothes
- Overseeing by the center 71 days (at Brill 25 days)
- Revealing and hospitalization in the center all patients with the fever by duration more than 5 days
- Vaccination under the special indications (dry « chemical» a vaccine in a dose 0,5 mls)

# THE MARSEILLES FEVER

( Mediterranean fever, African tick typhus, spotty fever ) :

Acute transmissible disease with good-quality current appearing by a **primary dermal affect**, by regional the lymphadenitis and **by the maculopapular eruption**

The infectious agent - **R. conori**

Carrier and source – dog tick (**Rhipicephalus sanguineus**) with transphase and transovarial transmission of the infectious agent

The mechanism of infection - sting tick or rubbing in of its hemolymph through broken of a skin or mucosas

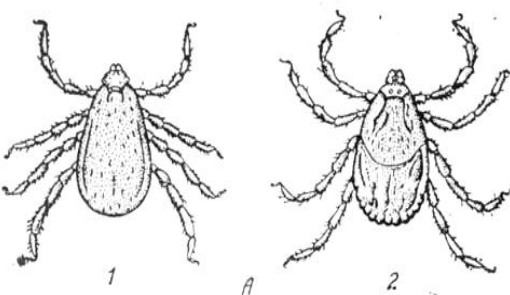
**Season uprise** - May - October

**Susceptibility** - general, more often meets in seaside cities of the Black and Mediterranean seas

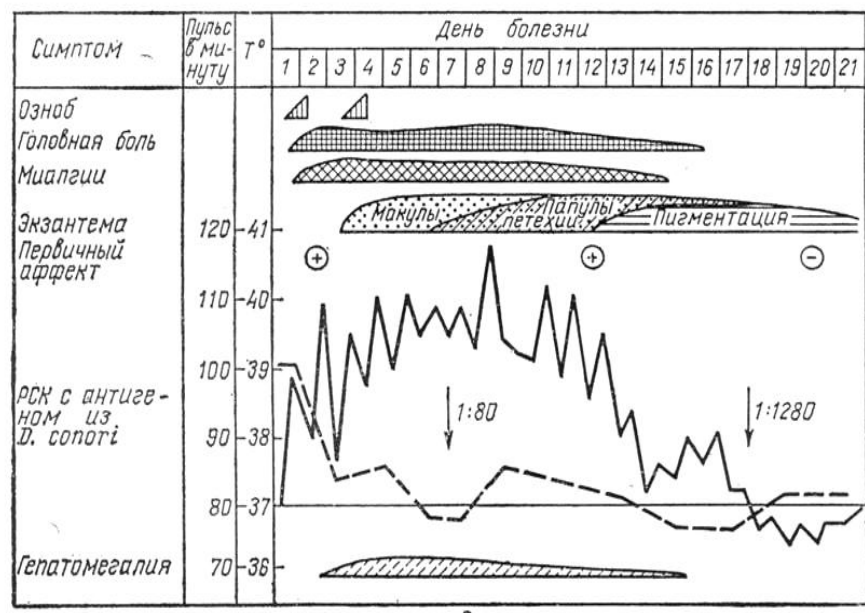
## **Clinic**

- incubation interval 3 - 7 days
- Acute beginning with chill and fever 38 - 39 d.C
- Strong headache, but meningocephalitis and the typhous status does not develop
- Arthralgia and myalgia, insomnia, weakness
- **Appearance of a primary affect** from 3 to 10 mm with necrosis and crust in a place of a sting tick, ( **but without subjective sensations** )- prior to a fever 5-7 days!!!
- **regional lymphadenitis** and **maculopapular eruption** on to all body and palms and soles with 2 - 4 days for **100 %** the patients!!!





Марсельская лихорадка.  
 А — *Rhipicephalus sanguineus*: самец (1) и самка (2) (по Б. И. Померанцеву и М. В. Поспеловой-Штром); Б — локализация сыпи на коже больного: под лопаткой справа виден первичный аффект (по К. В. Бунину); В — схема температурной кривой и развития основных симптомов у больного марсельской лихорадкой.





- Increase of a liver and spleen
  - Extension of boundaries of heart, dull of its tones, bradycardia
  - Leukopenia, lymphomonocytosis, rise moderate ESR
- Complications** - thrombophlebitis, bronchitis, bronchopneumonias is (rare)

**Laboratory diagnosis** –CFT with 5 - 7 days of illness in titer (1:46 - 1:60) or PHAT in titer (1:800 - 1:3200)

**Treatment** - as at the mild forms of a louse-borne typhus

**Prophylaxis** – antitick processing of dogs

- disinfestation in the centers and microcenters (box dog)
- isolation of vagrant dogs
- preventing an attack ticks on the people!!!

