Chapter 15

Analyzing a Long Essay

A long essay may draw on many of the strategies that we have examined. It may also fall into more than one failure in logic or more than one informal fallacy. Consider a case study in the history of medicine. It includes analogical, statistical, and causal reasoning. Scientific theories, hypotheses, experiments, and predictions all play a prominent role; so does refuting and confirming evidence. Is the essay convincing? You will decide. As you read, you can apply many of the logical skills that you have learned to identify and reconstruct its arguments. You will be able to analyze governmental reaction and the social policies that were enacted in the face of an ongoing tragedy. (*Note*: The paragraphs have been numbered so that you can easily locate specific passages while working on the exercises.)

The essay format allows for a comprehensive series of arguments and analyses within the context of a single complex issue. You will face complex arguments in your career, in politics, and in ordinary life almost every day. We hope that you will thoroughly enjoy facing them. We hope, too, that your practice throughout this book makes you a more engaged and effective reader.

A. CHILDBED FEVER

1. The following is a reconstruction of the reasoning, research, and experiments that enabled Ignac Semmelweis to find the cause of childbed fever. Semmelweis claimed that his discovery (that the so-called disease was actually blood poisoning) was a leap of the imagination that came to him after an extensive experimental process whereby he eliminated many false causes. Semmelweis's written account has become the "received view" and is accepted by nearly all writers on the subject. Upon close analysis, however, Semmelweis's written account reveals several important gaps; in addition, it does not mesh with other historical information.

2. This paper will propose two main points: (1) Semmelweis's final discovery came later than even he realized. (2) The discovery was arrived at by circumstances that have been overlooked by the received view. The reconstruction and analysis begin with a brief description of the "lying-in" (maternity) hospital of Vienna, where Semmelweis did his work. Since Semmelweis began working on the problem of childbed fever (also called *puerperal fever*) from the standpoint of the prevailing theories of disease, it will be necessary to sketch a profile of the two major competing theories of the 1840s, *miasm* and *contagion*. Following the background information, a detailed look at Semmelweis's own report of the discovery will be undertaken. Finally, the crucial gaps in the received view will be filled in by an alternative account of the discovery.

B. VIENNA

3. In 1784, Joseph II made a decree setting up the lying-in hospital of Vienna. His mother had been worried about the number of illegitimate births in Vienna, which was almost equal to the number of legitimate births for quite a number of years. Concerned that the young girls and their newborn might not be getting the best care, the decree stated that a secure place of refuge was to be provided for "the many seduced females who are under the compulsion of shame and necessity, and for the preservation of the blameless, unborn offspring which they carry in their wombs, so that they may at least be brought to Holy Baptism" [11, p. 335]. (*Note*: The references in brackets are to the bibliography at the end of this chapter.) It is ironic that this charitable act would eventually lead to the tremendous number of deaths from childbed fever that took the lives of the very women the lying-in hospital was set up to protect in the first place. There were indeed a great number of deaths to mothers, and as the fever did not normally affect the newly born, this left many children without mothers. It would appear from this that there were a great number of children who had to grow up without mothers. "During the period of Semmelweis' service in the first division, and for some 20 years before, for that matter, there was a surfeit of motherless infants, because of the high mortality rate from puerperal fever among the new mothers. This was however nicely canceled by the frightful mortality rate in the foundling hospital" [11, p. 339]. From 1784 to 1838 there were 183,955 infants admitted to the foundling hospital, 146,920 of whom died.

4. In 1840, the Vienna Hospital set up two divisions in the obstetric department. The first clinic was staffed by doctors and medical students doing intern work in obstetrics, while the second employed midwives who had no duties other than assisting in the care of the patients and in deliveries. Admissions to the clinics were as follows: On Tuesday, Thursday, and Saturday patients were admitted to the second clinic; on Sunday, Monday, Wednesday, and Friday patients were admitted to the first clinic. When Semmelweis began his investigation, the rates of death from puerperal fever were approximately 12% monthly for the first clinic, but only 3% for the second clinic. Semmelweis was interested in finding answers to two questions: What was the cause of childbed fever, and why did more deaths occur as a result of childbed fever in the

first clinic than in the second? Many people had proposed answers, but none of the explanations had been shown to be correct. It is against the background of these proposed explanations that Semmelweis began his research.

EXERCISES 15B

1. According to the information in paragraph 3, what was the reason for setting up the lying-in hospital of Vienna? Was it successful?

Answer: The mother of Joseph II was worried about the high number of illegitimate births in Vienna. The concern was that young girls and their newborns might not be getting the best care. It was not successful because of the high mortality rate from puerperal fever among the new mothers. In addition, the mortality rate in the foundling hospital was also very high (of the 183,955 infants admitted, 146,920 died).

2. Describe how the two clinics in the lying-in hospital were staffed. (paragraph 4)
3. How were admissions handled in the two clinics? (paragraph 4)
4. At the beginning of Semmelweis's investigation what were the rates of death from puerperal fever for the two clinics? (paragraph 4)
5. What were Semmelweis's initial questions? (paragraph 4)

C. MIASM AND CONTAGION

5. Until Semmelweis made his discovery, *childbed fever* (also called *puerperal fever*) was universally believed to be a disease peculiar to women. In order to get the disease, it was thought that two conditions had to be realized. First, the woman had to be pregnant, and second, she had to come in contact with the cause (whatever it was). Both conditions were thought to be necessary; being pregnant was not sufficient, and coming in contact with the cause was not enough either. It was believed that nonpregnant women never got puerperal fever. Thus, the prevalent view was that childbed fever was a *specific disease* that affected only pregnant women.

6. In the early 1800s, the explanations given for the spread of childbed fever fell mainly under two dominant theories of disease: miasm and contagion. Quite simply, *miasm theory* postulated that diseases were carried by the air; certain combinations of the basic elements in the atmosphere were potentially harmful to humans. This theory sought to explain why diseases, such as plagues, occurred in certain areas and not in others. In other words, "Miasmatic diseases result from the invasion of infectious agents from without, which cannot always be traced either directly or indirectly to some other case of the same disease" [1, p. 59].

