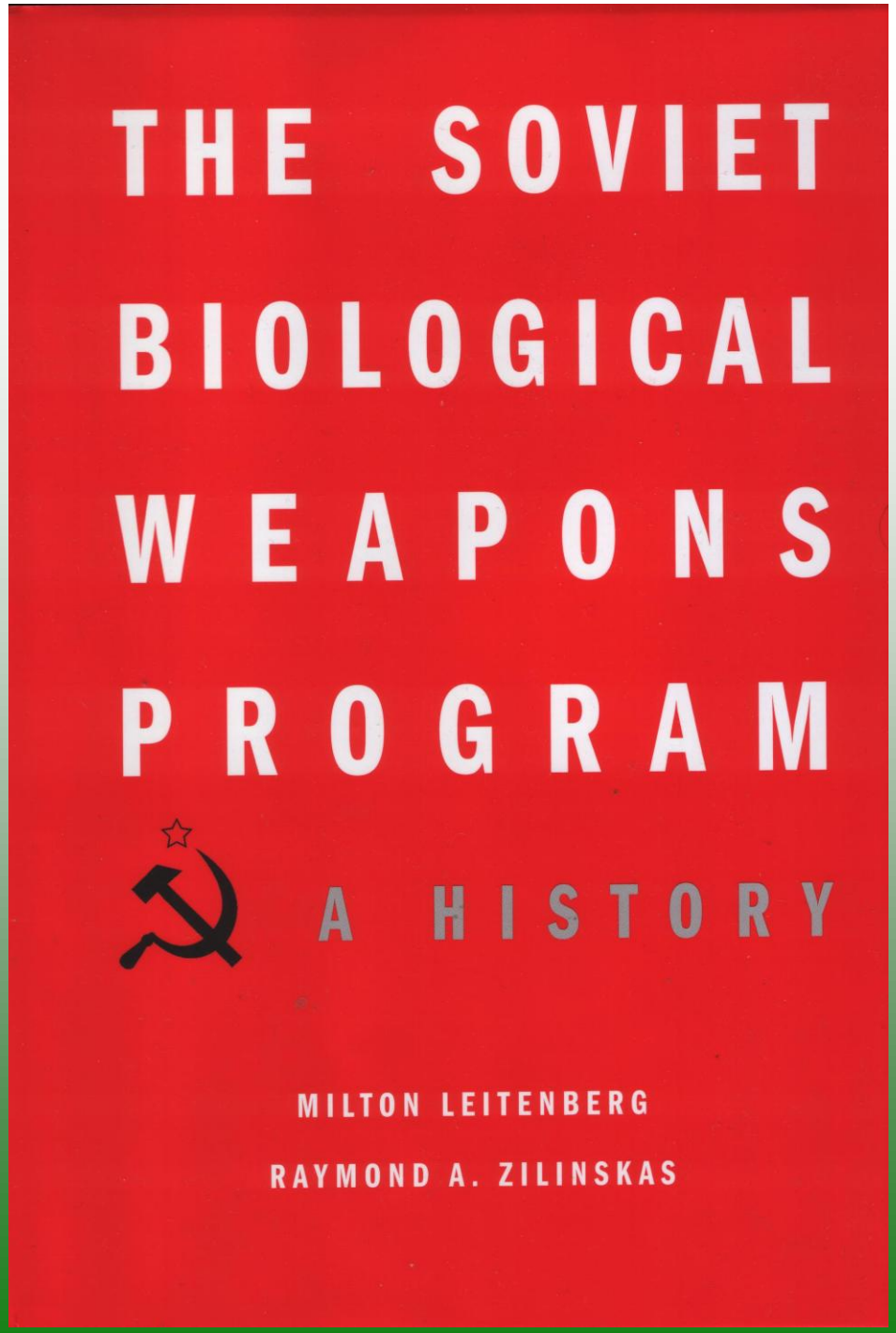
# ЗАВЬЯЛОВ ВЛАДИМИР ПЕТРОВИЧ

ПРОФЕССОР БИОТЕХНОЛОГИЧЕСКОЙ ЛАБОРАТОРИИ УНИВЕРСИТЕТА Г. ТУРКУ, ФИНЛЯНДИЯ

ПРОФЕССОР КАФЕДРЫ БИОЛОГИИ ЧЕЛОВЕКА И ИММУНОЛОГИИ ХЕРСОНСКОГО ГОСУДАРСТВЕННОГО УНИВЕРСИТЕТА

# СОВЕТСКАЯ ПРОГРАММА РАЗРАБОТКИ БИОЛОГИЧЕСКОГО ОРУЖИЯ

Biodefense


THE SOVIET BIOLOGICAL WEAPONS PROGRAM
A HISTORY
MILTON LEITENBERG
RAYMOND A. ZILINSKAS

# НИИ И ЗАВОДЫ, УЧАСТВОВАВШИЕ В СОВЕТСКОЙ БИОЛОГИЧЕСКОЙ ПРОГРАММЕ

# USSR MINISTRY OF DEFENCE, 15TH DIRECTORATE (P.O. BOX A-1968)

USSR Academy of Sciences

USSR Academy of Medical Sciences

USSR Academy of Agricultural Sciences

USSR Ministry of the Medical and Microbiological Industry

USSR Ministry of Health

USSR Ministry of Agriculture

"Biopreparat" (P.O. BOX A-1063), the BW program against humans, the code name "Ferment"

Anti-plague system

The BW program against animals and plants, the code name "Ekologiya"

