



# LEISH MANIASIS

**CRACKING THE  
PARASITE  
CODE**



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centre  
integrative  
parasitology**



'LEISHMANIASIS: CRACKING THE PARASITE CODE' IS WRITTEN AND ILLUSTRATED BY EDWARD ROSS, FIRST RELEASED IN 2023.

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**WRITTEN AND ILLUSTRATED BY  
EDWARD ROSS**



PORTUGAL, 20 YEARS AGO.

I STILL REMEMBER THAT DAY.

OUR DOG WAS SICK

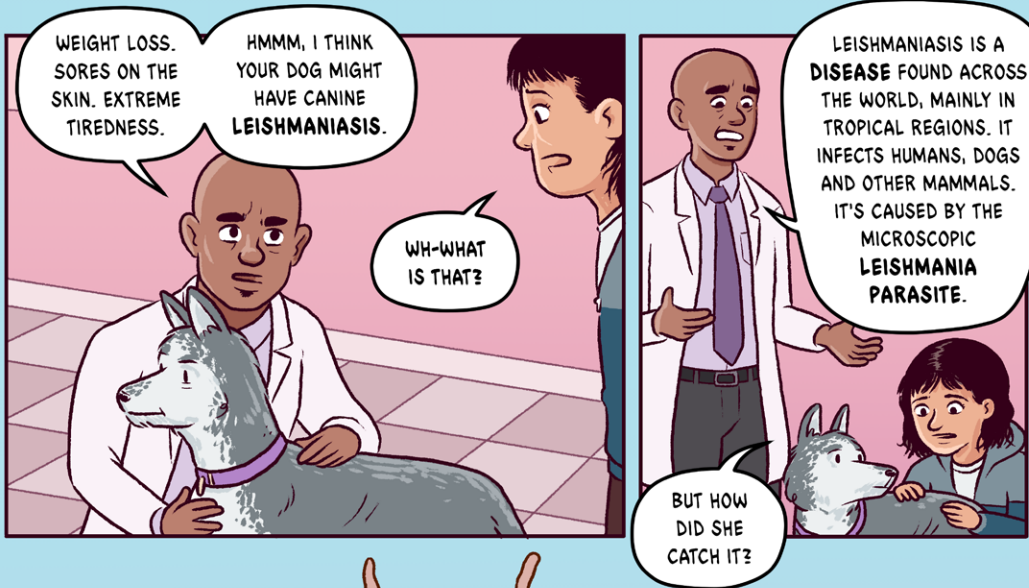
AND WE DIDN'T KNOW  
WHAT WAS WRONG  
WITH HER.

NEXT,  
PLEASE!

I'M ANDREIA. HER NAME'S  
NANCY. DO YOU KNOW WHAT'S  
WRONG WITH HER?

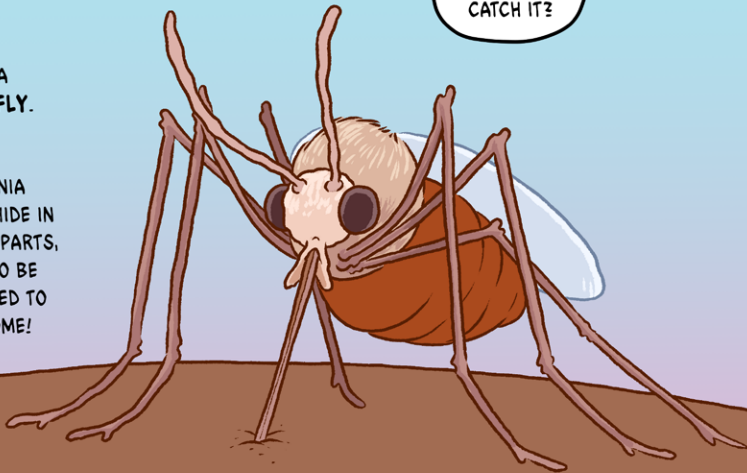
WELL ANDREIA,  
LET'S SEE...



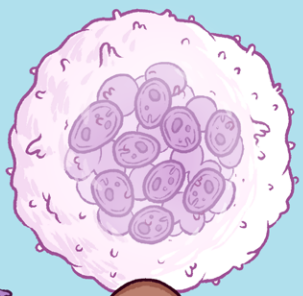


THE BITE OF A FEMALE SAND FLY.

LEISHMANIA PARASITES HIDE IN THEIR MOUTHPARTS, WAITING TO BE TRANSFERRED TO A NEW HOME!



ONCE INSIDE THE BODY, THE PARASITES GET EATEN BY WHITE BLOOD CELLS.



BUT INSTEAD OF BEING DESTROYED THEY MULTIPLY, AND THEN BURST OUT TO INFECT MORE WHITE BLOOD CELLS!



AND WHEREVER THIS IS GOING ON IN THE BODY, IT CAUSES PROBLEMS...



**CUTANEOUS LEISHMANIASIS**  
THE MOST COMMON FORM, CAUSES LESIONS ON THE SKIN, WHICH HEAL SLOWLY AND MAY CAUSE DISABILITY.

**MUCOCUTANEOUS LEISHMANIASIS**  
MOST COMMON IN SOUTH AMERICA, THIS FORM DESTROYS THE MUCOUS MEMBRANES OF THE NOSE, MOUTH AND THROAT.

**VISCERAL LEISHMANIASIS**  
AFFECTS INTERNAL ORGANS, CAUSING FEVER AND WEIGHT LOSS. THIS IS THE MOST SERIOUS FORM AND CAN BE FATAL IF LEFT UNTREATED.

