

Offenlegung von Interessen

Der Inhalt der folgenden Vorträge ist das Ergebnis des Bemühens um größtmögliche Objektivität und Unabhängigkeit.

Der Vortragende gibt an, dass keine Interessenskonflikte bestehen.

Sofern nicht entsprechend gekennzeichnet sind alle Aussagen die Meinung des Vortragenden und nicht zwingend mit den Vorgaben und Meinungen von Behörden oder Institutionen des Infektionsschutzes etc. identisch!

One Health – Umwelt und Resistenzentwicklung

René Gottschalk

Goethe-Universität

Universitätsklinikum Frankfurt am Main — Medizinische Virologie



Agenda

📌 Tag 1
➔ Leben; Bakterien, Viren, Toxine; Historie

📌 Tag 2
➔ Definitionen; Pandemien im 21. JHDT; EID

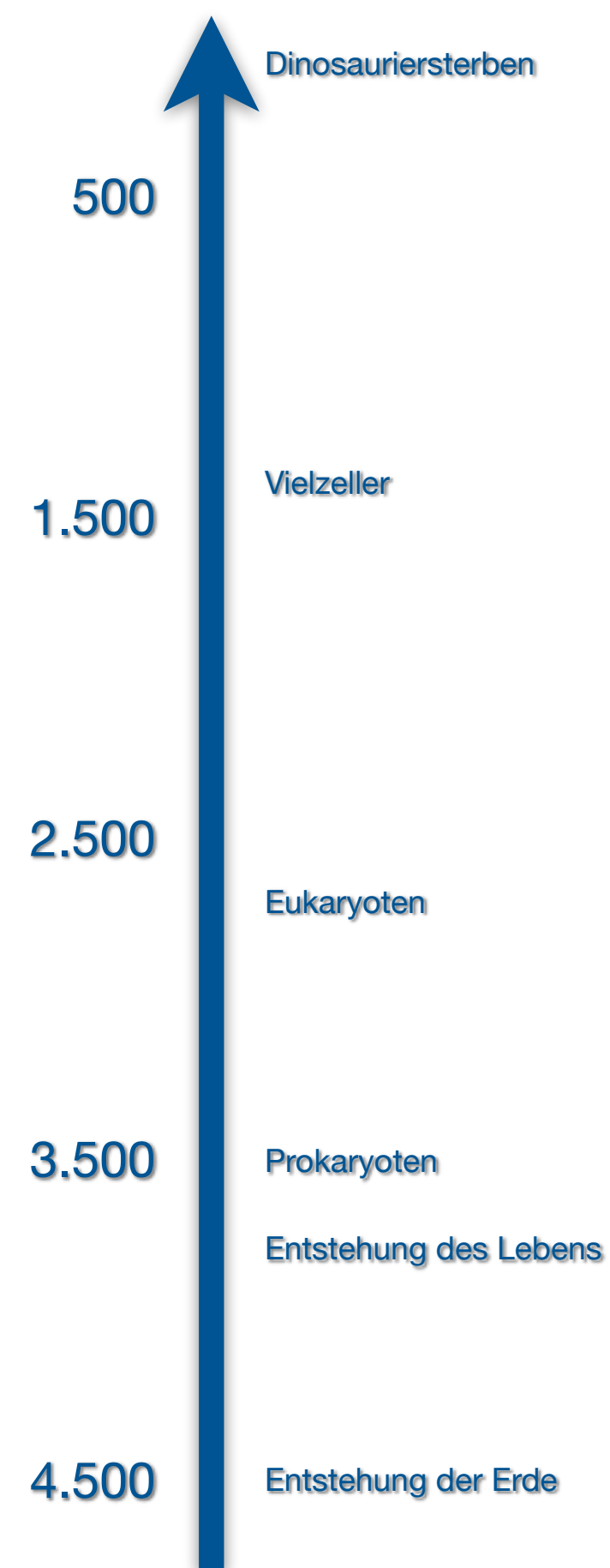
📌 Tag 3
➔ Infektiologische Gefahrenlagen; Aufbau ÖGD; Kommunikation

📌 Tag 4
➔ Biodiversität; Resistenzentwicklung

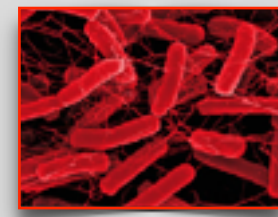
📌 Tag 5
➔ Globale Gesundheit - gibt es sie wirklich?; Epilog

Leben ...