7. As an alternative, *contagion theory* (at least in the early 1800s) held that "a contagious disease is one transmissible from individual to individual by immediate or direct contact"

[1, p. 59]. It should be kept in mind that *infectious* is understood as being distinct from *contagious*, in that the former is the broader of the two. Whereas *infectious* refers to the *causation* of the disease, *contagious* refers only to the *manner of transmission*.

8. The debate between these two dominant theories took a definite geographic flavor. The British regarded childbed fever as a *contagion*, and thus their methods of combating it were different from those practiced on "the Continent" (Europe), where *miasm* theory held sway. In England, doctors who came in contact with patients washed their hands in a solution of chlorinated water in order to destroy any contagion that might be around. However, the British considered childbed fever to be a *specific disease* that was contagious. They were under the assumption, similar to that held on the Continent, that childbed fever affected *only* pregnant women. The British belief that childbed fever was a specific contagious disease was erroneous; nevertheless, their method of treatment against childbed fever was successful. What was needed, and what no one had ever done, was to recognize the fever as a *symptom* and not as a disease.

9. Although the majority of doctors in England thought childbed fever to be a contagion, some did side with miasm theory. These physicians took precautions to clean up sewage and foul odors in and around hospitals. They used chlorinated water in various solutions as a disinfectant. They often built their lying-in hospitals away from dumps and other areas where foul odors could be found. The fact that both systems of combating childbed fever had some success further complicated the debate between the two opposing sides.

10. It is difficult to characterize accurately the climate in Vienna regarding the debate between miasm and contagion. Both theories were being revised and both sides were shifting their ground as diverse forms of evidence became more available. An important historical point must also be kept in mind—the extreme difficulty Semmelweis had in getting his discovery accepted in 1847. Semmelweis could not use *germ theory* as support because Pasteur's experimental results would not be universally accepted for another 16 years. "The concepts of bacteriology—which would have added credibility to Semmelweis's findings—awaited Pasteur's work; and the concepts which reigned instead—miasm, epidemic constitution and telluric influences (contagion)—made acceptance of Semmelweis's (theory) improbable" [7, p. 12].

11. It is against this historical backdrop that we find Semmelweis in the obstetric department of the Vienna Hospital, understandably appalled by the great number of deaths from childbed fever. He set himself the task of finding its cause.

EXERCISES 15C

1. What two conditions were thought to be necessary in order for a woman to contract childbed fever? (paragraph 5)

Answer: First, the woman had to be pregnant, and second, she had to come in contact with the cause (whatever it was). Both conditions were thought to be necessary.

2. Was the prevalent view that childbed fever was a specific disease that affected only pregnant women? (paragraph 5)
3. Explain miasm theory. (paragraph 6)
4. Explain contagion theory. (paragraph 7)
5. Describe the distinction between *infectious* and *contagious*. (paragraph 7)
6. How did the British view childbed fever? How did they combat it? How did the British view differ from thinking on the Continent? (paragraphs 8 and 9)
7. Why couldn't Semmelweis use Pasteur's germ theory as support for his ideas? (paragraph 10)

D. SEMMELWEIS'S ACCOUNT OF THE DISCOVERY

12. Since Semmelweis was looking for the *cause* of childbed fever, he began testing some obvious implications of the miasm view to see if it could explain why the rates of death in the two divisions were so radically different. If the fever was caused by something in the atmosphere, as miasm theory suggested, then why did it not strike the second clinic as well? Since the two clinics had a corridor in common, one might reasonably conclude that the atmosphere should be the same in both clinics, and thus the rates of death should be similar as well. Semmelweis also wondered why the fever occurred more in women who were admitted on Sundays, Mondays, Wednesdays, and Fridays (the first clinic). Surely the fever did not happen to enter the atmosphere only on those 4 days.

13. However, perhaps women came in contact with puerperal fever miasms in the atmosphere *outside* the hospital. Semmelweis rejected this similar idea, because it would mean that it was equally likely for all women to get the fever. If the fever was contracted outside the hospital, then the rates in the two clinics should be the same regardless of the day the women were admitted.

14. It was well known that the rate of the fever in the population at large had never reached the high percentage that it had in the hospital. If childbed fever was like cholera—if it was a true epidemic—then why did it not appear like one? It should have been relatively easy to find similar degrees of fever outside the hospital, if the miasm theory of atmospheric epidemics was correct; but the statistics did not bear this out. In addition, epidemics have periodic intermissions. They usually do not continue for long periods of time, and they were thought to be seasonal. But the high rate of fever, at least in the first clinic, had apparently not regressed since the two clinics were set up. Since there was no periodic remission accompanying the changes of the seasons, then puerperal fever did not seem like a true epidemic.

15. Statistics from other hospitals and lying-in clinics revealed yet another curious result. In places where there was no medical teaching, other than midwifery, the rate of death by puerperal fever was usually (but not always) very low. Even in cities where the rate was high in a hospital where general medicine was practiced and taught, the

rate was usually lower where no medical teaching was done. If the epidemic theory was correct, then how could it account for two completely different rates in the same city? Semmelweis's early conclusion to these preliminary studies was that puerperal fever was *endemic*: a disease that was the result of causes *within the hospital* from endemic noxious agents. Semmelweis now faced the task of testing the many conjectures that fell within the group of endemic causes.

16. The first endemic explanation that Semmelweis checked was overcrowding. It turned out that there was no real difference between the two clinics in terms of number of patients per available area. If anything, the second clinic might at times have been more crowded than the first, because women were becoming aware of the great chance of death that accompanied admission to the first clinic. Semmelweis relates that women would fall down on their knees and beg not to be admitted to the first clinic. It was said that women who had not known of the admission procedure, and who were told that they had come on the day that women were being admitted to the dreaded first clinic, actually fainted at the prospect. But Semmelweis argued that the rate had been high long before it had become common knowledge. The first clinic was consistently higher than the second in both the incidence of childbed fever and the number of deaths. Therefore, terror could not account for the high rates in the early years of the clinic.

17. Since Semmelweis did not have his own apartment, he slept in a room that was close to the first clinic. He noticed one night that the priest who had to deliver last rites to a dying patient went through the first clinic. Semmelweis became disturbed when he was aroused from sleep by the ringing of the bell. He felt sorrow at the thought of some patient's imminent death. He wondered if the women lying in the first clinic were as affected by this as he was and, if so, if this might be the cause of the high rate of childbed fever. If he, a healthy person, were sorrowed by the incident, then how much more might a woman who was in a highly emotional and sensitive state be affected? He knew that the priest went through only the first clinic, not the second, on his way to hospital calls. Having spoken to the priest about this and made him aware of the grave peril, Semmelweis was able to convince the priest to go a different way and to stop ringing the bell. However, this experiment did not unearth the true cause.

