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< How Scientists Created A Typhus Vaccine In A 'Fantastic Laboratory'

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TERRY GROSS, HOST:

This is FRESH AIR. I'm Terry Gross. When Germany invaded the Soviet Union in World War II, Nazi commanders had another worry besides the Red Army - the disease of typhus. Epidemics of typhus, which is transmitted by body lice, killed untold numbers of soldiers and civilians during and after the First World War. As World War II raged, it reappeared in war-torn areas and in Jewish ghettos, where cramped, harsh conditions were a perfect breeding ground for lice. Our guest Arthur Allen has a new book about two scientists, one Christian and one Jewish, who were employed by the Nazis to produce a typhus vaccine. One technique involved raising millions of infected lice in the laboratory and harvesting their intestines to get the materials for a vaccine. What's remarkable about the story is that the labs of these two immunologists actually sent weakened, ineffective vaccines to the German army while smuggling the real product to Jews in a Polish ghetto and a concentration camp. One lab sheltered Polish intellectuals and resistance fighters from the Nazis by employing them as lice feeders, meaning they allowed hundreds of lice to suck their blood. Arthur Allen has written for the New York Times, The Washington Post, The Atlantic, Science and other publications. He spoke to FRESH AIR contributor Dave Davies about his latest book, "The Fantastic Laboratory Of Dr. Weigl."

DAVE DAVIES, BYLINE: Arthur Allen, welcome to FRESH AIR. Let's start by just talking about the disease typhus. Now, this is distinct from typhoid fever. That's completely different. Tell us about typhus. What were the symptoms of the disease - how it affected its victims?

ARTHUR ALLEN: Typhus would begin with a terrible headache and back pains leading to fever, vomiting, nausea, diarrhea. And you'd - around the time the fever began, there would be a rash that often broke out on the abdomen that was described as looking like little, red jewels. It was a petechial rash. And eventually you would have deafness, you know, terrible, hysterical fits of laughter and tears. And sometimes suicides would happen when people jumped out of their beds and jumped through windows or ran down stairs. And sometimes the long-term effects could include things like loss of limbs. People were known to have - you know, lose toes and fingers or a penis.

DAVIES: From gangrene, right?

ALLEN: From gangrene, yeah.

DAVIES: What was the mortality? How often did people die from the disease?

ALLEN: Well, it varied quite a bit. But in general, it was about 20 percent. But what happened was that young children, for some reason, rarely died of it. But if you were 50 or older, you were very likely to die - more like a 50 percent or more chance of it.

DAVIES: And tell us how typhus is spread and what conditions create a typhus epidemic.

ALLEN: So back in the day when everyone was carrying lice and they were as much a part of our armature as our clothes, typhus could happen in a number of different places where people were wearing their clothes and didn't change them. And that could be in - that was in England and the United States and many countries. But basically, when you look at the sort of - starting in the late 19th century, early 20th century, when people start bathing, it became a disease that was really associated only with these very extreme situations of war - concentration camps, barracks, ghettos, places where people really didn't have running water, didn't have access to changes of

clothes. And then it spread, you know, very quickly in these kind of environments - mostly in northern climes.

DAVIES: And that's because the **disease is transmitted, I guess, exclusively by body lice**, right?

ALLEN: Right. I mean, the kind of typhus that we're talking about is spread only by body lice. And the body lice **live in clothing**. They actually live in your clothing, and then they go to your skin and bite you and then retreat to your clothing. So if you don't have clothing, there are no body lice.

DAVIES: And body lice are distinct from head lice, right?

ALLEN: Right. I mean, the strange thing is that body and head lice are very similar anatomically, genetically. But there's some subtle differences. And head lice prefer a temperature that body lice can't stand. And so they only live in hair, whereas body lice live in clothing around your body.

DAVIES: There's one fascinating detail here, and that is how the louse actually transmits the disease to its human victim. Explain that.