Jahre x 10⁶



Bakterien



Pflanzen



Pilze

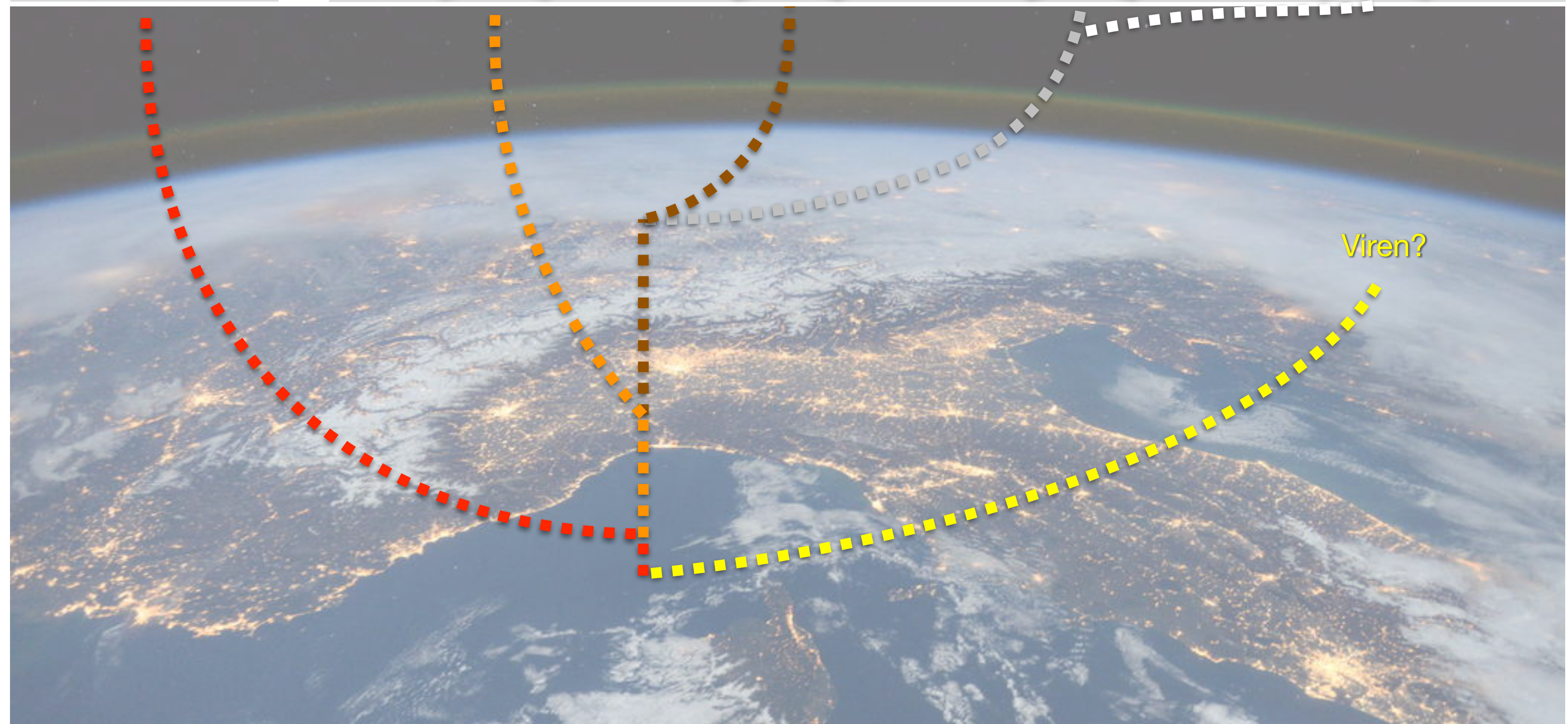


Eukaryoten

Tiere



Menschen



Man kennt

$\approx$ 1.000.000 Bakterienarten

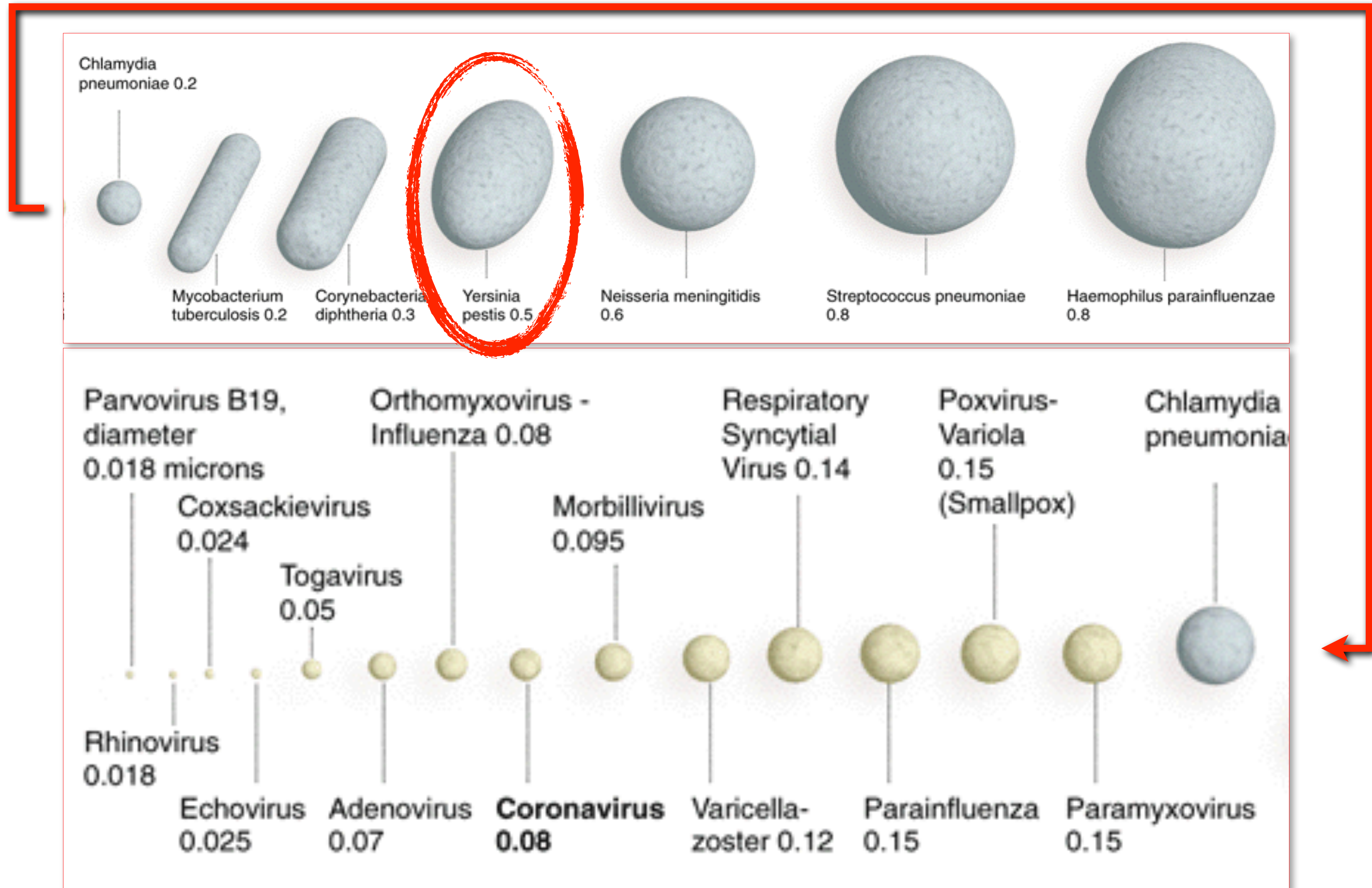
$>$ 300.000 Virenarten (offiziell anerkannt: 11.273)