18. It was suggested to Semmelweis that perhaps the first clinic contained more poor patients. If so, the poverty of the patients might have caused them to be unhealthy before they were admitted. However, Semmelweis could find no facts to support this idea.

19. Another idea was that the first clinic had happened to admit more unmarried young women than the second clinic. Although no explanation was given as to why this should cause more cases of childbed fever, nevertheless Semmelweis tested it anyway. Once again, Semmelweis could find no substantiation for this claim.

20. Another explanation had been circulating for some time as well. Perhaps the doctors and medical students were "rougher" in handling women than the midwives, who, being women, were more apt to treat the patients in a gentle manner. Semmelweis

responded that the fetal body was much rougher on women through delivery than were the male doctors' examinations.

21. A different, but related, idea was that the women were embarrassed by being examined by men, but not by the midwives. Semmelweis rejected this idea, because he could not see why modesty should cause anything like a disease.

22. Semmelweis's investigations showed that patients in both clinics received the same kinds of medical attention and treatment when necessary. For example, the women in the first clinic were required to walk back to their beds 3 hours after delivery. But this policy was followed in the second clinic as well.

23. Could poor ventilation be the cause? Semmelweis determined that the ventilation was the same in both clinics.

24. Could the linen be a factor? Perhaps it was of a different kind or laundered differently. Semmelweis determined that the linen was the same and was laundered at the same place.

25. Could food be the answer? The food for both clinics was prepared in the same place and the diets were the same.

26. If there were an unlimited number of possible explanations of the death rate (and by the look of things, this is what Semmelweis seems to have faced), then he could eliminate as many as he liked without getting any closer to the truth. He doubted that he would ever stumble on the answer. Semmelweis felt that he was grasping at straws.

27. One day a colleague pointed out something that Semmelweis had not noticed. The procedure in the second clinic, but not in the first clinic, was to have women assume a lateral position for delivery. Semmelweis immediately implemented the use of the lateral position in the first clinic. Every delivery was performed this way in the hope that the death rate in the two divisions would be comparable. But this experiment failed to change the death rate in the first clinic. The high rate in the first clinic seemed immune to change, however hard Semmelweis tried to lower it.

28. There seemed to be an unending supply of explanations for Semmelweis to test. One popular belief was that conception itself was to blame for childbed fever. That is, the women in the first clinic had a different experience that brought about their present condition. Semmelweis commented on this idea:

> Recent investigators have indeed accused the *conception itself* as the factor in producing the puerperal processes, in that the effect of the *Spirma Virile* postulates a series of metamorphoses and stimulates many, in part unknown, changes in the blood. I do not consider that I am laboring under any illusion when I make the assertion that those individuals, who have borne in the second clinic, were preceded by a conception also. [15, p. 380]

29. Semmelweis also considered the birth act itself. Possible causes of childbed fever were protracted labor, death of the fetus, and the wounding of the inner surface of the

uterus by the fetus. However, Semmelweis pointed out that all these effects could be seen in both clinics. The outcomes of the birth act had to be similar in both divisions.

30. Additional aspects of childbed fever were puzzling as well. For one, when labor lasted 24 hours or more, puerperal fever almost always occurred, especially in first pregnancies. Semmelweis writes, "I did not know, to be sure, why this happened, but I saw it happen often; the fact was the more inexplicable, because it was not repeated in the second division under similar circumstances" [15, p. 381].

31. With the power of hindsight, let us see what would have happened in the first clinic. If there was a protracted labor, and if it lasted for, let us say, 2 days, what was likely to happen? Since there were two shifts of medical students in the first clinic, there would be four clinic visits in a 2-day period. Each shift had at least five students, plus a physician examining the patient. This would amount to at least twenty-four examinations of the patient. We can easily see why these cases almost always resulted in childbed fever, because the chance of blood poisoning was great. This is especially so since the physicians and students did not take care to disinfect their hands before the examinations were conducted.

32. In addition, in these cases of protracted labor the child, too, was usually affected with childbed fever-like symptoms and died along with its mother. Semmelweis came to believe that the symptoms occurred in both *female* and *male babies*. Semmelweis was the first to notice this: "The anatomical findings in the cadavers of such newborn were identical to the dead bodies of puerperae (the mothers) who succumbed to puerperal fever. To recognize the changes in the bodies of the puerperae, and not to recognize the identical changes in the bodies of the newborn, invalidates the pathological anatomy" [15, p. 381]. Semmelweis tells us that these early clues gave him the first real breakthrough: He stopped thinking of puerperal fever as occurring only in pregnant women.

33. Through painstaking effort and thought, Semmelweis had acquired new facts that strengthened his rejection of the previous conjectures. "The many etiologic factors which have been cited as productive of childbed fever among the mothers are impossible of acceptance with reference to the newborn. The newborn were probably unafraid of the first division, because its evil reputation was unknown to them; and the injured sense of modesty, because they are born in the presence of men, would be less liable to do harm among the newborn" [15, p. 383].

34. Semmelweis thought that he might be finally getting close to the answer. He had conducted numerous experiments to weed out the false conjectures. He had some important new facts, which he could not yet explain; but he was aware that these facts were necessary to finding the true cause of childbed fever.

35. The scandal surrounding the notorious first clinic and its appalling number of deaths had reached its peak, and this poor reputation was a blemish on the otherwise highly acclaimed Vienna Hospital. Something had to be done, and the government did what most governments do in times of crisis: It formed a commission to investigate the situation. The commission, consisting of nonmedical people, went to the head of the

clinic for advice. Its conclusion was that the medical students were rougher than the midwives. The commission further stated that the foreign students were roughest of all. What was the remedy? Get rid of the foreign students. As a result, the staff in the first clinic was cut in half, from about forty students down to around twenty. And for the next 4 months the death rate did indeed go down in the first clinic—from an average of 12% to 3%. Given this result, the commission felt justified, and the government was satisfied. (Once again, with hindsight we can understand the sudden drop. Fewer students meant fewer examinations; thus, the chance of infection was reduced.)