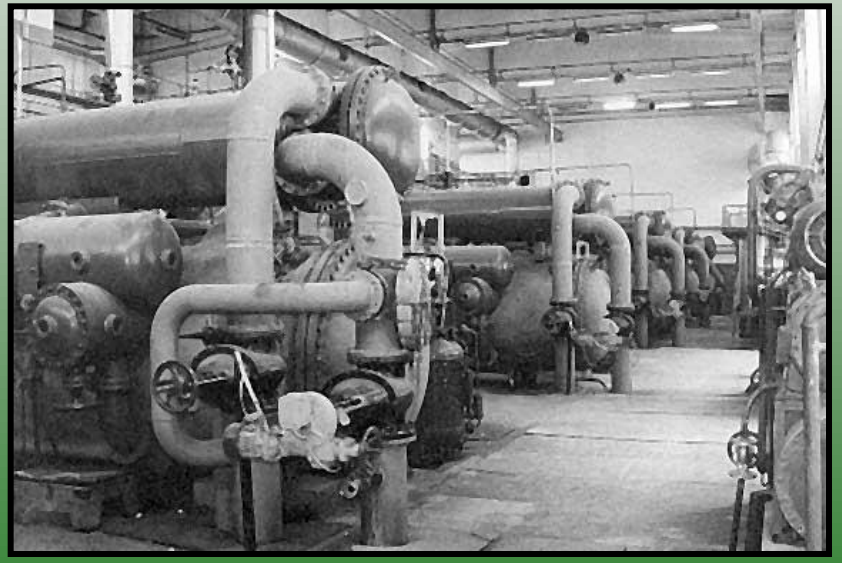
Awarding of the Soviet scientists who had made significant contributions to the field of molecular biology in both the civilian and the military spheres. Photograph taken on July 16, 1981, in the Saint George Hall, Kremlin Palace, Moscow.

# Директора НИИ и заводов «Биопрепарата» (п/я А-1063), Протвино, Московская область, 1988 г.

# ЗАВОД ПО ПРОИЗВОДСТВУ БИОЛОГИЧЕСКОГО ОРУЖИЯ

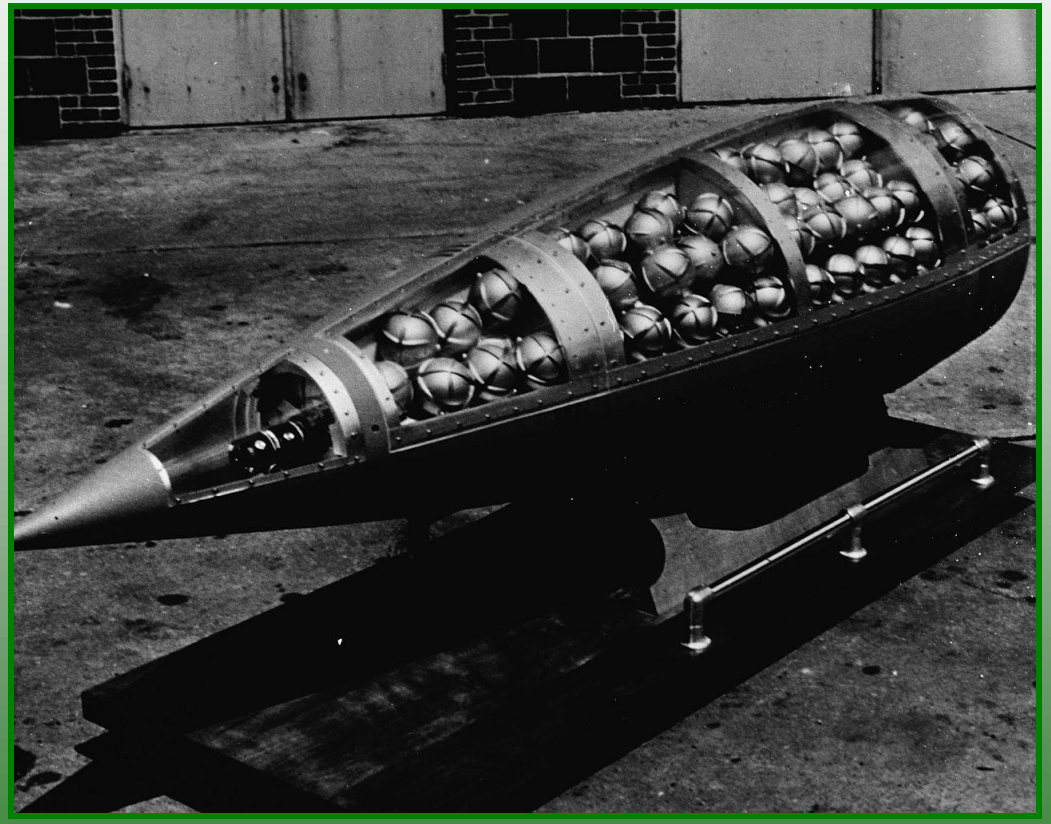
Storage bunkers in foreground, Building 211 behind bunkers, and Building 221 in background

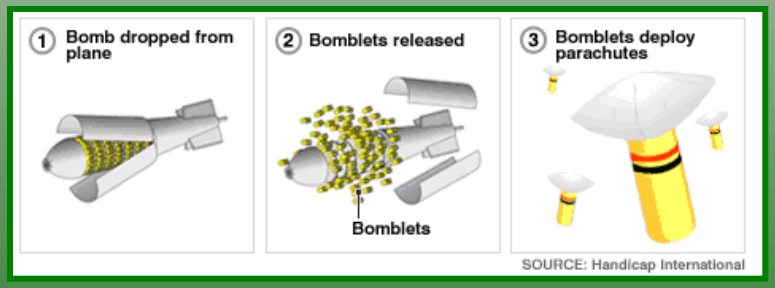
Building 221 interior with a row of 20,000 liter fermenters



