

VOYAGES IN TUBERCULOSIS

A PROJECT OF THE CENTER FOR NEUROSCIENCE AND CELL BIOLOGY OF THE UNIVERSITY OF COIMBRA, PORTUGAL

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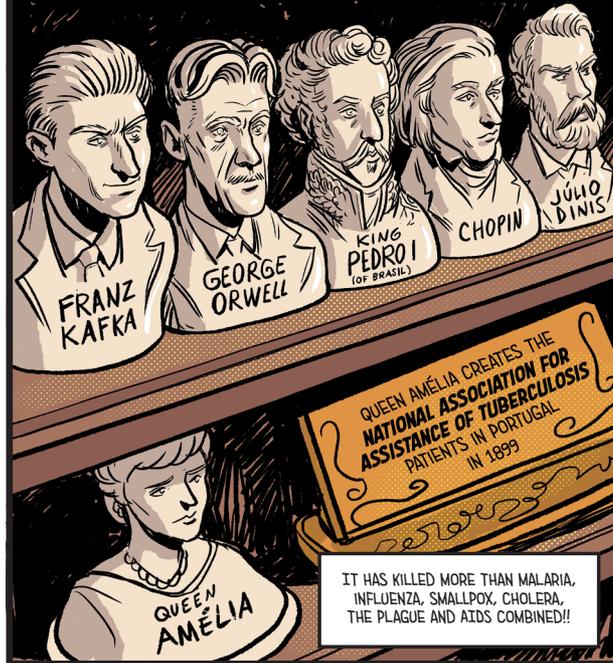
MYCOBACTERIA ARE A GROUP OF BACTERIA THAT CAUSE SEVERAL SERIOUS INFECTIONS. THE BEST KNOWN IS **MYCOBACTERIUM TUBERCULOSIS**, THE CAUSAL AGENT OF TUBERCULOSIS.



THIS BACTERIUM WAS IDENTIFIED AND LINKED TO THE DISEASE IN 1882 BY **ROBERT KOCH**. BUT TUBERCULOSIS IS A VERY ANCIENT DISEASE, THE EARLIEST EVIDENCE COMING FROM NEOLITHIC SKELETONS (~7000 YEARS B.C.) AND EGYPTIAN MUMMIES.



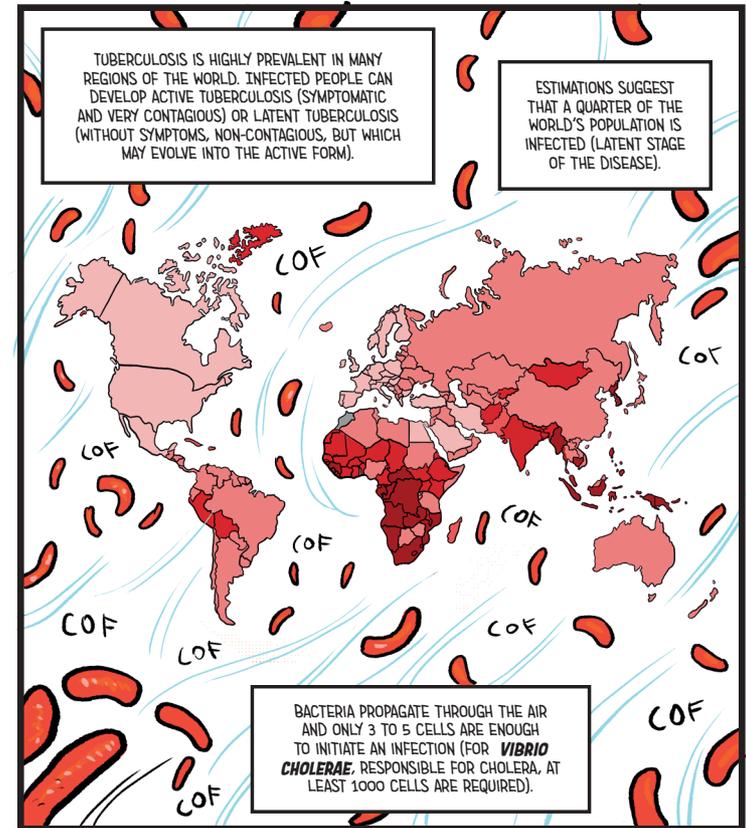
TUBERCULOSIS HAS KILLED MORE THAN ONE BILLION PEOPLE OVER THE LAST 200 YEARS, INCLUDING MANY FAMOUS INDIVIDUALS.



