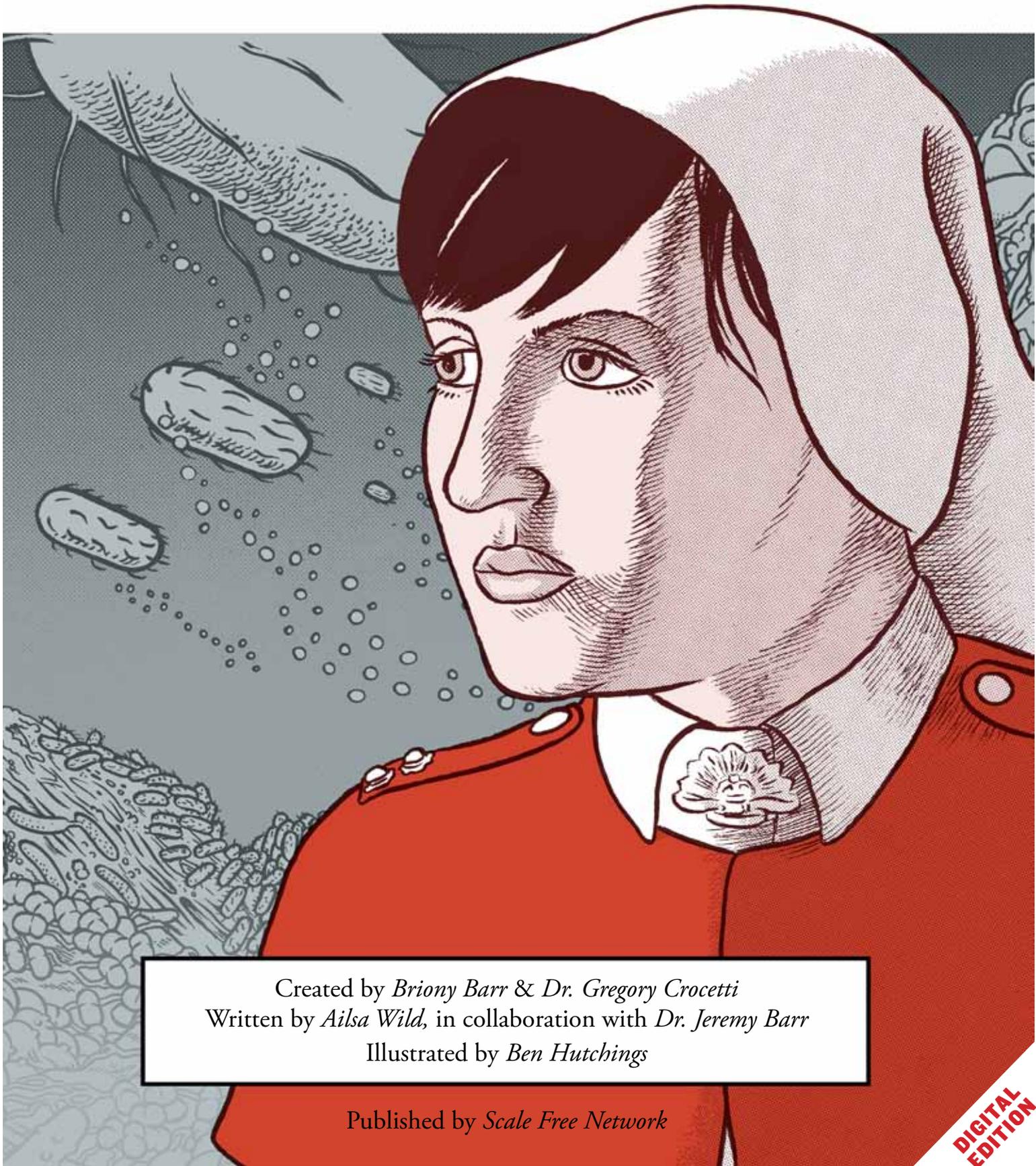


THE INVISIBLE WAR

A Tale on Two Scales



Created by *Briony Barr & Dr. Gregory Crocetti*
Written by *Ailsa Wild*, in collaboration with *Dr. Jeremy Barr*
Illustrated by *Ben Hutchings*

Published by *Scale Free Network*

**DIGITAL
EDITION**

**“THE ENEMY OF MY ENEMY
IS MY FRIEND”**

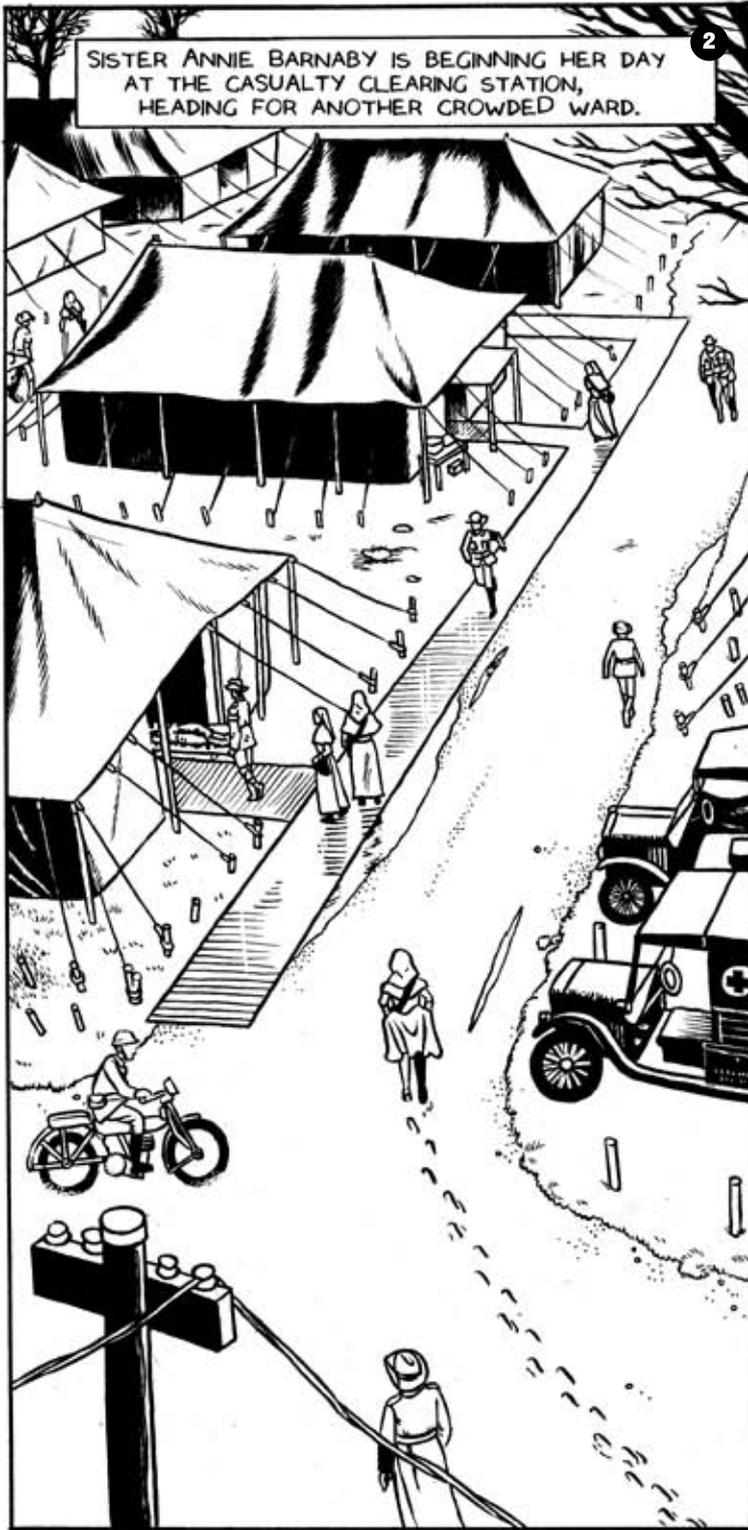
Ancient proverb



The WESTERN FRONT



23rd AUGUST 1916, FRANCE, WORLD WAR 1. THE BATTLE OF POZIÈRES HAS BEEN DRAGGING ON FOR EXACTLY ONE MONTH. THOUSANDS ARE DEAD AND MORE ARE WOUNDED. SOLDIERS WITH SERIOUS ILLNESS OR INJURY ARE TAKEN TO THE CASUALTY CLEARING STATION.



SISTER ANNIE BARNABY IS BEGINNING HER DAY AT THE CASUALTY CLEARING STATION, HEADING FOR ANOTHER CROWDED WARD.



FIVE GUNSHOT WOUNDS ON THE WAY!

TRENCH FEVER CASE HERE! NEEDS IMMEDIATE CARE!

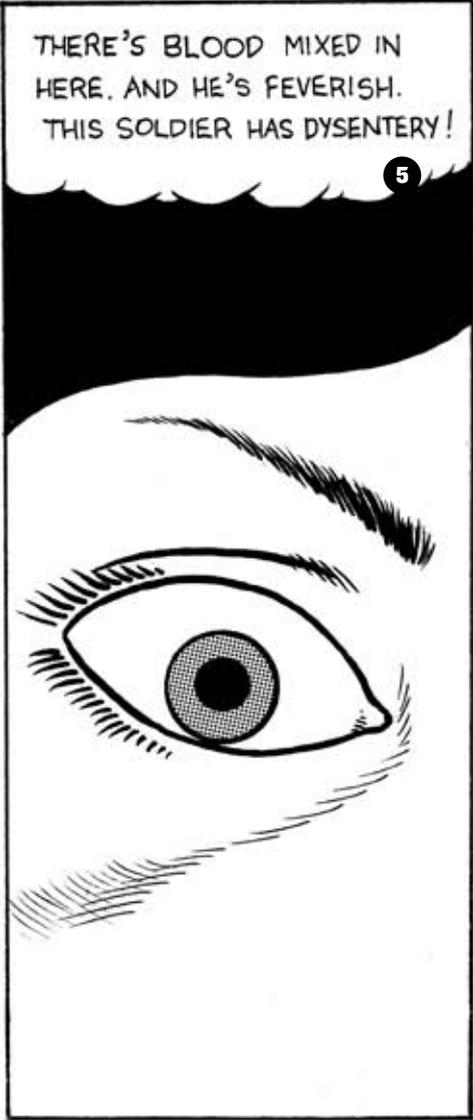
ORDERLY, OVER HERE NOW!