zum Vergleich

$>$ 1.000.000 Insekten

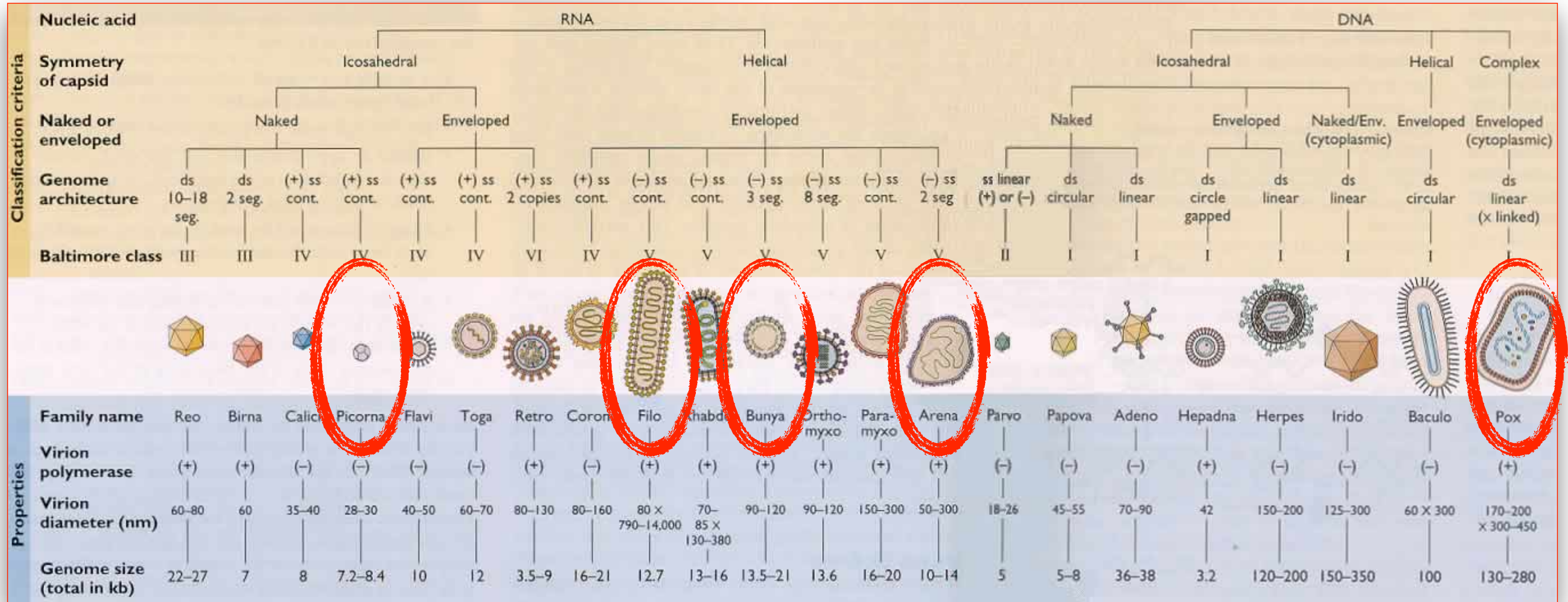
$<$ 6.000 Säugetiere

Größe bekannter Krankheitserreger

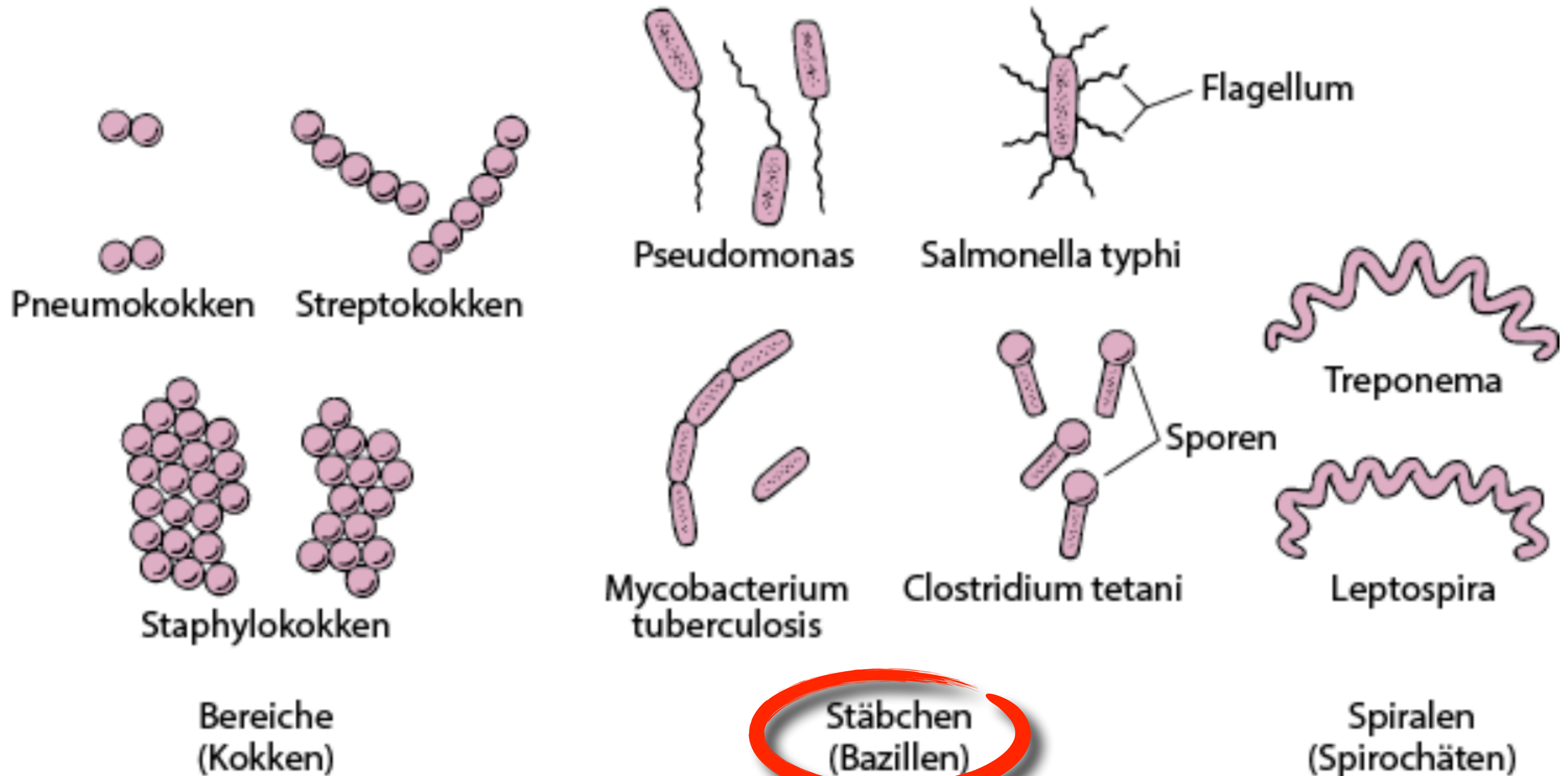


Quelle: The New York Times

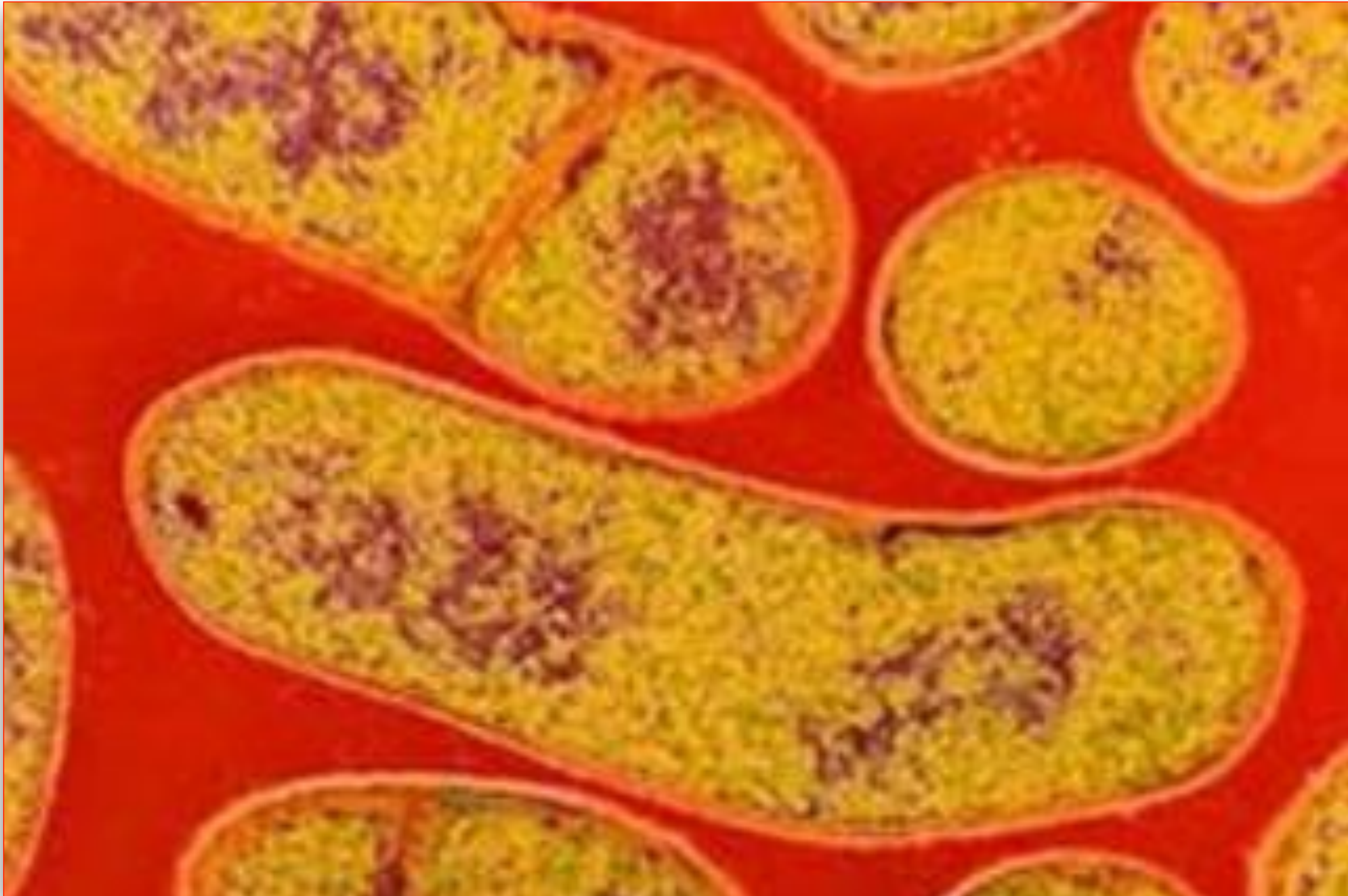
Einteilung der Viren



Formen von Bakterien



Clostridium botulinum-Toxin



Clostridium botulinum-Toxin

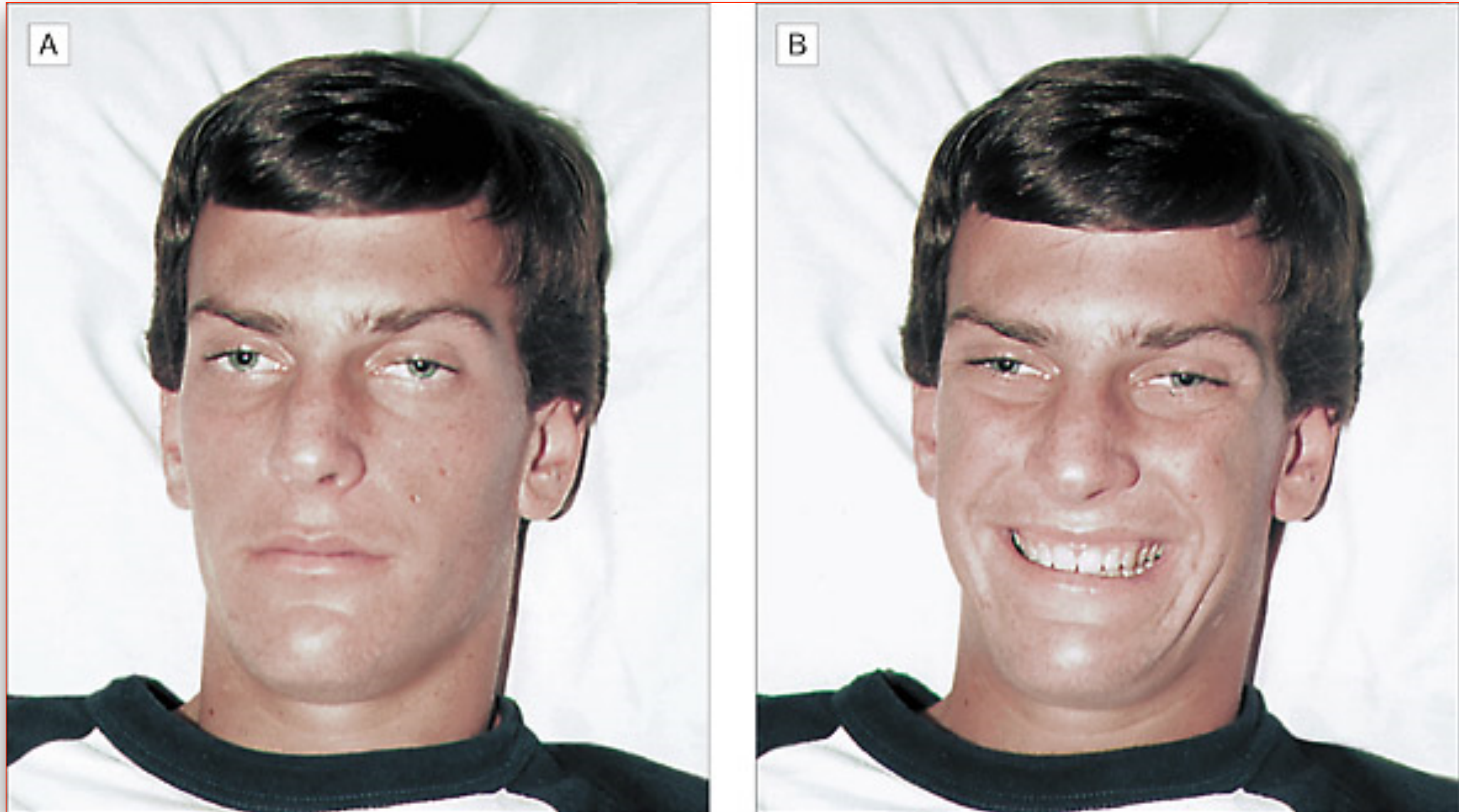