36. However, the remaining staff began making up for lack of help, and Semmelweis did more than his share of work. Little by little the death rate rose again. After 5 months it was right back at 12%. What was the commission's reaction to this turn of events? It concluded that childbed fever must be an epidemic. Semmelweis's comment to all this: "Everything was uncertain, everything was inexplicable; only the enormous number of deaths was an indubitable fact" [15, p. 390].

37. Just when it appeared that Semmelweis was beginning to get some interesting information, he was relieved of his position. He had been hired as a substitute in February 1846, a position that lasted until October 1846, when he expected to get his own 2-year assistantship. However, this did not happen, and it meant that he would have to wait 2 more years to get the assistantship back. Without the position he could not try his ideas, because he no longer would have free access to and control over the first clinic. He continued his autopsy work and performed other duties in the hospital where needed, but he longed to return to his search. He gave up hope of continuing on at Vienna, and so he began studying English with the idea of going to Dublin Hospital. However, before he could begin anything new he got back the assistantship. The doctor who had taken his job back got an offer from another hospital. So, after a 5-month delay, Semmelweis was able to resume his study.

38. Naturally he was relieved by this news, and having admitted to being depressed during those 5 months, he was given permission to go on a vacation. He and a few friends went to Venice for 3 weeks. Semmelweis related how this period was calming and he forgot all about the problem awaiting him at the lying-in hospital and, instead, concentrated on the beautiful paintings and fantastic surroundings of Venice.

39. When he reached Vienna he was given some shocking news; his good friend Dr. Kolletschka had died. Kolletschka had been performing a routine autopsy when an assistant accidentally cut Kolletschka's finger, and he died within 2 weeks. Semmelweis studied the autopsy findings in great detail. This is where Semmelweis tells us he made the discovery of the cause of childbed fever:

> a. Kolletschka . . . was stuck in the finger by a student, with a knife which was used during the post-mortem. . . . [He] then became ill with lymphangitis and phlebitis in the same upper extremity and died . . . of bilateral pleuritis, pericarditis, peritonitis, and meningitis, and some days before his death a metastasis formed in one eye. . . . [T]here was forced on my mind with

irresistible clarity in this excited state the identity of this disease, of which Kolletschka died, with that which I had seen so many hundred puerperae die. The puerperae died likewise of phlebitis, lymphangitis, peritonitis, pleuritis, pericarditis, and meningitis, and metastases were also formed in them.

b. Day and night this picture of Kolletschka's disease pursued me, and with ever increasing determination, I was obliged to acknowledge the identity of the disease, from which Kolletschka died, with that of which I saw so many puerperae die.

c. From the identity of the pathological findings in the cadavers of the newborn with the pathological findings in the women, who died from childbed fever, we had concluded earlier, and we think rightly, that the newborn died also of childbed fever, or in other words, the newborn died of the same disease as did the puerperae. Since we came upon the identical results in the pathological findings of Kolletschka as in the puerperae, then the conclusion that Kolletschka died of the same disease from which I had seen so many hundred puerperae die, likewise was justified. The . . . cause of Kolletschka's illness was known, that is to say, the wound produced by the autopsy knife was contaminated at the same time by cadaveric material. Not the wound, but the contamination of the wound by cadaveric material was the cause of death. Kolletschka was not the first to die in this fashion. I must acknowledge if Kolletschka's disease and the disease from which I saw so many puerperae die, are identical, then in the puerperae it must be produced by the selfsame engendering cause, which produced it in Kolletschka. In Kolletschka, the specific agent was cadaveric particles, which were introduced into his vascular system. I must ask myself the question: Did the cadaveric particles make their way into the vascular systems of the individuals whom I had seen die of an identical disease? The question I answer in the affirmative. [15, pp. 391–92]

40. Semmelweis therefore concluded that it is through the doctors' and medical students' examinations of the women that cadaveric particles are absorbed into the system. Semmelweis writes that "from the first this seemed to me more than likely, since the fact was known to me that decaying organic matter brought into contact with living organisms produced in them a putrefactive process" [15, p. 393].

41. Semmelweis now had a hypothesis that he could put to the test: Cadaveric material was *the cause* of puerperal fever. The solution was to eliminate the particles by correct washing. The results should be a lower death rate. Since Semmelweis believed that cadaveric particles were not removed by soap and water, because the odor remains, he started using a solution of chlorinated lime, with the idea to eliminate the odor, and by so doing, to eliminate the particles. He emphasized washing the hands until they squeaked, thinking this would ensure that all particles were removed.

42. An experiment was set up to ensure that no other changes were allowed in the first clinic. The only new factor was the washing of hands in the solution. The immediate result was that the childbed fever rate dropped from 12% to 3% in the first clinic. For

the year 1848, the rates of the two divisions were as follows: first division, 1.27%; second division, 1.33% [15, p. 394]. For Semmelweis, the reason that the second clinic always had a lower death rate was now understood; the midwives did not come in contact with cadaveric material.

43. Semmelweis later refined his discovery and concluded that puerperal fever was not a specific disease as everyone had believed; it was a variety of blood poisoning. So childbed fever was not a contagious disease in the usual sense, because a contagious disease produced a contagium by which it spread as the identical disease. For example, smallpox cannot cause a different disease, such as scarlet fever. On this topic, Semmelweis writes:

> This explains why the dispute over the contagiousness or noncontagiousness of childbed fever can never be brought to a satisfactory conclusion, because the contagionists can cite cases where the spread of childbed fever from an ill puerpera to a healthy one could not be denied. And the opponents of the contagion theory can likewise bring forward cases in which the spread of childbed fever did not occur under circumstances where it should have happened if it were a contagious disease. Childbed fever is not a contagious disease, but it is communicable from an ill puerpera to a healthy one by means of *decomposed animal-organic matter*. [15, p. 434]

EXERCISES 15D

1. What was Semmelweis's reasoning concerning the hypothesis that something in the atmosphere in the hospital was the cause of the disease? (paragraph 12)

Answer: Since the two clinics had a corridor in common, the atmosphere should be the same in both clinics, and thus the rates of death should be similar as well. Also, the fever occurred more in women admitted on Sundays, Mondays, Wednesdays, and Fridays, which happens to coincide with admissions to the first clinic. Surely the fever did not appear in the hospital's atmosphere only on those 4 days.