UGHHHH...

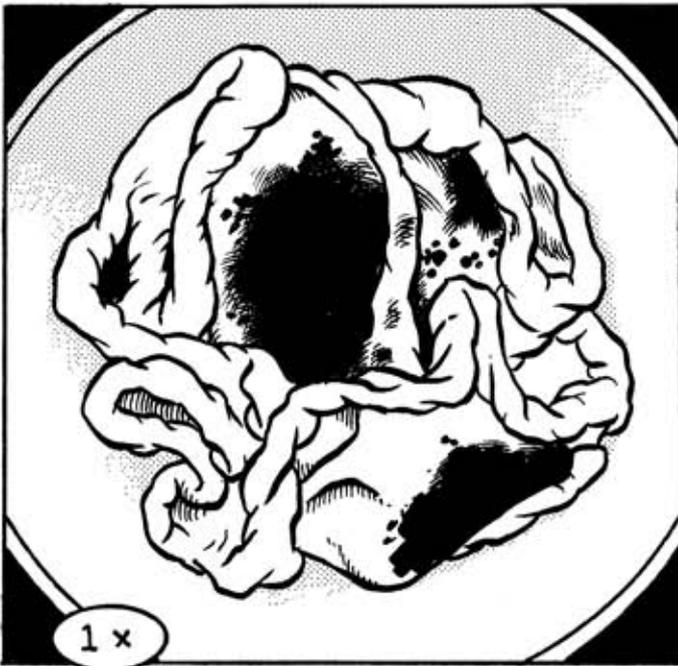


ANOTHER LOAD... ALREADY? WE BARELY HAVE ANY BEDS!





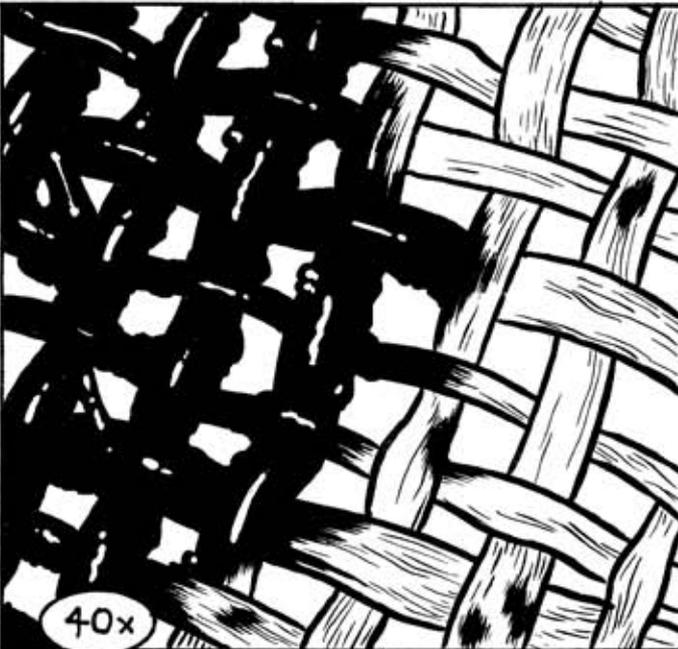




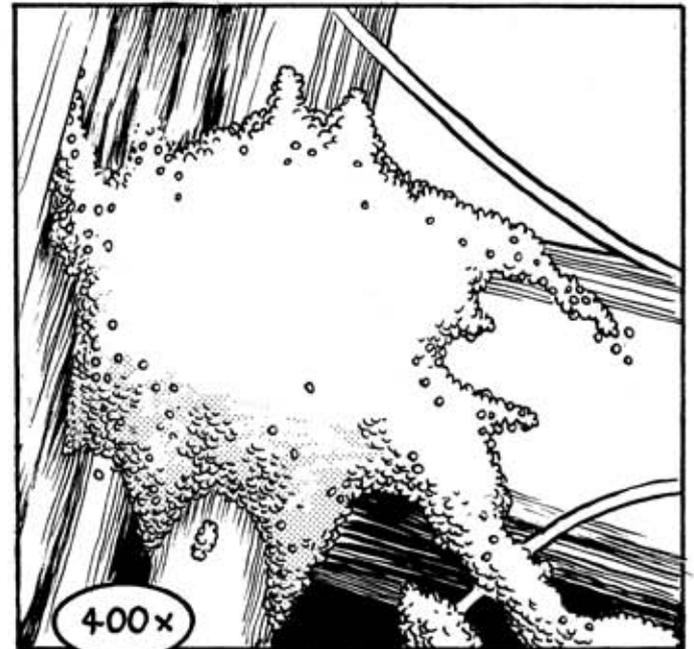
1 x



10 x



40 x



400 x



WOAH!
WHERE THE
HELL ARE
WE?

4000 x

MEET THE SHIGA GANG (SHIGELLA FLEXNERI)... FRESH FROM CAUSING WRETCHED DEVASTATION IN PRIVATE ROBBINS' GUT. ...AND LOOKING FOR SOMEWHERE NEW TO BREED!

8

9

WHAT IS THIS GARBAGE DUMP?

HOW COME WE EVACUATED?

MUCUS STRANDS

RED BLOOD CELL

DUNNO, BUT THAT WAS AN AWESOME POPULATION EXPLOSION BACK THERE!

YEAH, SICK AS. SO MUCH SLIME!

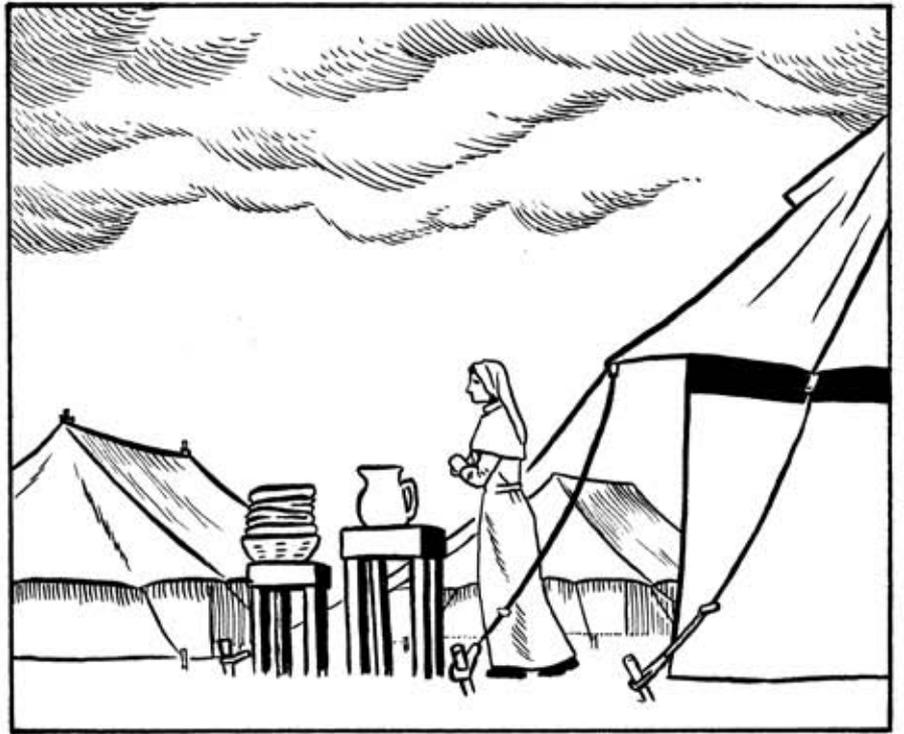
SHIGELLA FLEXNERI

WE SHOULD DO IT AGAIN REAL SOON.

CAN'T DO ANYTHING WITH NO SLIME TO RIDE...

YEAH...

I'M HUNGRY.



AFTER WASHING HER HANDS CAREFULLY, ANNIE IS STRAIGHT BACK ON THE WARD.



"I'M A FITZROY GIRL. FITZROY, MELBOURNE."











THIS IS NOT GOOD. WHY DID WE EVACUATE THE COLONY?

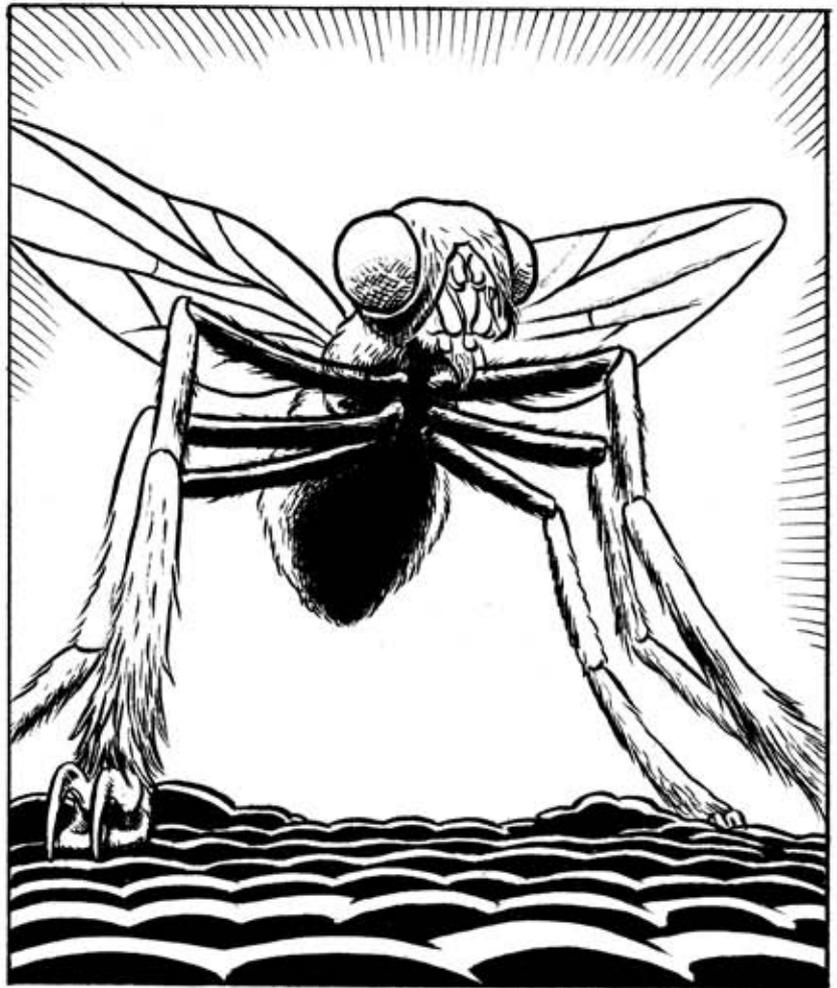
WE HAD NO CHOICE! WE JUST GOT CARRIED AWAY...



