Chapter Three

The truly great problems are set forth only
when they are solved.

—Henri Bergson, *The Creative Mind*

All manner of cures, From Ash to Antibiotic,

have had to prove their value. At the end of the nineteenth century, the bacteriologist Robert Koch proposed a cure for tuberculosis whose substance remained, for a time, a mystery. Nevertheless, his penchant for pageantry allowed him to gather support for his seemingly miraculous discovery. Koch's quite literal reliance on spectacle over substance opened the door to a broad questioning of what counted as evidence of cure, and how such evidence should be produced. With the development of antibiotics in the mid-twentieth century, the question of demonstrating cure's efficacy once again became a matter of serious concern. As a procedure for determining once and for all whether a cure worked, the randomized controlled trial proposed to do away with ambivalence, as well as with historical forms of cure and modes of evidentiary production. In 1950s Madras, an international team of researchers undertook India's first randomized controlled study, a test of antibiotics on working-class tuberculosis patients. Their aim was to determine whether these new medicines were a universal cure. If antibiotics could work in India, indifferent to the influences of poverty, geography, race, and environment, then they could work on anyone, anywhere—or so it was thought. Cure would no longer be elsewhere. Yet, even as sanatoria shuttered their doors, the antibiotic cure quickly stumbled onto its limits, in the form of relapse and resistance.

The Trial of the King

In the royal city of Madurai lived a hunchbacked king. He ruled over the Pandya kingdom, under the guidance of the Jain monks who occupied the hills just beyond the city. There were those close to the king who found this arrangement distressing, to say the least. The king's wife, for example, a former Chola princess named Mankaiyarkkaraci, as well as his minister, Kulaccirai. Both were devout followers of the god Shiva and were perturbed by their king's allegiance to another faith.

One day, Mankaiyarkkaraci and Kulaccirai heard news of a precocious child from the nearby town of Sirkazhi who spun beautiful verse and exhibited miraculous power. The child's name was Sambandar, and his reputation grew with each passing day. In Sambandar, the king's wife and minister sensed an opportunity. They invited him to Madurai to exorcise the Jain monks from the city and extract the king from their control.

What Sambandar lacked in years he more than made up for through the force of his commitments. His love for Shiva was overpowering, rivaled only by his enmity toward competing sects. The two feelings hummed symbiotically throughout Sambandar's devotional stanzas:

> Those Buddhists and mad Jains may slander speak.
> Such speech befits the wand'rers from the way.
> But He [Shiva] who comes to earth and begged for alms,
> He is the thief who stole my heart away.[1]

The antagonism was undoubtedly mutual. At the time—roughly the sixth century—varied sects vied for followers and political patronage. Buddhism and Jainism posed potent challenges to the Shiva-centered traditions of south India.

As the story goes—at least from the Saivite perspective—the Jain monks of Madurai feared that Sambandar would turn the king away from them, and from their faith. Casting aside their famed ethic of nonviolence, they torched the inn where Sambandar was staying. Caught in the flames, Sambandar cried out to Shiva for salvation (and a bit of retribution):

> False Jains have lit for me a fire:
> Oh, let it to the Pandyan ruler go,
> That he the torture of slow flame may know.[2]

1. Sambandar, "Stanza 18," 27.
2. Sambandar, "Stanza 23," 33.

Figure 3.1. Bronze statue of the Saivite poet-saint Sambandar. Collection of the Metropolitan Museum of Art, New York City, https://metmuseum.org/toah/works-of-art/2010.230.

As he prayed, so it was: the fire metamorphosed into a ravenous fever that consumed the Pandya king. The Jain monks chanted over the king's febrile body their most potent mantras, but this was, after all, no ordinary illness. The king's fever refused to subside.

Capitalizing on this failure, Mankaiyarkkaraci and Kulaccirai whispered into their liege's ear about a recent arrival in the city who wielded tremendous spiritual powers. The stories they told the king were impressive. Sambandar, it was said, had cured a man of malaria, rid a woman of epilepsy, and reanimated the bones of the dead. For one who could cure death, what was a little fever?

Against the protests of the Jain monks, Sambandar was summoned to the royal bedside. He slathered the king's body in ash while reciting his own hymns:

> The sacred ash is our mantra,
> the ash covers the bodies of the gods;
> the sacred ash is all beautiful things,
> the ash is all that is praised.
> The sacred ash is the tantra text,
> the ash is the core of our faith.[3]

The sacred ash was also the cure, better than any mantra or tantra. Sambandar transformed the hunchbacked ruler into a beautiful, upstanding specimen of a man, his fever banished. Beauty, after all, was but an outward-facing sign of the king's newfound spirituality and restored health.[4]

The grateful king converted to Saivism. To be clear, this wasn't a kind of exchange at gunpoint, your life for your religion. If a Jain couldn't cure the king, and a Saivite could, what did that say about their respective faiths? The therapeutic dual between Sambandar and the monks was in effect a trial pitting Saivism against Jainism. Through his victory, Sambandar proved, at least to the king, that his faith was truer, stronger, better, and, most importantly, efficacious.[5] The defeated Jains, as some people like to tell the story, were impaled for their efforts.[6] Their cure had proven itself to be no cure at all. And with its

3. Peterson, "Campantar II.202 *Tirunirrup Patikam*," 277.

4. On Tamil visions of beauty and its relationship to power both royal and divine, see Wentworth, "Yearning for a Dreamed Real."

5. On the critical role of efficacy as a reason for worshipping one deity over another in Tamil-speaking south India, see Roberts, *To Be Cared For*.

6. The reality of the event of impalement is a matter of much popular and scholarly debate and has come to define a certain kind of Tamil Saivite hagiography.

failure, their spiritual authority was diminished, their political reach cut short, their very lives rendered forfeit.

The Savior of Guinea Pigs

In the earliest days of my research in India, I stood in the spare on-call room of Tambaram Sanatorium, the institution just beyond the city limits of Chennai that was founded by David Chowry Muthu in the late 1920s.[7] On the wall hung a framed image of Robert Koch, overseeing the quiet movements of government physicians during their breaks. Koch is widely regarded as the father of microbiology, the discoverer of the bacteria that causes tuberculosis, and the man who confirmed—along with Pasteur—that pathogenic microbes live among us. As with Sambandar, Koch's fame—and his reputation for producing something that bordered on the miraculous—traveled. His influence was such that his image found its way across an ocean and into many chest hospitals across India.

Koch himself had crossed that ocean twice.[8] After spending months in Egypt in pursuit of a microbiotic cause of cholera, the outbreak abruptly ended. Refusing to end his investigations, Koch packed up and headed to India in December 1883, which was thought to be the source of the disease. Within two months of arriving in Calcutta, Koch's team identified the same bacteria that they had found in an Egyptian water tank shared by many of those who had fallen ill. Koch concluded that this bacteria was the cause of the disease.

His findings were an irritant to sanitary policy in India, which operated largely through an environmental mode of understanding disease, relying on concepts like miasma or climate. Koch's contagion was also a threat to the reputation of health officials, including the sanitary commissioner for the colonial government of India, J. M. Cunningham, who spent years working to undermine or at least minimize Koch's findings by stressing the importance of local conditions. The fact that Koch was unable to replicate the disease in an animal model provided health officials with ammunition to argue that Koch's bacteria were either an insufficient cause for cholera, or that they were only a symptom of the disease.[9] As an editorial note in the Lahore *Tribune* put

7. On the founding of Tambaram Sanatorium, see the end of chapter 1.

8. On Koch in India, see Harrison, *Public Health in British India*; Chakrabarti, *Bacteriology in British India*.

9. For similar arguments about the place of bacteria in the etiology of tuberculosis, see chapter 1.

it, Koch's "discovery has not been accepted by members of the profession in England and India. One ardent scientist had the audacity to swallow the bacillus alive before a wondering audience!"[10] What counted as adequate evidence (and how you could demonstrate it) was a problem, it seemed, not only in matters of cure, but of cause as well.

Koch would return to India once more, in May 1897, this time to Bombay, where he worked to prove that rats were the vector for the bacteria that cause plague (although he attributed the spread of plague between rats to cannibalism). His investigations into the etiologies of cholera and plague, however, were bookended by a concern with tuberculosis. Just before his first trip to India, he had declared that microscopic bacteria were the cause of tuberculosis. His colleagues expected that a cure would naturally follow in the wake of his etiological investigations; knowledge of cure was understood to be immanent to knowledge of cause. Instead, Koch turned his attention to cholera and plague.

It was only in August 1890, eight years after that earlier declaration of cause, and after his two trips to India, that Koch announced that he had found something like a cure for tuberculosis. Nearly six thousand physicians had descended on the city of Berlin, including some of the most preeminent names in science and medicine, Joseph Lister, Paul Elrich, and Rudolph Virchow among them, to attend the Tenth International Medical Congress. Koch's announcement, delivered that day to his peers, was construed as the fulfillment of a long-awaited promise.[11] His words, carefully chosen as they were, nonetheless spread with the force of rumor on that sweltering August day.

To be clear: what Koch said was that he had identified a substance that halted the spread of tuberculosis in guinea pigs. What many heard was that he had finally found a cure for a dreaded disease that had plagued humanity since antiquity. "Koch's lymph," as this miraculous discovery was called, generated intense excitement among both physicians and the general public, garnering write-ups in medical journals and newspapers around the world. In the immediate wake of Koch's announcement, the American surgeon Nicholas Senn declared that "no other event in the world's history ever attracted so much attention, and no discovery in medicine or surgery ever found such ready introduction and

10. "Editorial Notes," 11.