ALLEN: Right. So people originally thought it was because of the bite because the louse sticks a little sort of needle into you to extract your blood. But it turns out that the mouth of the louse is actually sterile. And what happens is that as the louse bites you, it excretes. And then you scratch 'cause it itches. And when you scratch, you're sort of **inoculating yourself** with the bacteria that are in the louse poop, as it were.

DAVIES: **So you scratch and rub louse poop into yourself, and that's how you get typhus.**

ALLEN: That's how you get typhus.

DAVIES: And what conditions cause a louse to leave the human body? And this is - this matters in the spread of the disease, right?

ALLEN: Right. So the louse is - there's a very narrow temperature range on the human body that the louse likes. And **if you get too feverish**, meaning that you, in this case, are very likely to be sick with typhus, **the louse leaves**. And it - they've seen lice that **can walk, you know, five feet in an hour. They are pretty good walkers when they want to be**. And so this is how it spreads. And this is also why medical personnel, during all of the wars when there were a lot of cases of typhus, would often be the first people to get ill after the initial cases because they were treating these people. And the lice would come off of the feverish patient and, you know, crawl up and arm or a leg of a doctor.

DAVIES: So give us a sense of the scale of typhus epidemics in, you know, in history, particularly around the turn-of-the-century and in World War II - and in World War I.

ALLEN: So in World War I you had a terrible typhus epidemic in the Balkans that began in the Austrian army, which probably picked it up from civilians in Serbia. And then the Russians - **typhus was always endemic to Russia**. And Russian soldiers brought it to the Eastern front. The Germans managed to keep it pretty much out of their forces through de-licing and other measures. But then following World War I, when there was this terrible chaos all over the Eastern front after Lenin pulled his troops from the Eastern front, and Russian soldiers were roaming through all parts of Russia - what's now Russia, Ukraine, Belarus - and there were POWs in Poland...And the disease just spread like wildfire through that entire region. There have been estimates of as many as **20 million cases of typhus and, you know, 3 million, 4 million, 5 million deaths. Nobody knows**; the records are terrible. But the reports of eyewitnesses from that time are just staggering and hard to even fathom.

DAVIES: So as World War I ends, it's understood that body lice transmit the disease. **But there's no vaccine**. And that brings us to the central character of your book, Rudolf Weigl. Tell us a little bit about him.

ALLEN: So Weigl was actually an ethnic German, born in what's now the Czech Republic. His parents were both, you know, ethnic Germans. In this time, you know, there were different ethnicities spread around the Austro-Hungarian Empire. But his father was an inventor and had invented one of these large-wheeled bicycles. And he fell off one of his inventions and killed himself. And his - Weigl's mother remarried a Polish schoolteacher. And they were very tight, and Weigl identified himself always as

a Pole. And he studied in Lwow, which is now Lviv - studied zoology and started developing this expertise, initially as an entomologist and then as a typhus expert.

DAVIES: Right. And he was in the city now called the Lviv, which is in this area of Galicia, which was in Eastern Poland between World War I and World War II. He was an army doctor, I guess during World War I, and then set up a lab because he wanted to study lice. When Rudolph Weigl wanted to study lice, he had a problem, which is that lice, once they are themselves become carriers of typhus, the disease kills the lice themselves. And so he needed a way to get a supply of infected lice. He had a fascinating solution to this problem. Tell us about that.

ALLEN: So bacterial diseases in those days were usually cultured in sort of broths. But you couldn't grow typhus germs that way. And the only animals that carried typhus were humans and lice. So Rudolf Weigl figured out that what he needed to do was to learn how to grow typhus in lice but in a controlled way. And he was a terribly clever sort of technical wizard who could invent all kinds of little machines. Some of the microscope devices that we use today he invented, like a secondary focus knob on a microscope. And he invented a way to inject a tiny droplet of typhus, sort of a slurry of typhus germs, into a louse through its anus using a tiny sort of micropipette that he would draw out - a glass pipette that he drew out - and a Bunsen burner. And he was able to demonstrate that he could inject the germs into an individual louse this way while looking at the louse and the pipette under a microscope.

DAVIES: Yeah. So some people will infect guinea pigs or mice. This is a guy looking through a microscope at an individual louse...