WOAH!

BOOM!

WHAT'S GOING ON?

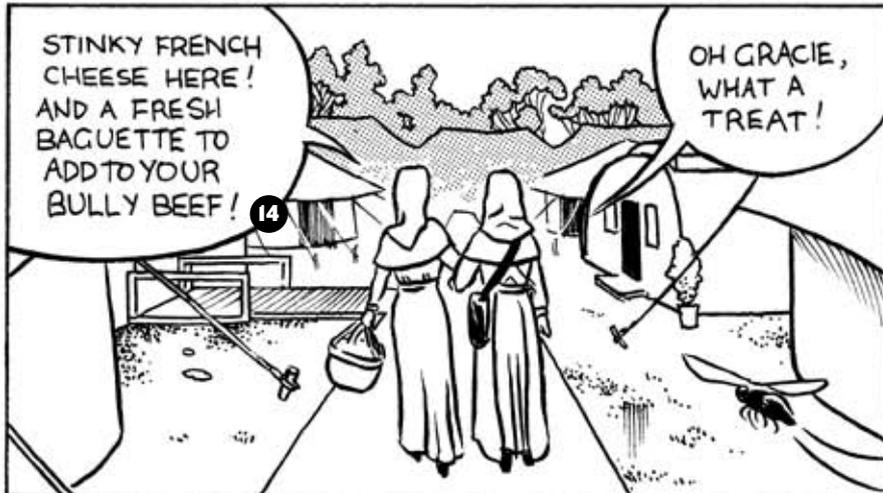
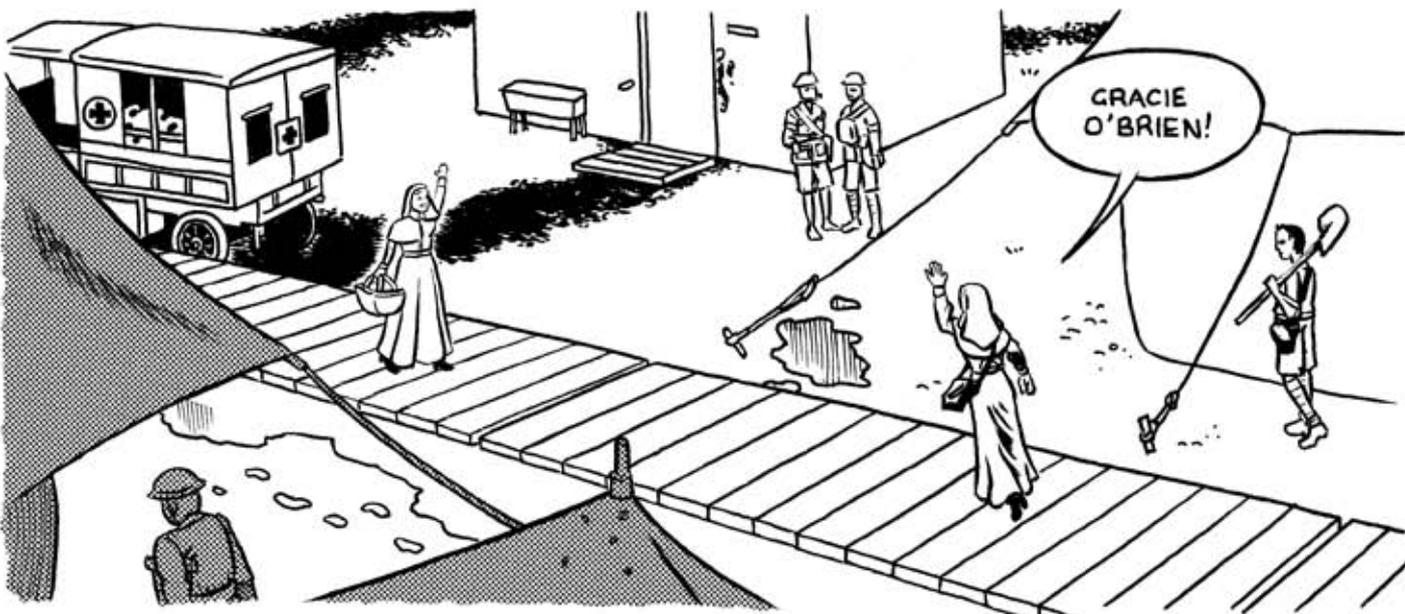


A WAY OUT!

WE'RE HITCHING A RIDE!

BUT IT COULD BE GOING ANYWHERE!

ANYWHERE IS BETTER THAN THIS DUMP!



HOW WAS YOUR
BARGE TRIP ?

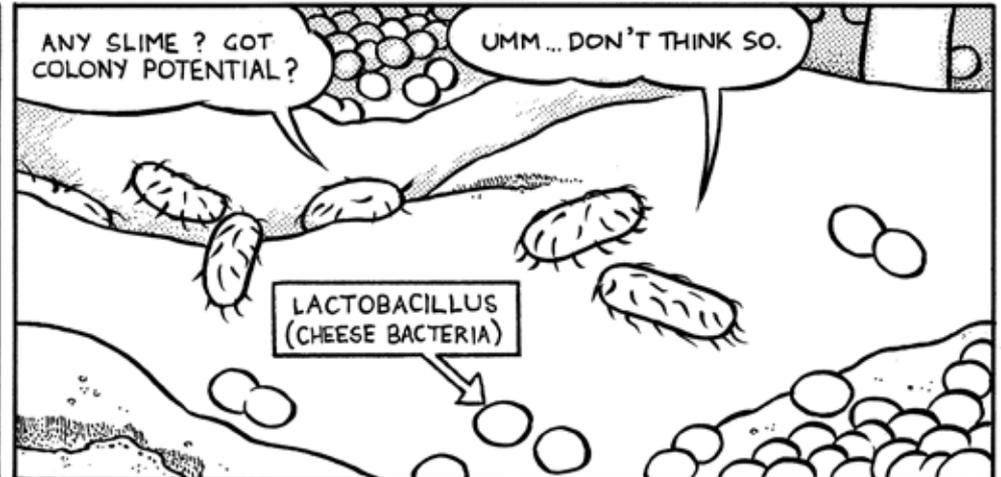
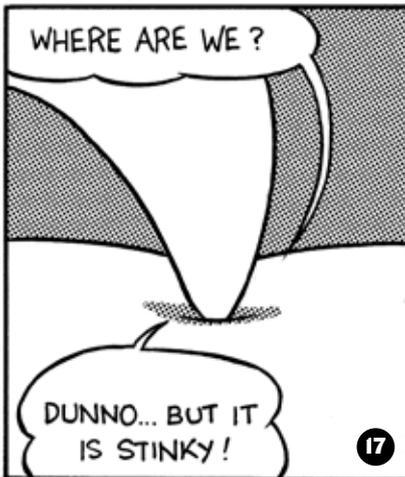
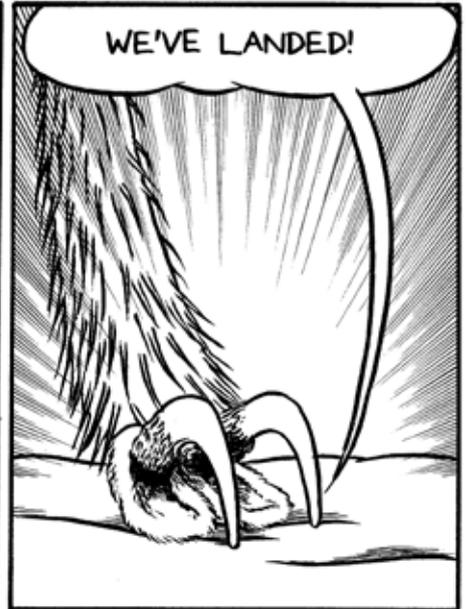
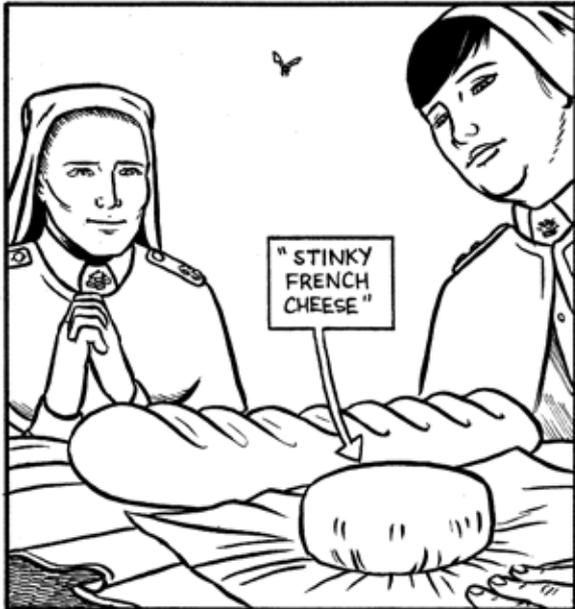
COMING BACK UP ON AN EMPTY BARGE?
LOVELY. I CAUGHT UP ON ALL MY MELBOURNE
LETTERS AND WENT SHOPPING ON THE WAY.

BUT
BEFORE THAT ?
ON YOUR WAY DOWN
WITH THE
INJURED ?

AWFUL. STIFLING. THE WINDOWS WERE
CLOSED ALL NIGHT BECAUSE OF THE LIGHT.
EVEN A CRACK COULD GIVE AWAY OUR POSITION
TO FRITZ.

"HALF THE
BOYS HAD BEEN
GASSED AND THE
REST WERE
BASICALLY
ROTTING."

"I COULD
BARELY BREATHE.
SO MANY DEATHS,
ANNIE."



THEY SAY THERE'S HUNDREDS MORE INJURED EXPECTED TOMORROW.



I DON'T KNOW IF I CAN BEAR IT.



YOU WILL. AS SOON AS THE NEXT POOR INJURED BOY IS IN FRONT OF YOU.



ANY WORD FROM YOUR BROTHER, EDITH?