IT'S A SERIOUS PROBLEM IN 98 COUNTRIES AROUND THE WORLD, CAUSING MISERY TO HUMANS AND ANIMALS. AND NOW LITTLE NANCY HAS IT TOO.



POOR NANCY! CAN YOU HELP HER?

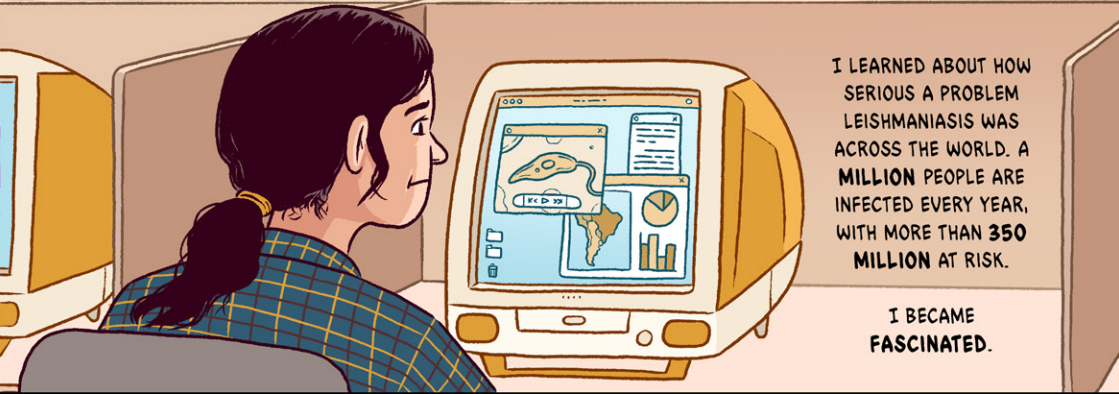


LET'S SEE WHAT WE CAN DO...

LEARNING ABOUT  
THESE TINY  
PARASITES HAD A  
HUGE EFFECT ON ME.

I NEEDED TO  
KNOW MORE.

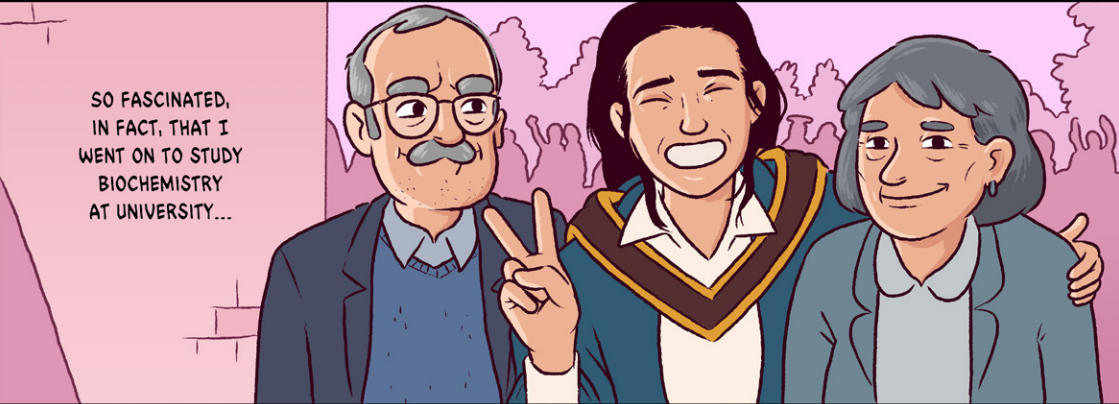
OH NANCY, HOW DOES  
SOMETHING SO SMALL  
CAUSE SO MUCH MISERY?!



I LEARNED ABOUT HOW  
SERIOUS A PROBLEM  
LEISHMANIASIS WAS  
ACROSS THE WORLD. A  
MILLION PEOPLE ARE  
INFECTED EVERY YEAR,  
WITH MORE THAN 350  
MILLION AT RISK.

I BECAME  
FASCINATED.