ALLEN: Right.

DAVIES: And injecting it with the typhus. And he does this again and again and again to create an infected colony that he can study.

ALLEN: Right. And there's - that's the only way to do it because lice don't spread it amongst themselves. They only spread it by picking it up from a human. So he had to inject it into each of these lice. And eventually he devised these machines, which would use a sort of hydraulic pump that you stepped on while you were looking at the

louse under a microscope. And it would inject, you know, a droplet into a louse. And you could go down a row of lice that he would set up in a clamp, with their little louse butts in the air, and inject the typhus germs into each of, like, 50 lice in a row. It's just sort of an amazing contraption and the whole idea is very surprising.

DAVIES: And it gets weirder as we proceed. He faced another problem. In order to maintain this colony of lice, he had to feed them.

ALLEN: Right. So the way to feed lice is to give them humans to feed on. And he developed these little sort of matchbox-sized cages. He would put the lice into the cage and put a sort of a little screen over the cage that was wide enough mesh for the louse to stick its little needle through but narrow enough so the louse couldn't escape. And people would strap a number of these cages to their legs with a rubber band and feed - the lice would feed on their blood for about an hour. If you let lice feed for more than an hour, apparently they blow up. So you don't want to do that. But this is how he would keep this colony alive.

DAVIES: Now, in the course of doing this he had to make sure that he wasn't engaging healthy humans to feed lice which had typhus. But that could happen because he did have typhus-infected lice. He himself became infected at some point. Tell us about his experience with the disease.

ALLEN: So at this time, it was very difficult for scientists to know what kind of bacteria they were working with. And Weigl was intent on proving that he was growing typhus in the lice. And an opportunity to prove this once and for all happened when he accidentally infected himself with some solution of typhus solution in the lab. And he became ill with typhus. And even though he was delirious and raving, like people often are when they have typhus, he instructed his wife to put boxes of lice on him that had not been infected with typhus. These were clean lice, so to speak. And they became infected with typhus. And this was another sort of brick in the wall of evidence he was building that he was able - that he indeed had typhus growing in these lice colonies. And, you know, there were a number of accidents in his lab where people would get sick. A couple of very famous scientists died experimenting with typhus there. It was not an easy bacteria to work with in a laboratory.

DAVIES: We're speaking with Arthur Allen. His new book is "The Fantastic Laboratory Of Dr. Weigl." We'll talk more after a short break. This is FRESH AIR.

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DAVIES: This is FRESH AIR. And if you're just joining us, we're speaking with writer, Arthur Allen. His new book about scientist who developed a vaccine for typhus before and during World War II is called "The Fantastic Laboratory of Dr. Wiegler." So this is the period between the world wars, in the 1930's really, and word gets out that - that Wiegler is making progress towards a typhus vaccine. And what's fascinating is that the one - the way he would produce the vaccine in the lab was this very **painstaking process of growing this colony of infected lice and then harvesting the disease and pulling out the proteins**. Do you want to just describe how that happened?

ALLEN: Right, so it would start by **injecting typhus solution into these lice serially**. He'd put them in something that became known as **The Wiegler Clamp**, which **held the little lice in place while they were injected with this hydraulic pump**, which pumped a little bit of **typhus juice** into them. **Then they would feed on people**, and then after about five days they would be taken and **dissected individually**. They had to **pull the louse gut** - which is where all of the typhus germs grew - pull it out under a microscope, put it in a little pot, and then that would be **ground up and basically killed** - **the typhus germs were killed with formalin or some other chemical solution**. **And that was the vaccine**. But it involved, you know, **first injecting these lice**, then having them **grow in these matchbox-sized cages on people's legs**, then pulling them out, **taking out the guts** and then beginning the **whole process all over again**.

DAVIES: So thousands and thousands of lice had to be...

ALLEN: Millions of lice.

DAVIES: So millions of lice had to be **injected with this stuff by somebody pumping them full of the typhus vaccine**. Once they died, **taking their guts out very carefully**, again each of them done under a microscope by somebody, and **then the vaccine was created**.