HE WROTE A WEEK AGO. FROM THE FRONT. I SUPPOSE IF HE'S STILL ALIVE THAT'S WHERE HE IS.



I WISH AUSTRALIA WOULD HURRY UP AND CALL THAT REFERENDUM, CONSCRIPT MORE SOLDIERS, AND WIN THIS THING SO WE CAN ALL GO HOME.



REALLY EDITH? YOU WANT CONSCRIPTION?



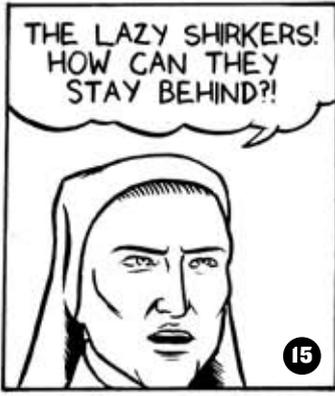
AFTER GALLIPOLI AND ALL THE DEATH AND SUFFERING WE'RE SEEING OUT OF POZIÈRES?



COULD YOU FORCE MORE BOYS TO GO THROUGH IT?



THE LAZY SHIRKERS! HOW CAN THEY STAY BEHIND?!



HIDING AT HOME BEHIND THE SKIRTS OF THEIR WOMENFOLK, LEAVING MY BROTHER TO FIGHT FOR THEIR FREEDOM.



BUT WHOSE FREEDOM?



ALL OF OURS. AUSTRALIA. THE EMPIRE.



EDITH... THE BRITISH EMPIRE DOESN'T PROVIDE FREEDOM FOR EVERYONE ...



YOU SAW WHAT HAPPENED IN IRELAND AFTER EASTER! THEY AREN'T EXACTLY FREE!



THE IRISH ARE BACKSTABBING COWARDS... WHO BETRAYED US IN OUR TIME OF NEED!

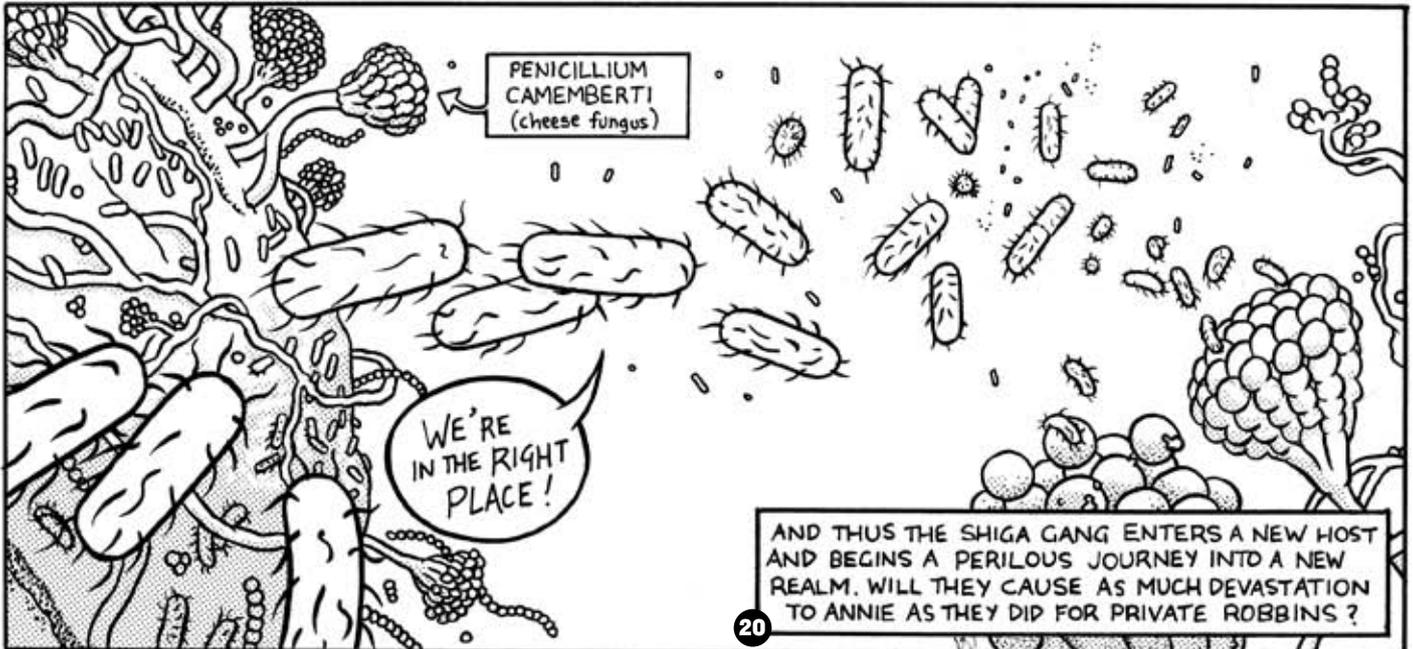
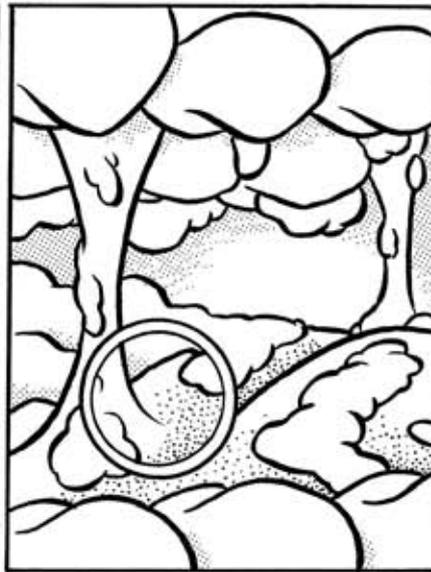
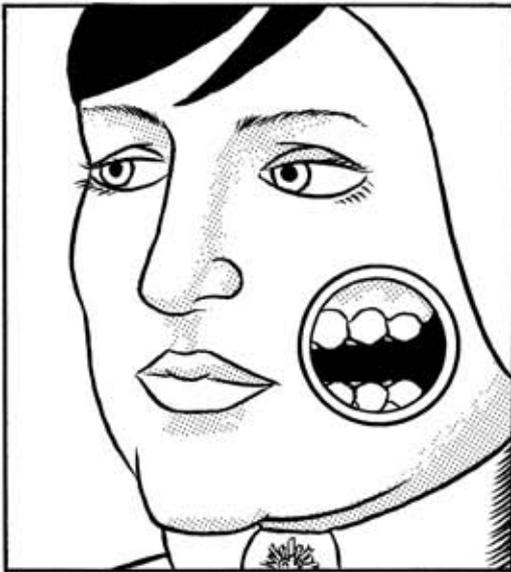


CAREFUL, EDITH. PLENTY OF US IRISH IN MELBOURNE. MY GRANNIE REMEMBERS THE FAMINE YOU KNOW.



AND IF THE IRISH REBELS HAD WON WOULD WE CALL IT BETRAYAL? AMERICA ONCE REBELLED AGAINST THE BRITISH EMPIRE AND NOW WE CALL IT INDEPENDENCE.





WANT TO KNOW MORE?

**CONTINUE READING TO LEARN MORE ABOUT THE SCIENCE,
THE HISTORY AND THE TEAM BEHIND THE STORY.**

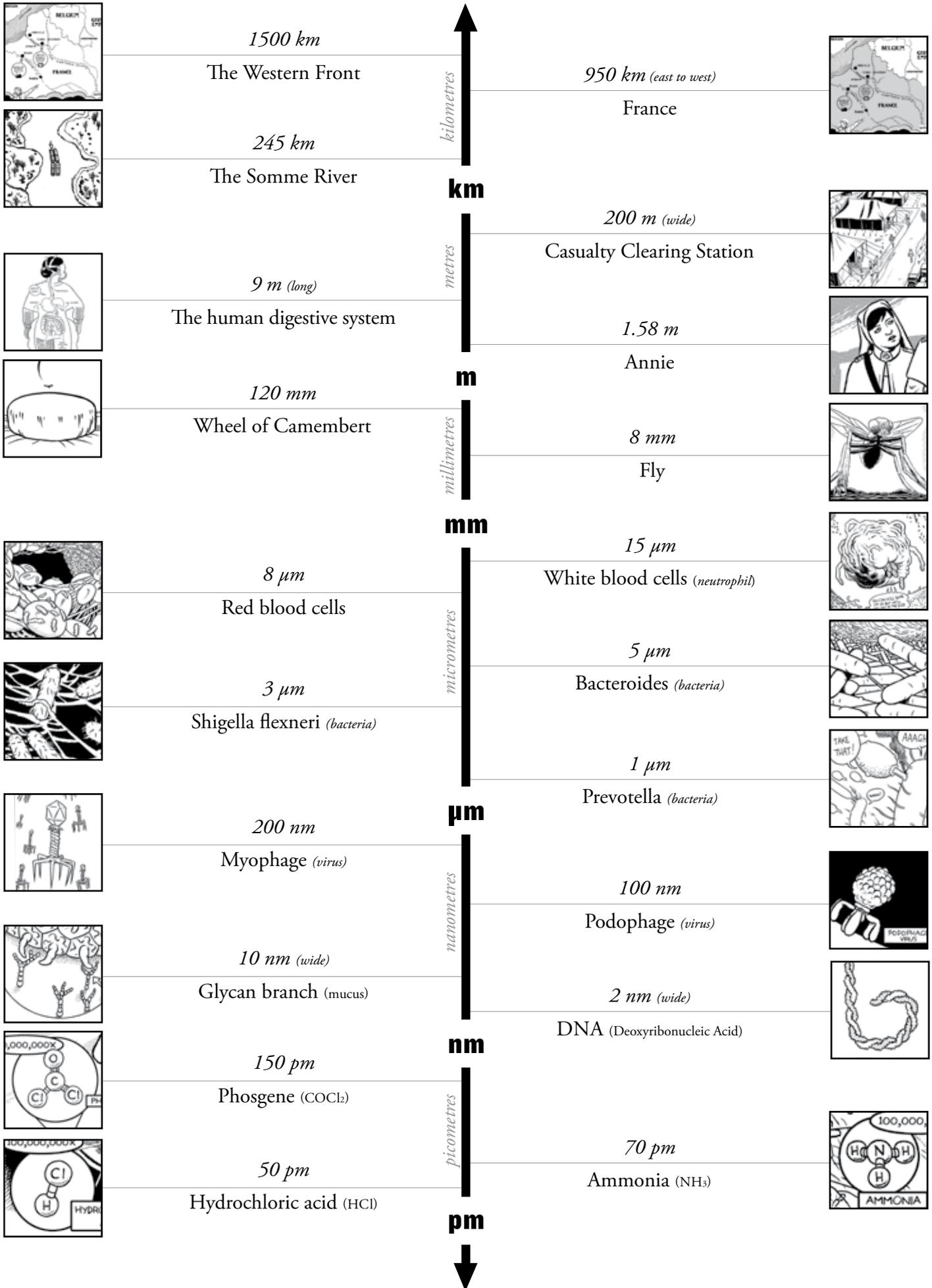
And visit

www.theinvisiblewar.com.au

to:

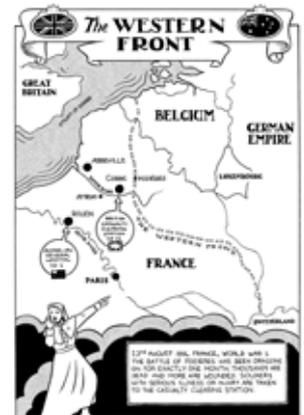
- download teaching resources,
- order print copies of *The Invisible War*,
- and more...