11. Within other forms of bacteriological reason—for example, that of Pasteur and French bacteriology more generally—the identification of a microbial cause of disease might be understood to lead not to cure, but rather to vaccination. See Valmet, "The Making of a Pastorian Empire."

universal acceptation."[12] By November, English-language newspapers in India like the Allahabad *Pioneer* and the Lahore *Tribune* were carrying almost daily commentary and coverage of Koch's discovery and of its potential value for India:

> The general belief is that consumption is incurable. . . . In Punjab many more cases are met with now than was the case only 10 years ago. All *hakims*, *vaidyas*, and doctors are unanimous that consumption is on the increase. The Punjab was comparatively free from it a few years back. . . . Poor Guru Dutt, whose life was of such brilliant promise, and for whose untimely death the heart of the Punjab is still bleeding, was a victim of this disease. . . . The news that Dr. Koch, the well-known pathologist of Berlin, has well-nigh succeeded in discovering a cure for consumption, has been hailed with joy throughout the world. . . . The accounts of the results of Dr. Koch's experiments have been watched with breathless interest.[13]

In the absence of sectarian battles over spiritual power, the determination of curative efficacy in biomedicine remains tied to questions of authority (who claims to have the power to cure), substance (what precisely they claim is curative), and demonstration (how they articulate their claims to others). Cure is a procedure or process (to cure or to become cured); but it is also an established fact (this is a cure) marked by signs of efficacy produced through this process. In the case of the Pandya king, one such sign was beauty. But in biomedicine, how can a cure be established as curative? By turning to evidentiary logics every bit as tied to concerns about authority, substance, and demonstration as was the trial of the king.

On November 13, 1890, Koch published a much-anticipated summary of his findings in the *Deutsche Medizinische Wochenschrift*, a preeminent German medical journal. Koch was quite circumspect, almost coy, about his miraculous discovery. He explained that he had meant to keep his research quiet until he had gained "sufficient experience regarding the application of the remedy in practice and its production on a large scale."[14] Forced now to counter the "many accounts [that had] reached the public . . . in an exaggerated and distorted form," Koch had grudgingly agreed to set the record straight in the

12. Senn, *Away with Koch's Lymph!*, 3. The embrace of Koch's views was particularly enthusiastic in the United States, where the *New York Times* ran a front-page story under the heading "Koch's Great Triumph." See Feldberg, *Disease and Class*, 57.

13. "A Cure for Consumption," 11.

14. Koch, "A Further Communication on a Remedy for Tuberculosis," 1193.

Figure 3.2. Koch portrayed as St. George, warrior, martyr, and healing saint. Image reprinted in Stead, "Dr. Koch," 547. In a study on the folklore of pulmonary tuberculosis, Rolleston notes that the cure of tuberculosis was frequently associated with the Holy Trinity, Mary, and St. Pantaleon. Rolleston, "The Folk-Lore of Pulmonary Tuberculosis."

pages of the journal.[15] Nevertheless, he refused to reveal the composition of his cure until he had completed his research, offering only that it was a "brownish transparent liquid."[16]

Koch was deeply concerned with managing the forms of publicity around his cure. In the absence of a singular standard for evidentiary production, witnessing and other forms of publicity remained critical to the acceptance of a scientific discovery as truth. Scientific truth required dissemination and enactment, either on the stage or on the page.[17] Undoubtedly Koch's words held great weight. He had proven himself to be a credible witness to his own genius, so much so that many of his colleagues accepted his assertion of having found a cure despite his refusal to divulge its contents. According to the reformist journalist William Thomas Stead, Koch's secrecy represented a grievous breach of professional ethics. "All dealers in secret remedies are quacks," he wrote, questioning Koch's actions and the ready acceptance of many of his medical colleagues.[18]

Koch staunchly defended his secrecy. He feared that making the production process public would lead to the untrammeled manufacture of inferior serum injected into desperate patients.[19] Not only would patients be harmed, but the reputation of his cure would be tarnished. For Koch, concerns about the ethics of scientific secrecy were greatly overshadowed by the dangers posed by inappropriate variability in how his cure was produced and applied.

Despite his desire to manage the dissemination of information, Koch knew that he had to do more than simply claim that he had found a cure. Seeing was still believing. In order to gather together witnesses of the highest scientific renown, Koch arranged for a demonstration of his cure in Berlin. News of Koch's discovery, and of his demonstration, traveled swiftly across the waters.[20] And as it traveled, it attracted ever-larger audiences to witness his miracle firsthand. Many observers of the chaos in Berlin—of the lay and

15. Koch, "A Further Communication on a Remedy for Tuberculosis," 1193.

16. Koch, "A Further Communication on a Remedy for Tuberculosis," 1193.

17. On the historical relationship between stagecraft and truth, see Sennett, *The Fall of Public Man*.

18. Stead, "Dr. Koch," 547.

19. Concerns about reputation, trust, and patient desperation have persisted into the era of randomized clinical trials. See, for example, Lowy, "Trustworthy Knowledge and Desperate Patients," 49–81.

20. Both direct witnessing and virtual witnessing (made possible by the circulation of descriptions of scientific spectacle) were central to the making of scientific truth in the seventeenth century. Such practices remained important to establishing the validity of claims to cure until the development of the randomized controlled trial

professional crowds, of the intense excitement, of the hopes sufferers and their families pinned to Koch's discovery—were reminded of the journeys undertaken by pilgrims to sacred places of healing.[21] The pilgrim hoped for a vision of the divine on earth, and for an end to their suffering. Koch's demonstration promised just that: the miracle of the cure on display, and the faint possibility that the spectator might also be healed. The mysterious substance—Koch's lymph—was even named in the same fashion as a saint's relic. Koch's demonstration succeeded in bringing together elements of theater, scientific witnessing, and religious pilgrimage.

For those who could not make it to Berlin, other demonstrations would soon follow, through the select distribution of his cure across Europe and the United States. In carefully distributing his cure, Koch also distributed the possibility of direct witnessing across a range of sites. Proof of cure was a question not only of epistemology, but of aesthetics.[22] Science had to be made available to the senses and, in Koch's case, to the sense of vision—which also meant that the spectacle had to be bound by time and space.

But what precisely had these crowds come to see? Although Koch refused to reveal the composition of his miraculous substance, he was quite forthcoming about its purported effects. Unlike the more tepid remarks he had made in August, Koch boldly claimed in his article that early-stage phthisis, or pulmonary tuberculosis, "can be *cured with certainty* by this remedy."[23] The duration of treatment was also appealingly brief: "Within four to six weeks," he reported,

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in the mid-twentieth century, as discussed below. Shapin and Schaffer, *Leviathan and the Air-Pump*.

21. Here too, cure was in a sense elsewhere. Yet the dissemination of Koch's substance through both spectacle and reportage brought cure closer to home for many.

22. Aesthetic concerns remain central to arguments about therapeutic efficacy, particularly in contemporary forms of investment and marketing related to pharmaceutical production and sales. See, for example, Kaushik Sunder Rajan's work on the forms of speculation that bridge the life sciences and the market. Sunder Rajan, *Biocapital*, 281. See also Lochlann Jain's work on the aesthetics of enforced optimism built into advertising related to cures for cancer in the United States. Jain notes that "cancer fills the core of so many economies," such that "if a cure were to be found, the economy might just crash." Jain, *Malignant*, 8. See also Joseph Dumit's reflections on the persuasive power of pharmaceutical advertising as dependent upon a relation to the would-be patient that resembles a religious form of witnessing that leads to conversion. Dumit, *Drugs for Life*, 66–67.

23. Koch, "A Further Communication on a Remedy for Tuberculosis," 1195, emphasis added.

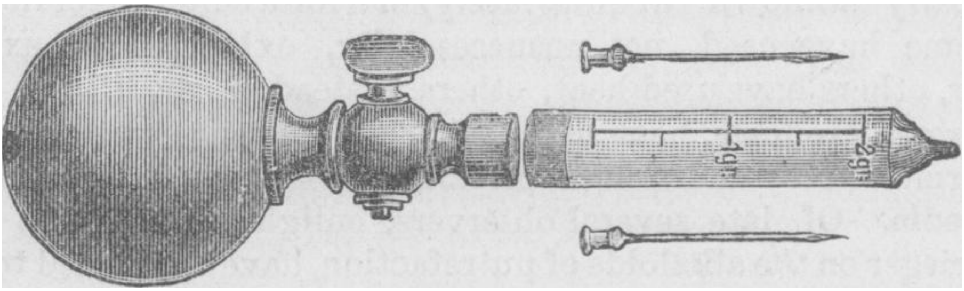

Figure 3.3. Electrotype of Koch's syringe, used to inoculate patients. Koch, "A Further Communication on a Remedy for Tuberculosis," 1197.

"patients under treatment for the first stage of phthisis were all free from every symptom of disease, and might be pronounced cured."[24] In his article, Koch conceptualized cure in terms of the recession of clinical symptoms over a period of time, rather than relying on a more bacteriologically based definition as would have been expected from a founding figure in microbiology. This choice would come to haunt him.