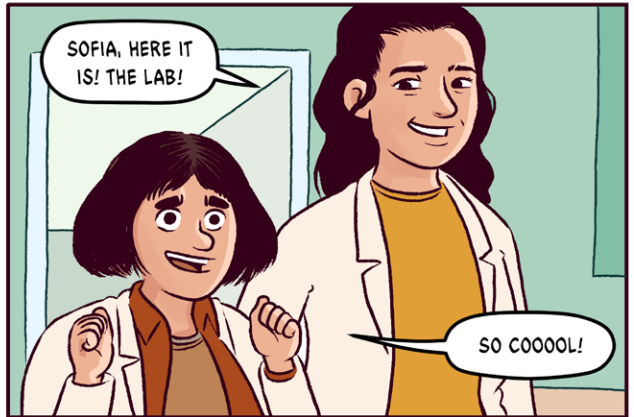
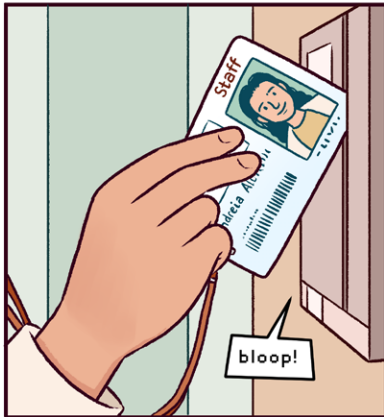
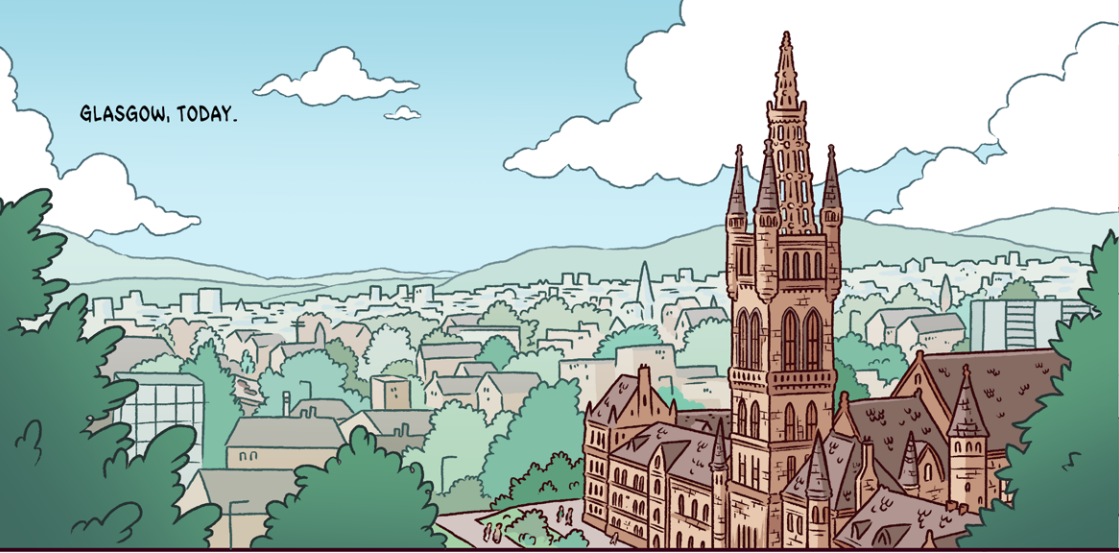
SO FASCINATED,  
IN FACT, THAT I  
WENT ON TO STUDY  
BIOCHEMISTRY  
AT UNIVERSITY...

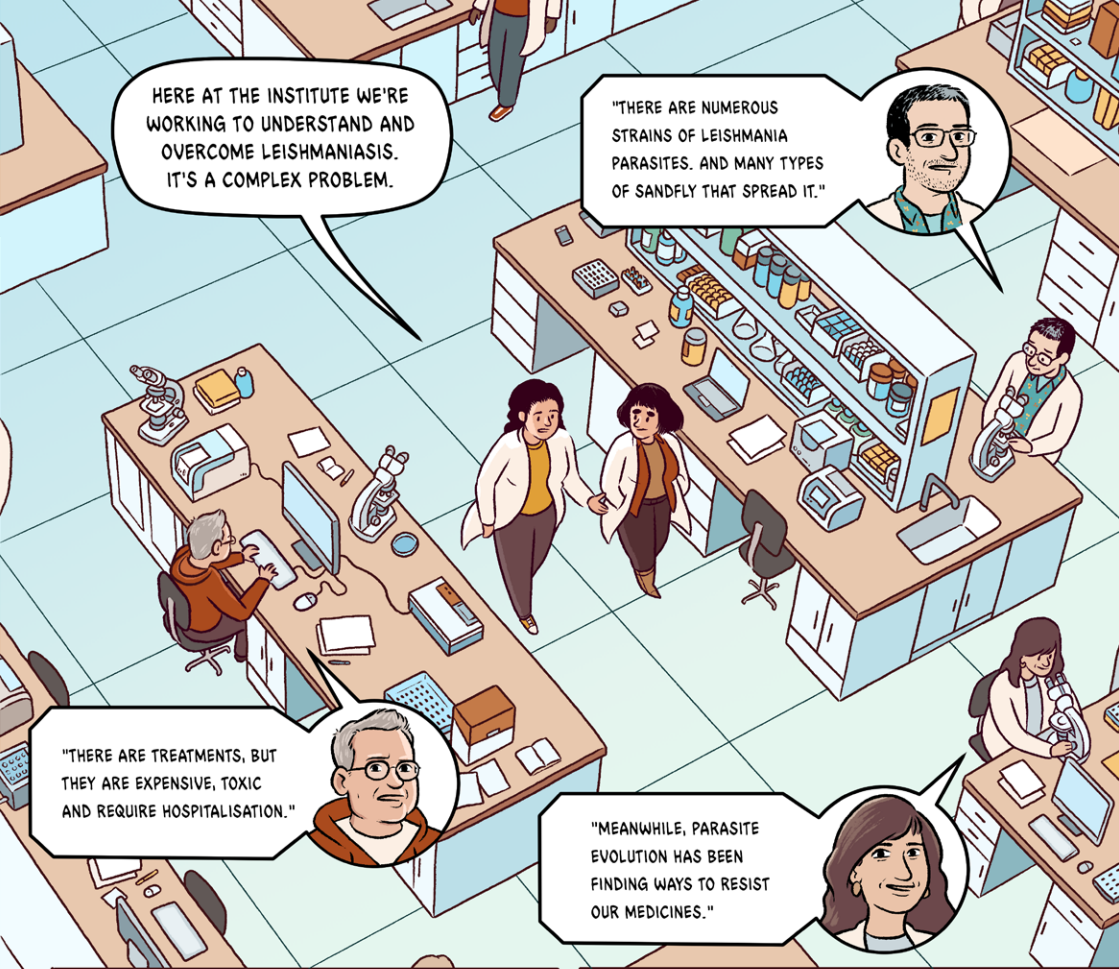


AND THEN MOVED ACROSS EUROPE TO  
PURSUE MY PASSION FOR PARASITES!