THE INVISIBLE WAR: BIG TO SMALL



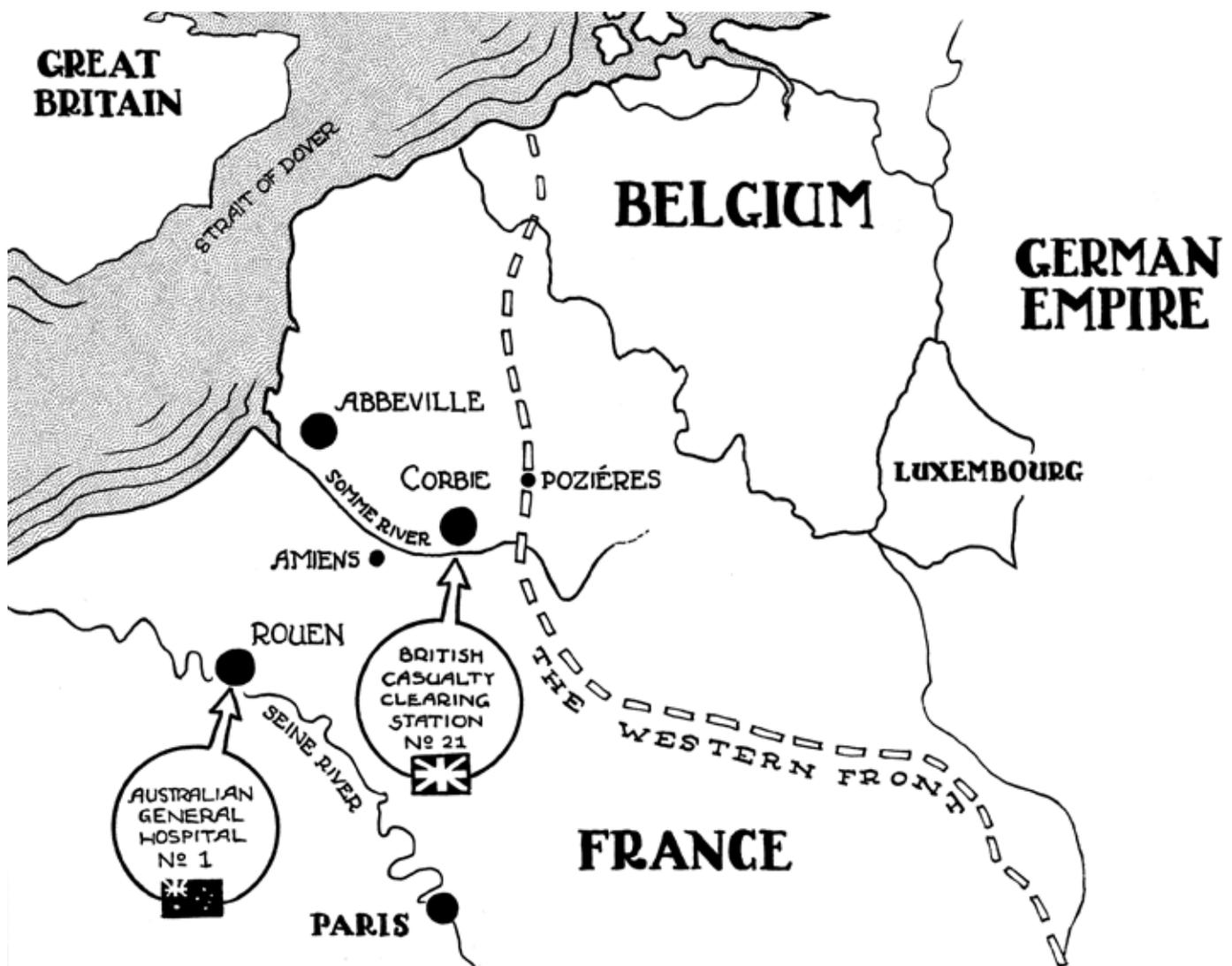
**BUT HOW,
AND WHY,
AND ARE YOU
SERIOUS?**

I. WHERE WAS THE WESTERN FRONT?



see pg 4 >

The Western Front was the main theatre of war during World War I (WWI). Essentially it was a series of trenches across 1500 km of Europe, from the North Sea across Belgium and France to the border of Switzerland.



2. WHAT IS A CASUALTY CLEARING STATION?



see pg 5 >

A Casualty Clearing Station (CCS) is a military medical facility behind (but close to) the front line. They were usually out of reach of artillery fire, but not always! They were sometimes in range of gas attacks – depending on the way the wind blew, and they were often bombed from the air.

These stations were not for long-term patients. They were for initial medical treatment that couldn't be handled closer to the front, or a stop on the way to larger hospitals. Nurses from the Australian Army Nursing Service and New Zealand Army Nursing Service worked in Australian and New Zealand CCSs but both also served in the British ones as necessary.

The Clearing Station in the story is British Casualty Clearing Station 21. We chose it because it was a busy place in August 1916. It was also next to a canal, which was part of the transportation system we wanted to show.



Image: Duckboards and tents at a Casualty Clearing Station.
Source: Australian War Memorial.

3. WHO ARE THE NURSES?



see pg 6 >



see pg 11 >

Australian nurses joined the war effort for similar reasons men did – adventure, patriotism, and a desire to see the world. They also went to be closer to their brothers, friends and to the men enlisted to fight. Their work was hard and dirty. It included lifting heavy patients and dealing with blood, pus and excrement.

Nurses lived under strict military discipline. Women were only allowed to serve as nurses in the Australian military if they were not married or were widowed. They were required to have a high standard of moral behavior. There were 2286 members of the Australian Army Nursing Service who served during WWI and more than 500 in the New Zealand Army Nursing Service.

SCIENTIFIC CLASSIFICATION OF HUMANS

Domain:	<i>Eukarya</i>
Kingdom:	<i>Animalia</i>
Phylum:	<i>Chordata</i>
Class:	<i>Mammalia</i>
Subclass:	<i>Theria</i>
Infraclass:	<i>Placentalia</i>
Order:	<i>Primates</i>
Family:	<i>Hominidae</i>
Subfamily:	<i>Homininae</i>
Tribe:	<i>Hominini</i>
Subtribe:	<i>Hominina</i>
Genus:	<i>Homo</i>
Species:	<i>sapiens</i>

WHY DOES PRIVATE ROBBINS SAY 'HELLO AUSTRALIA' WHEN HE SEES ANNIE?

Australian soldiers recognised the uniforms of Australian nurses and would often greet them with the friendly, 'hello Australia!' which signified comradeship without requiring names. Australian soldiers might just have easily been treated by nurses of another nationality, but many said it was good to see a face from home.



Image: No.2 Australian CCS at Trois Arbres 1917.
Source: Australian War Memorial.

4. WHO ARE THE PATIENTS?



see pg 6 >

The soldiers at the Casualty Clearing Station came via the field ambulance, where battles led to awful wounds. Shells, bullets and hand-to-hand bayonet fighting blew holes in men, ruptured their skin, destroyed organs, and tore off limbs. Nurses' caseloads included many surgical patients treated for shrapnel removal and amputations. Poison gas and gangrene were also common. Stress, lack of nutrition and poor hygiene meant nurses were also working with a large numbers of sick and diseased soldiers, not just the battle-injured. Rations for soldiers were poor, lacking in fresh food or any diversity. Sleep was continuously interrupted, causing huge stresses on the body.

Drinking water was not always clean. The British forces knew about the importance of clean drinking water and used ceramic filters and later chlorine to make water potable. But, there were still times when clean water was inaccessible and the only available drinking water was rainwater collected from shell-holes. These holes might have had blown-apart human or animal corpses in them. Shell-hole water, polluted by a corpse, was commonly known as ANZAC soup.



Image: An injured soldier being treated in a trench.
Source: Wellcome Library, London.



Image: Pools of water in shell holes.
Source: Wellcome Library, London.

5. WHAT IS DYSENTERY?



see pg 7 >

Dysentery is a disease of the human intestine that causes bloody diarrhoea. Widespread infection of the intestinal wall typically leads to ulceration, loss of blood and the production of massive amounts of mucus – resulting in catastrophic loss of fluid from the human body – and often death.

A few different types of dysentery have been described by doctors and scientists, but the two most important types during WWI were amoebic dysentery and bacillary dysentery. The amoeba parasite that causes amoebic dysentery prefers warmer weather, and so this disease was more of a problem in the trenches of Gallipoli.

Bacillary dysentery (or Shigellosis) is named after the bacillus (or rod-shaped) bacteria from the genus *Shigella*. There are four different species of *Shigella* – *dysenteriae*, *flexneri*, *sonnei*, *boydii*. These all call human intestines home but cause slightly different forms of dysentery.

Dysentery is tragically still a common disease among many poor communities around the world, particularly in Asia and Africa, where more than two billion people live without

regular access to clean drinking water and toilets ([WaterAid](#)).

Antibiotic-resistant *Shigella* are also making a comeback around the world ([Institut Pasteur](#)), including outbreaks in wealthy countries, such as the USA ([USNews](#)).