Botulinum Toxin A

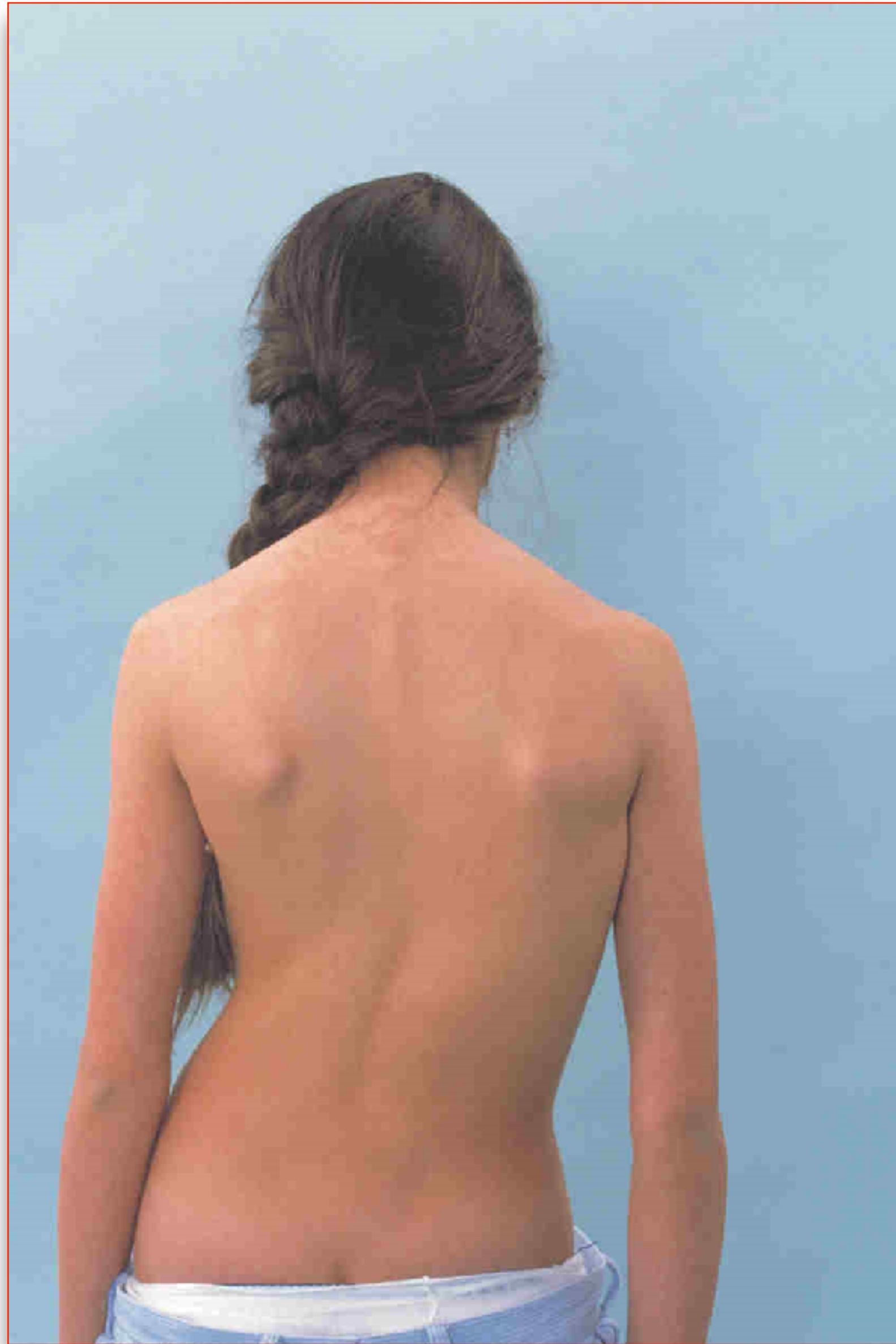


Botulinum Toxin B

Clostridium botulinum-Toxin



Clostridium botulinum-Toxin



Clostridium botulinum-Toxin



Clostridium botulinum-Toxin



- Wieviel Menschen können mit 1 g Botulinumtoxin getötet werden?
 - ▶ LD₅₀ Mensch (Bei pulmonaler Aufnahme): 3 ng/kg
 - ▶ Mensch mit 75 kg Körpermasse
- Ergebnis: > 2.200.000 Menschen