GLASGOW, TODAY.







HERE AT THE INSTITUTE WE'RE WORKING TO UNDERSTAND AND OVERCOME LEISHMANIASIS. IT'S A COMPLEX PROBLEM.




"THERE ARE NUMEROUS STRAINS OF LEISHMANIA PARASITES. AND MANY TYPES OF SANDFLY THAT SPREAD IT."



"THERE ARE TREATMENTS, BUT THEY ARE EXPENSIVE, TOXIC AND REQUIRE HOSPITALISATION."




"MEANWHILE, PARASITE EVOLUTION HAS BEEN FINDING WAYS TO RESIST OUR MEDICINES."




SOUNDS SERIOUS.

IT IS. THAT'S WHY WE'RE WORKING TO FIND LEISHMANIA'S WEAKNESSES, AND DESIGN NEW AND BETTER MEDICINES TO TARGET THEM.




SO HOW DO YOU FIND THE ACHILLES HEEL OF A PARASITE TOO SMALL TO SEE WITH THE NAKED EYE?

AH! THAT'S WHERE THEIR DNA COMES IN.

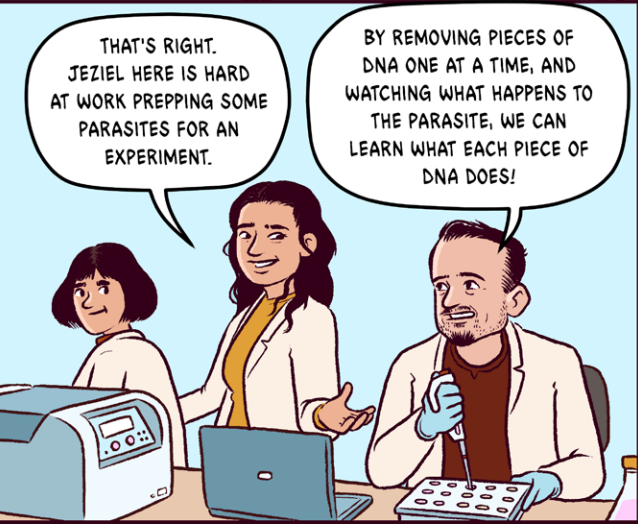


EVERY LIVING THING ON OUR PLANET USES DNA AS THE INSTRUCTION MANUAL FOR MAKING MORE OF ITSELF. THESE PARASITES ARE NO EXCEPTION.



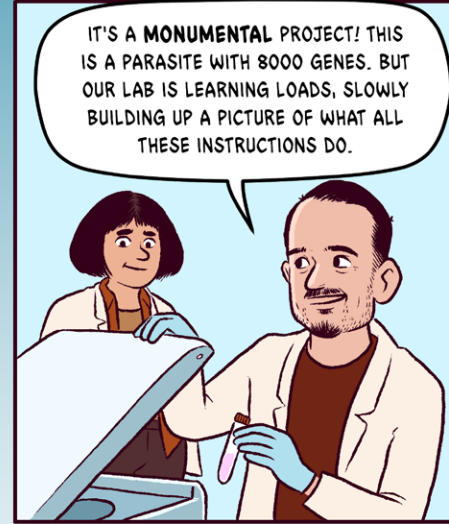
SO WHAT HAPPENS IF WE MESS WITH THOSE INSTRUCTIONS, CHANGING THE CODE, OR RIPPING OUT SOME PAGES ENTIRELY?

YOU'D GET SOME PRETTY WONKY PARASITES, I GUESS!




THAT'S RIGHT. JEZIEL HERE IS HARD AT WORK PREPPING SOME PARASITES FOR AN EXPERIMENT.

BY REMOVING PIECES OF DNA ONE AT A TIME, AND WATCHING WHAT HAPPENS TO THE PARASITE, WE CAN LEARN WHAT EACH PIECE OF DNA DOES!



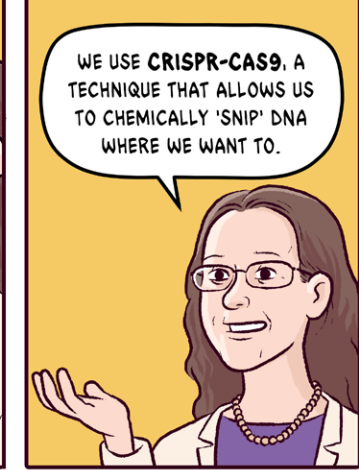
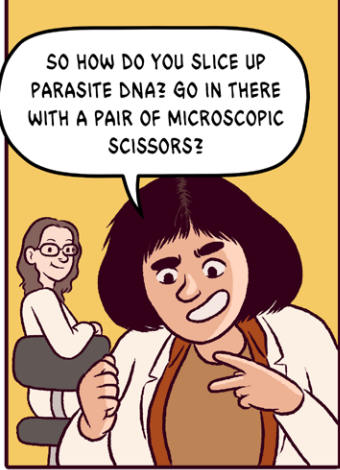
IT'S A **MONUMENTAL** PROJECT! THIS IS A PARASITE WITH 8000 GENES. BUT OUR LAB IS LEARNING LOADS, SLOWLY BUILDING UP A PICTURE OF WHAT ALL THESE INSTRUCTIONS DO.