## **FEVER Q (Q- fever)**

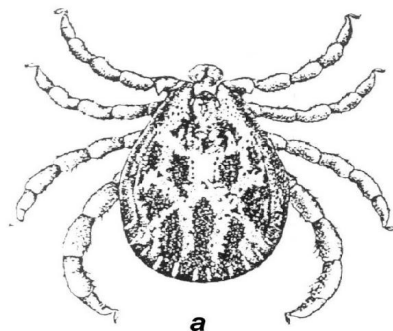
Zoonotic rickettsiosis with acute good-quality current, fever, intoxication and polymorphism of clinical manifestations.

**The infectious agent** - *Coxiella burnetii* - is well saved in the external environment: at 4 (+) d.C survives about one year, in meat - more than month, **warming up to 90 °C maintain about one hour**, but at boiling perishes in 10 minutes.

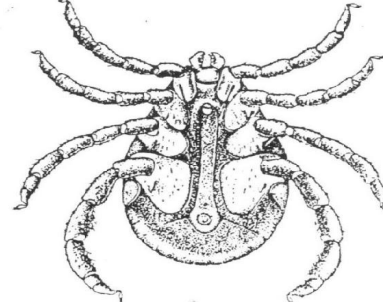
**The source** - numerous animals and birds, infected which reaches from 10 up to 33 %!!

**Ways of transmission** - aerogenic, contact, nutritional and transmissible (**70 sorts of ticks** )

**The infectious agent** circulates in natural and urban the centers



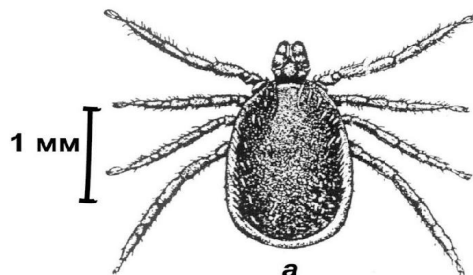
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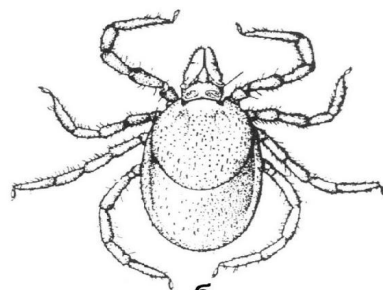
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***Dermacentor pictus*, самец:**

а- вид со спинной стороны; б- вид с брюшной стороны (по Б. И. Померанцеву)



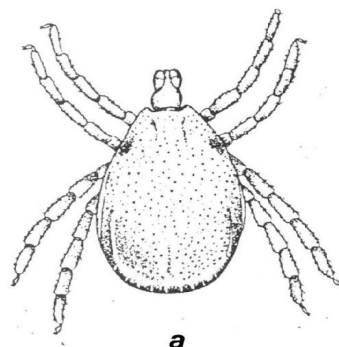
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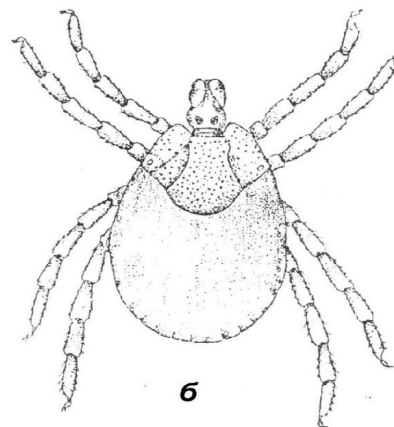
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***Ixodes ricinus*:**

а- самец, б- самка (по Б. И. Померанцеву)



а



б

***Hyalomma plumbeum*. Вид со спинной стороны:**

а- самец, б- самка (по Г. С. Первомайскому)



**Ixodes ricinus**



**Susceptibility general**, but a cattle-breeders are sick in spring-year's period ( lambing, superactivity ticks) more

**Incubation interval** 12 - 19 days (3 - 32 days)

**The clinical forms of disease:**

- **Acute** for 75 - 80 % of the patients, (duration 2 - 3 weeks),
- **Subacute** for 15 - 20 % of the patients (more than 4 weeks)
- **Chronic** for 2-5 % of the patients (about one year),

**Initial period of disease:**

- Acute beginning, fever up to 39 – 40 d.C, headache, weakness, sweating, anorexia
- Arthralgia, myalgia, pain in all body
- The fever can be remittent, continued, intermittent duration up to 2 weeks with lowering for the type **crisis - lisis**

## **Peak of illness:**

- All manifestations of illness amplify, can be encephalitis with delirium and hallucinations
- Maculo-papular eruption for 6-8 days for **3- 4 %** the patients
- Bradycardia or tachycardia, dull cardiac sounds
- **The pneumonias for 12 %** (are more often **on the right**) tracheitis, bronchitis
- hepatolienmegaly for 65 - 85 % of the patients
- **Duration of illness 10 - 13 days**
- The relapses arise for **3 - 7 %** of the patients, no more than **3 times!!**
- **Diagnostics** - CFT (diagnostic titer **1:8 - 1:16**)
- **Treatment** as at a exantomatic typhus
- **Prophylaxis** - common sanitary measures, vaccination on epidemiological indication