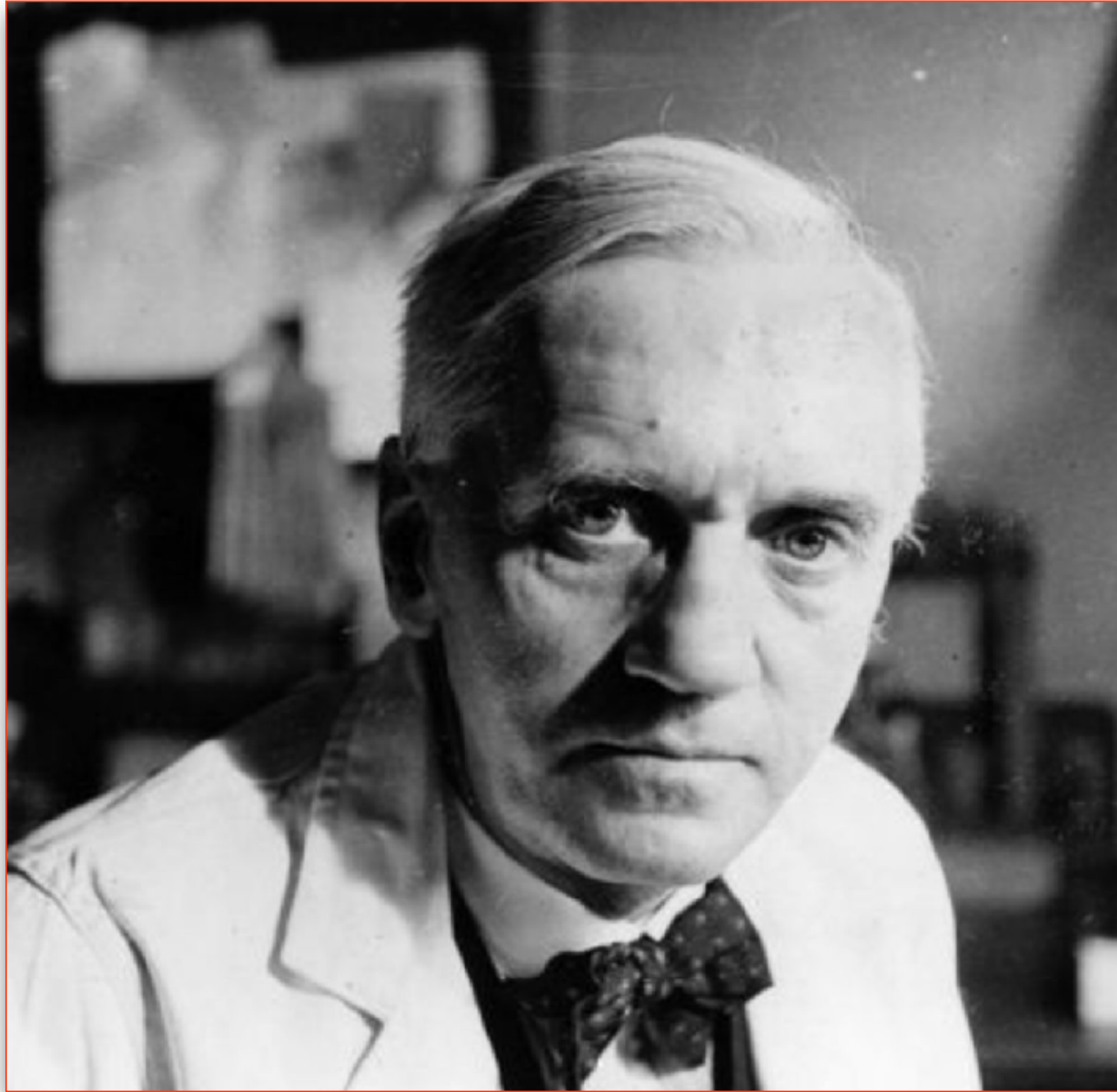
... etwas Historie

Paul Ehrlich



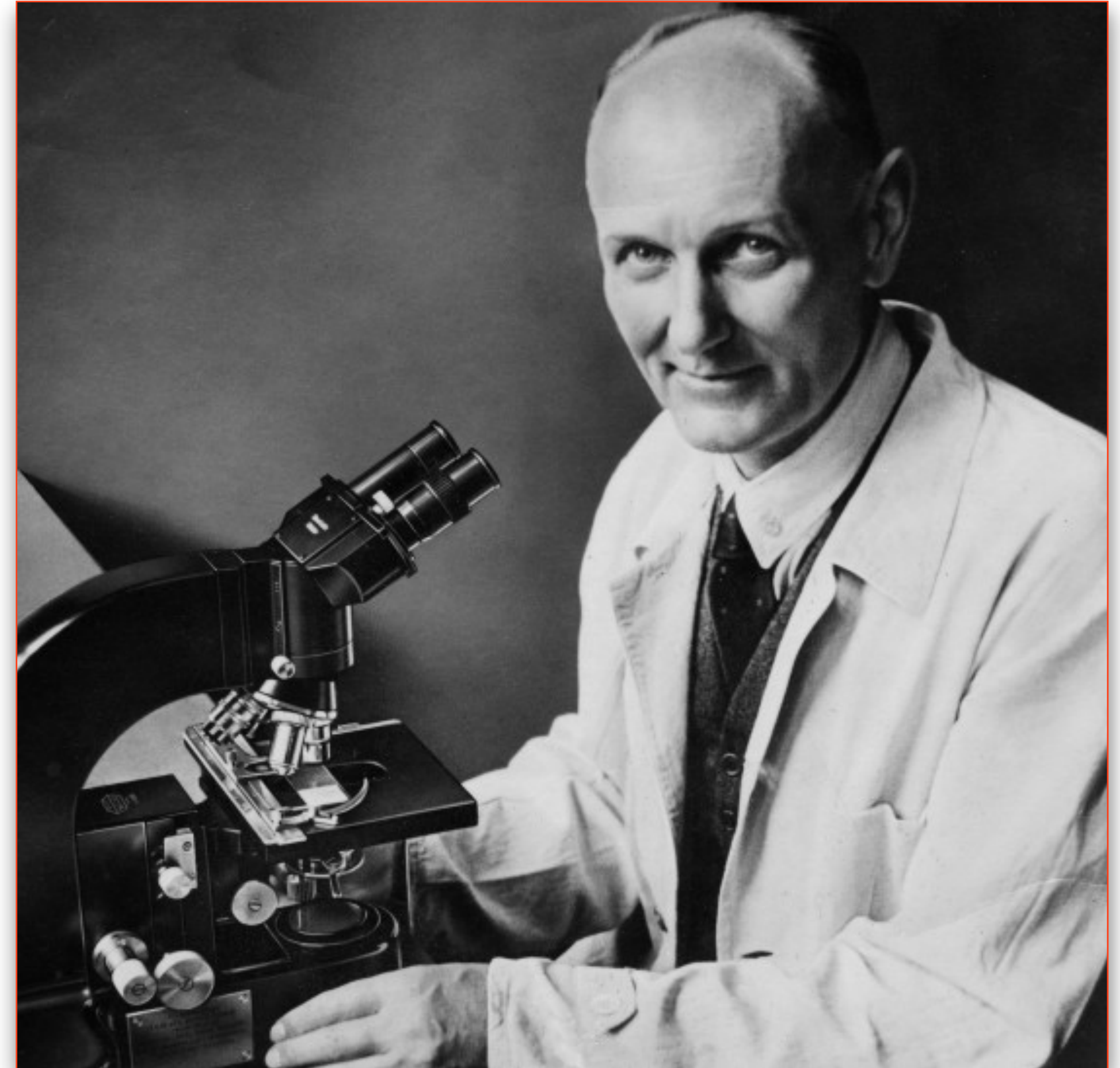


Alexander Fleming



© Biography

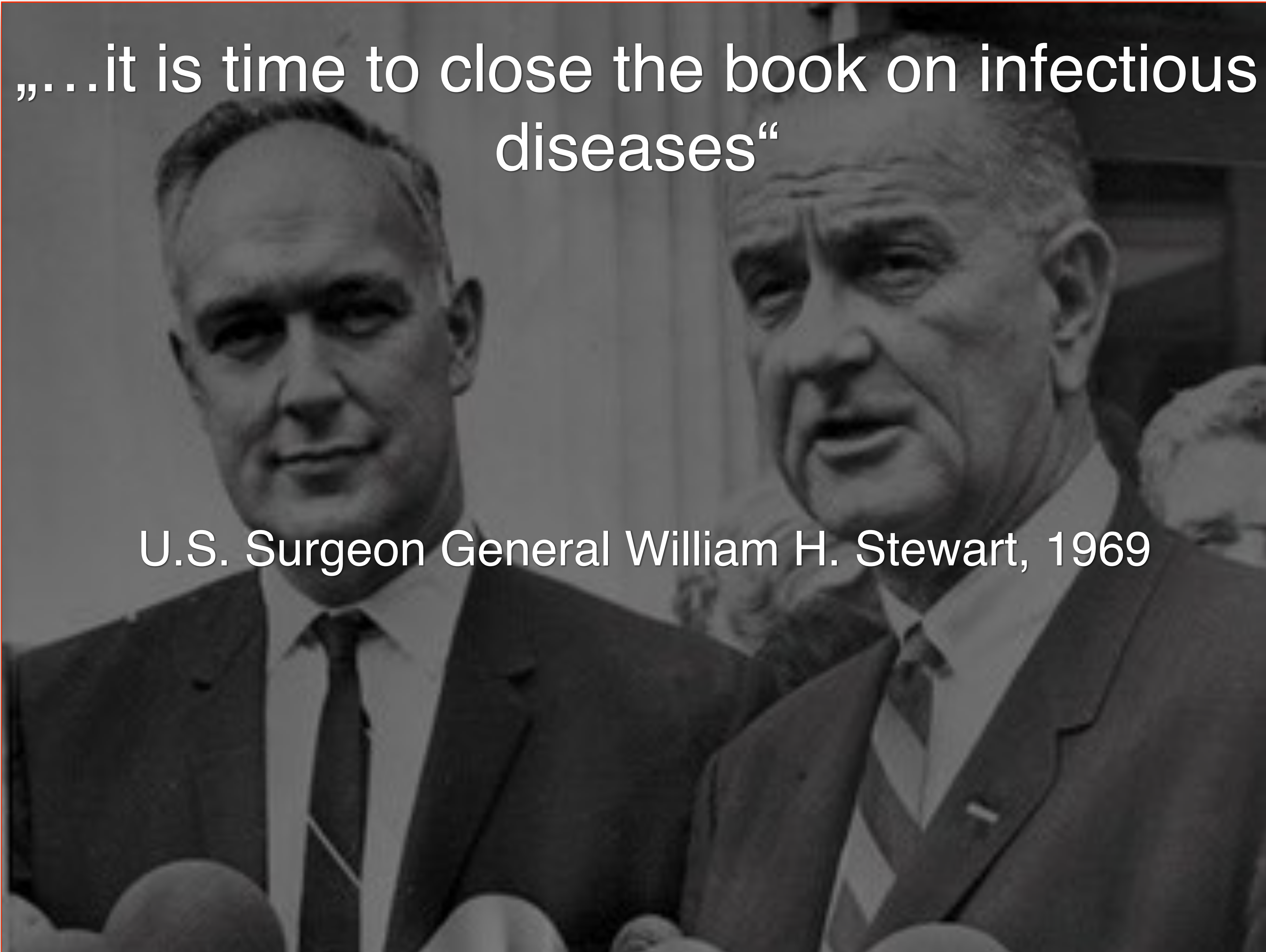
Gerhard Domagk



© Dirk Domagk/Universität Münster

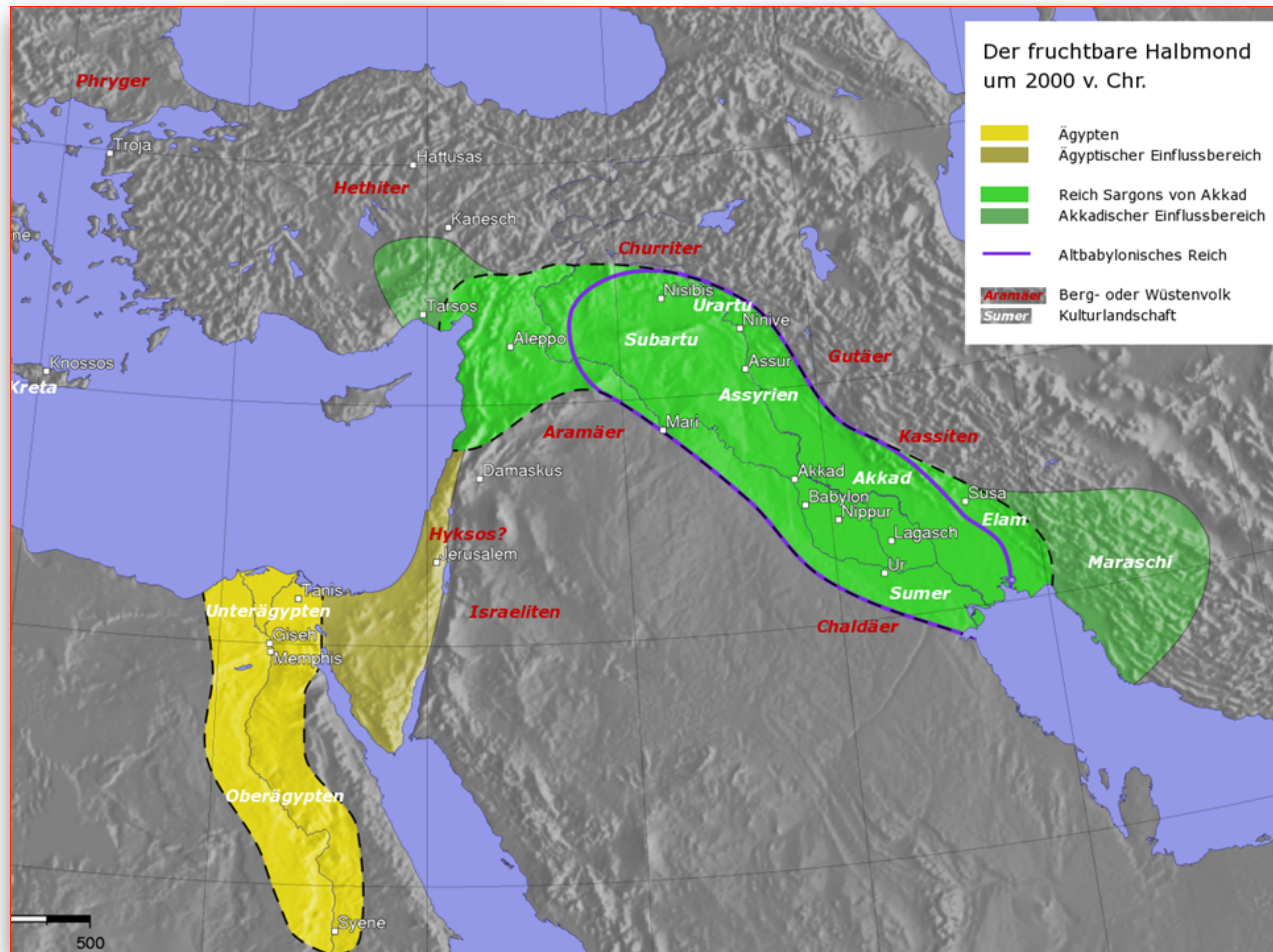
„...it is time to close the book on infectious diseases“

U.S. Surgeon General William H. Stewart, 1969



ca. 5.300 Jahre





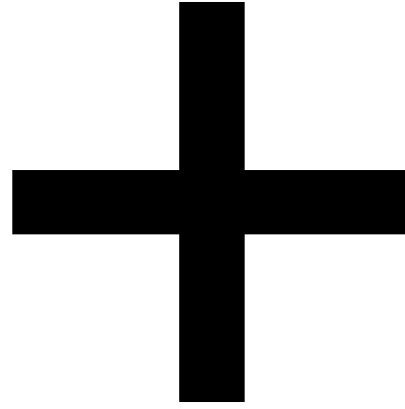
Tier-Mensch-Wesen (Chimäre)



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Yersinia pseudotuberculosis



A scanning electron micrograph (SEM) showing numerous spherical Staphylococcus aureus bacteria. The bacteria are arranged in clusters and are situated on a surface composed of several parallel, elongated, and slightly curved ridges. The bacteria appear as bright, textured spheres against the darker, more uniform background of the ridges.