Of Twisted Joints and Rotting Bones

Two days after its German publication, Koch's report was translated into English as a special supplement to the *British Medical Journal*, a copy of which found its way to the home of the writer and physician Arthur Conan Doyle. The creator of Sherlock Holmes was captivated by Koch's words, despite his admission that he had no particular interest in tuberculosis. Nevertheless, the broad fascination with Koch's cure for a nineteenth-century Britain plagued by tuberculosis cannot be overstated.[25]

Although a great admirer of Koch, Doyle was exceedingly skeptical of much that went under the umbrella of scientific advancement. Even so, Koch's

24. Koch, "A Further Communication on a Remedy for Tuberculosis," 1195.

25. The fascination extended beyond Britain to its Indian colony: "The youth of its victims, the general hopelessness the disease inspires in every one but the patient, and its wide prevalence, all contribute to invest consumption, of all the ills which flesh is heir to, with the most mournful interest; and if Dr. Koch's treatment is all it claims to be, his latest will also be the most signal and reputable of all his triumphs in the field of bacteriology. . . . Should it prove successful, [it] will be one of the greatest discoveries of modern medical science." Correspondent, "Latest Foreign Intelligence," 1.

report made quite an impression: "A great urge came upon me suddenly that I should go to Berlin. . . . It was an irresistible impulse and I at once determined to go."[26] Within a few hours, Doyle was aboard a train to London. After pausing there to see the aforementioned journalist William Thomas Stead, for whom he agreed to write a character sketch of Koch, Doyle continued on to Berlin.

Doyle arrived a day before one of the demonstrations, desperate to lay his hands on a ticket for this monumental piece of medical theater. He approached the British ambassador and a journalist from the *Times*, to no avail. "Tickets were simply not to be had and neither money nor interest could procure them," he wrote.[27] With no other avenues available to him, Doyle went to Koch's home hoping to meet the great scientist in person. To his great disappointment, he was turned away by Koch's butler. In a last-ditch attempt, Doyle bribed his way into the hall outside of the auditorium and threw himself in front of Koch's colleague, Dr. Ernst von Bergmann, who was to lead the demonstration (Koch himself would be absent, unwilling "to be present when his name would be so frequently mentioned").[28] Von Bergmann mocked Doyle's earnest plea and refused him entry.

Fortunately for Doyle, a sympathetic onlooker, a visiting physician from Detroit named Henry Hartz, witnessed this less than collegial behavior. He met with Doyle later that afternoon and shared his notes on von Bergmann's demonstration. Doyle had missed a grand display of medical pageantry. Over forty patients were exhibited, many of whom had been wheeled into the auditorium in their hospital beds. Some were inoculated in front of the assembled physicians, a small amount of Koch's substance subcutaneously injected into their backs by a uniformed Eduard Pfühl, an army surgeon and Koch's son-in-law. The majority of the patients suffered extreme reactions to the inoculation: fever, rigors, vomiting, swelling, and inflammation. Despite these symptoms, a correspondent from the *Lancet* reported that most of the patients who had already received the treatment "were now regarded as practically cured."[29]

The day after the demonstration, Hartz secured Doyle's entrance into von Bergmann's clinic so that he could examine these same patients for himself. As part of his character sketch on Koch, Doyle described the scene in the clinic:

26. Doyle, *Memories and Adventures*, 87–88.

27. Doyle, *Memories and Adventures*, 89.

28. *Lancet* Correspondent, "Demonstrations of Cases Treated by Koch's Antitubercular Liquid," 1120.

29. *Lancet* Correspondent, "Demonstrations of Cases Treated by Koch's Antitubercular Liquid," 1120.

> A long and grim array they were of twisted joints, rotting bones, and foul ulcers of the skin, all more or less under the benign influence of the inoculation. . . . Here and there I saw a patient, bright-eyed, flushed, and breathing heavily, who was in the stage of reaction after the administration of the injection: for it cannot be too clearly understood that the first effect of the [inoculation] is to intensify the symptoms, to raise the temperature to an almost dangerous degree, and in every way to make the patient worse instead of better.[30]

Doyle witnessed a similar state of affairs at the clinic of Dr. Levy and at the Charité Hospital run by Dr. Bardeleben, where patients were also being treated with Koch's lymph. But contrary to Koch, he did not interpret these clinical observations as signs of cure. Instead, Doyle concluded that "the whole thing was experimental and premature."[31] The miracle substance, he conjectured, very likely left bacteria hidden "deep in the invaded country."[32] Doyle was quite possibly the first to criticize Koch's cure in such a public fashion, and on the grounds of Koch's own science, bacteriology.

Koch's camp had, up to a point, been able to "harmonize" contradictory research results to align with their expectations.[33] Adverse reactions to Koch's lymph—renamed tuberculin—were partially explained away as cases in which the disease had progressed too far. Koch himself had freely admitted that treating more advanced cases was difficult, especially when the lungs contained numerous large cavities, excessive necrotic tissue, or other microorganisms.

Koch also made a point of laying out the specific action of his treatment. His lymph did not "kill the tubercle bacilli," he explained, but rather destroyed infected living tissue.[34] Koch acknowledged that bacteria might continue to survive in already-dead tissue and that uninfected living tissue must be protected at all costs from infection. For this reason, he advocated the use of surgery to remove necrotic tissue, as well as the repeated administration of his treatment at gradually higher dosages.

The fact that his cure had no direct effect on bacteria might explain why Koch made use of a nonbacteriological, symptom-based conception of cure. Despite this disclaimer, critics of Koch's cure formulated their arguments in terms of both bacterial survival and clinically observable symptoms.

30. Doyle, "Dr. Koch and His Cure," 556.
31. Doyle, *Memories and Adventures*, 87–88, 90.
32. Doyle, "Dr. Koch and His Cure," 556.
33. Gradmann, "A Harmony of Illusions."
34. Koch, "A Further Communication on a Remedy for Tuberculosis," 1194.

Dr. Fraentzel of Berlin warned of the possibility of relapse without long-term treatment. Dr. Feilchenfeld, an assistant at Dr. Levy's clinic, cautioned that bacilli might reappear in sputum samples after having seemed to disappear. On both bacteriological and symptomological grounds, Koch's cure was threatened by the future. As other scientists conducted their own inquiries into Koch's cure, they came to similar conclusions.

Proving Grounds

The debate around tuberculin was not simply about the efficacy of a particular substance. Equally crucial was the question of what constituted proper evidence of cure, as well as of its failure. Arguments against Koch arrived primarily from pathology and clinical medicine, rather than from experimental or laboratory-based research.[35] The highly esteemed pathologist Rudolph Virchow drew on autopsy findings to point out that the infection only spread as cells died. Against Koch, he corralled this evidence to interpret the death of infected tissue as a sign of spreading disease rather than cure. Likewise, the physician Ottomar Rosenbach demanded to know why certain clinically observable reactions to tuberculin, like fever, should be interpreted as signs of cure rather than as iatrogenic side effects.

The grounds for proving and refuting cure were unstable, which allowed for the admission of multiple methods for producing evidence and contradictory interpretations of such evidence. Put simply, there was no universal standard by which to judge the efficacy of the cure or its failure. Neither Koch's reputation nor his demonstrations proved capable of withstanding these critiques. Tuberculin would be shown to have some diagnostic value, and although it would continue to be used as a therapeutic option (even in India), it would never achieve broad acceptance as the ultimate cure for the dreaded white plague.[36]

A host of therapeutic options rushed to fill the vacuum left by Koch's failure. Gold treatment, heliotherapy, collapse therapy, travel, and confinement were all on offer to those who suffered from tuberculosis.[37] However, it was

35. See Gradmann, "A Harmony of Illusions."

36. On the use of tuberculin for therapeutic purposes in India into the 1920s, see Brimnes, *Languished Hopes*, 51.

37. Collapse therapy refers to a procedure that quite literally collapses a patient's lung to afford it time for caseous structures to sequester the offending bacteria, and for the lung to rest.

sanatorium-based treatment that took the lead. In the years following the tuberculin scandal, sanatorium therapy thrived despite its inability to offer a specific treatment that targeted bacteria.[38] With Koch's failure to make good on a cure, "sanatorium doctors made the case that their institutions should now be seen as the only credible alternative left to provide large-scale treatment."[39] Nevertheless, the heavy cost of sanatorium treatment, the difficulties involved in treating large numbers of patients, and skepticism about its efficacy meant that it remained an imperfect alternative.

The story of tuberculin is not only about the failure of a cure. It is also a story about the kinds of expectations that are made of science and medicine, about a charismatic scientist and the forms of publicity in which he engaged in order to gather support for his discoveries. For a few months, Koch's announcement raised hopes in Berlin, and around the world, that the end of tuberculosis was near.

The warm embrace of Koch's discovery was short-lived. Within the year, researchers and clinicians had scrutinized Koch's findings and raised serious objections on a variety of evidential grounds. This would be the scene of Koch's greatest failure. As criticism of Koch mounted, he would eventually reveal that his cure was in fact a denatured form of *Mycobacterium tuberculosis*. His hope had been that the bacterium would prove itself to be a *pharmakon*, threatening illness in one form while promising cure in another. Yet in the years to come, his reliance on denatured bacteria only offered further fodder to his critics, especially British medical officers in India who protested against the expanding authority of bacteriological reasoning. As Dr. Edward Berdoe put it in a rather colorful letter published in the pages of the Lahore *Tribune*: "it is quack-nostrum mongering and nothing paying like quackery. . . . I hope the Indian people will not be exploited to further the business but that such a strong opposition will be excited that the Indian Government will be forced to stay its hand."[40] Berdoe continued, "Dr. Koch's tuberculin was announced with a great flourish of trumpets and as we all remember proved a ghastly failure."[41] The status of Koch's discovery was downgraded from a triumph of bacteriological reason to an embarrassing footnote in an otherwise illustrious career.[42]

38. For more on the curative logic of the sanatorium, see chapter 1.
39. Condrau, "Beyond the Total Institution," 79.
40. Berdoe, "Plague, Pestilence and Quackery," 5.
41. Berdoe, "Plague, Pestilence and Quackery," 5.
42. Gradmann, "Robert Koch and the Pressures of Scientific Research."