AND IF A REMOVED PORTION OF DNA CAUSES BIG PROBLEMS FOR THE PARASITE, YOU HAVE A POTENTIAL ACHILLES HEEL ON YOUR HANDS!

EXACTLY!

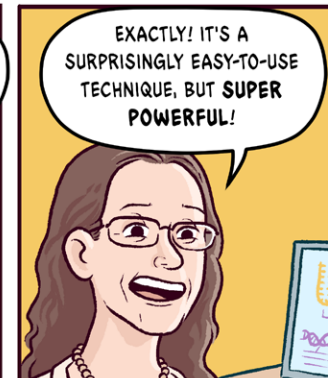
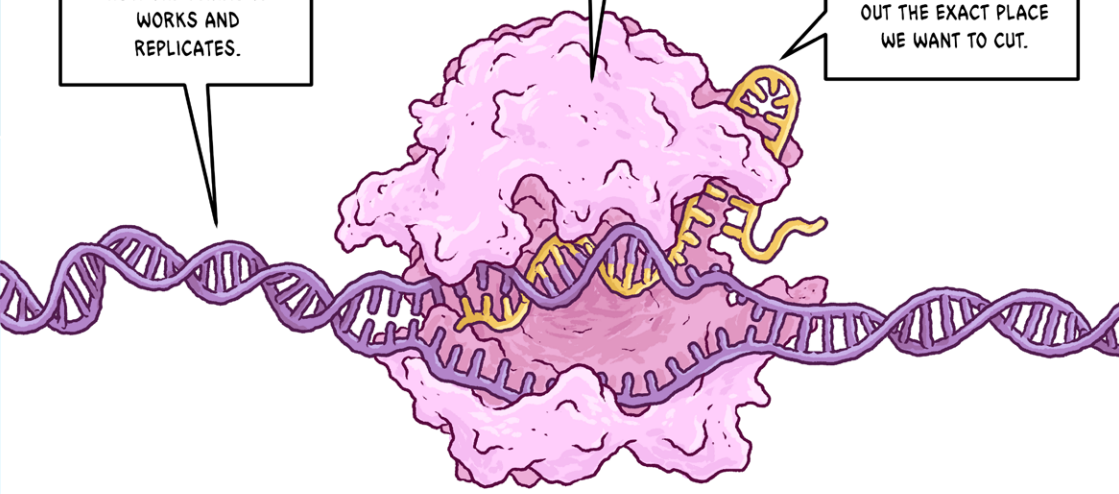


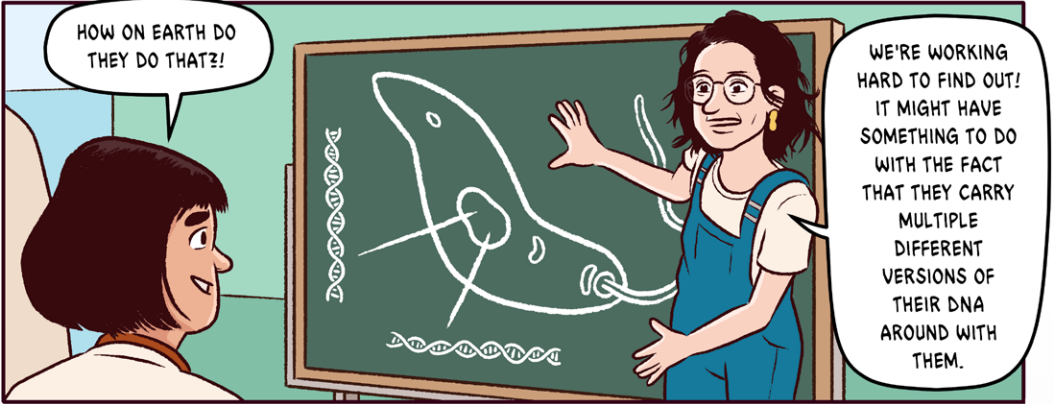
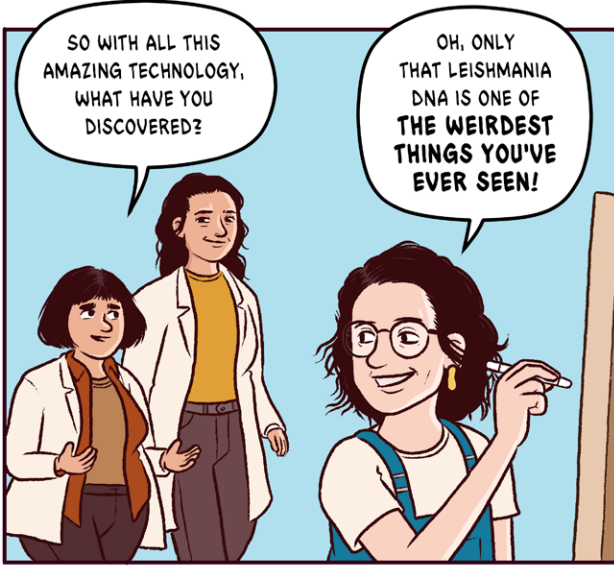