2. What was Semmelweis's reasoning concerning the hypothesis that something in the atmosphere outside the hospital was the cause of the disease? (paragraph 13)
3. How did the disease of childbed fever differ from cholera? (paragraph 14)
4. If the epidemic theory was correct, then it could not account for two completely different childbed fever rates in the same city (where medical teaching was conducted). Given this, what was Semmelweis's early conclusion? (paragraph 15)
5. What was Semmelweis's reasoning regarding the "overcrowding" hypothesis? (paragraph 16)
6. What experiment did Semmelweis conduct regarding the priest and the ringing of the bell? What were the results of the experiment? (paragraph 17)

7. What was Semmelweis's reasoning regarding the "poor patients" hypothesis? (paragraph 18)
8. What was Semmelweis's reasoning regarding the "unmarried young woman" hypothesis? (paragraph 19)
9. What was Semmelweis's reasoning regarding the hypothesis that "doctors and medical students were 'rougher' in handling women than the midwives"? (paragraph 20)
10. What was Semmelweis's reasoning regarding the "embarrassment" hypothesis? (paragraph 21)
11. What was Semmelweis's reasoning regarding the "medical treatment and attention" hypothesis? (paragraph 22)
12. What was Semmelweis's reasoning regarding the "ventilation" hypothesis? (paragraph 23)
13. What was Semmelweis's reasoning regarding the "linen" hypothesis? (paragraph 24)
14. What was Semmelweis's reasoning regarding the "food" hypothesis? (paragraph 25)
15. What was Semmelweis's reasoning regarding the "lateral position" hypothesis? (paragraph 27)
16. What was Semmelweis's reasoning regarding the "conception process" hypothesis? (paragraph 28)
17. What was Semmelweis's reasoning regarding the "birth act" hypothesis? (paragraph 29)
18. What was the "protracted labor" puzzle? (paragraphs 30 and 31)
19. What important evidence did Semmelweis become aware of regarding newborn children? How did this affect his thinking regarding the idea that childbed fever was a disease that affected only pregnant women? (paragraphs 32 and 33)
20. What did the government do in the face of the scandal surrounding the first clinic of the Vienna Hospital? What did the commission conclude? What policy was implemented? What was the result? (paragraphs 35 and 36)
21. Explain how the Kolletschka case affected Semmelweis's thinking. (paragraph 39)
22. What did Semmelweis conclude? Describe Semmelweis's reasoning. (paragraphs 39 and 40)
23. What was Semmelweis's hypothesis, and how was he going to test it? What did he predict should happen? Did the results confirm the hypothesis? (paragraphs 41 and 42)
24. What refinements did Semmelweis make to his hypothesis? (paragraph 43)

E. INITIAL QUESTIONS

44. At this point the attentive reader may be wondering why it took Semmelweis so long to make the discovery. With so much "obvious" evidence at his disposal, why didn't he make the connection sooner? A quick look at the clues Semmelweis admits having long before the Kolletschka case might seem to support this view:

45. A prolonged pre-birth period almost assuredly led to childbed fever, but not in the second clinic.

46. In the first clinic the patients sickened in rows, but not in the second clinic.

47. Those women giving birth outside the hospital had less chance of contracting the fever.

48. In hospitals where only midwifery was done, the rate of puerperal fever was generally low.

49. Babies, including males, could get puerperal fever.

50. The rate of puerperal fever was always lower in the second clinic.

51. The death rate did go down when the number of students was reduced in the first clinic.

52. Semmelweis tells us that the rate in the second clinic was normally very low, with one exception: "Only in 1842–1843, when in the second division there was one assistant who was engaged in several branches of pathological anatomy, did the mortality, which was otherwise small in that division, go up; in 1842, it rose to 202; in 1843, to 164" [7, p. 53].

53. It has been pointed out that the fact that Semmelweis had such a well-controlled experiment contributed to solving the mystery of childbed fever. Nevertheless, Semmelweis seems to have missed entirely what appears to be *the most obvious difference* (at least to us, looking back)—namely, midwives in the second clinic, doctors and interns in the first clinic. And yet it took the Kolletschka case to jolt Semmelweis out of his slumber.

54. The history of science shows us that simply having certain pieces of evidence does not ensure that someone will make a discovery. In the study of childbed fever, many doctors (at the same time Semmelweis was working) were in possession of similar facts but nevertheless failed to make the discovery.

55. It has been suggested that the experimental method was the key to Semmelweis's discovery—that is, using controlled experiments to eliminate false causes. However, given all the hints Semmelweis had, and even using controlled experiments to the fullest, Semmelweis still missed the crucial difference: doctors versus midwives. In fact, Semmelweis's own account emphasizes the importance of his "seeing" Kolletschka as like a childbed fever victim.

56. Since Semmelweis did not publish anything concerning his discovery until 1858, it has not escaped historians notice that Semmelweis's account may be faulty;

nevertheless, no alternative reconstruction has been given. Some work has been done exploring Semmelweis's career after leaving Vienna, as well as the controversy over the precedence of the discovery. This can be seen in regard to another issue, the priority of the discovery. For example:

> It is not that Dr. Holmes considered the disease contagious, while Semmelweis wrote an entire article arguing that it was not. The definitions of "contagion" and "infection" were everywhere so vague at that time that it would be extremely difficult to guess what they actually have meant. The important difference lies rather in that in the same article Semmelweis asserted firmly that puerperal fever was nothing else but a general sepsis or pyemia [blood poisoning]. Dr. Holmes simply did not think of it in these terms [7, p. 32].

57. A few inquiries into the historical accuracy of Semmelweis's discovery have concentrated on the obvious length of time until Semmelweis's first written reconstruction, his bitterness over the lack of acceptance of his discovery, and, recently, the possibility that Semmelweis had Alzheimer's disease [6, 17, 13]. All of this leads to some important questions concerning Semmelweis's account. Although a few writers have tentatively touched on the Kolletschka case and have questioned its central position as a point of discovery, no one has offered a complete alternative solution to where, when, and how Semmelweis made the discovery. So the Kolletschka case will be the point of departure for our subsequent discussion.