Row of refrigeration units

# КЛАСТЕРНЫЕ БОМБЫ С БОМБЛЕТАМИ ДЛЯ РАСПЫЛЕНИЯ БИОЛОГИЧЕКОГО ОРУЖИЯ





# ПОЛИГОН ДЛЯ ИСПЫТАНИЯ БИОЛОГИЧЕСКОГО ОРУЖИЯ


Vozrozhdeniye Island

Aralsk-7's Field Scientific Research Laboratory complex

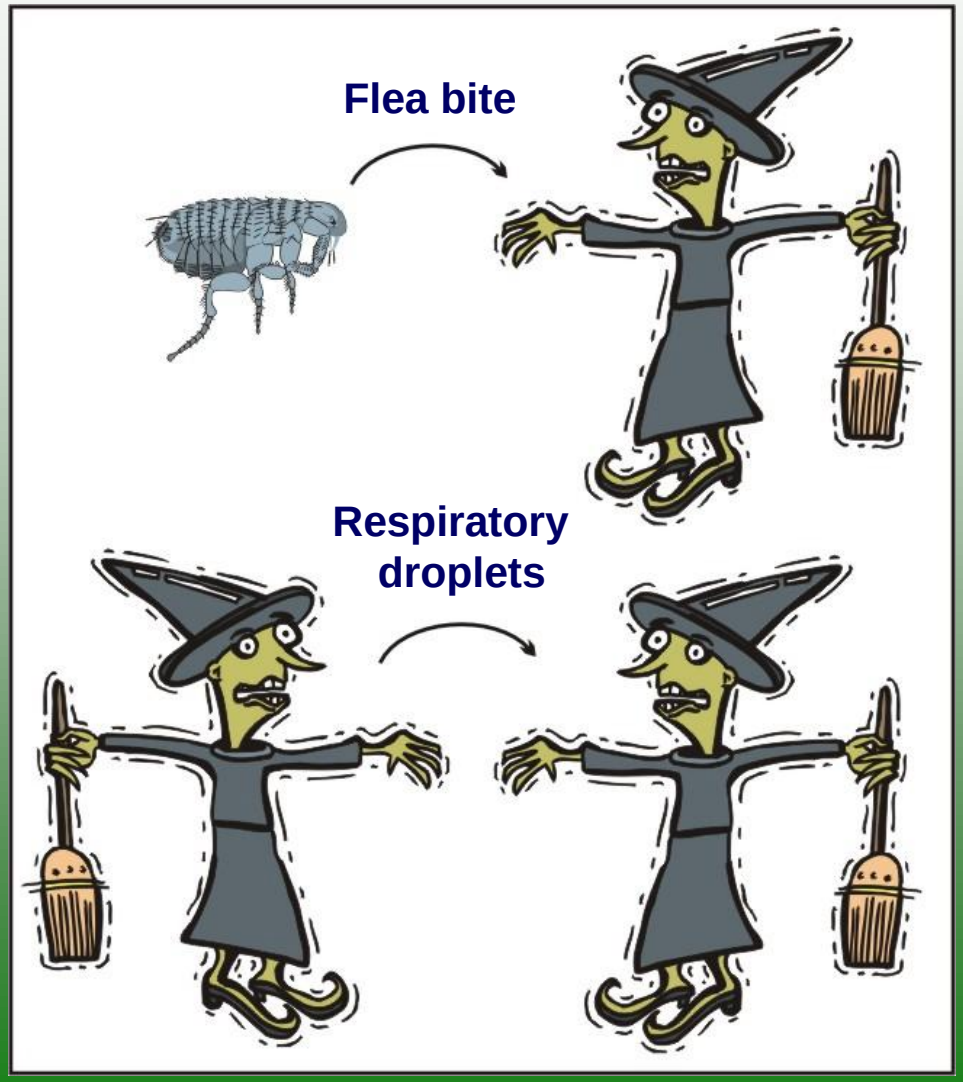
Aralsk-7

Biodefense

**Biopreparat's State Research Center for Applied Microbiology (P.O. Box V-8724), Obolensk, Moscow Region.**


**The director (1985-2000 ) and vice-directors of the Biopreparat's Institute of Immunology (P.O. Box G-4883), Lyubuchany, Moscow Region.**

# *Yersinia pestis* CAUSES TWO FORMS OF PLAGUE



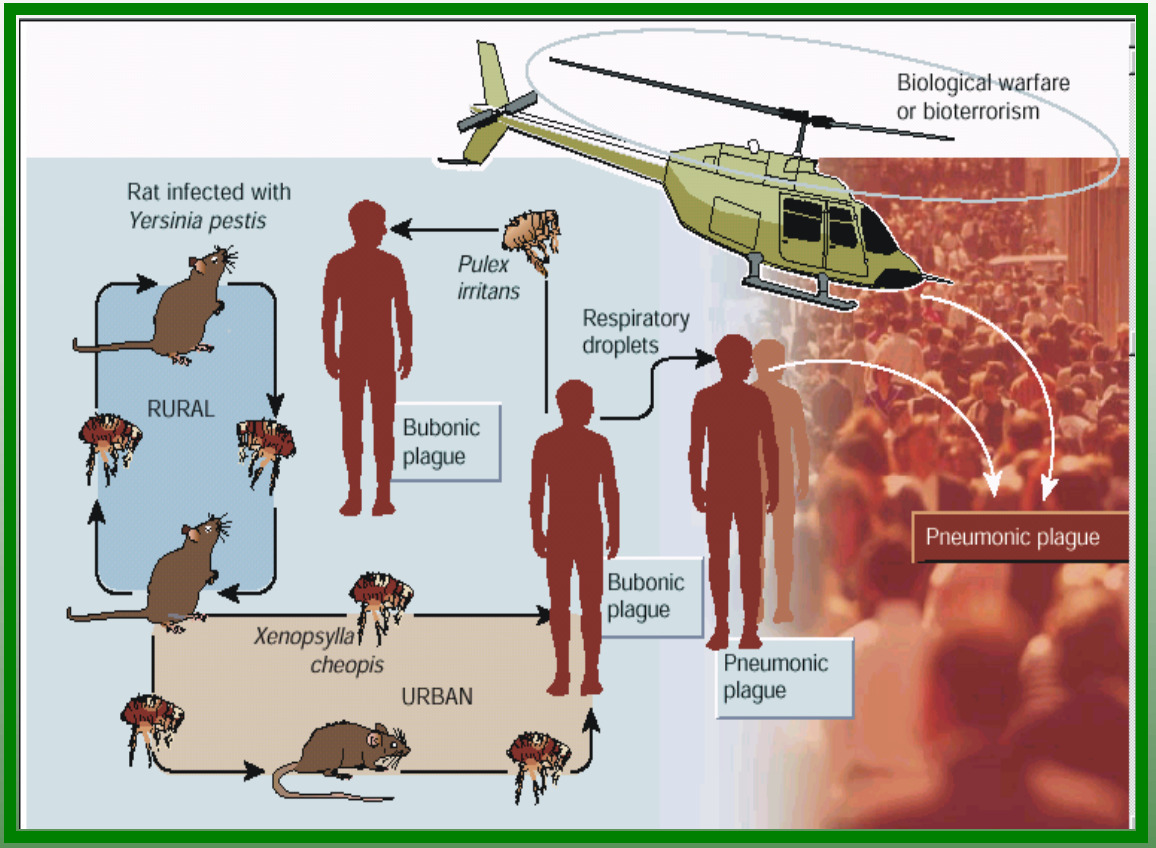

**BUBONIC PLAGUE:**

- 60 % of mortality
- vaccination is effective
- antibiotic therapy is effective

**PNEUMONIC PLAGUE:**

- invariably fatal
- no vaccine
- antibiotic therapy is effective only at the first 24 hours