ALLEN: Right.

DAVIES: Wow.

ALLEN: Yeah, it was an amazing process and very labor-intensive.

DAVIES: So Rudolph Wiegler develops this lab, begins growing lice by the millions, having them feed on humans who strap little cages of lice to their legs, and then a vaccine is developed. And then war comes - Poland is invaded by Germany in 1939, and the city he's in - now known as Lviv - first occupied by the Soviets because there was the, you know, the Hitler/Stalin pact and then eventually the Nazis, as the Nazis then invaded Russia. Tell us how Wiegler himself considered the question of whether to work for the Germans.

ALLEN: Well, I think that Wiegler was a very perceptive guy, and he saw that the Nazis were going to invade. And by the time the Nazi invasion occurred he was looking for the best way to deal with the situation. And he, you know, considered fleeing, he considered suicide and he decided that he would keep running the lab and - and it's - it's a little - we don't - I don't have - there are no diaries that show exactly what he was thinking but he turned out to have developed a relationship, probably by mail, with a German army commander named Eyer who had been stationed in Krakow and was making a vaccine from 1939-41 that was very similar to Wiegler's - it followed Wiegler's recipe. And so when Eyer came to Lviv and Wiegler saw that he could work under Eyer, and that he would be able to run the laboratory the way he wanted to, and to hire all of the people he knew from Lviv University, and their students, and other people that were in desperate need of help, he decided to keep it open. And this would cost him, you know - in the future he would be called a collaborator, but he made the best of a bad situation. He decided that all of these people in Lviv were in danger of being killed. The Nazis killed intellectuals. The Nazis killed anyone who was educated and represented another culture. And - so Wiegler made this very difficult decision that he would make this vaccine for the German Wehrmacht, the German army, but he would do so on his own terms.

DAVIES: That's a fascinating part of the story, because we have a situation where Wiegler has his laboratory open and it's a labor-intensive process. He needs a lot of people to feed the lice. He needs people to dissect the infected lice to create the vaccine. Tell us about what kind of people he employed in the lab and what they did.

ALLEN: Well, during the Interwar period, all of the intellectual life in Lviv was in the cafes. Well, the cafes were all closed during the Nazi occupation, or only Nazis went there, or collaborators. And all of the intellectual life basically migrated to Wiegl's laboratory. And people would go in there - **there were mathematicians, tables full of mathematicians, who would be doing their work as mathematicians while lice fed on their blood in these cages**. There were geographers, poets, all kinds of biologists - you know, every kind of walk of life. But particular - in particular there were many university professors and students who worked there. There were also people from the Polish Underground who worked there. It was a perfect cover to be an underground organizer because you had this pass that said Typhus Institute on it. You showed that to a Nazi SS person and on the one hand they were terrified anyone having to this Typhus Institute could be infected with typhus. It was dirty. It was associated with Jews, and lice and typhus. And on the other hand, they were told not to bother these people because they were making a product that was key to the German health defense.

GROSS: FRESH AIR contributor Dave Davies, will continue his interview with Arthur Allen in the second half of the show. Allen's new book is called "The Fantastic Laboratory of Dr. Wiegl." I am Terry Gross and this is FRESH AIR.

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GROSS: This is FRESH AIR. I'm Terry Gross. Let's get back to the interview FRESH AIR contributor, Dave Davies, recorded with Arthur Allen, author of the new book "The Fantastic Laboratory of Dr. Weigl: How Two Brave Scientists Battled Typhus and Sabotaged the Nazis." Typhus is spread by body lice and during World War II, epidemics were killing German soldiers, as well as people in war-torn areas and Jews in crowded ghettos. The two scientists Arthur Allen writes about were called on by the Nazis to produce typhus vaccines to protect German soldiers. But the scientists found ways to secretly help Jews and resistance fighters while undermining German soldiers.

DAVIES: So there was this typhus epidemic raging in the Jewish ghetto in Lviv. And you write that at least 30,000 doses of Weigl's vaccine actually found their way into people in that community. How did that happen?