**PARASITE DNA** - THE INSTRUCTIONS FOR HOW THE PARASITE WORKS AND REPLICATES.

**CAS9 ENZYME** - THE MOLECULAR SCISSORS THAT SLICE UP DNA.

**GUIDE RNA** - A STRAND OF GENETIC MATERIAL WE'VE PROGRAMMED TO SEEK OUT THE EXACT PLACE WE WANT TO CUT.



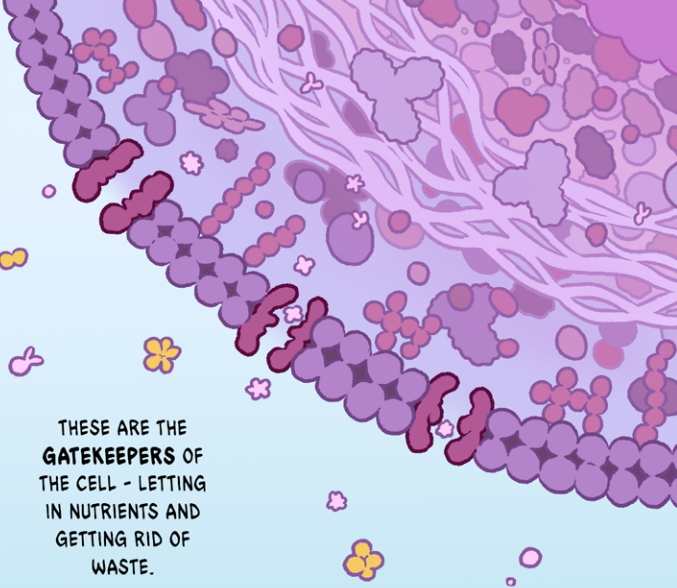


WITH THAT IN MIND, WE NEED TO FIND NEW WAYS TO TARGET THESE PARASITES.

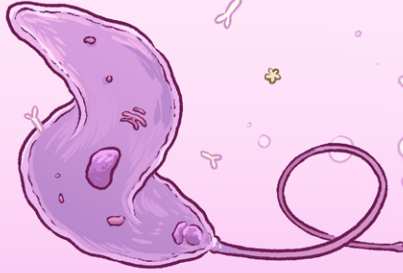
I'M INTERESTED IN LOOKING AT THE GENES FOR THE PARASITE'S TRANSPORTER PROTEINS.



THESE ARE THE **GATEKEEPERS** OF THE CELL - LETTING IN NUTRIENTS AND GETTING RID OF WASTE.



BY EDITING THESE GENES, WE'RE LEARNING HOW LEISHMANIA PARASITES SURVIVE INSIDE HOSTILE HOST BODIES.



HOPEFULLY, THIS KNOWLEDGE WILL REVEAL WAYS TO GET NEW MEDICINES PAST THE GATEKEEPERS, AND INSIDE THE PARASITE WHERE THEY CAN DO THEIR DAMAGE.

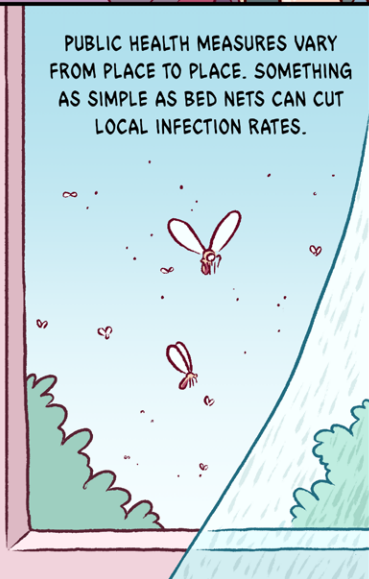
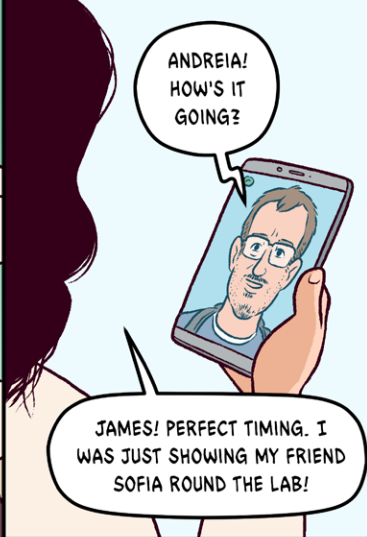
FOR THE WEAKPOINTS WE'VE IDENTIFIED, WE CAN DESIGN NEW TREATMENTS. BUT WE NEED TO SEE IF THEY WORK. THAT'S WHERE MIKE AND HIS TEAM COME IN.



WE TAKE POTENTIAL NEW MEDICINES AND EXPOSE THE PARASITES TO THEM! IT'S NOT ENOUGH TO KNOW THAT IT KILLS THE PARASITE... WE NEED TO KNOW HOW!











HERE IN ETHIOPIA, WE'VE SEEN PEOPLE MOVING FROM HIGHLAND AREAS, WHERE LEISHMANIASIS ISN'T COMMON, TO LOWLAND AREAS TO FIND WORK.


HERE THEY'RE EXPOSED TO LEISHMANIA PARASITES, AND THEIR BODIES DON'T HAVE THE IMMUNITY THAT LOCALS DO TO FIGHT IT OFF.



ADDED TO THIS, MANY PEOPLE HERE HAVE HIV - A DISEASE THAT AFFECTS THE IMMUNE SYSTEM. THIS LEAVES THEM MUCH MORE LIKELY TO GET SICK, OR EVEN DIE.



MY COLLEAGUE YEGNASEW HAS BEEN TRACKING SOME OF THESE PATIENTS WITH REGULAR BLOOD TESTS, COMPARING WHAT HAPPENS TO PEOPLE WITH JUST VISCERAL LEISHMANIASIS, AND THOSE WITH BOTH HIV **AND** VISCERAL LEISHMANIASIS.