# PNEUMONIC PLAGUE AS BW INFECTION



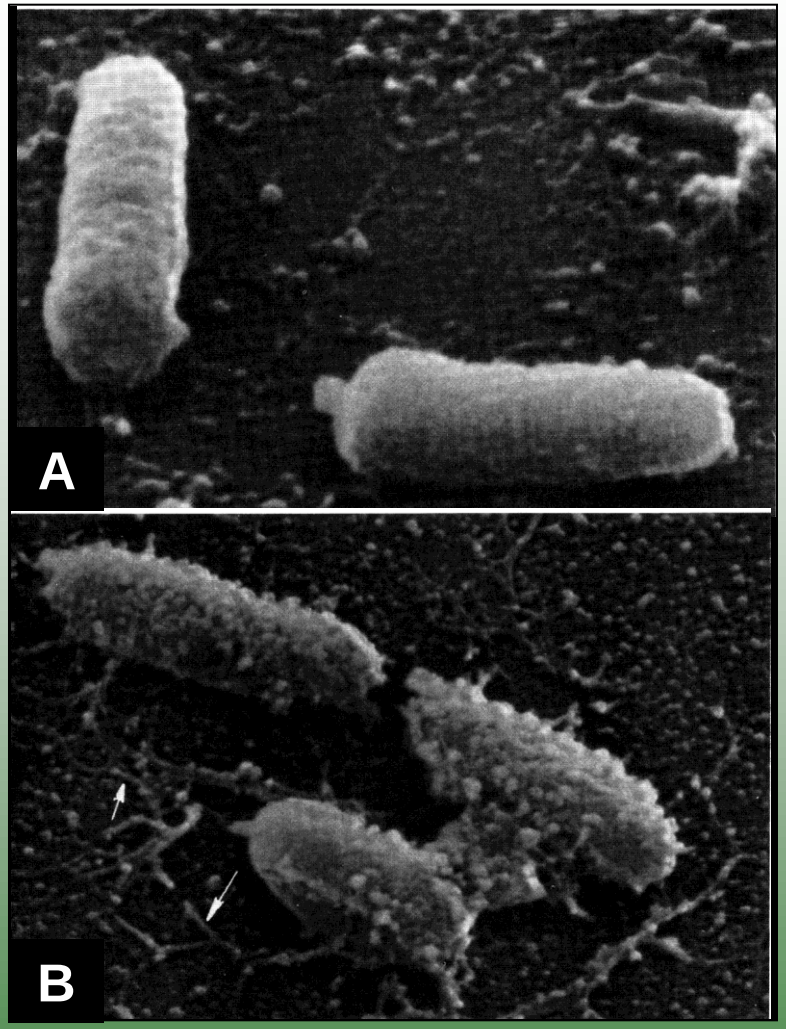

**Pneumonic plague or Black Death is the most contagious and deadly infection (Category A).**

**It can be transmitted from person to person through respiratory droplets, or even by artificially generated aerosols.**

**Several pandemies of pneumonic plague killed more people during last two millenia than all the wars during human history.**

Cole, S.T., Buchrieser, C. *Nature* 413, 467-469, 2001.

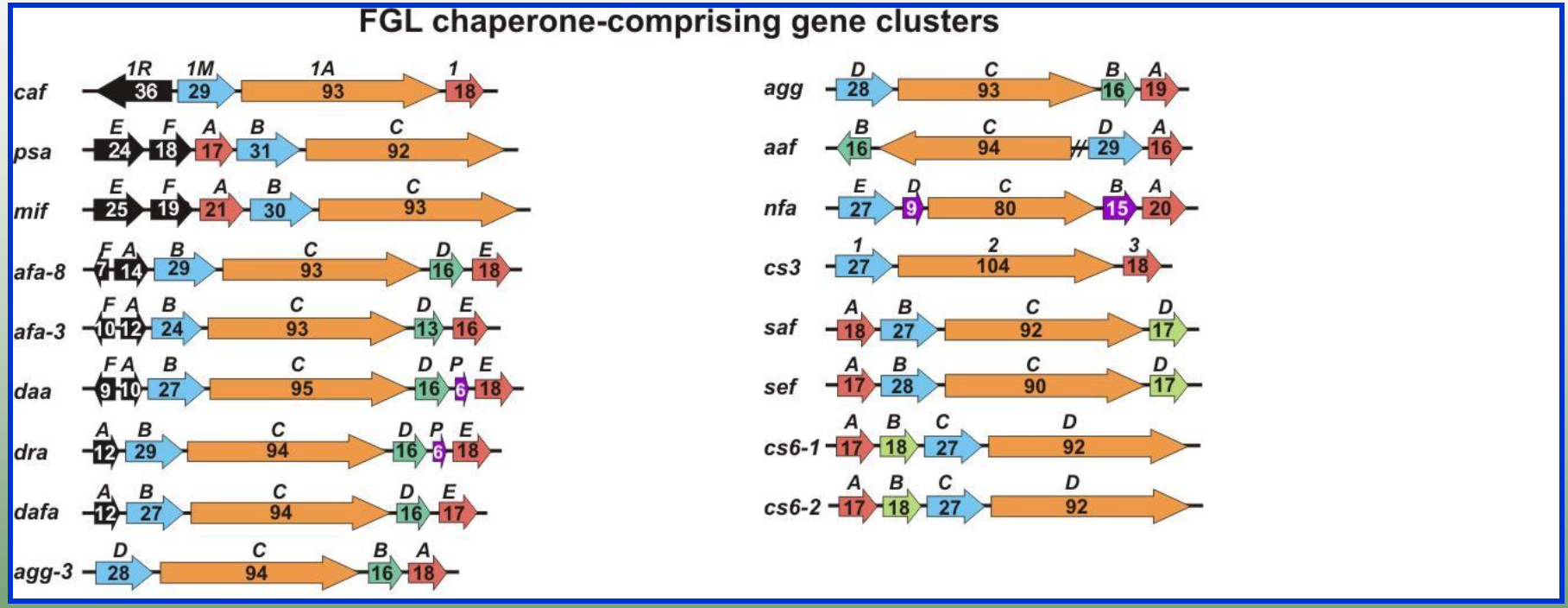
# ELECTRON MICROGRAPHS OF *Y. pestis*




*Y. pestis* T1 grown at 22°C (A, x55,000) and 37°C (B, x30,000), pH7.4 for 72 h.