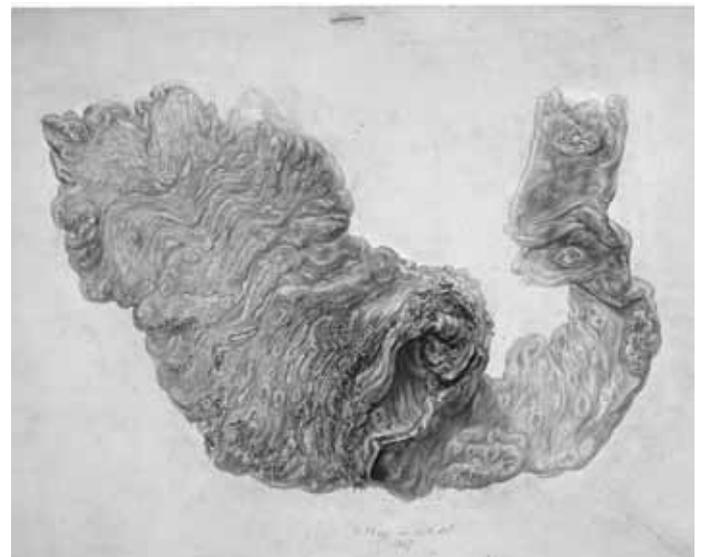


Image: Medical drawing of a portion of large intestine from 1848, illustrating the devastating ulceration of dysentery.
Source: St Bartholomew's Hospital Archives & Museum, Wellcome Images.

6. WHY ARE THE DOCTORS AND NURSES SO WORRIED ABOUT DYSENTERY?



see pg 8 >

Dysentery was on the list of highly infectious diseases. Along with cholera, typhoid, and scarlet fever, it required an immediate telegram to the Director General of Medical Services at General Headquarters. Dysentery was the only disease for which even a *suspected case* required a telegram. Perhaps this is because Australian troops had suffered so horribly from dysentery during the Gallipoli campaign in Turkey. In August 1915, more than 80 per cent of soldiers at ANZAC Cove were suffering from dysentery. Of the 5000 men a week evacuated for illness, more than 30 per cent of these were due to dysentery.

There were several reasons for this: lack of water for washing and drinking; a large fly problem; and an inability to manage sanitation due to the small land area inhabited. The trenches of WWI were commonly wet and always cramped, making it hard to maintain reasonable levels of hygiene, such as serving food and water in clean mugs. Even worse, it was hard keeping flies off food and human faeces.

During and after Gallipoli, bacteriologists working in army laboratories did important

research into diagnosing dysentery. By the time Australians were fighting on the Western Front, diagnosis and water sanitation had significantly improved. On the Western Front, less than two per cent of the soldiers incapacitated by an infectious disease were suffering from dysentery.

Dysentery is no longer common in regions such as Australia, Europe and North America. However, it still infects over 100 million people and causes over half a million deaths in the *Global South* each year – especially in the most crowded parts of Asia and Africa. Health experts suggest that access to clean water and basic sanitation would likely reduce this problem.



Image: Drawing of sickly dysentery patient from WWI. Source: Wellcome Library, London.

7. WHAT WAS THE MOBILE LABORATORY?



see pg 8 >

Mobile laboratories were first developed during WWI. They consisted of a truck outfitted with all the necessary tools of the bacteriologist, including microscopes, centrifuges and incubators. The first of these was built in 1915, and by the end of the war there were about 15 operating near the front. Each had a cycle car attached for gathering specimens, as a single mobile laboratory might have serviced several Casualty Clearing Stations.



Image: Mobile laboratory, outside.
Source: Wellcome Library, London.



Image: Mobile laboratory, inside.
Source: Wellcome Library, London.

8. WHO THE HECK ARE THE SHIGA GANG?



see pg 10 >

The genus *Shigella* originates from the name *Shiga*, after its discoverer – Lord Kiyoshi Shiga of Japan.

Shigella flexneri and *S. dysenteriae* were the most problematic of these in the trenches of WWI, with *S. flexneri* being more common on the Western Front. We set our story on the Western Front to avoid the chaotic conditions of Gallipoli, where the more toxic *S. dysenteriae* was spread extensively throughout water supplies and between the soldiers.

In the early 1900s (including during WWI), the name ‘Shiga’ was used to describe the bacterium *Shigella dysenteriae*, while *Shigella flexneri* were referred to as ‘Flexner’. It wasn’t until the 1950s that the different species were united within the same genus, given the name *Shigella*.

ARE SHIGELLA BACTERIA REALLY THAT HAIRY?

The hairs illustrated on the *Shigella* in the story are called fimbriae. These hairs are also called attachment pili. They can range from a few nanometres to a few micrometres long. These hairs help bacteria attach to other

bacteria and surfaces, such as mucus.

More information [here](#).

SCIENTIFIC CLASSIFICATION OF SHIGELLA BACTERIA

Domain:	<i>Bacteria</i>
Kingdom:	<i>Bacteria</i>
Phylum:	<i>Proteobacteria</i>
Class:	<i>Gammaproteobacteria</i>
Order:	<i>Enterobacteriales</i>
Family:	<i>Enterobacteriaceae</i>
Genus:	<i>Shigella</i>
Species:	<i>flexneri</i>



Image: Digital illustration of *Shigella* bacteria.
Source: James Archer, U.S. Centers for Disease Control and Prevention.

9. WHY DO THE SHIGA LEAVE PRIVATE ROBBINS' GUT?



see pg 10 >

Once the *Shigella* began to infect the epithelial cells lining the human intestine, their numbers explode exponentially – from tens to thousands to millions to billions within 24–48 hours! In response, the human intestine makes several litres of mucus in an attempt to flush out as many *Shigella* as possible. This means that most *Shigella* bacteria don't really leave their host intestine by choice. Rather, they are forced out. But it doesn't have to end there, because there is always a small chance the *Shigella* might find their way onto food or into drinking water, to colonise new human hosts.

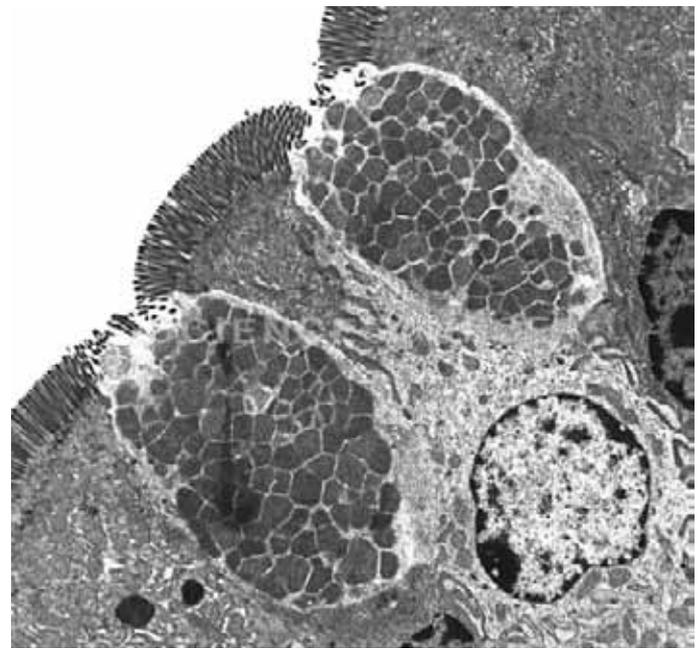


Image: Electron microscope image of goblet cells, showing mucin granules with the classic goblet shape.
Source: OpenStax College.

WHAT IS THE SLIME?

The slime referred to by the *Shigella* is the mucus made by specialised human epithelial cells in the large intestine (called goblet cells).

WHY ARE THEY COLD IN THE BIN?

The optimum growing temperature for *Shigella* bacteria is 37°C, which is the human body temperature. The hospital bin is much cooler than the warm intestine from which they had just been squirted.

10. WHAT'S SO INTERESTING ABOUT ANNIE TAKING A STOOL SAMPLE?



see pg 13 >

Some tools for diagnosing dysentery were developed during the war by Australian medical staff: Lieutenant Colonel C. J. Martin and Sister F. E. Williams. A combination of tests would have been used to diagnose a suspected case of dysentery:

- Direct observation of the size and shape of the bacteria under a microscope.
- Spreading bacteria from the stool sample on an agar plate designed to only allow *Shigella* bacteria to grow.
- A serum analysis that involved exposing a patient's stool sample to a mixture of different antibodies. If the stool contained *Shigella flexneri*, the antibodies would recognise and bind to the bacteria, forming visible clumps in the test tube. That patient was then considered positive for Flexner (*Shigella flexneri*). The serum analysis was the most accurate test available to doctors at the time.

These were very new diagnostic tools at the time. In the early 1900s, the scientific understanding of microbes and microbiology was still limited. Antibiotics, such as penicillin, were not developed until the 1940s – becoming available during World War II

(WWII). This means WWI was fought *without antibiotics* and many soldiers died from bacterial infections resulting from small wounds and scratches.

THE CHANCE OF RECOVERING DYSENTERY BACILLI FROM THE STOOLS ACCORDING TO THE TIME ELAPSING SINCE THE ONSET OF THE DISEASE.

EXPERIENCE AT A BASE HOSPITAL IN FRANCE.

BY
LIEUT.-COLONEL C. J. MARTIN, F.R.S., A.A.M.C.,

AND
SISTER F. E. WILLIAMS, A.A.N.S.

Prior to the war the notion seems to have been widespread that the bacteriological diagnosis of dysentery was as satisfactory as, say, that of diphtheria, and measures for the control of epidemics have been founded to some extent on this assumption. Our experience of laboratory work in the Eastern Mediterranean and Egypt in 1915 and 1916, however, led us to the conclusion that the chance of recovering dysentery bacilli from the stools was, after the first few days of the disease, a small one.

Similar experience seems to have been gathered elsewhere. Kolle and his co-workers¹ give an account of the bacteriology of an epidemic on the Russo-German front with which they dealt. They isolated *B. dysenteriae* Shiga from such a minute fraction of the samples examined that they came to the conclusion that, notwithstanding the general clinical resemblance to dysentery of this type, they must have had to deal with an outbreak from some other cause. Seligmann and Cossmann² also obtained very unsatisfactory results when working at a base hospital in Austria. They state that "they nearly always failed to recover dysentery bacilli" in undoubted clinical cases of dysentery. During eight months' work they recovered a dysentery bacillus but fifteen times out of "hundreds of attempts."