AND WHAT HAVE YOU FOUND?



BOTH GROUPS RESPONDED WELL TO TREATMENT. BUT WHILE THOSE WITH JUST LEISHMANIASIS FULLY RECOVERED, MOST PATIENTS WITH HIV **AND** LEISHMANIASIS WOULD GET SICK AGAIN.

BY LOOKING AT THE DNA OF THE PARASITES INFECTING THESE PATIENTS, WE DISCOVERED SOMETHING STARTLING...

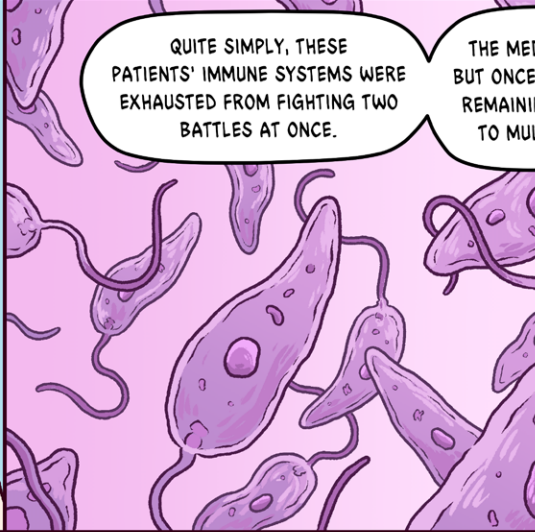
THESE WEREN'T NEW INFECTIONS - THE PARASITES FROM THE ORIGINAL INFECTION WERE BACK WITH A VENGEANCE!



HOW COME?!



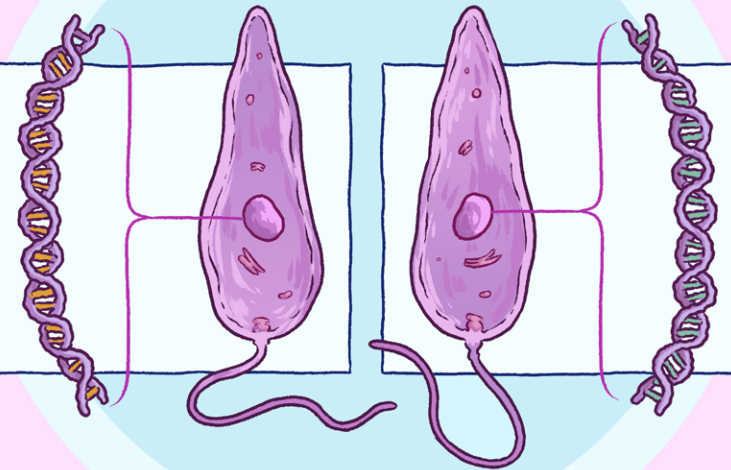
QUITE SIMPLY, THESE PATIENTS' IMMUNE SYSTEMS WERE EXHAUSTED FROM FIGHTING TWO BATTLES AT ONCE.



THE MEDICINE HAD DONE ITS JOB, BUT ONCE TREATMENT STOPPED, ANY REMAINING PARASITES WERE FREE TO MULTIPLY ALL OVER AGAIN!



BY COMPARING THE DNA OF PARASITES FROM DIFFERENT INFECTIONS, WE CAN LOOK FOR GENETIC DIFFERENCES THAT MIGHT EXPLAIN WHY SOME PEOPLE GET MUCH SICKER THAN OTHERS.



AND THAT'S WHERE CRISPR-CAS9 CAN COME BACK IN, ALLOWING US TO LOOK AT THESE SUSPECT GENES AND WORK OUT WHAT THEY DO.





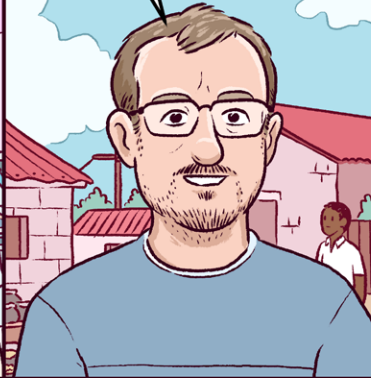
IN THE END, PREVENTING AND CURING A DISEASE LIKE LEISHMANIASIS TAKES WORK BY PEOPLE ACROSS THE WORLD



**LAB WORK** CRACKING THE GENETIC CODE OF THESE FASCINATING ORGANISMS, AND STUDYING PATIENT CELLS TO DISCOVER HOW THE IMMUNE SYSTEM IS AFFECTED BY THE PARASITE.



**FIELD WORK** INVESTIGATING THE MANY WAYS THAT **REAL LIFE** AFFECTS THE DISEASE AND THE PEOPLE WHO CATCH IT.



AND **PUBLIC HEALTH WORK** THAT SEEKS TO IMPROVE ACCESS TO TESTING AND MEDICINES, INCREASE AWARENESS, AND FIND WAYS TO STOP PEOPLE GETTING INFECTED IN THE FIRST PLACE.



IT SOUNDS LIKE A MASSIVE JOB...