IT HAS KILLED MORE THAN MALARIA, INFLUENZA, SMALLPOX, CHOLERA, THE PLAGUE AND AIDS COMBINED!!

TUBERCULOSIS IS HIGHLY PREVALENT IN MANY REGIONS OF THE WORLD. INFECTED PEOPLE CAN DEVELOP ACTIVE TUBERCULOSIS (SYMPTOMATIC AND VERY CONTAGIOUS) OR LATENT TUBERCULOSIS (WITHOUT SYMPTOMS, NON-CONTAGIOUS, BUT WHICH MAY EVOLVE INTO THE ACTIVE FORM).

ESTIMATIONS SUGGEST THAT A QUARTER OF THE WORLD'S POPULATION IS INFECTED (LATENT STAGE OF THE DISEASE).

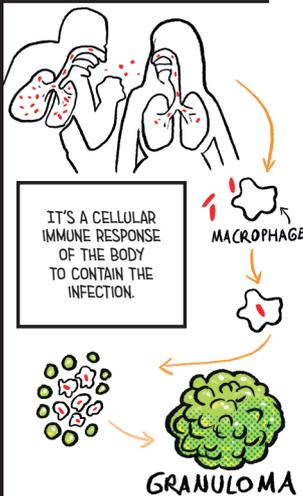


BACTERIA PROPAGATE THROUGH THE AIR AND ONLY 3 TO 5 CELLS ARE ENOUGH TO INITIATE AN INFECTION (FOR **VIBRIO CHOLERAE**, RESPONSIBLE FOR CHOLERA, AT LEAST 1000 CELLS ARE REQUIRED).

THE BACTERIUM IS MAINLY TRANSMITTED THROUGH COUGHING AND SNEEZING BY PATIENTS WITH ACTIVE TUBERCULOSIS, MANY OF WHICH MAY NOT YET SHOW CHARACTERISTIC SYMPTOMS, SUCH AS PERSISTENT COUGH WITH SPUTUM AND SOMETIMES CONTAINING BLOOD, LOW-GRADE FEVER, WEAKNESS, BREATHING IMPAIRMENT, NIGHT SWEATS, LOSS OF APPETITE AND WEIGHT LOSS.

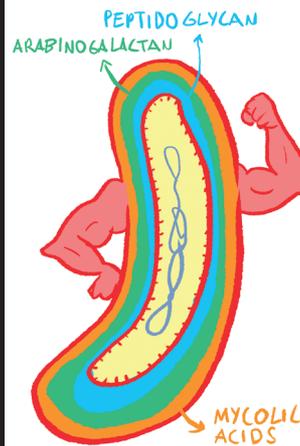


AFTER ENTERING THE LUNGS, **MYCOBACTERIUM TUBERCULOSIS** CAN TRIGGER THE FORMATION OF A STRUCTURE CALLED **GRANULOMA**.



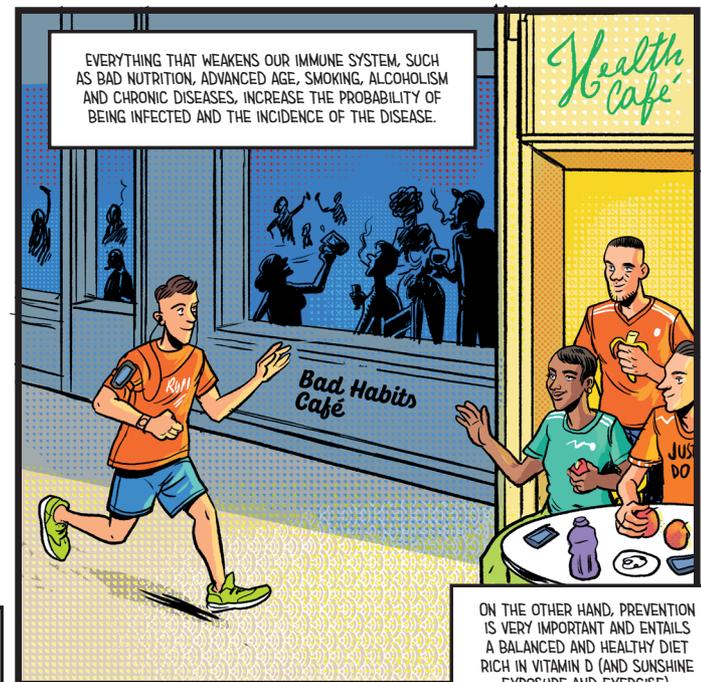
AFTER SOME TIME, THE FIBROUS STRUCTURE FORMED CALCIFIES AND CAN BE DETECTED BY X-RAY.