Later Seligmann was removed to a laboratory nearer the front, where he had opportunity to examine material from the recently evacuated sick. Under these conditions the results were entirely different, *B. dysenteriae* Shiga being

Image: Article by C. J. Martin and F. E. Williams published in 1918.
Source: The British Medical Journal 1.2990 (1918): 447-448.



see pg 13 >

SISTER WILLIAMS – HOW THE INTERSECTION OF BACTERIOLOGY AND WAR MADE A WOMAN’S CAREER POSSIBLE.

One bacteriologist studying dysentery was Sister Fannie Eleanor Williams – a rare role for a woman at that time. She trained as a nurse, but became a research attendant in the bacteriology laboratory in Adelaide Hospital before deciding to join the war effort. During WWI, the only capacity in which a woman was allowed to join the armed forces was as a nurse, so Sister Williams was titled and ranked accordingly. However her role was far more specialised than regular nurses. She spent the war years working in laboratories attached to various military hospitals, as well as the Lister Institute diagnosing and researching infectious diseases and their treatments. She worked in Lemnos (the closest hospital base for the Gallipoli campaign), Cairo, London and Rouen.

Her work with Charles Martin on the dysentery outbreaks in Gallipoli, and later developing treatment serums, was published in prestigious journals and she was considered an expert in the field. When she returned to Australia, Sister Williams was

appointed second assistant at Australia’s newest research institute – the Walter and Eliza Hall Institute of Medical Research – based in Melbourne. She was the first bacteriologist and serologist to be appointed there. She was also the first woman.



Image: Sister Williams.
Source: Australian War Memorial.

II. WHY IS THE DOCTOR BEING SO MEAN?



see pg 13 >

Some doctors were reluctant to accept the microscope and the agar plate as new tools to diagnose diseases – and instead preferred to trust their old tools – observation and experience.

Diagnosis was a subject of conflict and the doctor in this scene represents the ‘old school’ who were angry and afraid of the new diagnostic tools. Because of the British army medical establishment’s reluctance to accept bacteriology, it was not given much credit within the army at the beginning of WWI. Bacteriologists, the people using microscopes and agar plates, were considered mere technicians – useful for testing water purity – but not much else (certainly not for research).

Our story is set at a British-run Casualty Clearing Station. Australian medical culture supported bacteriology as a diagnostic tool slightly earlier and Annie would have been trained to respect it. By the end of the war, bacteriology had become firmly established as a respected tool of medicine.

Today, bacteriologists are usually referred to as microbiologists – who, with the aid

of high throughput DNA sequencing and powerful computational analysis – are discovering more and more about the powerful role of different microbes in the world inside us and around us.



Image: A laboratory in the field.
Source: Wellcome Library, London.

12. ARE FLIES REALLY THAT DIRTY?



see pg 16 >

Flies are great at spreading bacteria between food, water, animals, people and faeces, especially because of the way they vomit up digestive juices onto food, before sucking it back up again. It is thought that flies carried much of the *Shigella*-caused dysentery around during WWI, mostly between uncovered human faeces and drinking water.

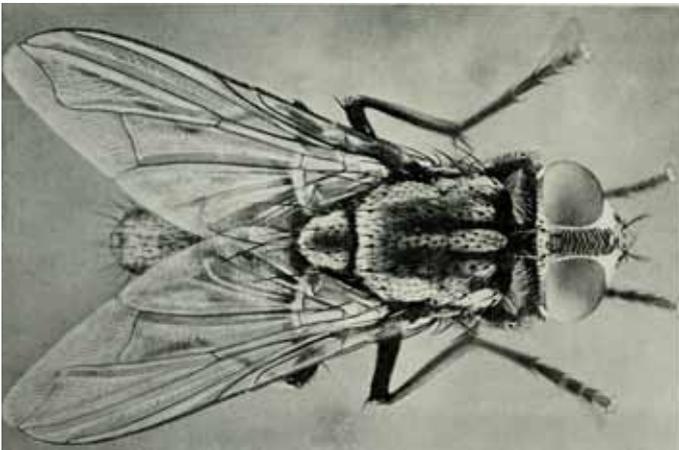


Image: The common house-fly (or Typhoid fly).
Source: The American Museum of Natural History (ca. 1900 – 1918)

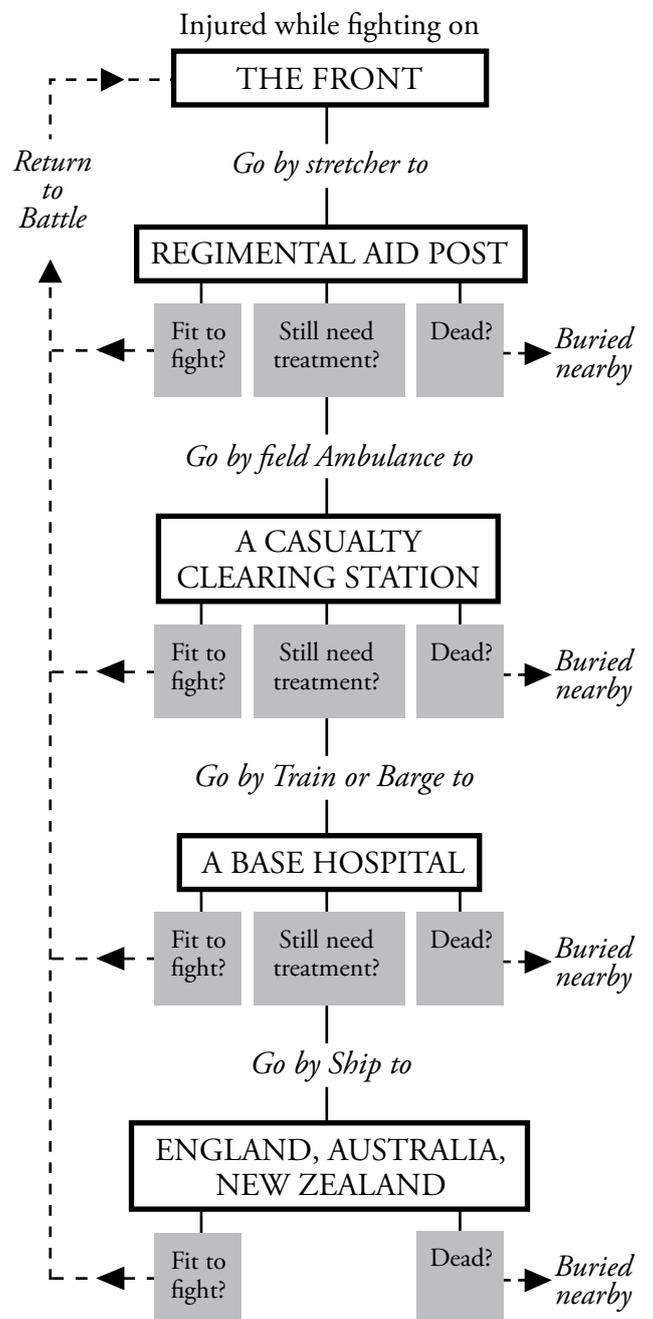
13. WHAT DOES ANNIE MEAN BY 'DOWN THE LINE'?



see pg 16 >

'Down the line' means away from the front, through military channels (and 'up the line' means towards the front).

The flow chart opposite shows how the sick and injured were transported 'down the line' and what the various stops along the way were.



14. WHAT THE HECK IS BULLY BEEF?



see pg 16 >

‘Bully beef’ was the nickname for canned corned beef – the standard daily ration of Australian soldiers. Nurses were fed similar rations. ‘Corned’ means preserved in salt, and bully beef was infamous for being salty, greasy and a bit disgusting. It has become a symbol of the ANZAC’s daily hardships. This means food rations for soldiers and nurses contained little fibre and resistant starches, which are important for maintaining a healthy diversity of gut microbes (called microbiota). If Private Robbins’ diet had been better, his gut microbes may have more easily repelled the invasion by *Shigella flexneri*.



Image: Soldiers eating their rations.
Source: Australian War Memorial.



Image: Corned beef packaging.
Source: Australian War Memorial.

15. WHAT'S THE ISSUE WITH CONSCRIPTION AND WHAT IS A SHIRKER?



see pg 19 >

During WWI, Australia was bitterly divided by the conscription debate. People on both sides felt very strongly and communities and families were split down the middle. Both nurses and soldiers serving at the front were permitted to vote in the two referendums deciding whether Australia should have conscription in 1916 and 1917. The conversation in our story is very similar to discussions from real nurses' diaries and letters home. One of the reasons some Australians voted no to conscription is the impact of the terrible losses the ANZAC troops suffered during the battle of Pozières (when our story is set).



Image: The Prime Minister, Mr William Morris Hughes, speaking to a large crowd during the conscription referendum campaign. Brisbane, 1916. Source: Australian War Memorial.

Men who refused to fight were despised by many as shirkers – cowards refusing their duty to Australia. They were often ostracised by their communities. Men chose not to fight for many reasons, including religious or ethical objections to killing, or to this particular war. For some, it took bravery to *refuse* to fight.



Image: Propaganda poster against conscription. Source: Australian War Memorial.

Both conscription referenda ultimately delivered a narrow 'no' result – with three states voting 'yes' and three 'no'.

16. WHAT'S THE DEAL WITH THE IRISH?



see pg 19 >

Another event that had an impact on the conscription debate in Australia was the Irish Easter Rising. In April 1916 (four months before our story is set), a group of armed Irish rebels seized key locations, mostly in Dublin. They fought the British military and declared an Irish Republic. The rebellion was unsuccessful and 90 people were sentenced to death under British law and 15 executions were carried out. The executions were seen as brutal and there was a groundswell of reaction against British rule. Many of the Irish population in Australia, lead by Archbishop Mannix, were swayed by these events. They were against conscripting Australians to fight for what they saw as an unjust British Empire. In the story, Gracie reflects this point of view.

17. CAN THE SHIGELLA BACTERIA REALLY SMELL?



see pg 18 >

Shigella bacteria don't have noses like humans and other animals. But many different types of cells, including bacteria, are able to use chemoreceptors to detect different molecules in their surrounding environment, which is much like the sense of smell.

18. WHY IS THERE A GAS ATTACK?



see pg 21 >

Prior to WWI, Britain, France and Germany were all signatories to a treaty agreeing not to use poison gas (Hague Conventions of 1899 and 1907).