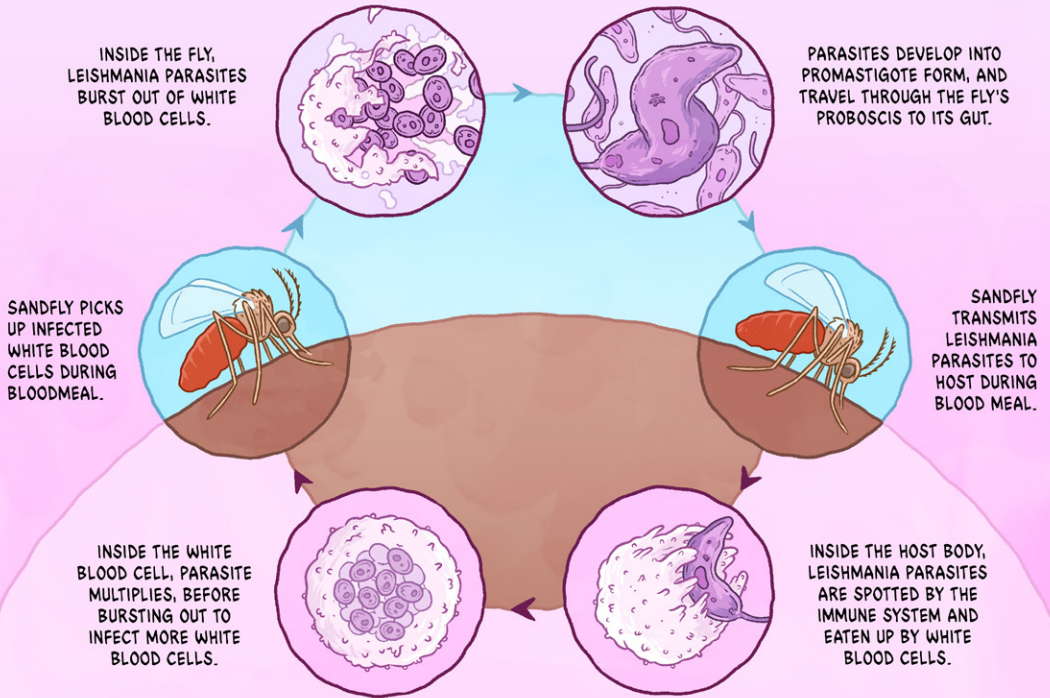
IT IS. BUT FROM GLASGOW TO GONDAR, AND BELO HORIZONTE TO BERN, THERE ARE AMAZING PEOPLE OUT THERE, WORKING TOWARDS A COMMON GOAL...



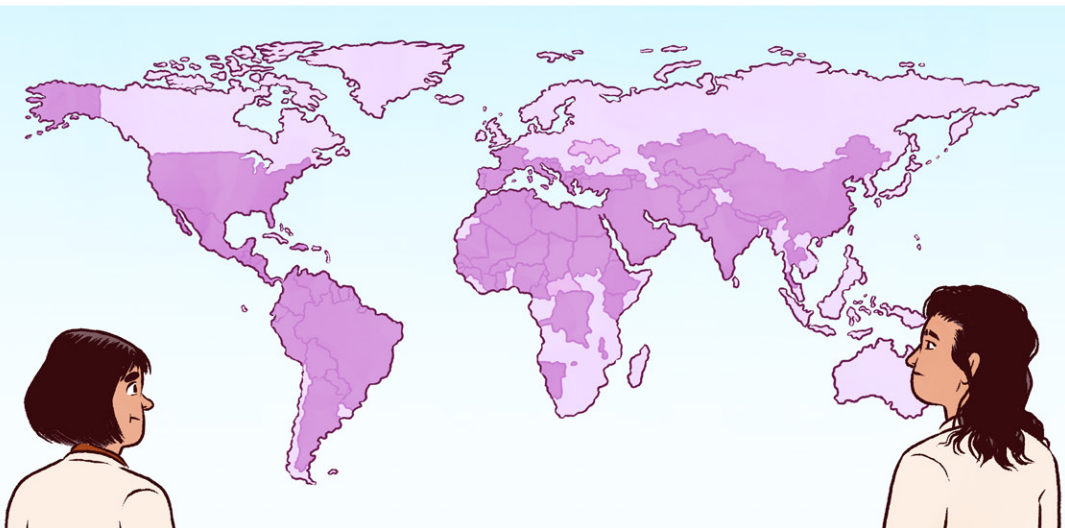
TO MAKE THE MISERY OF LEISHMANIASIS, AND DISEASES LIKE IT, A THING OF THE PAST.



# THE LEISHMANIA LIFE CYCLE



# LEISHMANIASIS ACROSS THE WORLD



THE WELLCOME CENTRE FOR INTEGRATIVE  
PARASITOLOGY IS BASED AT THE UNIVERSITY OF  
GLASGOW. OUR MISSION IS TO DEVELOP A  
DEEPER UNDERSTANDING OF PARASITES, HOW  
THEY INFECT US AND HOW THEY EVADE OUR  
IMMUNE SYSTEMS AND THE MEDICINES WE USE.

FOR MORE INFORMATION PLEASE VISIT:

[WWW.GLA.AC.UK/RESEARCH/AZ/WCIP/](http://WWW.GLA.AC.UK/RESEARCH/AZ/WCIP/)



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WHAT DOES IT TAKE TO CRACK THE PARASITE CODE? JOIN THE SCIENTISTS AT THE **WELLCOME CENTRE FOR INTEGRATIVE PARASITOLOGY** AS THEY USE CUTTING EDGE TECHNOLOGY AND A PASSION FOR PARASITES TO UNCOVER THE SECRETS OF LEISHMANIASIS, AND HUNT FOR A CURE.



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