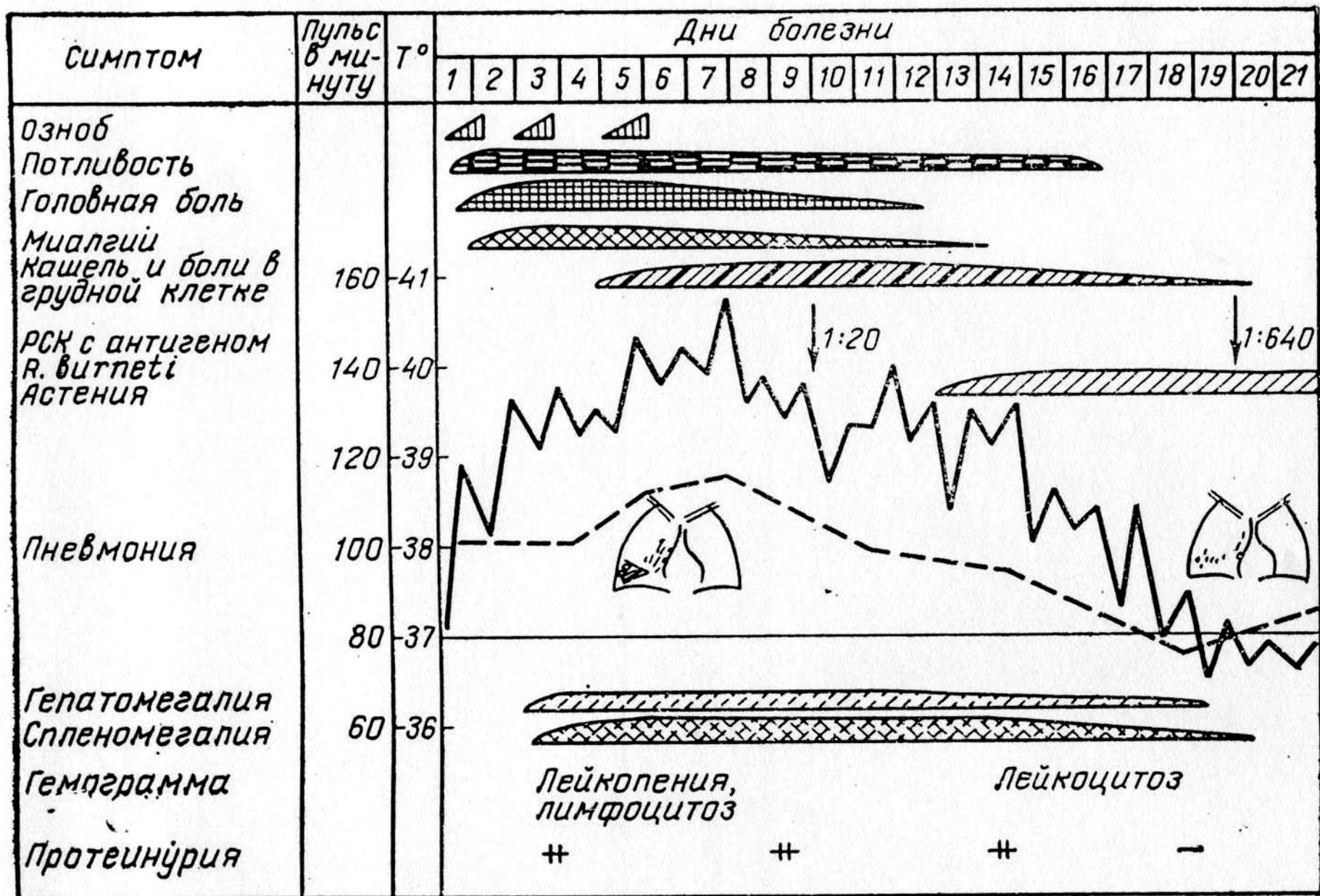


Схема температурной кривой и развития основных симптомов у больного лихорадкой Ку.

# SCRUB TYPHUS

**Identification.** Acute zoonotic rickettsiosis described by the high fever, the intoxication, formation of primary affect in the place of introduction of the infected mite, occurrence spotty–papular exanthema, general panvasculitis, interfering activity CN and cardiovascular systems. For the first time it is described in 1810 in Japan.

**The endemic countries :** Japan, Korea, China, Burma, Vietnam, New Guinea, Australia, Sri Lanka, Malaysia, Pakistan, Tadjikistan, the Far East Russia.