Chen & Elberg, Infect Immun (1977)

# GENERAL ORGANIZATION OF GENE CLUSTERS FOR CHAPERONE/USHER ASSEMBLED FIMBRIAL ADHESINS



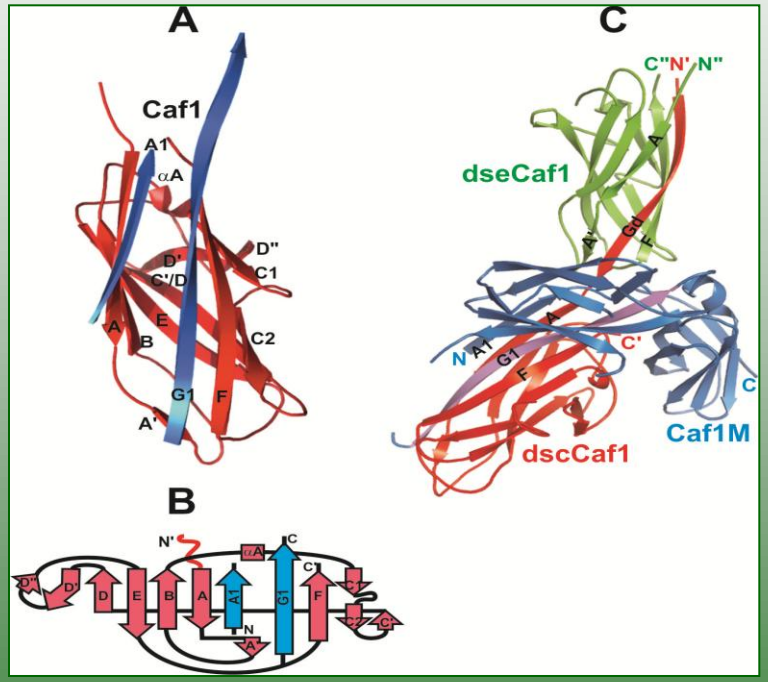

- chaperone; - usher; - adhesin; - invasin;

- transcriptional regulator

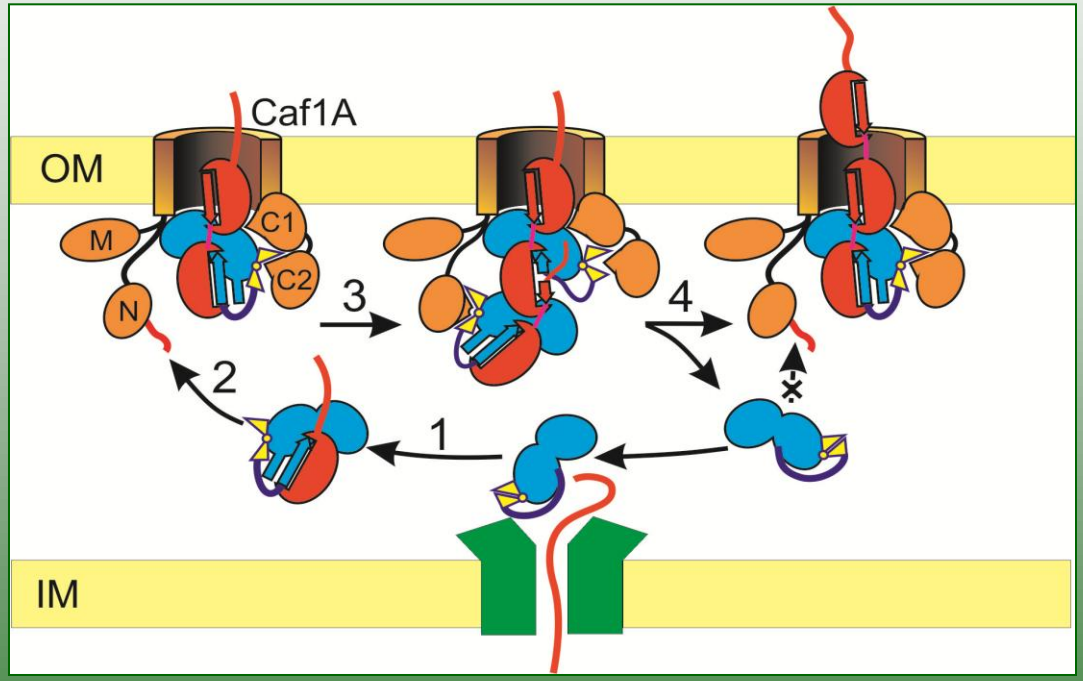
Galyov E.E., Smirnov O.Yu., Karlishev A.V., Volkovoy K.I., Denesyuk A.I., Nazimov I.V., Rubtsov K.S., Abramov V.M., Dalvadyanz S.M. & Zav'yalov V.P. (1990) Nucleoide sequence of the *Yersinia pestis* gene encoding F1 antigen and the primary structure of the protein. Putative T and B cell epitopes. *FEBS Lett*. 277: 230−232.