MYCOBACTERIA ARE CHARACTERIZED BY THEIR UNIQUE AND ROBUST CELL WALL, WHICH PROTECTS THEM LIKE A COCCON OR AN ARMOR.



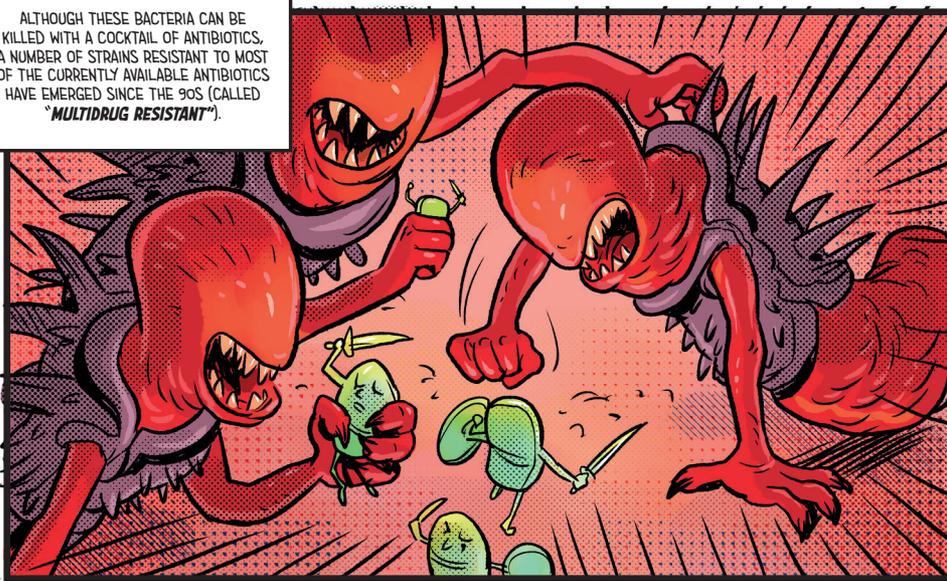
AND WHICH ALSO HELPS THEM ENTER THE BODY AND INACTIVATE CELLS OF THE IMMUNE SYSTEM THAT PROTECT US FROM INFECTIONS, WEAKENING OUR DEFENSES.

EVERYTHING THAT WEAKENS OUR IMMUNE SYSTEM, SUCH AS BAD NUTRITION, ADVANCED AGE, SMOKING, ALCOHOLISM AND CHRONIC DISEASES, INCREASE THE PROBABILITY OF BEING INFECTED AND THE INCIDENCE OF THE DISEASE.



ON THE OTHER HAND, PREVENTION IS VERY IMPORTANT AND ENTAILS A BALANCED AND HEALTHY DIET RICH IN VITAMIN D (AND SUNSHINE EXPOSURE AND EXERCISE).