But what if we instead ushered Koch's failure back into the limelight? Might it form the basis for a genealogy of cure, or at least of its limits? Might Koch's discovery—and its subsequent failure—also help us to grasp how we come to know whether a cure is, in fact, curative? The tuberculin episode is also a story about the many forms of evidence and interpretations that could be marshaled in the name of contending truths. This all changed in the 1940s and '50s, with the emergence of a new form of treatment—antibiotics—and a new evidentiary standard that was touted as universal: the randomized controlled trial.

Scarcity Is the Mother of Experimentation

In 1943, just over fifty years after Koch's failure, a laboratory at Rutgers University succeeded in isolating the first effective antibiotic against tuberculosis, streptomycin. Like Koch, the team led by the microbiologist Selman Waksman initially demonstrated the efficacy of this new substance in guinea pigs.[43] Another team of researchers, led by William Feldman and H. Corwin Hinshaw at the Mayo Clinic, extended these studies to human subjects. Within four years of beginning their research, the Mayo Clinic team discovered the existence of streptomycin-resistant strains of tuberculosis. The team reported that resistance developed within "weeks or months" of beginning treatment.[44] The newest hope of curing tuberculosis had met its limit, and quickly.

In spite of this limit, the story of streptomycin did not end there. The British government had imported a small supply of the drug in 1946.[45] The British Medical Research Council (MRC) took control over this supply, establishing a trials oversight committee and a separate tuberculosis research team. The MRC Tuberculosis Research Unit was composed of its director, a clinician named Philip D'Arcy Hart, a clinic coordinator named Marc Daniels, and Austin Bradford Hill, the head of the MRC Statistical Research Unit.

43. Streptomycin was first isolated in the lab by one of Waksman's graduate students, Albert Schatz, although Waksman would receive much of the credit.

44. Hinshaw, Pyle, and Feldman, "Streptomycin in Tuberculosis," 434. Although clinical resistance would become an issue from the 1940s, an earlier history of lab-induced resistance as a model for research purposes stretches back to at least 1905 (although in relationship to trypanosomiasis rather than tuberculosis). See Gradmann, "Magic Bullets and Moving Targets."

45. In the same year, the pharmaceutical company Merck began the mass manufacture of streptomycin in the United States.

For over a decade, Hill had been advocating for the use of randomization and control groups in clinical trials.[46] The British supply of streptomycin provided Hill with an opportunity to put his methods into practice. Hart was similarly eager to test out Hill's methods, frustrated with the many contradictory studies of gold treatment that lacked a standardized measure of efficacy. Although elements of the randomized controlled trial had been previously used in agricultural experiments and vaccine trials, the MRC study is widely recognized as the first to bring the pieces together.

The motivations behind the use of this new methodology have been a subject of much debate among research scientists and historians of medicine.[47] At the time, there was no domestic production of streptomycin in Britain. As Hill noted, "It was just after the Second World War . . . and Britain literally had no currency. We had exhausted all our supply of dollars in the war and our Treasury was adamant that we could have only a very small amount of streptomycin."[48] The MRC had access to about 50 kilograms of the drug, which was only enough to treat between 150 and 200 patients. The streptomycin shortage provided Hill a convenient alibi in his pursuit of a randomized clinical trial.

Approval for the trial hinged on the surmounting of a major ethical quandary: What was the proper way to distribute limited, experimental drugs for a life-threatening disease? Was randomization—basically, leaving it to chance—ethical given the exceedingly high stakes? In this moment, the grounds of ethical scrutiny had shifted from secrecy to chance, from the dissemination of knowledge to the distribution of therapy. It was no longer about the contents of the curative substance, but rather a matter of who would get it (and who would not). In the face of enormous public demand, randomization allowed for the allocation of scarce resources in a purportedly unbiased fashion.

Hill approached Geoffrey Marshall, the head of the oversight committee, arguing that "it would not be immoral to make a trial—it would be immoral *not* to make a trial since the opportunity would never rise again."[49] As with Koch's attempt to displace the ethical question of secrecy by focusing instead on the integrity of his cure, Hill attempted to refocus attention from the ethical question of distribution to what he took to be the more pressing ethical

46. On Hill's efforts, see Porter, *Trust in Numbers*, 204–5.

47. Doll, "Controlled Trials"; Teira, "On the Impartiality of Early British Clinical Trials."

48. Hill, "Memories of the British Streptomycin Trial," 78.

49. Hill, "Memories of the British Streptomycin Trial," 78.

concern around the possibility of knowledge production. Once streptomycin was manufactured in bulk, Hill feared that there would no longer be any external justification for attempting randomization. Ironically, scarcity of the drug allowed for a kind of ethical distribution that might have been impossible had the drug been more readily available. Scarcity produced its own ethical quandary, one that found its solution in the form of the randomized trial. In retrospect, he wondered whether the oversight committee would have approved the trial if not for the shortage: "I rather doubt it, but I shall never know."[50] As Hart noted, "The small amount of streptomycin available made it ethically permissible for the control subjects to be untreated by the drug—a statistician's dream."[51]

To further limit the number of patients eligible for the study, as well as to minimize the impact of confounding factors, the research team restricted participation in the study to subjects between the ages of fifteen and thirty with "acute progressive bilateral pulmonary tuberculosis of presumably recent origin, bacteriologically proved, unsuitable for collapse therapy."[52] Potential subjects were initially identified by referring physicians across Britain. The narrow parameters defining who counted as a desirable subject undoubtedly left many more severely ill patients untreated. Yet the epistemological validity of the results of any such study depended upon testing the drugs on a subset of patients whose conditions were somehow similar. How similarity was defined was of course not given in advance, but in this case, the focus on "recent origin" suggests a desire for favorable results (which might not have been as forthcoming with subjects suffering from more advanced stages of the disease). Subjects who fit the criteria were admitted into the nearest participating hospital or sanatorium with an available bed.

Every facility was provided with two series of randomly numbered envelopes, for men and for women. Each envelope contained a card inscribed with the letter *S* (for streptomycin) or *C* (for control). On admission, an envelope was opened and the subject was assigned to one of the two groups. Of the 109 subjects accepted into the trial, two died during the first week of preliminary investigations. The remaining 107 subjects were divided into two groups: fifty-five in the experimental group and fifty-two in the control group. A team of experts without knowledge of the subjects' grouping conducted monthly

50. Hill, "Memories of the British Streptomycin Trial," 78.

51. Hart, "A Change in Scientific Approach," 573.

52. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 770.

assessments based on chest X-rays, sputum samples, and cultures.[53] Importantly, patients from both groups were admitted into a hospital or sanatorium and put on bed rest, which until that point had been the standard for treatment. As I discuss below, the value of bed rest would soon become a critical concern for tuberculosis researchers.

The MRC team worked hard to establish the randomized controlled trial as the new standard for evidentiary production. Other evidentiary procedures, such as those that commanded attention in the controversy surrounding Koch's lymph, were at best only weak indicators. The form of evidentiary demonstration was no longer spectacular, contained in space and time and therefore visible to the eye; rather, this novel form of inquiry was distributed across space and time.[54] At best, it could be described, but not easily visualized. Even the earlier Mayo Clinic studies of streptomycin were described by the MRC team as "encouraging but inconclusive."[55] The MRC study further argued that "evidence of improvement or cure following the use of a new drug in a few cases cannot be accepted as proof of the effect of that drug."[56] The anecdotal or

53. This ignorance about which subjects were allocated into which group allowed for "blind," and therefore "truer," assessments. Such trials are exemplary of a paradigmatically modern mode of evidentiary production, one in which facts are deemed credible only if they "appear innocent of human intention." Daston, "Marvelous Facts and Miraculous Evidence," 94. It is only after a fact is produced that it can be rightfully conscripted as evidence for a particular claim. But as Thomas Kuhn famously argued, such claims are admissible only if they fit within an existing or emergent paradigm. Kuhn, *The Structure of Scientific Revolutions*. Read in one direction, the triad of paradigm-claim-fact produces a sociologically deterministic understanding of scientific research and knowledge production. Read in the other direction, the triad of fact-claim-paradigm comes off as a naively optimistic understanding of how science progresses.

54. To be clear, the place of spectacle in science did not entirely disappear after Koch. Halfdan Mahler, who would later lead the WHO, underscored the importance of overcoming resistance in India to the BCG antituberculosis vaccination by emphasizing that it was the "biggest show on earth." Halfdan Mahler in McMillen, *Discovering Tuberculosis*, 100. Such a spectacle operated less like a public performance on stage, as with Koch, and more through the assertion of scale, distributed across space and time: not directly visible to the eye, but still impressive. This same assertion of scale would occur in the randomized controlled trial, which was similarly unavailable to witnessing.

55. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 769.

56. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 769.

idiosyncratic (the results of a "few cases") could guide the shaping of research programs and the kinds of questions that might be asked, but Hill and Hart were adamant that such forms of inquiry could never hope to generate definitive answers.