# STRUCTURE AND ASSEMBLY OF THE F1 CAPSULE OF *YERSINIA PESTIS*

## Structure of the minimal F1 fiber




## Schematic illustration of F1 fiber assembly



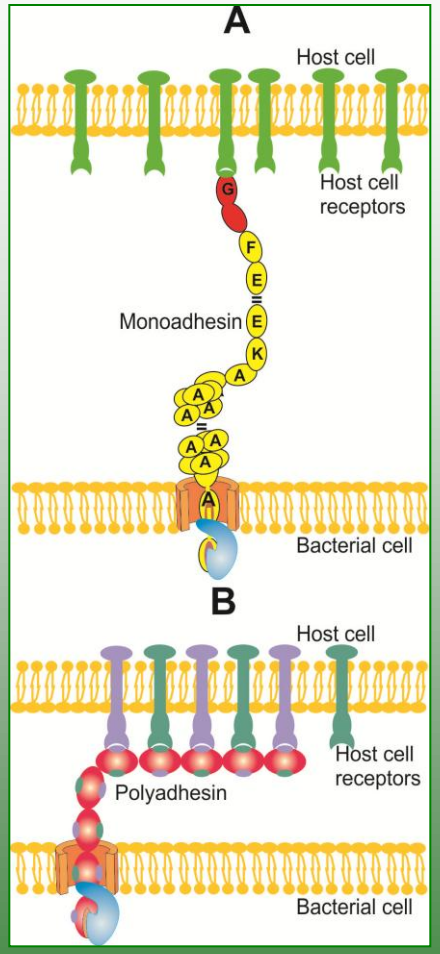


Zavialov AV, Berglund J, Pudney AF, Fooks LJ, Ibrahim TM, MacIntyre S & Knight SD (2003) Structure and biogenesis of the capsular F1 antigen from *Yersinia pestis*: preserved folding energy drives fiber formation. *Cell* 113: 587–596.

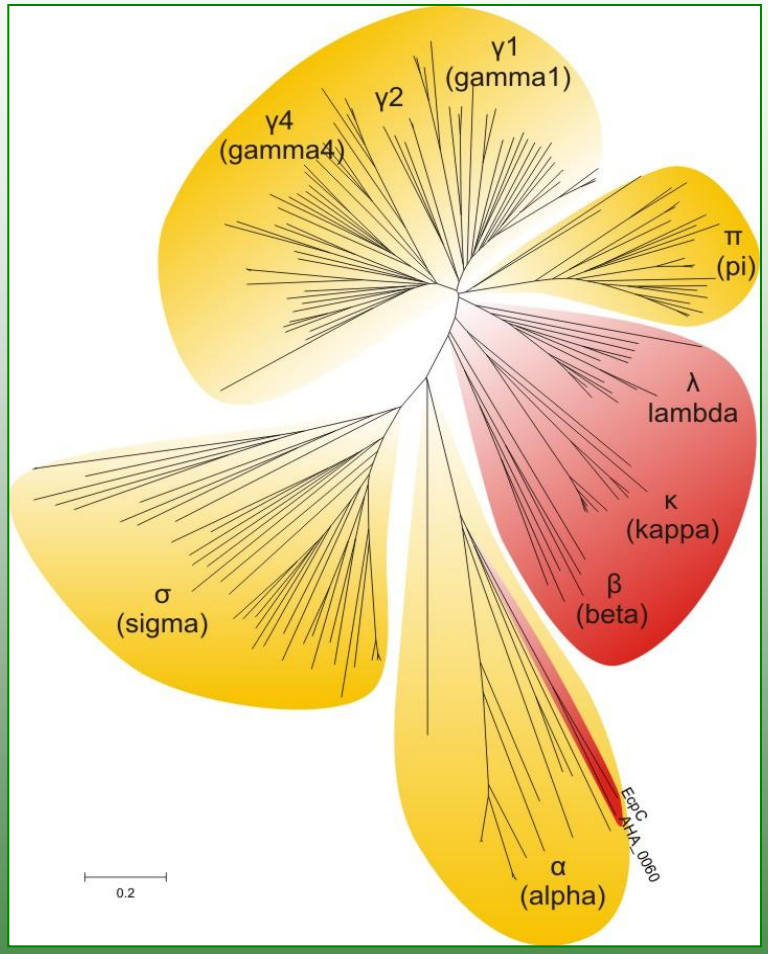
Yu XD, Dubnovitsky A, Pudney AF, Macintyre S, Knight SD & Zavialov AV (2012) Allosteric mechanism controls traffic in the chaperone/usher pathway. *Structure* 20: 1861–1871.

# FIMBRIAL ADHESINS OF GRAM-NEGATIVE PATHOGENS

**Binding of mono- (A) and poly- (B) adhesins to host-cell receptors**




**Phylogenetic tree of the fimbrial mono- (yellow) and poly- (red) adhesins**



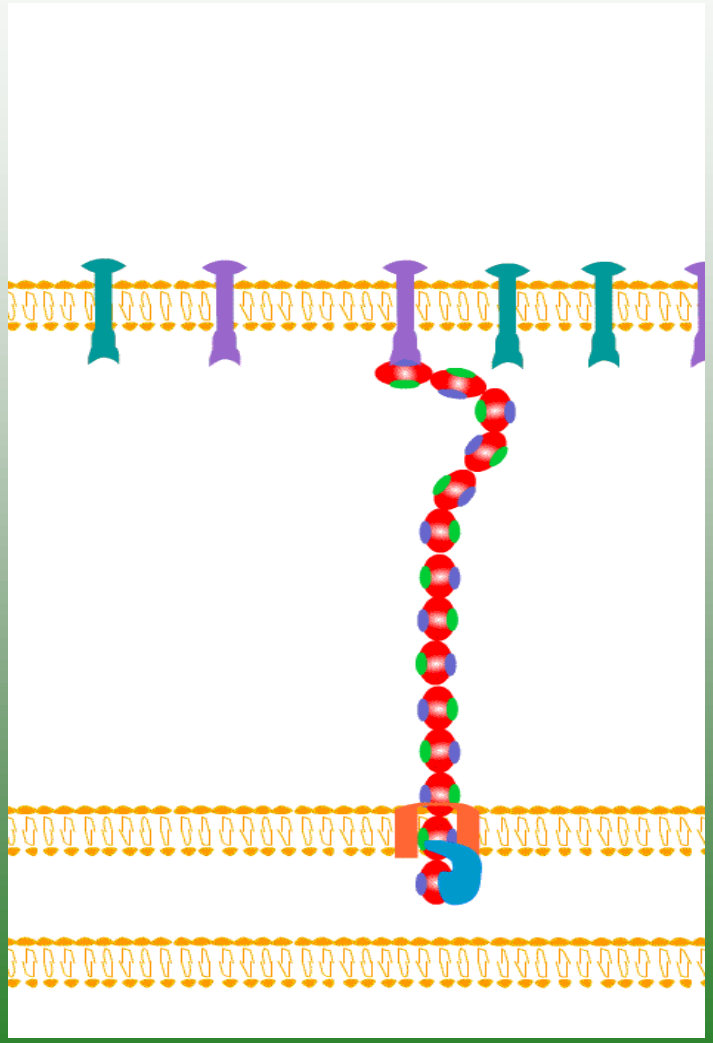


Zavialov A., Zav'yalova G., Korpela T. & Zav'yalov V. (2007) FGL chaperone-assembled fimbrial polyadhesins: anti-immune armament of Gram-negative bacterial pathogens. *FEMS Microbiol. Rev.* 31: 478−514.