When the Germans first attacked with gas, it was seen by their enemies as deeply dishonourable. The British and Australian public were outraged. However, soon both sides were using and developing new methods of chemical warfare. Initially chlorine gas was used, and then later phosgene and mustard gas. Symptoms of exposure to gas included coughing, vomiting and irritation to the eyes and throat. In high doses it was fatal. Those at and near the front relied on a small box respirator (pictured) for protection from phosgene.

Gas attacks were unpredictable because gas was affected by the wind and it crept along the ground. This meant that Casualty Clearing Stations were sometimes vulnerable to these attacks.

More information about poison gases used in WWI [here](#).



Image: Soldiers wearing small box respirators.
Source: Musee Somme.



Image: Phosgene gas attack at Fromelles.
Source: Hermann Rex.

19. WHERE ARE THE SHIGELLA GOING INSIDE OF ANNIE?



see pg 22 >

The *Shigella* bacteria enter Annie's digestive system through her mouth. The job of the human digestive system is to break down the food we eat into smaller and smaller bits that can be absorbed to make energy and new cells for our bodies. The gastrointestinal tract runs from our mouth, through the stomach, small intestine and large intestine, ending at the anus. Much like our external skin cells, the gastrointestinal tract is lined with an internal type of skin, called an epithelium, which creates a protective layer of mucus.

The gastrointestinal tract is comprised of the small intestine and large intestine (colon), and is about 7 – 10 metres long in an adult human.

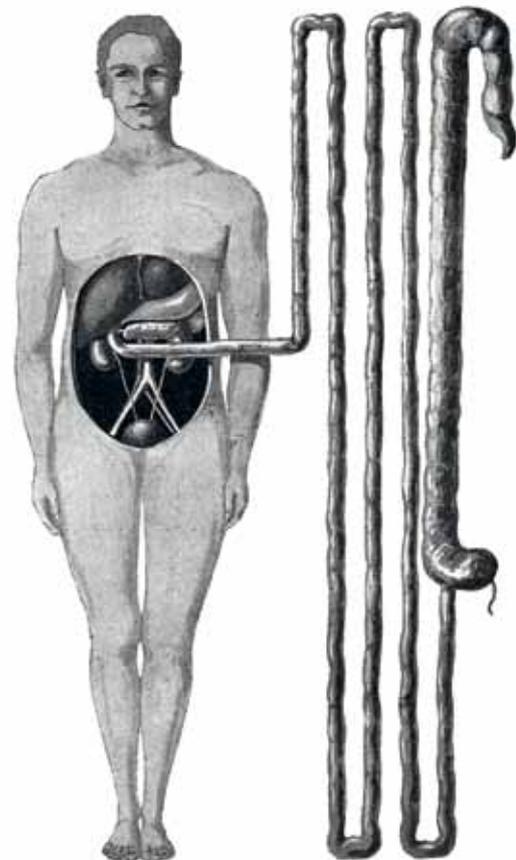
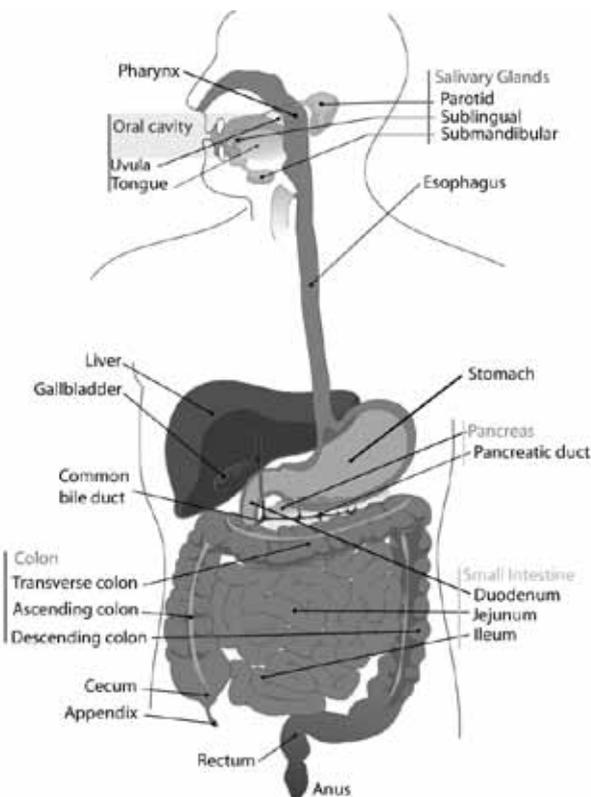


Image: © Fritz Kahn in: Das Leben des Menschen, Vol. III (1928), Kosmos, www.fritz-kahn.com



20. WHAT'S HAPPENING IN ANNIE'S MOUTH?



see pg 20 >

When the *Shigella* bacteria enter Annie's mouth, they encounter a mix of the food and drink consumed by Annie, combined with freshly secreted saliva, and the resident bacteria and viruses that live in her mouth. Our mouth makes about one litre of saliva each day, mostly to help lubricate chewing, but also to begin the process of breaking apart the chemical bonds holding the food molecules together.

Human saliva also contains the enzyme lysozyme. This enzyme is antimicrobial and kills many pathogenic (disease-causing) bacteria threatening to invade our bodies. Luckily for the invading *Shigella* bacteria, lysozyme can't kill them!

21. WHY ARE BACTERIA DYING IN THE STOMACH?



see pg 23 >

The stomach uses both physical and chemical processes to break food into smaller and smaller particles – allowing the body to absorb many of the tiny molecules, such as glucose, through the stomach wall and into our bloodstream. Simple foods like bananas can be broken down in minutes, while red meat can take several hours to break down.

The physical action of the stomach's smooth muscles create a mixing and churning motion, much like a washing machine. Even so, the most dangerous thing bacteria encounter within the stomach are the highly acidic conditions. The regular release of hydrochloric acid (HCl) into the digestive juices of the stomach creates a pH of between 1–2. This helps to break apart many of the food molecules for easier absorption, and kills many bacteria hitching a ride on any swallowed pieces of food.

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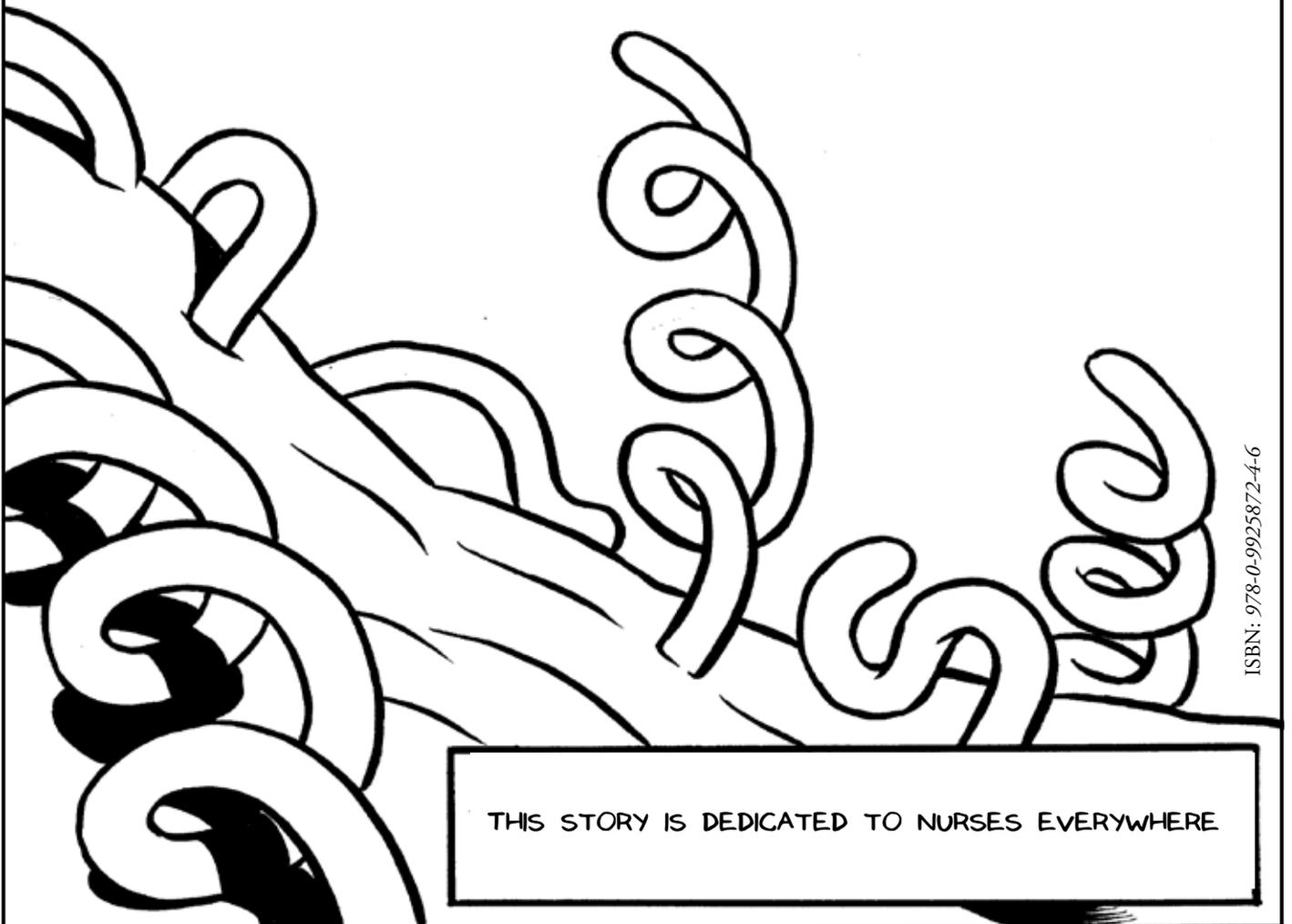
ONE NURSE TRILLIONS OF MICROBES A DEADLY WORLD WAR ONE BATTLE...

While treating a patient with dysentery, Sister Annie Barnaby encounters a strain of lethal bacteria. As the invaders journey deep into her gut, the resident microbes must fight to survive. Annie's life hangs in the balance. Enter the phage, a deadly predator, ready to wage war to protect their host.

Created by an expert team of scientists, artists, educators, writers and historians, *The Invisible War* is a story like no other.

"It shows and tells" *Hamish*, 14

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THIS STORY IS DEDICATED TO NURSES EVERYWHERE