Fannie's Fix:

How a Culinary Tradition Launched Modern Bacteriology

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Getting medicine when someone has an infection hasn't always been as easy as it is today in the 21st century. In fact, scientists and doctors didn't even fully understand how most infections happened until the 19th century. Using new tools like the microscope, they were finally beginning to understand that microorganisms like bacteria could make people sick. This new knowledge of microorganisms causing illness was called the germ theory of disease. Many scientists worked tirelessly to understand this process and find cures for the most deadly infections of the time. Tuberculosis was one of these deadly infections. In the 19th century, outbreaks of tuberculosis were common and many people died. The following is a piece of historical fiction that tells the story of a major discovery that helped scientists study bacteria and develop treatments for infections such as tuberculosis.

Part I – Disappointment in the Lab

She nervously opened the incubator door, peered in and could not believe her eyes. It was exactly the opposite of what she had hoped. Fannie let out a heavy sigh. Not a single sample was fit to put under the microscope. Another experiment was a complete failure and turned to mush, literally. What a mess! But before she had time to let the setback settle in, she heard Walther's footsteps excitedly approaching. He was going to be terribly disappointed. They had been working so hard for a breakthrough since they heard the news of the latest tuberculosis outbreak.

"Good morning, Fannie! How do the samples look?" said Walther as he peered over her shoulder at samples. She didn't have to say a word. One look at the liquefied samples said it all. He sat down and put his head in his hands.

Questions

1. Fannie and Walther saw the samples as "liquefied." Take a minute to consider what this means, then answer the following:
   a. What are the fundamental phases or states of matter?
   b. One type of liquefying is melting. What is a melting point and what are some other transition points between phases of matter?
2. A tuberculosis outbreak is mentioned. Tuberculosis is a highly contagious bacterial infection that usually occurs in the lungs. Visit the Center for Disease Control's (CDC) website (http://www.cdc.gov/tb/default.htm) to learn more about tuberculosis and answer the questions below.
   a. What organism causes tuberculosis?
   b. How is it spread?
   c. What are some common symptoms of the disease?
   d. Why would bacteriologists want to grow and study it in the lab?
   e. How is tuberculosis diagnosed and treated in the 21st century?
   f. Do you know anyone who has had tuberculosis? If not, ask your family members about it. They may know of ancestors or family friends who had tuberculosis.

Part II – Getting Back to Work

After a minute, Walther looked up and saw Fannie at her drawing table already deep in thought. He knew she was never one to dwell on failure. She had an amazing ability to learn from a mistake and move forward.

"Fannie, what are we going to do? We need something with a higher melting point."

She knew exactly what he meant. They had been adding gelatin to make a solid nutrient medium for growing microorganisms. It wasn't working. Any human pathogen like the one causing tuberculosis would need to be grown on a solid at human body temperature, 37°C. But gelatin melts at 35°C! She also knew it was too difficult to isolate and study different microorganisms if they were in a liquid. They had proof of that in the incubator right now. But what could they use instead of gelatin? That was the mystery.

Questions

1. Explain what Walther means by needing to make a solid with a higher melting point.
2. What are some ways Walther and Fannie could alter the melting point of their nutrient medium?
3. What are some substances with melting points higher than gelatin (35°C)?
4. Why might it be easier to isolate and study microorganisms using a solid medium instead of a liquid?
5. Why are microorganisms that are human pathogens usually grown *in vitro* at 37°C? In other words, why couldn't Fannie and Walther just lower the incubation temperature and keep using gelatin?

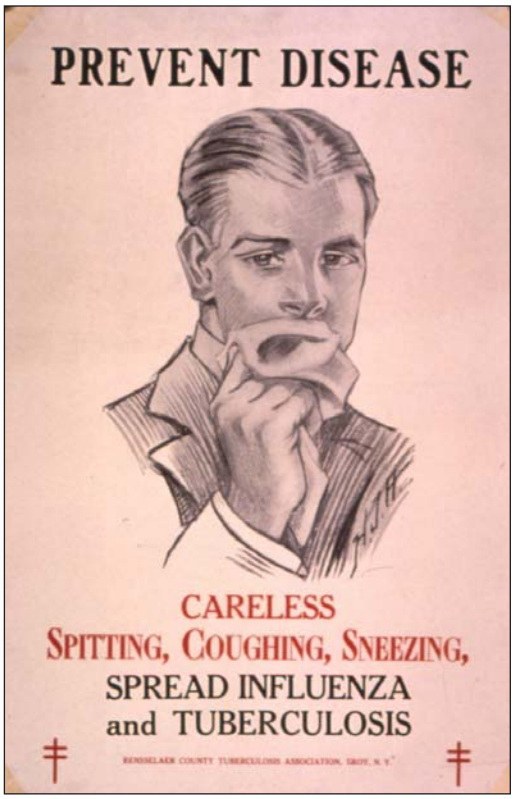

Figure 1. Poster circa 1920s. *Source:* <https://profiles.nlm.nih.gov/ps/retrieve/ResourceMetadata/VCBBBH>

Part III – Simple, yet Genius

Fannie was a master in the kitchen. Her recipes never failed the way her and Walther's experiments had been failing. She was especially known for her jams and jellies. Perfect batches every time, just how her mother taught her. She thought about her mother as she held up and examined a jar of jelly from a batch she made over the summer. "Why is this jelly solid through the hottest days of July, but our lab samples melt after one night in the incubator?" she muttered to herself. Then suddenly she cried, "That's it!" and ran to where Walther was studying. "Walther! I know what we need to do!"