ALLEN: Well, it was smuggled in various ways. But one method that Weigl had for doing this was to tell his bosses that they needed to do some experimental work in the - with the vaccine to make sure that it was up to snuff - that it was working well. And so this would be a pretense for bringing it into the ghetto and vaccinating people. So this went on throughout the war. And there were also thefts of the vaccine and a black market in it. It was one of the most valuable black market commodities because it was thought as being one of the only ways you could save yourself from typhus in the ghetto. A single, you know, dose of Weigl's vaccine could be worth as much as a month's wages or more.

DAVIES: So while Weigl kept his lab open, he made sure to include persecuted groups such as intellectuals, as well as members of the Polish underground in his lab working as feeders. And he also made sure that thousands of doses got to the Jewish community in the city. Now, he was - he was employed to produce a vaccine for the German army. Did he? Did he give them vaccine that would work to...

ALLEN: Yes.

DAVIES: ...To help inoculate German soldiers?

ALLEN: Yes, he did. And I mean, his boss, Hermann Eyer, estimated after the war that he might have saved the lives of 10,000 German soldiers. And there was a certain amount of sabotage that went on in the lab where the doses of the vaccine that were headed for the Eastern front were sometimes weakened or they would use fewer louse guts to make them, which made them weaker. But in general, I mean, this was legitimate vaccine that did go to protect their enemies. And, you know, this is a conundrum and a paradox that's unavoidable.

DAVIES: And just to clarify, you said that some of the vaccine that was sent to the German army was weakened. Was that Weigl's policy or was that done by others there...

ALLEN: Well...

DAVIES: ...Or was it not clear?

ALLEN: ...Weigl was this perfectionist who was always thinking about his vaccine. And in a way he - you know, he wasn't always focused on the current situation, but his associates were. And they looked the other way or were actively involved in a lot of sabotage of the vaccine. Weigl himself was involved in the smuggling operations of getting it to Jewish ghettos and to resistance fighters. But in terms of weakening his vaccine, it's not clear that he would have wanted to do that, even as paradoxical as that is.

DAVIES: Now, there was a young Jewish student, an assistant to Dr. Weigl, Ludwik Fleck. He was working at a hospital in the ghetto and managed to survive. How did - how did he find a way out of this?

ALLEN: Well, he partly survived because of the help of Rudolf Weigl. Rudolf Weigl gave doctors like Fleck, and several - probably a dozen people who worked with him as well as other Jewish doctors in the city - these passes that showed that they were employees of his institute, even though they actually weren't directly working there in most cases. But they had these IDs and those provided a special protection. And Fleck developed his own vaccine while working in the Jewish ghetto laboratory. He made it out of urine of all things. He discovered that when typhus patients were at a certain period of the disease, their urine contained pieces of, you know, typhus proteins that he believed could be protective if they were made into a vaccine. And they got the attention of some of the German medical authorities who became interested because they thought perhaps this vaccine could be used by the Germans. And so Fleck was brought in to the Gestapo headquarters. He went before some German doctors. He was asked if his vaccine could work for the Germans. And he said, well, of course, if you used German urine you could. And he was either making a - I guess he wasn't making a joke because he knew that they - that they wouldn't get it - that this was, you know, a crude joke about their racial idiocy. But they nodded their heads and they said OK. So he could continue making his vaccine with, you know, Jewish urine. And if it worked - why they could use the same technique to make one with German urine and it would work. And so he ended up working in the ghetto for about a year and then Himmler decided that he wanted to bring Jewish scientists from around Europe to the concentration camps to work in laboratories there.

DAVIES: So he eventually goes to Buchenwald and there works on developing a typhus vaccine. But I'd like to you talk a bit about what he and his family witnessed among the other concentration camp inmates and in particular what some of the Nazi scientists around them were doing.