58. Close analysis of the Kolletschka affair reveals many gaps and points the way to a new interpretation of the discovery. Although the leap of the imagination from the Kolletschka case to the *final answer* of the cause of childbed fever might seem immense, Semmelweis tells us that it happened. However, if we take a close look at Semmelweis's own recollection of this crucial time period, then many puzzles immediately arise. For example, Semmelweis tells us that the picture of Kolletschka's death haunted him day and night until the necessary connection struck him. Although he does not give us an exact date for the discovery, from Semmelweis's account it happened quite soon after March 20. If this is so, then Semmelweis never explains why he did not start implementing the use of chlorine lime until the end of May, *2 months after the Kolletschka case*. If he made the discovery soon after looking at Kolletschka's autopsy report, then why did he wait 2 months to test his hypothesis? Semmelweis provides no answer.

59. The two most important clues that Semmelweis had for the discovery were: (1) a realization that some babies had the same symptoms as women who died of childbed fever; and (2) the Kolletschka case. Semmelweis tells us that the crucial point came when he noticed that Kolletschka had died of the same symptoms as the women. The emphasis is on connecting Kolletschka with the women and babies. Semmelweis is using analogical reasoning here. The process he gives is this: The first analogy was that the symptoms of the babies and women were similar; the second analogy was that the symptoms of Kolletschka were similar to the women. Therefore, in both cases, Semmelweis claims that he made the connection by using the principle of going from the *same effects to the same causes*.

60. Recall that Semmelweis told us that he noticed early in his search that the uterus after birth could be seen as being like an open wound. He also knew that a cut during an autopsy could prove fatal. The important aspect was not simply the contact with cadaveric material, but the *open wound* coming in contact with cadaveric particles. Semmelweis realized that the second part was the deciding factor. As we saw earlier, he wrote, "Not the wound, but the contamination of the wound by cadaveric material was the cause of death." He had been looking for something that would explain the transmission of childbed fever, and he had eliminated many possible factors. He was struck by the fact that Kolletschka died of an open wound that had come in contact with cadaveric particles. Seeing the uterus *as being wounded* allowed him to realize how the disease could be spread. Just as the key factor with Kolletschka was not simply coming in contact with cadaveric material, but rather being wounded and coming in contact with it, so the wounded uterus coming in contact with cadaveric material through the doctors' and interns' many examinations was the answer to the mystery. What this interpretation does is change Semmelweis's analogical reasoning. We find that the process was this: From an open wound coming in contact with cadaveric material blood poisoning can occur. A wounded uterus coming in contact with cadaveric material can lead to blood poisoning as well. As we can see, this reasoning goes from *same causes to same effects.*

61. Semmelweis's account places the entire discovery on the Kolletschka case. However, no matter how we try to integrate Semmelweis's narrative with his *actions*, we find many curious incidents. It is therefore appropriate to analyze whether the discovery happened the way Semmelweis reports. In other words, what did Semmelweis know, and when did he know it?

EXERCISES 15E

1. What was the crucial difference that everyone had missed? (paragraph 55)

Answer: The first clinic was staffed by doctors and interns; the second clinic was staffed by midwives.

2. Discuss the "obvious" evidence at Semmelweis's disposal. (paragraphs 45–53)
3. What is the Holmes versus Semmelweis issue regarding the priority of the discovery? (paragraph 56)
4. What are some of puzzles regarding Semmelweis's received view of his discovery? (paragraph 58)
5. What were the two most important clues that Semmelweis had for the discovery? (paragraph 59)
6. What analogical reasoning principle did Semmelweis apply? (paragraph 59)
7. What is "new" interpretation of Semmelweis's analogical reasoning, and how does it change the overall principle behind Semmelweis's reasoning? (paragraph 60)

F. A NEW INTERPRETATION

62. An important period leading up to the discovery, and the least talked about by Semmelweis, is the 5 months during which he was relieved of his duties as assistant of the first clinic. It is ironic that the 5 months in which he did not have control over the clinic gave him the opportunity to do the necessary historical study that enabled him to make the discovery. Taking into consideration the information Semmelweis tells us he knew prior to the Kolletschka case, and noticing what he did during the 5 months in question, it becomes clear that Semmelweis had enough information to provide him with a new plan of action. Indeed, it will soon become evident that all Semmelweis had after he got his assistantship back, and after the Kolletschka case, was simply one more conjecture to put to the test. However, it will be argued that he had made *no final discovery directly* after Kolletschka's death.

63. Semmelweis was understandably crestfallen at the prospect of losing his assistantship. After all, it had been understood that he would be given the full-time position, since he had performed so well as a substitute. Losing the position meant that he would have to wait 2 years to resume the search. The prospect of finding the answer must have appeared bleak.

64. Semmelweis had a lot of free time during this period; time to study the history of the Vienna Hospital, whose records revealed something curious. Semmelweis discovered that the high death rate had not always been the case at the hospital; in fact, the rate had started going up only when the current head of the department, Dr. Klein, took over in 1822. Before this, Dr. Boer had been in charge for 30 years. Under Boer's direction, from 1789 to 1822, the rate of childbed fever averaged 1.4%. When Klein took control the rate almost immediately jumped to 7.5%, and it remained high [10, pp. 57 & 183–84; 16, pp. 46 & 55; 17, pp. 70–72; 6, p. 47].

65. This rate of childbed fever is interesting, because we can see that when the two-clinic system was implemented, the rate in the first clinic became 12%, while the second was 3%. But while the midwives and doctors/students worked together in one clinic the rate averaged out to 7.5%, under Klein. Why had the rate gone up when Klein took over? What changed when Klein assumed control?

66. Semmelweis's inquiries into Boer's history with the Vienna Hospital revealed some important clues. Semmelweis found that Boer had gone to England to study the methods used in combating childbed fever [10, p. 52; 16, p. 55]. Boer came back much impressed and immediately implemented the English methods of cleanliness and the use of disinfectants. Boer had considered childbed fever to be a deposit in the abdominal cavity and defined it pathologically-anatomically as "putrescence of the uterus" [10, p. 55]. Boer dissected cases assiduously and had the purulent discharge matter chemically analyzed. He also was conscientious about publishing truthfully the mortality figures of the clinic each year. These figures were statistically substantial. The number of births in the Vienna Hospital, dating back to 1789, was between 3,000 and 4,000 annually [10, p. 55].