What was Fannie's discovery?

Figure 2. Bacterial growth on plates used to diagnose infection.

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Figure 2. Bacterial growth on blood agar plates used to diagnose infection. *Source:* <https://visualsonline.cancer.gov/details.cfm?imageid=2230>.

Part IV – The Secret of Seaweed

"Agar?" said a startled Walther after Fannie's sudden outburst from the kitchen. "What is that? Never heard of it." He was curious where this idea was going.

"Sure you have!" said Fannie. "You know the seaweed extract I get at the market for my recipes? The one from red algae? That's agar! My mother taught me how to use it. She learned from her Dutch neighbors who spent time in the East Indies. It's been used by chefs as a thickener for over a century!"

Walther stood and immediately walked out of the room. Fannie stood and followed, barely able to keep up. "Walther? Why are you leaving? Where are you going?"

Walther turned with a smile. "To test your agar, of course!"

Pre-Lab Questions

1. Walther and Fannie want to test the agar.
    a. Explain what they mean by "test." How do scientists test something?
    b. What physical property of the agar do they need to test?
    c. What result are they hoping for that would make studying bacteria easier? (*Hint:* re-read Part II.)

Figure 3. Gelidium sesquipedale, photo by Joxemai, CC BY-SA 3.0. *Source:* <https://commons.wikimedia.org/wiki/File:Gelidium_sesquipedale_0001.JPG>.

Part V – Meet Angelina "Fannie" Eilshemius Hesse

Angelina "Fannie" Eilshemius was born in the United States to German and Dutch immigrants in 1850. Little is known of her youth, but she was the oldest of ten children and grew up learning her way around a kitchen. At age 15 she studied French and home economics at a finishing school in Switzerland. In 1874 at the age of 24 she went to Germany. In Germany, she met the man who would become her husband, Walther Hesse.

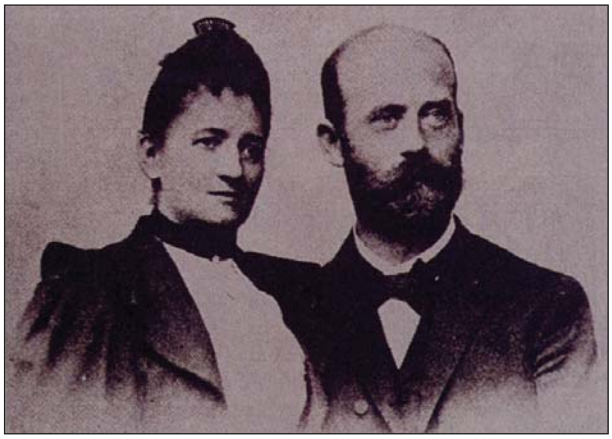

Figure 4. Fannie Eilshemius (1850–1934) and Walther Hesse (1846–1911).

Walther was a young and talented German physician with an interest in microbiology and airborne disease. As Walther worked and studied, Fannie was his partner and dedicated assistant. Using her knowledge in the kitchen, she prepared her husband's lab supplies and solutions. She was also his illustrator, a very valuable skill as the camera technology did not yet exist to take pictures of microorganisms. Together they worked relentlessly to improve the techniques for studying microorganisms and identifying airborne bacteria.

Fannie's contribution of agar to the lab came in 1881. The success of agar was communicated to Robert Koch soon thereafter. By 1905, Robert Koch had used Fannie's agar medium to help identify the causes of many infectious diseases such as tuberculosis, cholera, and anthrax. For this he received a Nobel Prize and is referred to as the father of modern bacteriology. Walther and Fannie received no money or recognition for their work at the time. Today Fannie is credited with this contribution that tremendously advanced science and continues to help scientists and physicians battle the infectious diseases of the 21st century.

Together with Walther, Fannie also raised and educated their three sons. More personal details of Fannie were published by her grandson, Wolfgang, in 1992. He fondly remembers that she was called "Lina" by family members and although she spent her entire adult life in Germany and spoke German, she kept her American accent and always counted in English. She was proud of her American roots. Fannie passed away in 1934 at the age of 84.

Questions

1. How do you think the roles of women have changed in science from the time of Fannie's discovery in the 1880s to today?
2. Had she made her discovery today, do you think she would have received more credit than she did back then? Why or why not?
3. How is credit given for modern day scientific discoveries?
4. Fannie was born in America, but lived most of her life as an immigrant in Germany.
    a. Describe how she assimilated into German culture without forgetting her past.
    b. What are some other ways immigrants can assimilate without forgetting their past?