More than a shift in what was true, the MRC study enacted a dramatic shift in how something came to be counted as true. When it came to determining whether a cure was a cure, truth was becoming a question of proper methodology. In the glaring light of this new procedure, the authors of the MRC study recast the preceding history of medical research as a series of ad hoc and potentially dangerous experiments lacking both ethical and epistemological grounding.[57] Their goal was to replace the variability of evidentiary forms with a single procedure that would produce reliable evidence through randomization, control, and statistical extrapolation—and through this, establish their own study as the paradigm for a new era of medical research.[58]

To a Certain Degree

If the form of the randomized controlled trial was meant to lend universality and credibility to truth claims, the use of statistical measures narrowed the range of claims that were possible. After six months of treatment, the MRC team cautiously noted that "no clinical 'cures' were affected, and that only 15% of subjects [treated with streptomycin] were bacteriologically negative."[59] These kinds of statistical figures provided a numerical representation of the limited efficacy of streptomycin. The form of the trial enabled the MRC team to claim that streptomycin with bed rest was effective in comparison to bed

57. Flurin Condrau makes a related observation: "Modern bio-scientifically informed judgments on historical treatments are of limited value. This is evident in the history of antibiotic treatment against tuberculosis. Here, the close link between antibiotic effectiveness and the regime for randomised clinical control studies has dramatically restructured the evaluation of medical success." Condrau, "Beyond the Total Institution," 76.

58. Things would change dramatically in subsequent decades, with the strategic use of the randomized controlled trial as a means of justifying, regulating, and profiting from the sales of particular substances. A telling example involves the assessment of Tibetan medicine via randomized controlled trials. See Adams, "Randomized Controlled Crime."

59. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 781.

rest alone, but they could not claim that streptomycin was curative in and of itself, bereft of bed rest.

What statistics offered was a means of measuring the relative efficacy of one treatment in comparison to another in a manner that might be touted as "objective."[60] Objectivity, in this sense, was also a kind of aesthetic, one that lent authority to particular kinds of claims by providing them with what might appear to be an unassailable numerical basis.[61] The use of statistical figures also made it more difficult to make absolute claims. The question was no longer "Is it a cure?" or even "Is it a cure for me?" With the development of the randomized controlled trial and the use of statistics, it became necessary to ask about degrees of efficacy. Treatments were increasingly understood as partial, potentially promises of cure but never guarantees.

The MRC team described the partial efficacy of streptomycin through the twinned concepts of relapse and resistance. Although no pathogenic bacteria could be detected in 15 percent of subjects after six months of treatment, there was a risk that these subjects might harbor bacteria in quantities below the threshold of detection. Sputum cultures had limited sensitivity, allowing bacteria to escape notice only to repopulate later. The MRC team admitted to this possibility of relapse after improvement, especially in subjects with greater cavitation in their lungs, where bacteria could effectively hide. While they felt confident declaring that a subject was bacteriologically negative at a particular point in time (at least as far as the sensitivity of their techniques would allow), they knew that the future posed a threat to any claim of cure.[62]

Along with posttreatment relapse, the MRC team was deeply concerned about drug resistance. Of the fifty-five subjects enrolled in the experimental group, almost two-thirds developed resistance to streptomycin during the course of the study. The MRC team monitored when each of these subjects first produced a sputum sample that was drug resistant in vitro, concluding

60. As the historian of science Georges Canguilhem put it, "The statistical calculation of therapeutic performances introduced into the understanding of the cure an objective measure of its reality." Canguilhem, "Is a Pedagogy of Healing Possible?," 57.

61. On the varying, historically specific aesthetics of different forms of objectivity, see Daston and Galison, "The Image of Objectivity." See also their book-length examination of these ideas, *Objectivity*.

62. The idea that statistics might be used to determine differential cure rates was debated at least as far back as the nineteenth century. Opponents of this idea argued against what they perceived to be the evacuation of clinical judgment. See Porter, *Trust in Numbers*, 203.

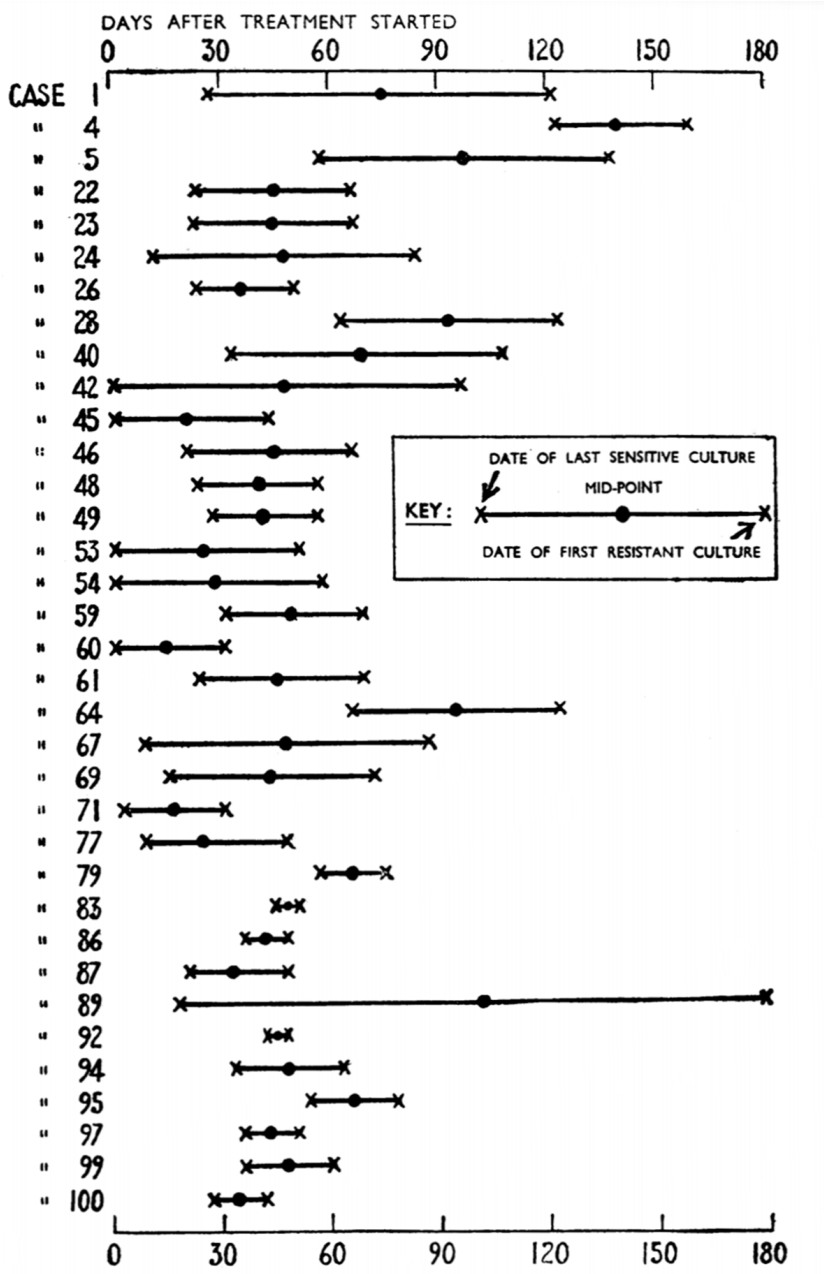

Figure 3.4. Diagram depicting time until emergence of drug resistance. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 779.

that resistance emerged on average fifty-three days after starting treatment.[63] Because subjects improved primarily during the first three to four months of treatment, the MRC researchers speculated that "resistance is responsible for much of the deterioration seen in [streptomycin-treated] cases after first improvement."[64] Streptomycin induced resistance in subjects, producing the limits of its own efficacy. As resistance occurred in the majority of subjects treated with streptomycin, resistance was not idiosyncratic but expected and highly measurable.

The identification of other antibiotics that were effective against tuberculosis raised hopes that resistance could be overcome. After streptomycin, the first potential candidate was para-aminosalicylic acid (PAS). Initially, studies of the efficacy of PAS resulted in contradictory results. To resolve the question of efficacy, the MRC was asked to conduct its own inquiries into the matter: "As a decisive answer had been reached for streptomycin by the method of controlled clinical trial, it was agreed by clinicians in doubt about the value of PAS that the method should be applied to trial of this drug."[65]

The MRC study on PAS, published in 1950, consisted of three groups: streptomycin alone, PAS alone, and streptomycin with PAS. During the six months of this study, each of these groups also received bed rest. As in the streptomycin study, the MRC report on PAS avoided the use of the word *cure* in favor of enumerating bacteriologically negative cases. The MRC team reported that the combination of streptomycin and PAS was more effective than either drug administered alone, providing the first proof of the efficacy of combination therapy within this new evidentiary model. What researchers found even more striking was the significantly decreased levels of streptomycin resistance in the group treated with the combination: resistance was detected in thirty-three of the forty-nine streptomycin-only subjects (about 67 percent), compared to only five out of the forty-eight subjects treated with combination therapy (around 10 percent). Combination therapy was found to be both more effective and less productive of resistance.

In the following years, many of the antibiotics currently used to treat tuberculosis arrived on the scene. The MRC conducted numerous trials to test

63. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 779–80.

64. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 782.