ALLEN: Well, at Auschwitz he was in the lab next to the laboratory where they were doing mass-sterilization experiments on women. They - he knew who Mengele was and saw the experiments he was doing with twins that were just hideous. And at Buchenwald, he was in a laboratory that was part of a complex that was doing highly unethical, immoral experiments with typhus. And this actually became one of the bases for the Nuremberg Code in medicine. And what they were doing is, they were giving people typhus intentionally and using their blood to inject other people with typhus. And they would first vaccinate them with a whole series of different vaccines that they were trying to develop for the use of the German military. But in the meantime, they were doing these experiments that were not only unethical, they were completely useless. They really didn't yield any - any good information.

DAVIES: So at Buchenwald, Fleck eventually works on a typhus vaccine. His technique is different from - from the one that Doctor Weigl used, where he would grow colonies of lice. Fleck used a way of infecting rabbits and collecting tissue there. But did he actually give the German army a usable vaccine? And did he - did he help others in the camp?

ALLEN: When - when Fleck got to Buchenwald, this fellow Erwin Ding, who was intent on becoming a university professor.

DAVIES: He's the SS doctor who -

ALLEN: He was the...

DAVIES: ...Ambitious Guy.

ALLEN: Very ambitious, very stupid guy - had been told to make a vaccine in rabbit lungs using a French technique that was developed at the Pasteur Institute. So he gathered a bunch of people together who included a pastry cook, a couple of doctors, a physicist, a politician. None of them had any clue how to make a vaccine. And he said

OK, make this vaccine. So everybody wanted to make the vaccine. He wanted it for his career. They wanted it to avoid being murdered. And Fleck arrived a short period after they'd begun. And he said hey, this stuff you're growing in the rabbit lungs is not typhus germs. It's some other bacteria. And they said to him let's not tell them. And he said OK. And so they went on for about 16 months making this vaccine - very serious, kept a straight face the whole time. This was this wonderful vaccine that the wonderful SS man, Ding, was developing for the German army. And it was a useless vaccine. There was no typhus antigen in it. But about halfway through that process, they did learn how to make a real vaccine. But they were only able to make much smaller amounts of it. And they used this vaccine to vaccinate people in the camp who were most likely to be exposed to typhus, you know, inmates and people working in the typhus laboratory and so on. And this charade went on for a year and a half. And it - no one ever discovered any - even after the war it's not clear how many people knew about it because they gave this vaccine to the German officers who were on trial at Nuremberg. And they thought they'd been vaccinated with a good vaccine. And they would say see we were making a wonderful vaccine and even at Buchenwald, this horrible concentration camp. But we made this wonderful vaccine. And then at this trial, some of the inmates testified. Uh, no, that was a fake vaccine. And of course the German officers were shocked at the dishonesty of the inmates.

DAVIES: And they never figured out that the vaccine that they thought they were giving to troops didn't protect them from typhus?

ALLEN: Right. And this has something to do with the fact that vaccines are never perfect. So let's say you vaccinate a group of soldiers - 100 soldiers. And 12 of them get typhus. Well, it's very plausible that it was a decent vaccine but it didn't work perfectly. And maybe more of them got typhus until you became a little suspicious. And so you'd send back the news to the Germans in Berlin. And they would send down to Buchenwald and say, hey, what's going on with this vaccine. It's not working. So then the inmates would put together some of the good vaccine, send that up to Berlin, say oh, well, this is the lot that they were vaccinated from. And they tested and sure enough it was a good vaccine.

DAVIES: Arthur Allen's book is "The Fantastic Laboratory Of Dr. Weigl: How Two Brave Scientists Battled Typhus And Sabotaged The Nazis." We'll continue our conversation after a break. This is FRESH AIR.

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DAVIES: This is FRESH AIR. And if you're just joining us, we're speaking with Arthur Allen. He has a new book about a scientist who developed a typhus vaccine before and during World War II. It's called "The Fantastic Laboratory Of Dr. Weigl." After the war, there was a lot of fury against those perceived as having cooperated with the Nazis. What happened to Dr. Weigl after the war?