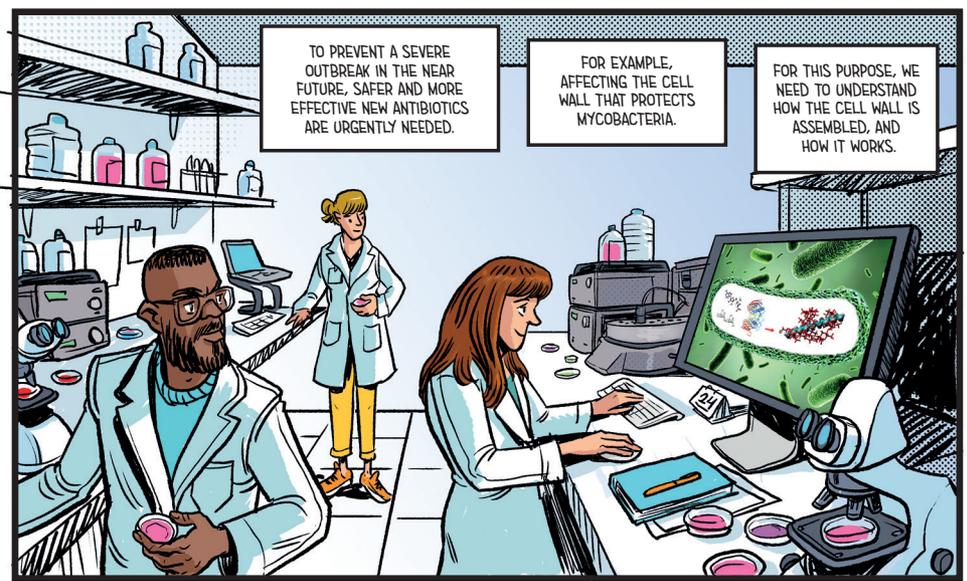
ALTHOUGH THESE BACTERIA CAN BE KILLED WITH A COCKTAIL OF ANTIBIOTICS, A NUMBER OF STRAINS RESISTANT TO MOST OF THE CURRENTLY AVAILABLE ANTIBIOTICS HAVE EMERGED SINCE THE 90S (CALLED "MULTIDRUG RESISTANT").



TO PREVENT A SEVERE OUTBREAK IN THE NEAR FUTURE, SAFER AND MORE EFFECTIVE NEW ANTIBIOTICS ARE URGENTLY NEEDED.

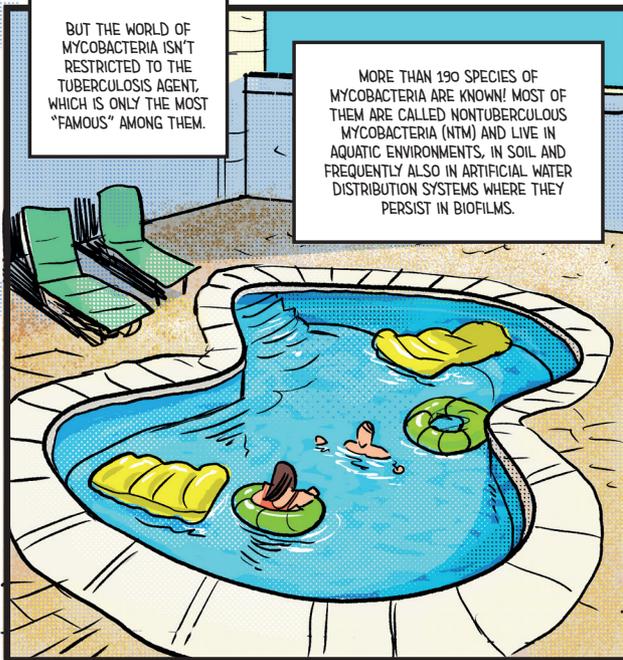
FOR EXAMPLE, AFFECTING THE CELL WALL THAT PROTECTS MYCOBACTERIA.

FOR THIS PURPOSE, WE NEED TO UNDERSTAND HOW THE CELL WALL IS ASSEMBLED, AND HOW IT WORKS.

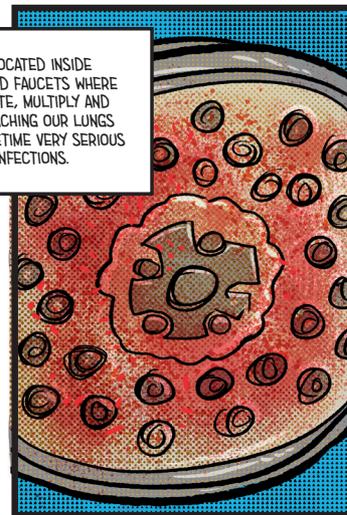


BUT THE WORLD OF MYCOBACTERIA ISN'T RESTRICTED TO THE TUBERCULOSIS AGENT, WHICH IS ONLY THE MOST "FAMOUS" AMONG THEM.