65. Medical Research Council, "Treatment of Pulmonary Tuberculosis with Streptomycin and Para-amino-salicylic Acid," 1073.

the efficacy and relative drug resistance of various combinations of these drugs. Nonetheless, it was hard to say whether antibiotics worked, at least by themselves, because they had always been offered with another form of treatment: bed rest. At the time, bed rest stood in for the entire complex of diet, exercise, rest, and discipline associated with the sanatorium, a combination whose strictness was impossible to achieve at home. The subjects involved in the MRC antibiotic studies had always been admitted to hospitals or sanatoria. As one of the early reports on streptomycin out of the Mayo Clinic declared: "It must always be emphasized that treatment with streptomycin is not a substitute for rest in bed and sanatorium care, which are still fundamental in the treatment of tuberculosis."[66] This was a view held across the United States and Europe, as evidenced by the words of a Swiss sanatorium superintendent who wrote that streptomycin would "never replace therapy by collapse measures or sanatorium treatment."[67] The advent of combination therapy provided an opportunity to change the equation. If bed rest could be eliminated entirely—if drugs were found to be effective on their own—then many more patients could be treated at a much lower cost. Treatment for tuberculosis could be brought to the masses. At least, that was the dream.

No Rest for the Consumptive

In 1956, the vexed question of bed rest was answered in the south Indian city of Madras. The 1950s and '60s were clearly a heady time for science in India. Under the influence of India's first prime minister, Jawaharlal Nehru, and in the wake of independence, science was imagined to be science for the people and the nation, as opposed to a universal or Western science that just as often worked against or at the expense of the people.

The Madras Study, as it has been described, was the first randomized controlled trial in India, designed to measure differences in outcome between subjects treated in a sanatorium with antibiotics, and those given antibiotics at home.[68] At the time, there were estimated to be about 2.5 million active cases

66. Hinshaw, Pyle, and Feldman, "Streptomycin in Tuberculosis," 433.

67. Mordasini, "Streptomycin and Tuberculosis," 52.

68. Notably, an earlier series of studies in Delhi had already tested home-based antibiotic therapy, but without the rigorous methodological control of the randomized controlled trial. See Brimnes, *Languished Hopes*, 185. See also Brimnes's chapter titled "Post-colonial Hopes II: Domiciliary Therapy" for a longer discussion of the Madras Study in the context of the institutional history of Indian antituberculosis efforts.

of tuberculosis in India, but only 23,000 available beds.[69] If admission and bed rest in a hospital or sanatorium were necessary for curing tuberculosis, then this mismatch presented a serious problem. Combination therapy raised hopes that tuberculosis treatment could be extended beyond institutional confines.[70]

The director of the Madras Study was the British Dr. Wallace Fox, a global expert on tuberculosis. Fox had been involved in many of the early MRC antibiotic trials. Prior to coming to India, he had worked for the MRC in Kampala, studying the efficacy of antibiotics on East African tuberculosis patients and comparing the results to a similarly treated British group.[71] In East Africa, where socioeconomic conditions were ostensibly worse than in Britain, were antibiotics still as effective? The Kampala studies demonstrated that the difference in outcomes was statistically insignificant. Antibiotics, like disease, were not racially or geographically specific, decisively countering a long history of mapping pathologies onto specific peoples and places.[72]

In all of these trials, subjects in both control and experimental groups were admitted to hospitals or sanatoria. As the MRC streptomycin study had noted,

69. The estimate of 2.5 million active cases was calculated by P. V. Benjamin, the director of Madanapalle Sanatorium, in 1943. He based this calculation on an estimated annual mortality of at least 500,000. This number continued to be cited as the official estimate for at least fifteen years. See Brimnes, *Languished Hopes*, 44.

70. The Madras Study prefigured the 1978 Declaration of Alma-Ata, in its aim of "Health for All," by focusing on developing a form of treatment that did not, in theory, require movement. In this formation, cure was not elsewhere (in the sanatorium, for example) but at home. The proper cure for the masses depended on immobility or stasis. Immobility became central to such a utopian dream of health, one that was simultaneously tied to economic concerns. If mobility was an elite privilege, then cure had to be here—localized, static, immobile—in order to be democratic, and therefore affordable. This was a medicine organized around people in place, a sedentary medicine, one that reflected the vision of the Bhore Committee.

71. Fox et al., "A Comparison of Acute Extensive Pulmonary Tuberculosis and Its Response to Chemotherapy"; Hutton et al., "Acute Pulmonary Tuberculosis in East Africans."

72. The use of India as a living laboratory for experimentation by the WHO was a matter of great concern for Indian critics, who objected in particular to the roll-out of the BCG antituberculosis vaccine. See McMillen, *Discovering Tuberculosis*, 94, 108. Yet, as Helen Valier points out, the decision to study antibiotic efficacy in India might have had less to do with the availability of Indian subjects for experimental treatments and more to do with British physicians' resistance to doing away with bed rest and extended therapy. Valier, "At Home in the Colonies," 226.

bed rest was until that time "considered the only suitable form of treatment."[73] In that sense, the Madras Study inverted the therapeutic logic of the previous MRC studies; all study subjects would receive antibiotics, but only some would receive bed rest.

This study was also a critical extension of a postwar and postcolonial internationalism in health, as a joint effort of the MRC, the World Health Organization (WHO), and the Indian government. For such a collaboration to work, Indians needed to be included not only as subjects, but also as researchers. One of the first Indian scientists to join the project was S. Radhakrishna, who had recently graduated from Madras Presidency College with a master's degree in statistics, just months before the start of the study. His was one of the first cohorts to which a degree course in statistics had been offered. Disinclined toward a career in agricultural science or government administration—the "IAS craze," as he called it—he applied for a job with the new research center being established by Fox in Madras.[74]

A few days after submitting his application, Radhakrishna was called in for an interview at Rajaji Hall, in the Madras neighborhood of Triplicane. There, he was confronted by an interview committee including the globe-trotting Dr. Fox. At the interview, Radhakrishna was asked about his education and presented with a few statistical problems to solve. Then, Fox turned to him and asked a series of rather different questions:

> What do you know about TB? (Nothing.)
> Would you be scared to work with coughing patients? (No.)
> Are you married? (Not yet.)

"Suppose you get married next year, and your wife objects [to you working with TB patients]?" Fox asked. Radhakrishna recalled answering this last question by explaining to Fox that "in India, marriage is all arranged. Only those [women] prepared to accept [this job] will come [for marriage]." His interview completed, Dr. Radhakrishna joined as one of the first Indian employees of the newly established Tuberculosis Chemotherapy Centre in October 1956. During the next five years, the two men worked together with a dedicated team including two medical officers, an assistant medical officer, two bacteriologists,

73. Medical Research Council, "Streptomycin Treatment of Pulmonary Tuberculosis," 770.

74. By IAS, Dr. Radhakrishna was referring to the Indian Administrative Service. Such jobs continue to be highly desirable, in particular for their stability.

an assistant bacteriologist, a laboratory technician, and a laboratory research assistant.

For the Madras-based research team, the question of relapse was of critical importance. Although the reduction of clinical symptoms and the improvement in radiological results were important measures in the Madras Study, the most important sign of therapeutic success was bacteriological. In the fallout of the scandal surrounding Koch's lymph back in 1890, no cure for tuberculosis could be worthy of the name unless it eradicated the cause of the disease. If bacteria survived the treatment, even in minute quantities below the threshold of detection, there was a danger that they could repopulate. This was a threat on the level of the individual, but there was an even greater risk at the level of the population. In discussing those patients who developed drug-resistant strains during the initial trials, the 1959 Madras Study report repeatedly described them as a "source of danger to the public health" and a "serious public health risk."[75]

Flip of a Coin

To learn more about the Madras Study, I met Dr. Radhakrishna in his familial home in the Egmore neighborhood of Chennai, on a January morning in 2012. His home was located on a dead-end street adjacent to the site of the old Hotel Dasaprakash, an art deco building erected in 1954 (only two years before the start of the Madras Study) and just recently torn down to the ground. After a good deal of wandering around in search of this phantasmic landmark, I finally found Radhakrishna's home. Through a set of double doors and up a rickety spiral staircase, I was welcomed into a sparsely furnished but comfortable sitting room, introduced to Radhakrishna's brother, and offered a cup of freshly brewed filter coffee. A black-and-white photograph of a graduation day hung on the wall alongside portraits of deceased parents and grandparents. Radhakrishna's family was from Andhra Pradesh, but like all of his siblings, he had been born in this house, he explained to me, pointing through a side door to indicate exactly where the event had taken place.

Radhakrishna related the story of his life as a fortuitous combination of epiphany and serendipity. Born in 1935, he described to me idyllic scenes of a pre-Independence Madras, a time without the ill-advised flyovers and rampant corruption that characterizes the city today, at least according to its critics.

75. Tuberculosis Chemotherapy Centre, "A Concurrent Comparison of Home and Sanatorium Treatment," 91, 52.

He told me of family friends, once honest and hard-working people, who had descended into the murky and criminal world of Tamil Nadu politics.

No surprise then, that for Radhakrishna, the era of the Madras Study represented better, more hopeful times. In his view, the historical gleam of the study came from it having been the first randomized controlled trial in India. Through a "flip of a coin," as he put it, subjects were divided into the home-based and sanatorium-based arms of the study. The coin was a metaphor; treatment had in fact been allocated using sealed envelopes with cards denoting whether a subject belonged to the control or experimental group (the same method developed by Hill for the original MRC streptomycin study).