ALLEN: Well, unfortunately, his fate was very sad. He went to Krakow because all of the Poles who lived in Lviv were basically deported or forced to leave one way or another. He ended up in Krakow. The Krakow establishment was mistrustful of him. The Soviets distrusted him. Actually, they tried to get him to go to Moscow to make a vaccine for them there. He wouldn't go. He fell afoul of a very ambitious typhus expert who had nowhere near the expertise that he had but was in with the system. And basically, although he wasn't, you know, imprisoned, he was shunned and made to do things that someone of his age and expertise really should never have had to undergo. He was never, for example, admitted to the Polish Academy of Sciences. And he died basically unknown, unrecognized, in 1957.

DAVIES: And the steps he had taken to get vaccine to the Jews in the ghetto and to save members of the intelligencia and the Polish Resistance - that was never known or credited?

ALLEN: It was really ignored throughout his life, and even into the '80s there would be occasional sort of remarks about him in the press or in articles that he had been a, you know, collaborator. It wasn't until after the fall of the Soviet Union that his reputation was rehabilitated. Some of the people who had worked with him in the United States - who had gone to the United States or were still in Poland, began to sort of write articles. There were some articles in the Polish press. And then eventually, word got to, for example, the Israeli authorities. And Yad Vashem, which isn't always recognized, you know, Gentiles who did work to protect Jews during the Holocaust,

gave him recognition. You know, belatedly, in 2003, he was named as a righteous among nations.

DAVIES: And that was, of course, long after his death.

ALLEN: Long after.

DAVIES: And what about Ludwik Fleck?

ALLEN: The interesting thing about Fleck is his paper trail sort of indicates that he wanted to go to the United States after the war, or maybe Israel. His son, actually, was on the Exodus, the famous ship that brought Jews to Israel in 1948. So his son was in Israel, but Fleck and his wife remained in Poland. He continued to work as a scientist, first in the city of Lublin and then in Warsaw. There was anti-Semitism, but he kind of brushed it off. And then, in '57, he decided he was ill. And perhaps anti-Semitism played a role in this, but also his friends in Israel got him a job. And he left with his wife and went to Israel, remained there for about four years and died in 1961.

DAVIES: Isn't typhus pretty much gone?

ALLEN: Well, lice carry other diseases. I'm not sure a lot of science has been done with these lice, but lice also carry diseases that are still around. Although, the main this is now there aren't many people who are lousy, especially in the areas where there are lice. But there's research to be done. And also, I have thought a couple of times during these last several months in Ukraine that, you know, it's possible that we could have typhus again. It would never be as bad as it was before because you just - it can be handled quite well with antibiotics. But people who have had typhus - it's possible for the disease to remain dormant in them. And if they become lousy again, they can spread the disease. This used to happen in the Lower East Side with immigrants who'd come from Russia. And late in life, their immune systems would fade, and these dormant infections would come back to life. And they would get what was essentially typhus again. And this actually answers the mystery of how typhus remains alive because you figure when the people die and the lice die, then there's no more typhus. But it turns out certain people, when they get typhus, remain as reservoirs of the

disease, sort of like typhoid Marys. And if they ever become lousy again, they could spread it again. And hopefully things won't get to that point in Ukraine.

DAVIES: And we don't see it today mostly because hygiene has improved - people change their clothes?

ALLEN: Right. And the initial way that typhus was basically - quickly became a nonissue in global health was DDT. It was used first to fight a typhus epidemic in Naples in 1943. And then it was used in the concentration camps to end typhus epidemics that were happening there when the Allied armies came in. And then it was used, you know, throughout North Africa and Eastern Europe. And antibiotics can control a particular case of typhus - can, you know, treat - it could be used to treat it. And so - but the main thing is yeah, people aren't lousy anymore.

DAVIES: Well, Arthur Allen, thanks so much for speaking with us.

ALLEN: Thank you so much for having me on.

GROSS: Arthur Allen's new book is called "The Fantastic Laboratory Of Dr. Weigl." You can read an excerpt on our website, freshair.npr.org. He spoke with FRESH AIR contributor Dave Davies, who is also senior news reporter at WHYY.

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