67. This information fits squarely with Semmelweis's claim that during the 5 months' break he began studying English in the hope of going to Dublin. Additional evidence points to ideas that directly influenced Semmelweis at this time. A Dublin Hospital report, published in 1835, stated that there were over 10,000 deliveries without a single death [14, p. 202]. A routine of cleanliness and disinfection of wards, beds, and equipment with chlorine water was observed. It is probable that Semmelweis was aware of the success reported in Dublin; after all, he tells us, "The fact that the English physicians regarded childbed fever as contagious and use chlorine solutions against it was certainly well known to me" [7, p. 97]. His interest in their work was coupled with the knowledge that Boer went to England and had been successful when he was in charge.

68. What Boer had done was to suspend the use of cadavers as a teaching device for students in the obstetric department. All teaching was done by using the "phantom model," a mannequin body-machine with an artificial uterus and pelvic canal [10, p. 57; 17, p. 72]. The students, therefore, had no chance of coming in contact with cadavers before examining patients.

69. But when Klein (who was an avowed believer in miasm theory) took over, he immediately changed the routines of Boer. Klein immediately put the phantom model away and had all students learn by actual work on cadavers [6, p. 47]. Since Semmelweis had been trained in this manner, he could not be expected to realize that it had been different in the past. Therefore, the process of compiling statistics and examining the history of the obstetric department provided Semmelweis with crucial information showing the great rise in the death rate after Klein took over.

70. It appears that long before Kolletschka's death Semmelweis had gathered sufficient relevant information to put a new hypothesis to the test. All the work that he did up to this period had enabled him to eliminate many ideas. He had weakened severely the epidemic theory and thus found himself in a position to try ideas connected with contagion theory. But he was cut short before he had a chance to implement anything. However, even if he had not been relieved of his duties, it seems unlikely that he could have gone very far. *It was only after he had gained the information about the phantom model, saw Boer's success rate, and studied the English methods of combating childbed fever that he had a program to implement.* Therefore, when Semmelweis got back his position, he was ready to apply the new information. He did not need the Kolletschka case at all to give him any new ideas, because he already had knowledge that the use of the phantom model was important, plus the fact the English had used disinfectants very successfully. He could apply these facts without any help gained by Kolletschka's death.

71. If we look carefully at Semmelweis's address to the Vienna Medical Society in May 1850, we find that Semmelweis explained in detail the painstaking method he applied to his search. He placed great emphasis on his use of the comparative history of the two clinics and his refutation of alleged causes, and he makes it a point to single out the importance of Boer's success [16, pp. 100–101]. Thus it seems that when Semmelweis started implementing the use of chlorinated lime, he had not made any real

breakthrough. All he was doing was testing the English contagion theorists' methods. At this point, Semmelweis had no reason to believe childbed fever was not in fact a specific disease. He states that his *sole idea* at this time was to *eliminate the cadaveric particles*. He had no idea that the disease could be spread any other way. This is clear in that complications arose that required additional explanation.

72. In October 1847, Semmelweis examined a woman suffering from a "foully discharging cancer of the uterus." This meant that Semmelweis and his students came in contact with the cancerous discharge. The result was that eleven out of twelve women who delivered along with this woman died [15, p. 396; 6, p. 53]. Semmelweis was very disturbed by this result. How could it have happened? Semmelweis knew that they had washed their hands carefully *before* entering the clinic. He kept constant watch for people coming into the clinic who had been working on cadavers. What had gone wrong?

73. Semmelweis retraced the events leading up to the deaths, and the only thing he could seize on was the fact that the woman with the cancer of the uterus was in the first bed in the clinic that he and the students had examined. He realized that, after having examined her, they had failed to wash their hands again. *But of course there was no reason at the time to do so*. After all, up to this point Semmelweis firmly believed that the disease was caused *only by cadaveric particles*. He had no reason, until now, to think that there was more than one cause. But the latest deaths, and the new facts associated with them, forced Semmelweis to devise a new hypothesis: Childbed fever was *not caused only* by cadaveric particles, but by *any* ichorous discharge (putrid matter) originating in living organisms. This explains why Semmelweis was so surprised when the deaths occurred from the woman with the cancerous uterus. Since he originally believed that cadaveric material was the *only* cause, he was unprepared for the latest deaths. This was not, however, a strong enough blow for him to abandon his hypothesis; after all, the death rate had dropped dramatically since he tried his new method. All Semmelweis had to do was to modify his theory to include *any putrid matter,* not just cadaveric material. This dovetailed with contagion theory, because at this point Semmelweis believed that *direct contact* must be made in order for the disease to spread.

74. However, further results would cause Semmelweis to revise his hypothesis even more. In November 1847, a woman was admitted to the clinic with a "severely discharging carious [decaying] knee." The odor and the amount of putrid material pervaded the room. Of course Semmelweis made sure that persons coming in contact with this woman had to wash their hands immediately before examining another patient. Semmelweis had no reason to believe that this would not work. But the odor from the fluid coming from the wound was so strong that nearly everyone in the clinic giving birth at that time died [15, pp. 396–97; 6, p. 53]. Here was another phenomenon that Semmelweis had to absorb into his expanding hypothesis.

75. His first modification came from the necessity to explain how something *other* than cadaveric particles could cause the fever. Now he had to explain why it was *not even necessary* for direct contact to take place. The fact that the air being so fouled with

matter was *sufficient* for the disease to be contracted forced Semmelweis to revise his thinking a second time. He had to admit that putrid matter could be absorbed by the internal surface of the uterus whose mucous membrane after delivery was similar to an open wound. Semmelweis's *final conclusion* had to take all of these additional facts into consideration. He had to be able to account for all the various ways that a woman could get childbed fever.

76. The case of the woman with the carious knee was a seemingly unexplainable anomaly for Semmelweis. If puerperal fever was a contagious disease that was received by *direct contact only* (and Semmelweis's actions up until this point confirm that he believed this), then how could he explain the fact that childbed fever could be received without direct contact? Semmelweis had thought that washing of the hands would eliminate the possibility of spreading the disease. If you eliminate the direct contact, then the disease should not spread. Therefore, the new deaths must surely have been upsetting to Semmelweis. After all his work eliminating the miasm theory, and the success of the contagion approach, he was stuck with something for which he could give no account.