According to Gaye Fox, the wife of Wallace Fox, the Madras Study had been accomplished under "very difficult conditions."[76] Having accompanied her husband to Madras, she had witnessed the study firsthand: "It was said that the Indians might not be cooperative, but with a dedicated team the patients were persuaded to cooperate and the studies had very few absconders. The climate was also notoriously hostile, and yet many of the staff worked long hours, and Wallace usually worked an 18-hour day, often bringing colleagues back to chew over the problems in the evening."[77] In my meeting with Radhakrishna, he too stressed to me the difficulties of cooperation. It had been a challenge to instill the "concept of a randomized controlled trial" in both patients and the research staff, he explained. "Everyone wanted sanatorium treatment." He noted that it was particularly "hard to sell this concept to patients," that their fate would be decided arbitrarily. Patronage networks, gifts, status, clout: none of these mattered in the face of randomization. He suggested to me that the presence of foreign medical professionals helped to smooth over the arbitrariness of the coin: "People felt that this place was very superior, as there were foreigners here, that something special was being given here."

It was not only patients, but doctors as well, who objected to randomization. "[Doctors] said you can't do trials on human beings—it's unethical. The doctor knows best; you can't experiment [on people]," Radhakrishna told me. But in the absence of tested and validated protocol, "every time a doctor gives medicine to a patient, he is experimenting," he argued. Radhakrishna himself admitted that randomization would be "extremely unethical" in the course of regular medical practice. Deciding a patient's fate randomly was only

76. Cited in Christie and Tansey, *Short-Course Chemotherapy for Tuberculosis*, 46.
77. Christie and Tansey, *Short-Course Chemotherapy for Tuberculosis*, 46.

acceptable, and in fact mandatory, within the context of the randomized controlled trial. Modern medical trials are rarely about curing any one person. While a clinician might work to cure the patient standing before them, a researcher is generally tasked with discovering a cure for a condition shared by many.

For Radhakrishna, such a trial was an exceptional event through which the normally unethical became imperative, as a means of establishing the ethical and epistemological grounding for everyday clinical practice. Like Hill—and like Koch before him—Radhakrishna displaced the grounds of ethics: the locus of concern should not be the trial, he maintained, but rather the clinic. From the vantage point of the present, it's difficult to say whether Radhakrishna was simply reading contemporary understandings of evidence-based medicine into the past. In the absence of trials to produce such evidence, medical treatment is figured as idiosyncratic and variable, vulnerable to the whims of individual physicians. Without the backing of this new form of evidence, Radhakrishna argued that all clinical practice would be rife with epistemological and ethical uncertainty. In other words, it was not the randomized controlled trial that was ethically dubious, but rather those everyday practices of clinical medicine unsupported by evidence from such trials.[78]

Unscientific Feelings

The subjects for the Madras Study were recruited primarily from poor neighborhoods adjacent to the Tuberculosis Chemotherapy Centre. In total, 193 subjects were admitted into the study: ninety-six in the home-based group and ninety-seven in the sanatorium-based group. Both sets of subjects received isoniazid and PAS for twelve months. During the study, home-based patients attended the clinic on a weekly basis to collect their medications. In addition, research staff regularly visited homes to retain patients in the study, and to urge them to adhere to the strict therapeutic regime. Surprise urine tests were administered, as drug levels were taken to be a more reliable index of adherence than

78. Ethnographic studies of randomized controlled trials have shown how a presumably standardized evidentiary procedure has nevertheless been deployed in variable ways to take advantage of what are framed as local ethical and regulatory norms. Standardization, then, is not at odds with variation. See in particular Petryna, "Ethical Variability." Moreover, such variability can be a feature, rather than a bug, producing more successful and cost-effective results that meet the demands of capital. See Sunder Rajan, *Biocapital*.

patient testimony. The research team's involvement in the lives of the home-based study participants suggests that a quality of sanatorium treatment—the supervision of a physician or superintendent—had become decentralized and mobile, extending to the home.

Considerable effort was also exerted to keep subjects in the sanatorium. The Madras government had made about one hundred beds available for the study at Tambaram Sanatorium.[79] "Nobody wanted to go to the sanatorium for twelve months," Radhakrishna explained, except when they were experiencing symptoms. A year was a long time, and symptoms often receded after a few months. To stem the desire to leave, Fox, Radhakrishna, and a public health nurse visited subjects at Tambaram every Saturday. Special accommodations were made to maintain enrollment in the study—for example, subjects were permitted to take a few days leave to attend family weddings, like "prisoners on parole," as Radhakrishna put it. Milk powder was also given to the children of patients, as a way of supplementing their food supplies in the absence of a parent.[80] The research team also established a fund to provide financial assistance to families when it was deemed "essential."[81] Some home-based subjects also received funds to subsidize transportation to the clinic.

These retention strategies did not go unnoticed. Fox was heavily criticized by his Danish colleague at the nearby Madanapalle Sanatorium, Dr. Johannes Frimodt-Moller, for allowing the scientificity of his results to be endangered by humanitarian sentiments. A similar critique was issued to Fox by Johannes Holm of the WHO: "You wish to do everything possible for each one of your patients . . . including those who, for the purposes of the trial, can be described as failures and thereafter can be of little or no scientific interest. I realize that this is from humanitarian, or if you prefer it, clinical considerations and feelings."[82]

79. This was in fact the same sanatorium founded by Dr. Muthu in the 1920s, where I found myself looking at a framed image of Koch near the beginning of this chapter.

80. Ramah McKay has written about the ways in which investments in global health tied "therapeutic food" to medical aid while simultaneously making food unavailable to those without medical conditions. Within such a formulation, food is not a government-provisioned good distributed to the poor, but rather a form of humanitarian aid. In the Madras Study, the provision of food was also a kind of incentive to keep subjects in the study. McKay, *Medicine in the Meantime*.

81. Tuberculosis Chemotherapy Centre, "A Concurrent Comparison of Home and Sanatorium Treatment," 53.

82. This source has also been cited in two earlier studies that were foundational to my research, by Sunil Amrith and Helen Valier. Amrith, "In Search of a 'Magic Bullet' for Tuberculosis," 124; Valier, "At Home in the Colonies," 223.

"Failures," for Holm, were those subjects who proved resistant to cure by the standardized experimental regimen.[83] In theory, such failures provided important data about the limitations of cure. But in describing these subjects as failures, Holm revealed his own agenda: not simply to test whether antibiotics alone worked as well as antibiotics with sanatorium admission, but to produce powerful evidence that it was so. Historians have interpreted Holm's irritation with Fox as indicative of a fundamental divide between the aims of the WHO and the MRC. Whereas the WHO was interested in halting the spread of infection, the MRC, at least as represented by Fox, was focused on curing patients.[84] A divide, in other words, between an epidemiologically focused public health and an almost social work–style clinical science.[85] Whereas the WHO cared about developing cost-effective public health interventions, the MRC's investment was in individual cures.[86]

However, the criticisms levied by both Frimodt-Moller and Holm suggest to me that their concerns ran deeper. The extension of supervision and incentives outside of the sanatorium and into the home threatened to muddy the difference between the two wings of the trial. If a randomized controlled trial was the ultimate arbiter of the curative power of a drug, Fox's ad hoc modifications threatened to diminish the validity of the results.[87] The tension between standardization and adaptation to local conditions was palpable: while

83. That Holm describes experimental subjects or participants as "patients" reveals the conceptual difficulties inherent in separating research from clinical medicine.

84. Valier, "At Home in the Colonies," 223.

85. Brimnes, *Languished Hopes*, 189.

86. On the centrality of economism, and in particular cost effectiveness, to tuberculosis research in post-Independence India, see Amrith, "In Search of a 'Magic Bullet' for Tuberculosis."

87. In an essay on the uses of standards and standardization, Stefan Timmermans and Steven Epstein argue that "the uniformity achieved through standardization necessarily carries traces of the local settings." Timmermans and Epstein, "A World of Standards but Not a Standard World," 83. The suggestion is that standardization does not only and always arrive at absolute uniformity but rather creates a space within which certain variations are permitted without necessarily detracting from the standard. However, as Marcia Meldrum has pointed out in her assessment of a polio vaccine trial conducted just two years before the start of the Madras Study, concessions to local needs, such as those made by Fox, raised questions about the validity of the study procedure and the universality of its results. Meldrum, "'A Calculated Risk,'" 1233–36. Such concerns were more deeply felt in the early years of randomized controlled trials, when such variability could throw into question the validity of the very form of the randomized controlled trial.

researchers understood that there were limits to portability, there remained a desire that both cure and the methods for demonstrating cure could be used elsewhere.[88]

Despite these criticisms, the Madras Study generally succeeded in producing the kind of data many researchers and government officials hoped for. In both wings of the study, 90 percent of men were bacteriologically negative at the end of the treatment period. The gap between women in the two groups, however, was quite significant. In the sanatorium wing of the study, 97 percent of women were bacteriologically negative, compared to only 76 percent in the home-based group. The published report contains no serious discussion of the gendered characteristics of home life that might have contributed to the discrepancy between the two groups, other than a brief comment on increased marital infidelity and pretreatment differences.[89]

The Madras Study was lauded as providing the first evidence from a randomized controlled trial that sanatorium treatment was unnecessary and that it would be "appropriate to treat the majority of patients at home."[90] In what was conceived of as the worst of conditions—abject poverty, tiny dwellings with limited air circulation, little rest, hard labor, and perennial malnutrition—the majority of home-based subjects not only became clear of the pathogenic bacteria but remained clear, according to follow-up studies performed by the research team.