MORE THAN 190 SPECIES OF MYCOBACTERIA ARE KNOWN! MOST OF THEM ARE CALLED NONTUBERCULOUS MYCOBACTERIA (NTM) AND LIVE IN AQUATIC ENVIRONMENTS, IN SOIL AND FREQUENTLY ALSO IN ARTIFICIAL WATER DISTRIBUTION SYSTEMS WHERE THEY PERSIST IN BIOFILMS.



ESPECIALLY LOCATED INSIDE SHOWERHEADS AND FAUCETS WHERE THEY ACCUMULATE, MULTIPLY AND LIVE BEFORE REACHING OUR LUNGS AND CAUSING SOMETIME VERY SERIOUS CHRONIC INFECTIONS.



LITTLE IS KNOWN ABOUT THE METABOLISM AND BEHAVIOR OF NTM, WHICH ARE EXTREMELY RESISTANT TO ADVERSE CONDITIONS SUCH AS HIGH TEMPERATURES, ACIDIC ENVIRONMENTS AND DRYNESS, AMONG OTHER STRESS CONDITIONS.

AND WE NEED TO UNDERSTAND THEM BETTER SO THAT THEY NEVER REACH THE "FAME AND REPUTATION" LEVEL OF THEIR DEADLIEST RELATIVE!

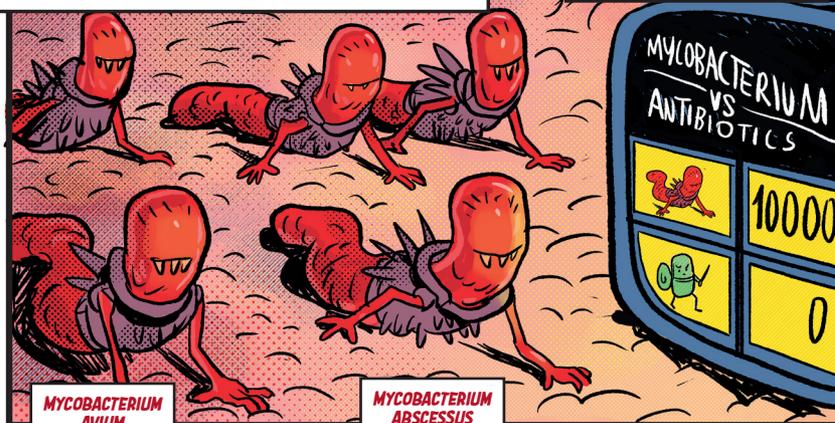


NTM MAINLY AFFECT IMMUNOCOMPROMISED PEOPLE, THE ELDERLY, THE CHRONICALLY ILL, PEOPLE WITH PREVIOUS LUNG DISEASES, ETC. TREATING INFECTIONS BY SOME STRAINS OF **MYCOBACTERIUM AVIUM** AND **MYCOBACTERIUM ABSCESSUS** IS DIFFICULT, LENGTHY AND REQUIRES ADMINISTRATION OF ANTIBIOTIC COCKTAILS DIFFERENT FROM THE ONES USED FOR TUBERCULOSIS TREATMENT.

IN THE CASE OF **MYCOBACTERIUM ABSCESSUS**, SOME STRAINS ARE OFTEN INDESTRUCTIBLE WITH THE ANTIBIOTIC ARSENAL AVAILABLE TO US.



A BIOFILM IS A COMPLEX AND STRUCTURED BIOLOGICAL MATRIX THAT ADHERES TO SURFACES AND ACCOMMODATES MICROBIOLOGICAL COMMUNITIES WHILE PROTECTING THEM FROM EXTERNAL AGGRESSIONS.



MYCOBACTERIUM AVIUM

MYCOBACTERIUM ABSCESSUS

ANDRÉ CAETANO