Zav'yalov V., Zavialov A., Zav'yalova G. & Korpela T. (2010) Adhesive organelles of Gram-negative pathogens assembled with the classical chaperone/usher machinery: structure and function from a clinical standpoint. *FEMS Microb. Rev.* 34: 317−378.

# POLYADHESINS TRIGGER ANTI-IMMUNE OR NON-PRODUCTIVE PRO-INFLAMMATORY RESPONSES

HOST CELL

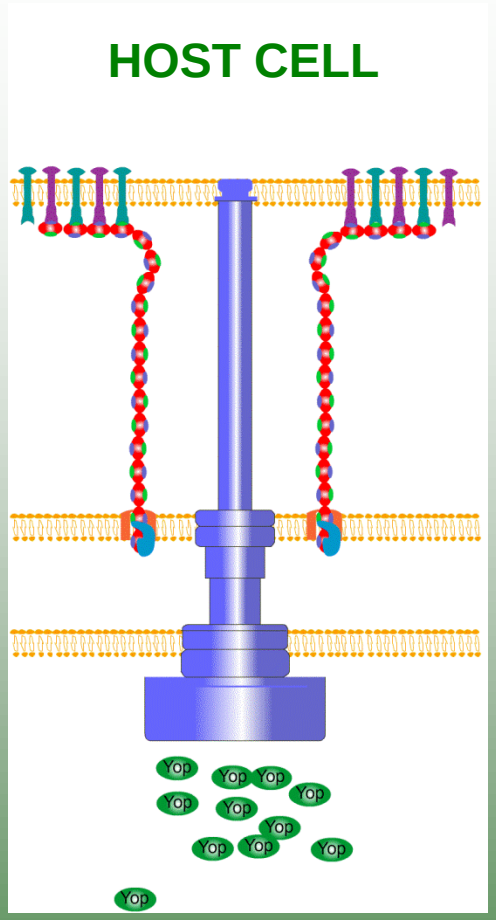


Host cell receptors

Polyadhesin

BACTERIAL CELL

# POLYADHESINS ACT IN CONCERT WITH THE TYPE III SECRETION SYSTEM




Zav'yalov V. (2012) Fimbrial polyadhesins: anti-immune armament of *Yersinia*. *Adv. Exp. Med. Biol.* 954: 183−201.
Zav'yalov V. (2013) Polyadhesins: an armory of Gram-negative pathogens for penetration through the immune shield. *Biotecnologia acta* 6: 144−161.