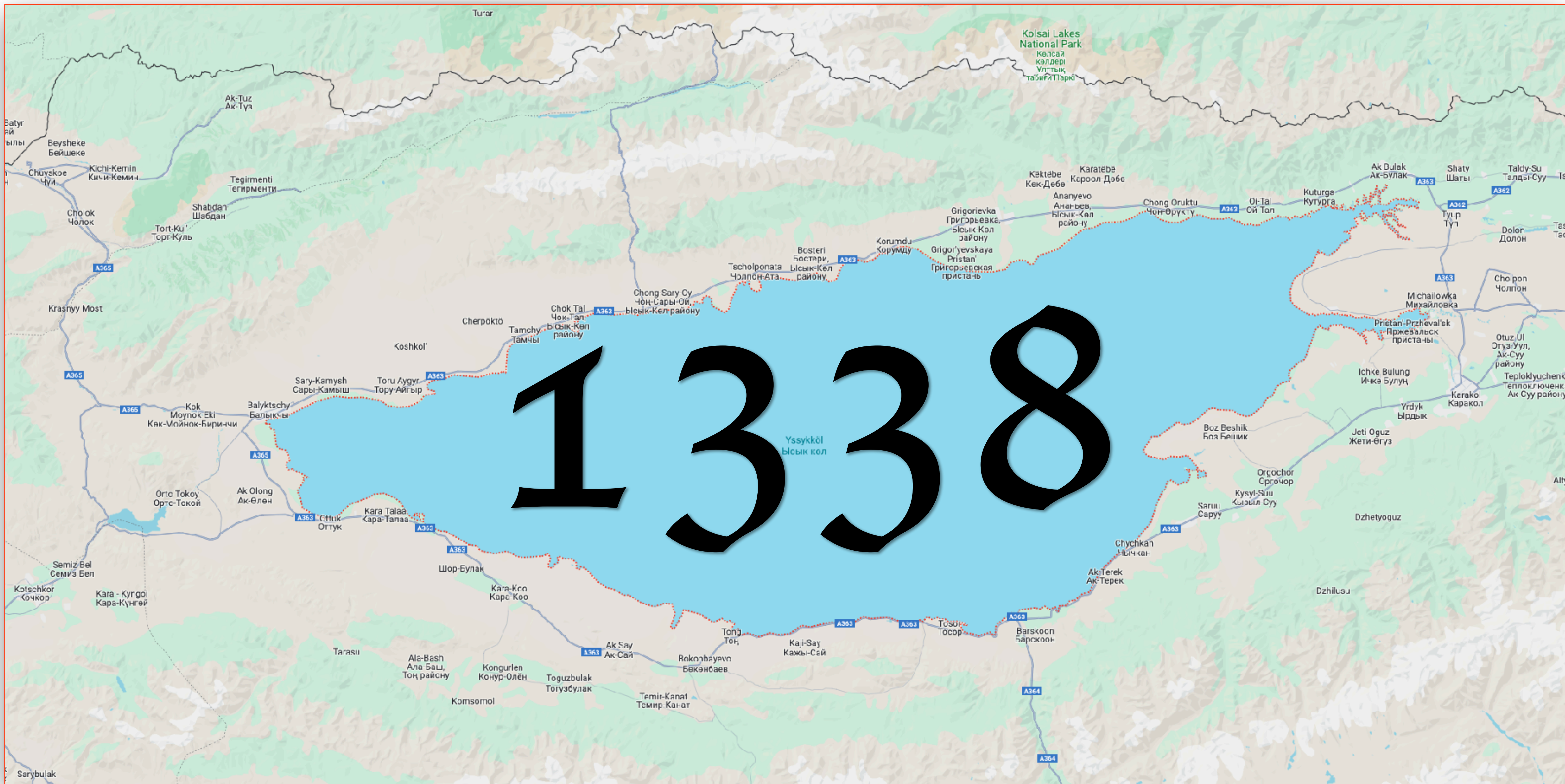
Staphylokokkus aureus





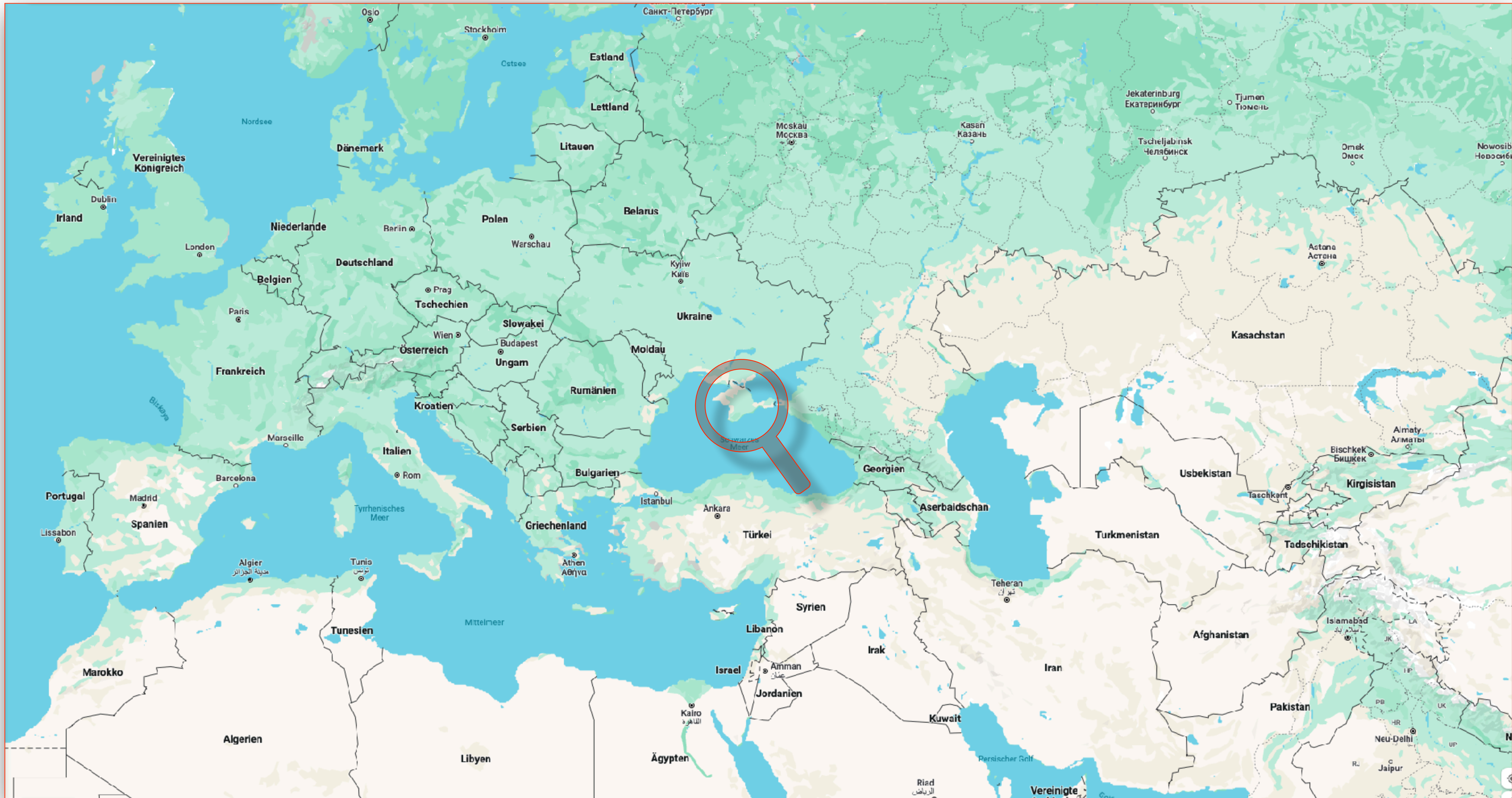
Yersinia pestis





Yssykköl-See/Kirgisistan





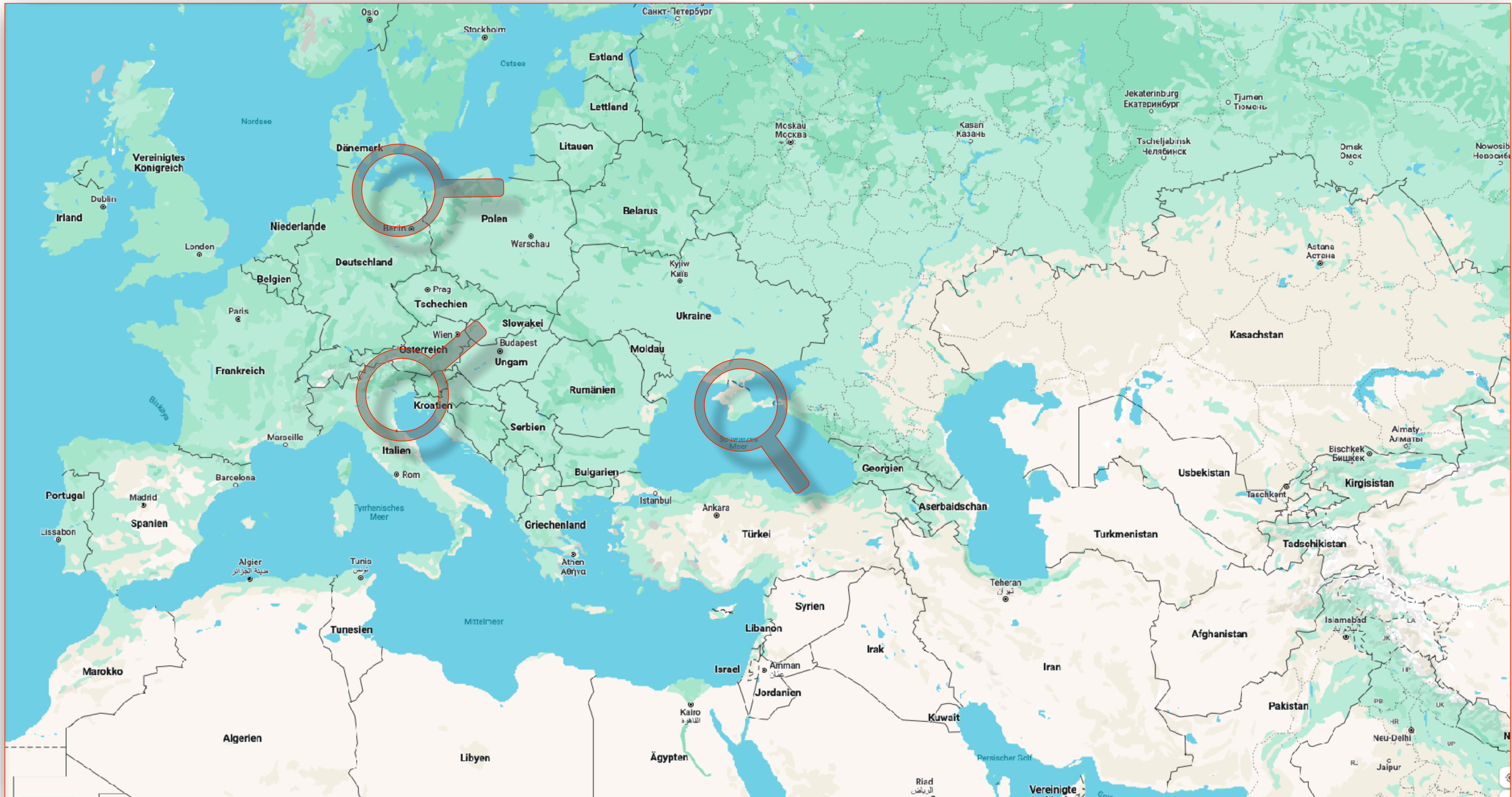


Kaffa/Feodosija

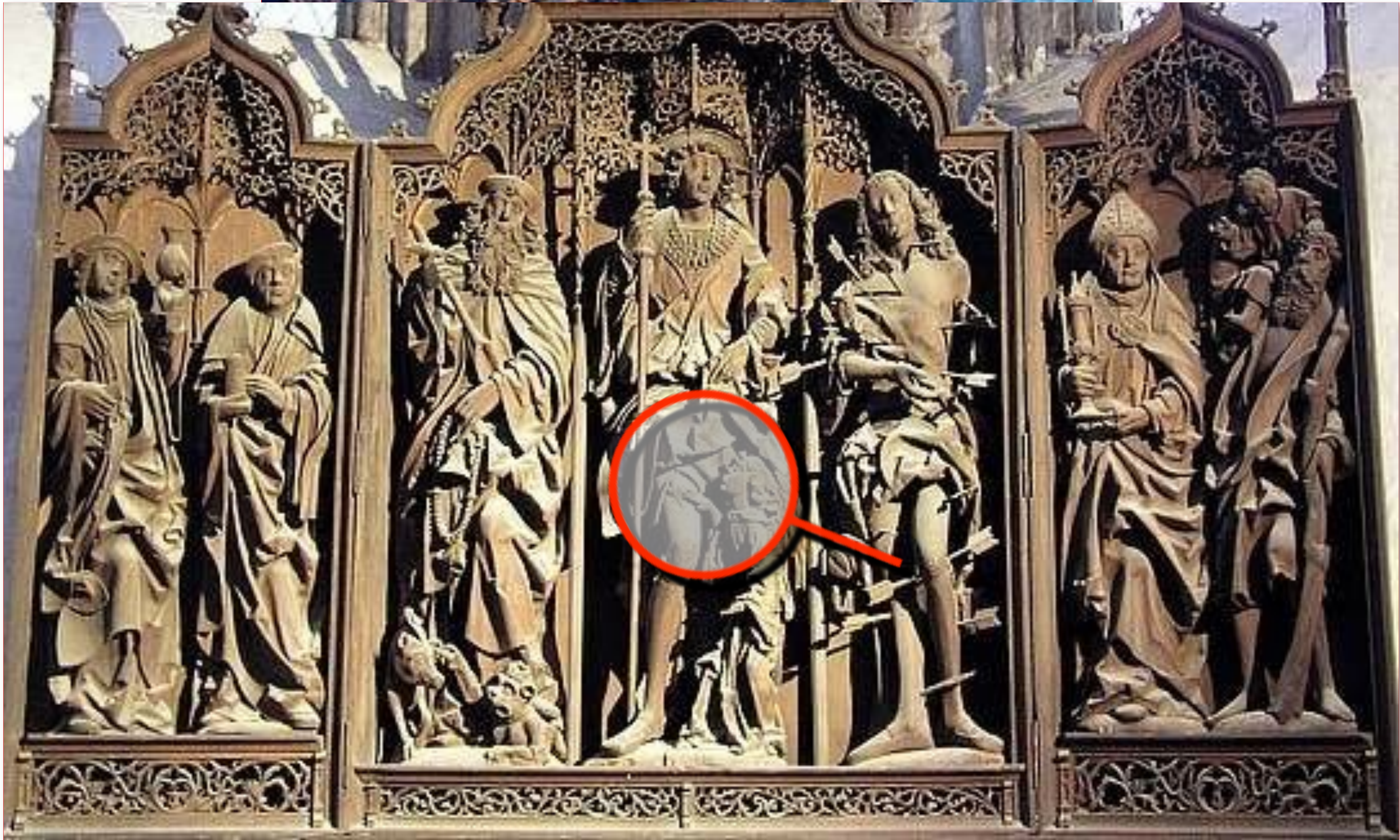
Carlo Bossoli: Feodosia, 1856











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Impf-Schein

über eine der gesetzlichen Pflicht genügende Pockenschutz-Erstimpfung.

Impfliste-Revier **XIV a** Lfde. Nr. *8*
(Entsprechend der amtlichen Liste der zur Erstimpfung vorzustellenden Impflichtigen auszufüllen.)

Impfbezirk Frankfurt am Main

Heberhard René Gottschalk
(Vor- und Zuname des Impflings)

geboren am *3. 7.* 19*16* in **Frankfurt a. M.**
(Kreis)

wurde am *13. 4. 59* zum *1.* Male mit Erfolg gegen Pocken geimpft.

Durch diese Impfung ist der gesetzlichen Pflicht (gemäß Impfgesetz vom 8. April 1874) genügt.

Frankfurt a. M., den *20. 4. 59*



R. Gottschalk
(Unterschrift des Arztes)

Impfarzt

(Eigenschaft - Arzt oder Impfarzt)

Anmerkung: Bei 1 bis 2 maliger **erfolgloser** Erstimpfung ist der blaue Impfvordruck zu verwenden.

Der letzte Pockenpatient



Labormitarbeiter finden vergessene Pockenviren

WASHINGTON, 9. Juli (dpa/AFP). In einem Labor in den Vereinigten Staaten haben Mitarbeiter vergessene Fläschchen mit Pockenviren entdeckt. Die wohl aus den fünfziger Jahren stammenden Glasfläschchen mit der Aufschrift „Variola“ (lateinisch für Pocken) seien in einem nicht genutzten Teil eines Lagerraums in dem Labor der Lebensmittel- und Medikamentenbehörde (FDA) in Bethesda, Maryland gefunden worden, teilte die amerikanische Gesundheitsbehörde CDC mit. Die Fläschchen seien gut verschlossen gewesen, so dass für das Laborpersonal keine Gefahr bestanden habe. Sie seien nach der Entdeckung sofort gesichert und in ein Hochsicherheitslabor in Atlanta zur Prüfung gebracht worden. Dort wurde die DNA von Pockenviren nachgewiesen, unsicher war noch, ob die Erreger in einer Kulturlösung auch wachsen können. Sobald die Testergebnisse vorlägen, was bis zu zwei Wochen dauern könne, würden die Proben zerstört. Nach den internationalen Regeln darf nur jeweils ein Labor in den Vereinigten Staaten und Russland die Erreger der seit Jahrzehnten ausgerotteten Krankheit aufbewahren. Pocken sind hochansteckend und verlaufen oftmals tödlich. Der letzte Fall trat 1977 in Somalia auf.