77. Semmelweis had been confronted with two clear anomalies. It is interesting to see how these anomalies (the deaths from the cancer of the uterus and the carious knee problem) came about. Semmelweis simply began testing the contagion theory by using disinfectants to eliminate cadaveric particles. Although this produced amazing results, it also gave rise to anomalies. However, it would be incorrect to think that the solution to the two new problems was simply a refinement of the initial discovery—that it clinched the fact that puerperal fever was a blood poisoning. From the available evidence, we can conclude that the two anomalies were not simply further clarifications of the discovery, *because Semmelweis did not have the discovery until after he resolved the second anomaly.*

78. The problem situation kept changing for Semmelweis. It is his work on these new problems that enabled Semmelweis to finally hit upon the discovery. Semmelweis had to explain how childbed fever could be *both* a contagious and a noncontagious disease at the same time. What could he do to make sense of this? Until the second anomaly, Semmelweis was simply following what had been common practice in England for years. But it is his particular insight at this critical juncture that ensures Semmelweis's place as *the* discoverer of the cause of childbed fever.

79. The idea that childbed fever was a form of blood poisoning was the answer that Semmelweis needed to make sense of all the facts. The final anomaly vanished. The great debate over the status of childbed fever between contagion and miasm theory disappeared. Semmelweis no longer had to explain how the disease fits in with both theories. He was able to eliminate the problem by seeing that the disease was a form of blood poisoning. By doing this, he eliminated the need to explain that childbed fever was a specific disease that had a specific cause. This is precisely what no one else had been able to do. This is Semmelweis's great accomplishment. It is also why the English

contagion theorists cannot be given credit for having made the discovery. No one before Semmelweis was able to break out of the trap of seeing childbed fever as being a *specific disease* that affected *only pregnant women*. No one else found that childbed fever was simply a form of blood poisoning.

80. We can conclude that the final discovery could not have occurred before December 1847, almost 9 months after Kolletschka's death. The problem posed by the first anomaly simply led to an expansion of a *contagion* hypothesis. The second anomaly brought about a completely new problem situation, the resolution of which enabled Semmelweis to make his final discovery.

EXERCISES 15F

1. What was the death rate of childbed fever under Dr. Boer's direction? How did it change after Dr. Klein took over? (paragraphs 64 and 65)

Answer: Under Boer's direction the rate of childbed fever averaged 1.4%. When Klein took control the rate almost immediately jumped to 7.5%, and it remained high. When the two-clinic system was implemented the rate in the first clinic became 12%, while the second was 3%.

2. What important clues did Semmelweis find in his examination of the history of the Vienna Hospital under Dr. Boer? (paragraph 66)
3. What additional ideas did Semmelweis find out about the Dublin Hospital, and how did this information influence Semmelweis's thinking? (paragraph 67)
4. What was the "phantom model" procedure? How was this important to Semmelweis's research? (paragraph 68)
5. Describe what Semmelweis knew before the Kolletschka incident. (paragraph 70)
6. What did Semmelweis emphasize in his address to the Vienna Medical Society in May 1850? Why does this support the conjecture that at that time Semmelweis still thought that childbed fever was a specific disease? (paragraph 71)
7. What happened in the clinic when there was a woman suffering from a foully discharging cancer of the uterus? Why would the results be surprising to Semmelweis? (paragraph 72)
8. What was Semmelweis's new hypothesis? Why did he need to modify his original hypothesis? (paragraph 73)
9. What happened in the clinic when a woman was admitted with a severely discharging carious (decaying) knee? Why would the results be surprising to Semmelweis? (paragraph 74)
10. Why did Semmelweis think that washing the hands would eliminate the possibility of spreading the disease, and how did the new facts affect his thinking? (paragraphs 75 and 76)

11. Describe the two anomalies that confronted Semmelweis. Why can these be used to conclude that Semmelweis did not have the final discovery of the cause of childbed fever until after he resolved the second anomaly? (paragraphs 77 and 78)
12. What was Semmelweis's final discovery and how did it make sense of all the facts? (paragraphs 79 and 80)

Summary

- In 1784, Joseph II made a decree setting up the lying-in (maternity) hospital of Vienna.
- In 1840, the Vienna Hospital set up two divisions in the obstetric department. The first clinic was staffed by doctors and medical students doing intern work in obstetrics, while the second employed midwives who had no other duties than assisting in the care of the patients and in deliveries.
- When Semmelweis began his investigation, the rates of death from puerperal fever were approximately 12% monthly for the first clinic, but only 3% for the second clinic.
- Until Semmelweis made his discovery, childbed fever (also called "puerperal fever") was universally believed to be a disease peculiar to women.
- Miasm theory postulated that diseases were carried by the air; certain combinations of the basic elements in the atmosphere were potentially harmful to humans.
- Contagion theory held that a contagious disease is one transmissible from individual to individual by immediate or direct contact.
- Infectious: Refers to the causation of the disease.
- Contagious: Refers to the manner of transmission of a disease.
- Semmelweis could not use germ theory as support because Pasteur's experimental results would not be universally accepted for another 16 years.
- Since Semmelweis was looking for the cause of childbed fever, he began testing some obvious implications of the miasm view.
- Semmelweis's early conclusion was that childbed fever was endemic—a disease that was the result of causes within the hospital.
- Semmelweis came to believe that the symptoms occurred in both female and male babies.
- Semmelweis concluded that it is through the doctors' and medical students' examinations of the women that cadaveric particles are absorbed into the system.
- An experiment was set up to ensure that no other changes were allowed in the first clinic. The only new factor was the washing of hands in the solution. The immediate result was that the childbed fever rate dropped from 12% to 3% in the first clinic.
- Semmelweis used analogical reasoning: The first analogy was that the symptoms of the babies and women were similar; the second analogy was that the symptoms of Kolletschka were similar to the women.

- It was only after he had gained the information about the phantom model, saw Boer's success rate, and studied the English methods of combating childbed fever that he had a program to implement.
- Semmelweis's first modification came from the necessity to explain how something other than cadaveric particles could cause the fever. Then he had to explain why it was not even necessary for direct contact to take place.
- The idea that childbed fever was a form of blood poisoning was the answer that Semmelweis needed to make sense of all the facts.

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