# БЫВШИЕ ИНСТИТУТЫ «БИОПРЕПАРАТА» И ПРОТИВОЧУМНОЙ СИСТЕМЫ В РФ


Ministry of Health and Social Development

Sanitation Inspector-General

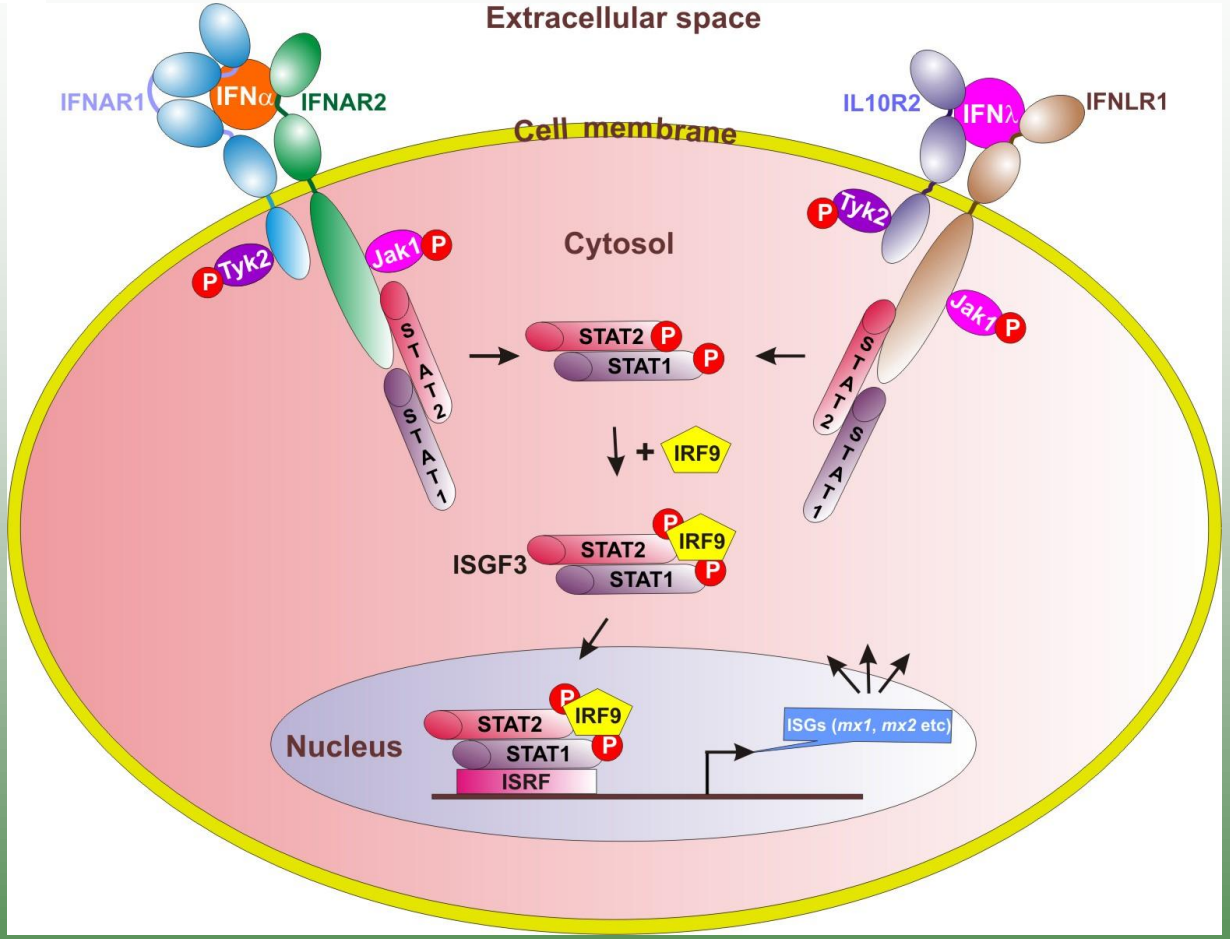
Federal Medico-Biological Agency

- State Scientific Center- “The State Scientific Research Institute of Biological Instrument Making”, Moscow
- Federal State Unitary Institution "State Research Institute of Highly Pure Biopreparations" St. Petersburg
- State Institution “Research Center for Toxicology and Hygienic Regulation of Biopreparations”, Serpukhov

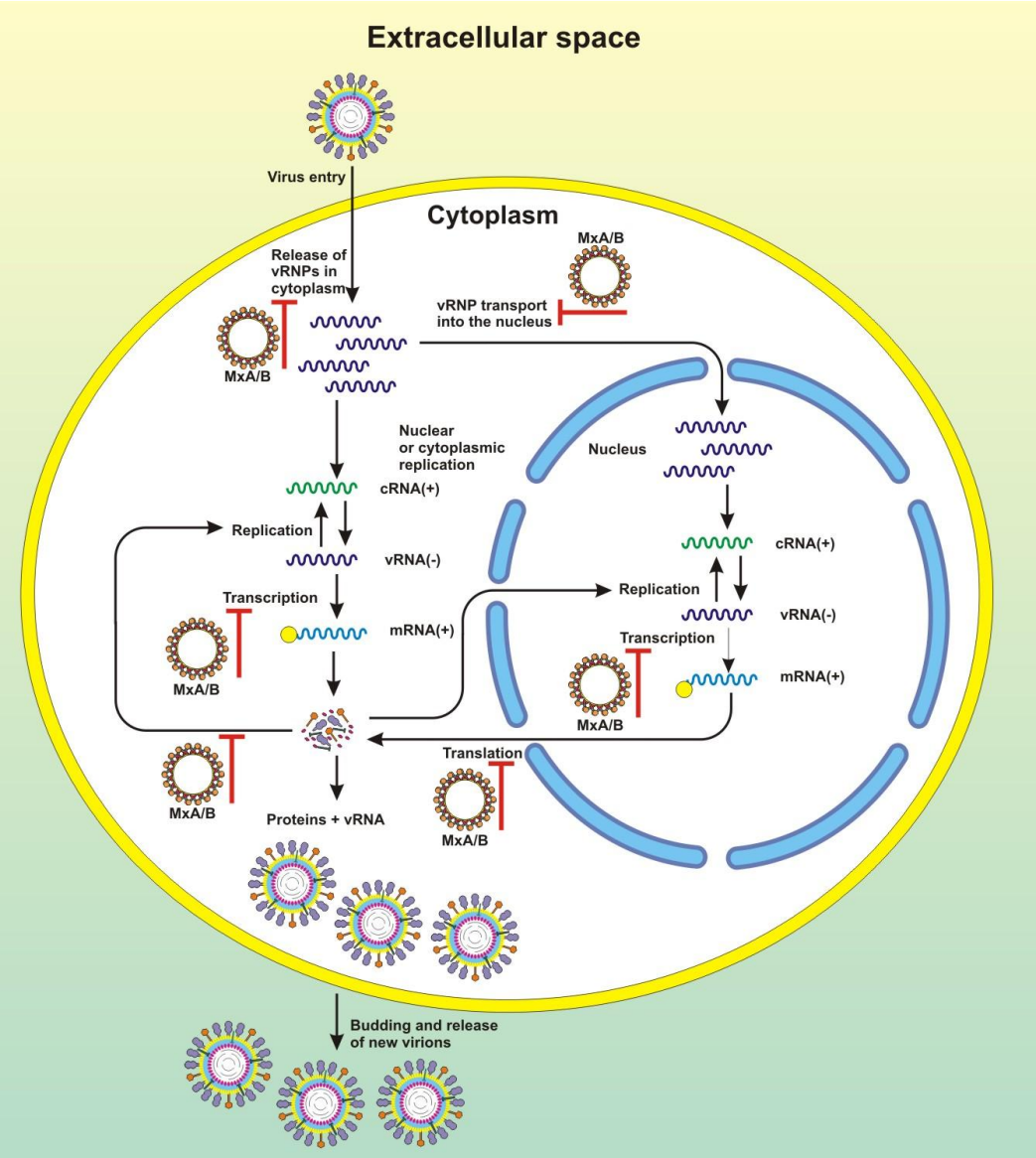
Federal Service for Surveillance in Consumer Rights Protection and Human Well-Being

- State Scientific Center of Applied Microbiology and Biotechnology, Obolensk, Moscow region
- State Scientific Center of Virology and Biotechnology VECTOR, Koltsovo, Novosibirsk Region
- Russian Scientific and Research Anti-plague Institute “Mikrob", Saratov
- Rostov-on-Don Research and Development Anti-plague Institute
- Stavropol Research and Development Anti-plague Institute
- Volgograd Scientific and Research Antiplague Institute
- Irkutsk Research and Development Anti-plague Institute of Siberia and the Far East

The former “Biopreparat” institutes are shown by red letters, the anti-plague institutes are shown by green letters




Vladimir Zav'yalov et al. Interferon-Inducible Myxovirus Resistance Proteins – Potential Biomarkers for Differentiating the Viral from Bacterial Infections. Clinical Chemistry 65, 739-750 (2019)




Vladimir Zav'yalov et al. Interferon-Inducible Myxovirus Resistance Proteins – Potential Biomarkers for Differentiating the Viral from Bacterial Infections. Clinical Chemistry 65, 739-750 (2019)