MARCH OF DIMES





Report

Ancient *Mycobacterium leprae* genome reveals medieval English red squirrels as animal leprosy host

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<https://doi.org/10.1016/j.cub.2024.04.006>

SUMMARY

Leprosy, one of the oldest recorded diseases in human history, is still a global health burden in some regions, such as sub-Saharan Africa, India, and Latin America, with over 200,000 cases every year.^{1,2} Although ancient DNA has revealed that *Mycobacterium leprae* is the causative agent, *M. leprae* have elucidated the disease's transmission routes, but the role of animal hosts and interspecies transmission in the past remains unexplored. Here, we studied 25 human and 12 squirrel samples from a medieval English city well known for its leprosarium and connect it to four medieval *M. leprae* genomes, including one from a red squirrel. Phylogenetic analysis revealed a phylogenetic placement of all strains on branch 3 of the *M. leprae* tree, with the red squirrel strain and one newly reconstructed medieval human strain being more closely related to some medieval human strains from Winchester, indicating a yet-undetected circulation of *M. leprae* in non-human hosts in the Middle Ages. Our study represents the first One Health approach for *M. leprae* in archaeology, which is centered around a medieval animal host strain, and highlights the future capability of such approaches to understand the disease's zoonotic past and current potential.

RESULTS AND DISCUSSION

During the COVID-19 pandemic, the zoonotic potential of both new and millennia-old re-emerging infectious diseases and their multidrug resistance took center stage in modern society.^{1,8-15} This calls for the development of new perspectives and scientific tools for disease characterization, prediction, and eradication. Interdisciplinary and collaborative approaches, such as One Health studies,¹⁶ have come to the forefront to better understand disease dynamics and the complexity of factors that lead to adverse health outcomes.

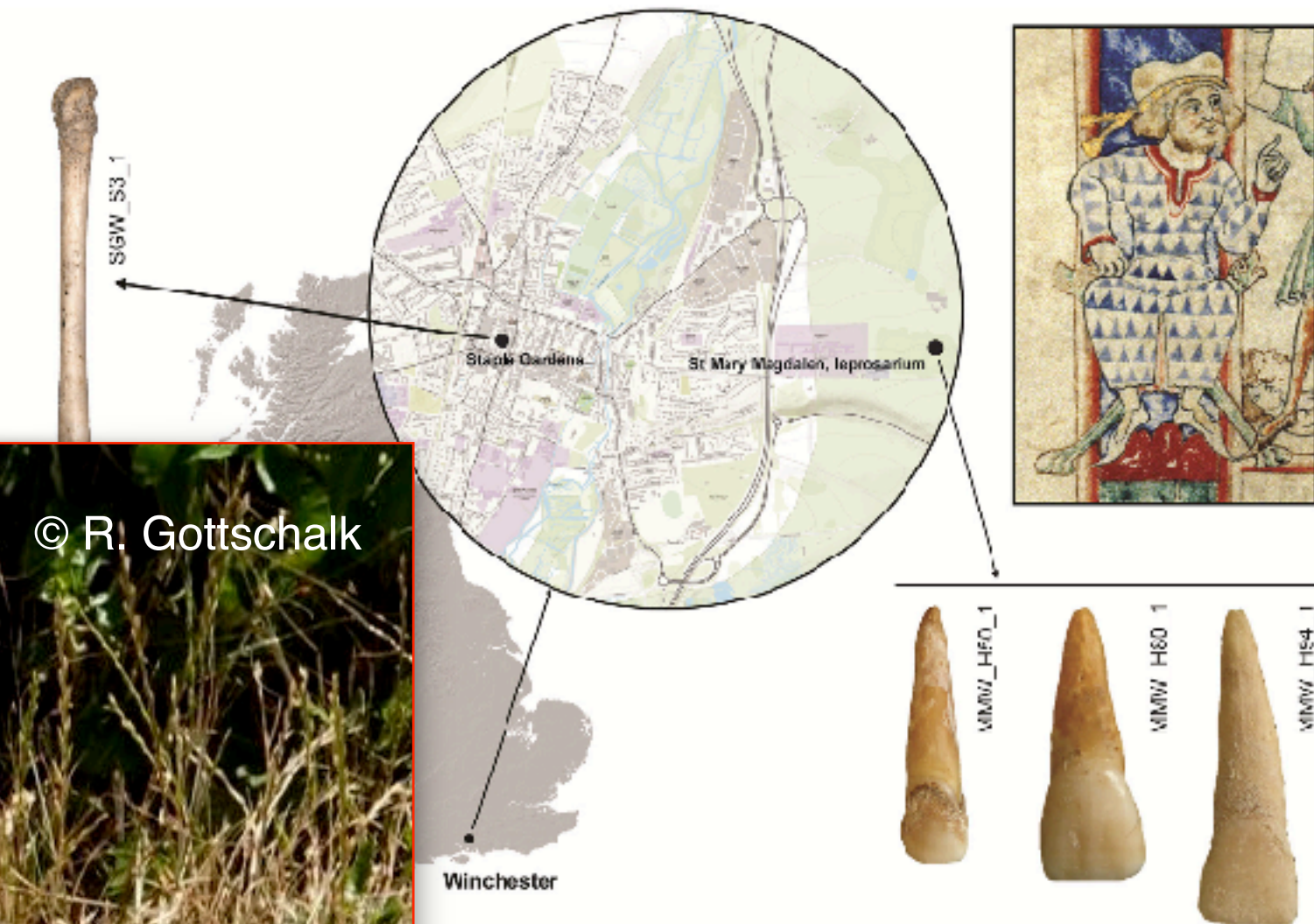
Although zoonotic diseases have become increasingly prominent in modern health agendas, historical zoonoses have