**The infectious agent** - Rickettsia **tsutsugamushi** (orientalis).



# Epidemiology

- the natural reservoir- rodents (mice, rats, hares, etc.) and their ectoparasites (mites of family Trimbiculidae)

**Mode of transmission-** **only infected larvae mites.** Adult mites and nymphs - do not feed on the vertebrate hosts

**Susceptibility** high in all age groups, but the agricultural workers and visitors is more often are ill. Biotype of the centers are **valleys of the rivers**

**Seasonal prevalence** depends on climatic conditions, but always coincides with a maximum of number **infected larvae mites.**

**Vector rickettsia tsutsugamushi - Trombiculid mite**



## Pathogenesis and Pathomorphology:

- the **primary affect** is formed on the skin in a place of introduction of the agent. The specific intoxication leads to damage of a fine vascular network **as panvasculitis** as well as at the typhus but less expressed.
- at pathomorphologic research attributes myocarditis, glomerulonephritis, interstitial pneumonias, meningo-encephalitis, hemorrhagic a syndrome are found out

## Clinic

incubation period from 7 to 20 days (on the average 10 - 12 days)

### Disease begins abrupt:

- fever, myalgia, intensive headache, insomnia
- the temperature to the 3<sup>th</sup> - to the 4<sup>th</sup> day reaches 39- 40 dg.C. It is kept 14-16 days (sometimes 3 weeks and more) and comes to the end accelerated lysis

## Objectively:

- hyperemia and edema of the face, conjunctival injection, profuse sweating, relative bradycardia
- primary affect on the skin of a trunk or extremities as:  
**macula** of 0,3- 2 sm > **vesicula** > **ulcer** > black scab + regional lymphadenitis
- **macular rash** on the skin about 5<sup>th</sup> -8<sup>th</sup> day of illness (the breast, abdomen, extremities (**except for palms and soles**))  
In some days turns in maculo-papular and disappears
- the period of occurrence of the rash is accompanied by amplification of the **intoxication** - intensive headache, insomnia, delirium, hyperkinesis, meningeal syndrome.

**CV system** - hypotonia, tachycardia, expansion of borders of heart and dullness of its tones, pancarditis (less often)

**Lungs**- bronchites, the **interstitial pneumonia**

**Moderate splenomegaly**

**Kidney** - attributes of “toxic kidney” or glomerulonephritis

**The general analysis of blood** – has **nonspecific** changes

**Variants of current** – from severe (**in Japan** and among **visitors** in endemic areas) - to easy and erased

**Lethality** - without antibiotic therapy from **1 %** (islands Peskadorskie) up to **60 %** (Japan and Taiwan)

**Complications:** myocarditis, meningoencephalitis, glomerulonephritis acute cardiovascular insufficiency



# Diagnosis:

- **Luminescent** method and **biological** (infection of mice)
- HA with antigene Proteus OXK about 2-nd weeks of disease
- Complement-fixation test
- **Specific diagnosis is** complicated because of an antigenic variety strains the infectious agent
- **Differential diagnosis** - others rikettsiosises, a fever dengue, medicinal and infectious erythema

**Treatment** - as at a typhus

## Preventive maintenance:

- processing place in endemic areas acaricides
- carrying of special clothes
- use of mite repellents

Active immunization by the weakened vaccines ( **seldom**) - no currently available vaccine is effective

**The isolation, the current disinfection, quarantine, immunization and inspection contact are not carried out**

## **Clinic of a epidemic typhus (H. Fracastoro, 1546 r)**

... At first illness is expressed weakly, ... but soon there are malignant signs, because, though the high temperature on a nature of these fevers and is not felt by the patient, some is noted inside disorder, breakdown in all body, as at fatigue.

Decubituses on a back, the head grow heavy, sensivity is killed also consciousness, more by a part, after 4-7 days is blacked out, **the patient speaks many words** (delirates)

The eyes have **reddened**. Pulse **infrequent and weak**. The urine, is usual in the beginning paleish, but dense, then soon becomes **reddish** and **turbid**, similar on pomegranate wine. A feces corrupt, mephitic.

About 4 - 7 days on arms back and breast break out red, frequently and purple **spots**, similar to stings fleas, quite often and greater size reminding lentil.

**Sleepiness**, sometimes **insomnia**, sometimes alternately that and another sometimes prevails. The similar state keeps in other cases about 7 days, in others up to 14, in others and is longer  
Sometimes there is an **ischuria**, that is very poor sign ....





**queensland tick typhus**



**rickettsia tsutsugamushi**



**Ixodes ricinus**



**Rocky mountain wood tick**

# Rocky mountain wood tick, rocky mountain spotted fever





The head louse, *Pediculus humanus capitis*, has an elongated body and narrow anterior mouthparts. **Body lice look similar** but lay their eggs (nits) on clothing fibers instead of hair fibers.



*P. humanus capitis*  
Dirk M. Ebston M.D.