received scant attention, despite the potential importance of earlier transmission events in shaping past and present health landscapes.^{17,18} Essential in the evolution and persistence of zoonotic pathogens are animal hosts,¹³ which have been largely omitted from most studies on past diseases due to the lack of pathological and genetic research on zooarchaeological remains.²⁰ Without full pathogen genomes from archaeological animals, our understanding of long-term disease dynamics and animal-pathogen-human-environment interactions is hindered, as these are essential for contextualizing current trends and identifying potential spillover or reemergence risks.

Leprosy is mainly caused by *M. leprae* and to a lesser extent by *M. lepromatosis* and can lead to chronic infection, nerve



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Magdalen and Staple Gardens in Winchester (center circle), within the UK. The manuscript page shows the three human samples that tested positive for *M. leprae*. Top left shows red squirrel sample that tested positive for *M. leprae*. Bottom left shows a red squirrel in a 15th century Book of Hours.

dry skin in human and animal hosts, and disease in history for both agents, the Americas and Europe have been studied.^{5,6,25,26} These

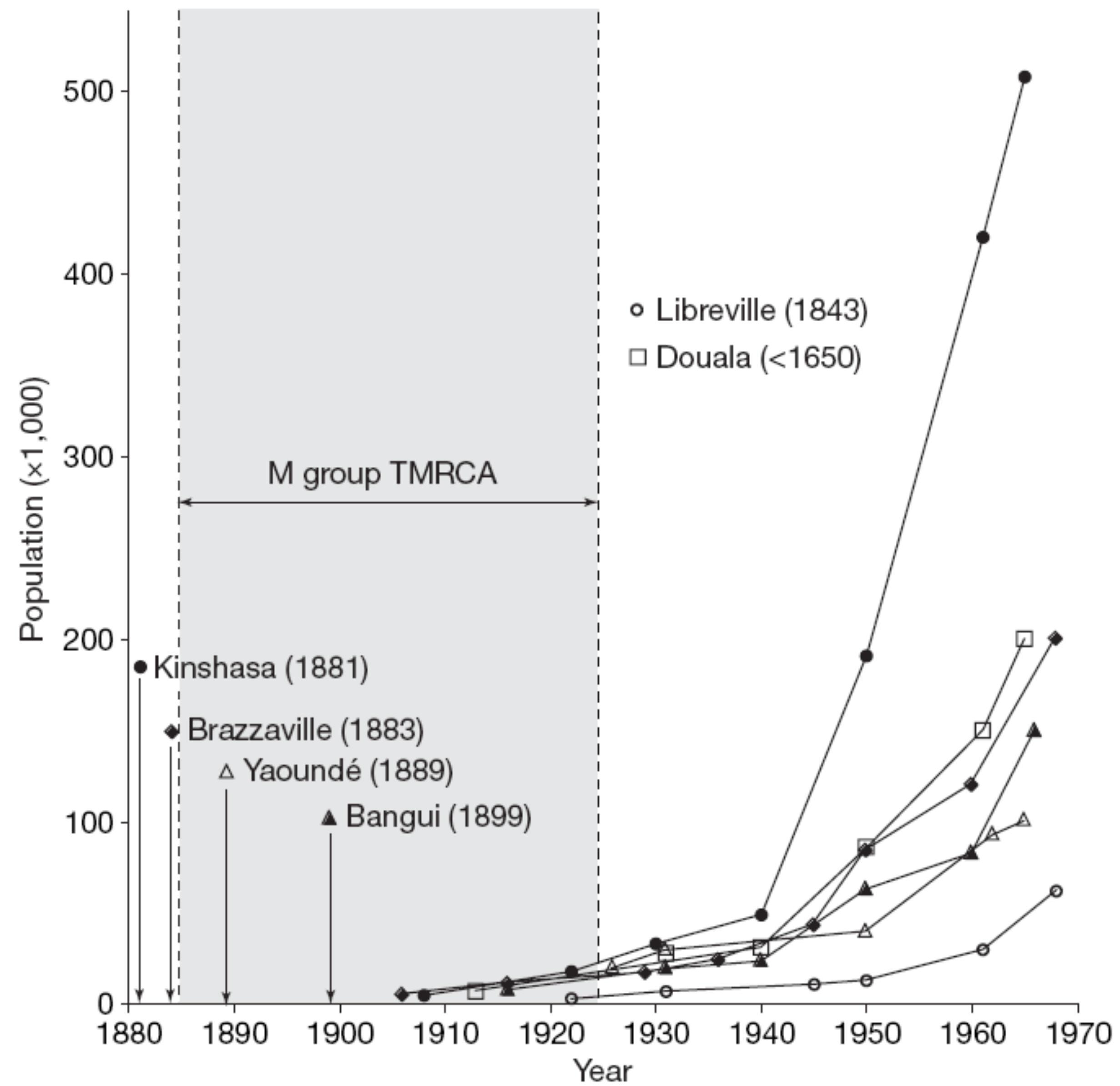
findings are consistent with the strain, insinuating a historic transmission event. Even today, however, the mode of transmission between people, let alone the mode and direction of transmission between different potential animal hosts, is poorly understood. As an obligate intracellular pathogen, survival outside a host is unlikely, making the coexistence of animal and human hosts a likely factor in leprosy persistence. *M. leprae* has also been found in soil and water, suggesting a possible environmental component in the chain of transmission, though specifics remain unknown.²⁷ A better understanding of the significance, type, and contribution of all hosts in transmission is essential in leprosy eradication.^{2,28} This, combined with potential historic interspecies transmission, makes leprosy an excellent focus for a first deep-time One Health pilot study. We present such a One Health approach by studying the historic and archaeological context of ancient cases of leprosy in humans and squirrels. We reconstruct four medieval *M. leprae* genomes, including a 2.2-fold average coverage genome isolated from a red squirrel bone, and contextualize them with ancient and modern data to decipher possible modes of transmission

in medieval England and potential risk factors for transmission and evolution in this animal host today.

Opportunities for transmission in the medieval era

Extensive opportunities for transmission between humans and squirrels in the Middle Ages are visible in historic sources on the fur trade and petkeeping. Squirrel fur was by far the most widely used fur to trim and line garments in the High and Late Middle Ages.^{29,30} In England, most of the skins came from Scandinavia, the Baltic, Eastern Europe, and Russia, along with Ireland, Scotland, and Italy. Squirrels would be trapped in the wild throughout the year and the skins would be transported for trade. Staggering quantities of squirrel skins were imported: for example, the English exchequer customs accounts for 1384 record 377,200 imported squirrel skins (with all other animal skins totaling less than 15,000). Vair, a way of laying out the backs and bellies of squirrel skins in a checked pattern (Figure 1), even became a heraldic tincture because it was so widely used in clothing.³¹ Medieval iconography is replete with individuals wearing garments lined with squirrel fur.³² Squirrels were also widely kept as pets. The practice is detailed in various sources, from records of episcopal visitations to the purchase of collars and leashes and the collared pet squirrels that abound in the margins of manuscripts.³³ Squirrels intended as pets were captured in the wild as kits and raised close to humans, often sitting on laps or shoulders.³⁴





Bevor der damalige Präsident
Reagan das Wort „AIDS“ erwähnte,
waren in den USA über 4.000 Menschen
an dem HI-Virus gestorben ...

Mortalitätsrate pro 100.000 pro Jahr

2.000

1.500

1.000

500

USA

alle Todesursachen

nicht-infektiöse Ursachen

Influenza-Pandemie

↑
Toilettenpapier

↑
Beginn der
Trinkwasser-Chlorierung

Einführung des Penicillins

↓
Einführung der Salk-Vakzine

Infektionskrankheiten

1900

1920

1940

1960

1980

2000

Jahr

HISTORICAL ARTICLE

A Tribute to Toilet Paper

Walter T. Hughes

*From the Division of Infectious Disease, St. Jude Children's
Research Hospital, Memphis, Tennessee*

In modern use, toilet paper would seem to play an important role as a barrier to the transmission of enteric infection by the fecal-manual-oral route. A historical review reveals a dearth of information on this topic. The remarkable compliance with the hygienic practice of toilet paper use is in contrast to the more limited compliance with hand-washing policies touted universally as a sound infection-control measure.

The value of modern sewage systems, waste disposal, water purification, and personal hygienic practices is well known in the prevention of infectious diseases. Antibiotics and vaccines are lauded as miracles of modern medicine. Skilled epidemiologic studies,

soldiers per year. In the Spanish-American War (also before toilet paper), this rate more than doubled [1].

The report of the Surgeon General of the Army in 1905 emphasized the importance of the infant science of hygiene and noted that "the issue of toilet



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