In subjects with no detectable bacteria at the end of the trial, follow-up studies were conducted in order to determine whether the cure was truly a cure. Were these patients really bacteriologically negative, or were the bacteria

88. Tuberculosis researchers working across India and East Africa were aware of the specificity of local conditions. To treat nomadic communities, for example, was something quite different than treating sedentary populations with stable homes. It's notable that a similar problem has emerged around the treatment of migratory laborers in contemporary India, who might move throughout the year in relation to work-related opportunities. See McMillen, *Discovering Tuberculosis*, 63–64. Nevertheless, Fox and others were committed to the idea that a treatment that works under what were perceived to be the worst of conditions should be applicable to the rest of the world. On this, see Valier, "At Home in the Colonies," 227.

89. According to Dr. Radhakrishna, one of the nurses involved in the trial had been working on a study of male subjects whose wives purportedly ran away with other men while they were away in the sanatorium. These "other men" were, for some reason, often suspected to be milkmen. I'm not sure that this study ever saw the light of day, and I've unfortunately been unable to locate a copy.

90. Tuberculosis Chemotherapy Centre, "A Concurrent Comparison of Home and Sanatorium Treatment," 128.

in hiding? Of the 130 study subjects who showed no bacteria at the end of the first year, 90 percent remained clear throughout the four years of follow-up. The relapse rate was about equal between subjects from both wings of the study. The majority of these relapses occurred in the first year following treatment. As such, the passage of time increased certainty that the treatment had been effective. A bacteriologically negative result four years after the end of treatment was stronger evidence of efficacy than the same result immediately after treatment, when the bacteria could simply be in hiding.

Initially, Fox was cautious about how he discussed his findings. In the Madras Study and in the studies that followed, patient improvement was neatly delineated in terms of clinical, radiological, and bacteriological measures. Throughout the 1960s and early '70s, a series of further studies across Asia and East Africa were undertaken to determine the most effective and efficient combinations and schedules of treatment.[91] The method of these studies was to test various combination therapies provided intermittently and for shorter durations. By 1971, Fox had the confidence to declare that "standard regimens given for 18 months or more . . . should *cure nearly all patients*."[92] Here, cure was understood as the cessation of all clinical, radiological, and bacteriological signs over an extended period of time. If relapse was proof of failure, nonrelapse stood as a kind of negative proof of cure—but a shaky one. The possibility of relapse would always haunt the security of the cure, particularly in the first year following treatment. However, this possibility diminished significantly over time. In this sense, time lent assurance that relapse might no longer pose a threat.

The specter of relapse forms a kind of limit, one that is not necessarily insurmountable, but nevertheless remains at the heart of cure. Within a bacteriological imagination, where microbes lurk in shadowy corners of the body, cure is always haunted by the possibility of this limit. Such a limit is organized not only around bacteria, but around time. The evidence of this limit is, in fact, sturdier than the evidence of cure itself. Cure can only be defined negatively, as an absence of symptoms and signs, which raises the question—is it a real absence, or merely a perceived one? Against relapse, there is no insurance,

91. As Joseph Dumit has argued, contemporary clinical trials are oriented against both cure and short-duration treatments, focusing instead on the increased profits that come from medicalizing ever larger populations for chronic conditions that require extended treatment. In this earlier moment, however, before the marketization of the randomized controlled trial, the aims were precisely the opposite. See Dumit, *Drugs for Life*.

92. Fox, "The Scope of the Controlled Clinical Trial," 569, emphasis added.

neither in the literal nor figural sense—no way of knowing whether cure will be maintained or fade away.[93]

The possibility of resistance and the ever-present specter of relapse offer a limit to claims to a cure for tuberculosis. Such cures might be thought of less as endings tout court, and more precisely as endings lacking finality. Rather than a permanent rupture with illness, the temporal structure of such a cure might be usefully modeled as a promise that, like all promises, could be broken. Despite advances in chemotherapy, such as that represented by the Madras Study, the global treatment of tuberculosis remained on shaky ground.[94] Antibiotics have never been able to cure everyone suffering from tuberculosis, and even a cured subject might not be cured forever.

Many of the ethical and epistemological questions related to demonstrating treatment efficacy in biomedicine first emerged through investigations into tuberculosis treatment. In this sense, tuberculosis might be understood as a kind of model organism, one that helped to fashion certain habits of thought that have come to inflect how we understand other conditions, such as cancer or schizophrenia. The point, however, is not that problems of cure related to tuberculosis apply equally to all conditions but rather that this history of research opened up and provided (at least provisional) answers to ethical and evidential questions that continue to be grappled with in contemporary biomedical research.[95] Throughout this history, concerns about authority, substance, and demonstration remained central to proving cure. Yet, even as what counted as a proper procedure for producing evidence narrowed, and procedure itself became critical to confirming the efficacy of cure, there remains a sense in which cure itself becomes evidence of authority—as in the story of Sambandar and the king.[96] Even when cure is fragile, incomplete, or partial—and

93. On insurance in India and the idea that one's life is something in which to invest, see Patel, "Risky Subjects."

94. Even in the 1950s and '60s, researchers and international bodies like the International Union against Tuberculosis had reservations about the possibility of properly controlling, much less eradicating, tuberculosis. These concerns were often framed in terms of socioeconomic problems. See McMillen, *Discovering Tuberculosis*, 166.

95. For a discussion of how clinical trials for HIV drugs were opened to nonscientists, thereby continuing debates about the appropriate means of proving therapeutic efficacy, see Epstein, "The Construction of Lay Expertise"; Epstein, *Impure Science*.

96. An important example can be found in debates beginning in the 1970s concerning the necessity of randomized controlled trials (RCTs) for demonstrating the curative efficacy of coronary artery bypass grafting (CABG) in the face of techniques of

even when this is openly admitted, through the language of relapse, resistance, and rates—the fact of cure nevertheless serves as assurance of the authoritativeness of the procedure through which it is certified.

Superimpositions

The Madras Study aimed to refigure the scientific imagination, establishing new parameters for what counted as rigorous research and ethical clinical practice. No longer was it enough to cure the king with sacred ash. Nor could you stand on your gleaming reputation as a prominent scientist. And the results of treatment on a few guinea pigs, or humans, were only suggestive. When the story of the Madras Study is told, it is often recounted with a triumphalist conclusion: randomized controlled trials became the new gold standard for determining whether a treatment was effective; tuberculosis became curable; and the era of sanatorium treatment was over.[97]

But to what extent did this vision of science, and of curative research more specifically, echo beyond the protocols of the Madras Study? In 1961, in the wake of the first phase of the study, a film was released in Madras and across Tamil-speaking south India called *Paalum Pazhamum*, or *Milk and Fruit*.[98] In the film, science becomes articulated with questions of love, duty, and domesticity.

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visualization like angiography. "The controversy over RCTs for CABG was also a battle for professional authority and financial resources." Jones, "Visions of a Cure," 505–6.

97. The number of sanatoria in Europe and the United States was already declining prior to the Madras Study, due to the general decrease in tuberculosis-related morbidity. See Valier, "At Home in the Colonies," 218. Although trials like the one in Madras influenced clinical practice, the evidence they produced was not uniformly and passively adopted into treatment. Bed rest, for example, remained critical to many physicians' view of tuberculosis treatment even after the results of the Madras Study had been publicized. See Valier and Timmermann, "Clinical Trials and the Reorganization of Medical Research."

98. The turn to film allows for an understanding of how the aesthetics of science and medicine, and in particular the cure for tuberculosis, travel far beyond the laboratory or clinic. Given the centrality of cinema to Indian public culture, examining film allows us to come closer to lay understandings of tuberculosis and its cures, as well as of the process of scientific research. Moreover, film allows us to understand something about what Tim Boon describes as the "*cultural* presence, the variety of beliefs—held not only by those suffering [from] or treating the disease but by the whole of society—in the culture of particular periods." See Boon, "Lay Disease Narratives, Tuberculosis, and Health Education Films," 24. In other words, according to

Figure 3.5. Shanti washing dishes and coughing as superimposed lab equipment floats across the screen in the Tamil film *Paalam Pazhamam*. Screenshot from *Paalam Pazhamam* (1961), directed by A. Bhimsingh.

The actor Sivaji Ganesan played the role of Ravi, a medical researcher who lands a prestigious job at a hospital in Madras. Ravi is both caring and ambitious. He immediately announces to his new colleagues that he will not rest until he has found a cure—not for tuberculosis, but rather, for cancer. The nonspecific symptomology of both conditions allows for their frequent intersubstitution, not only in film but in clinical practice as well. Moreover, the cure for cancer remains—even more than tuberculosis—a kind of high-status pursuit, the ultimate challenge for medicine. From the very beginning, cure is at the center of the film, a powerful motor for plot development, and perhaps more importantly for romance. Ravi falls in love with and marries Shanti, a nurse at the hospital who doubles as his lab assistant, played by the actress Saroja Devi.

One sequence in the film is particularly crucial, both for the narrative push that it provides, but also for the way in which it depicts the relationship

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Boon, we move beyond the patient's account to the forms of narrative that circulated among those who might not (or not yet) be sick (24).

between science and health. The sequence begins with Ravi and Shanti happily mixing chemicals in the lab, side-by-side as researcher and assistant, husband and wife. But their happiness is short-lived. In the very next scene, Shanti is washing glassware when a superimposed array of lab equipment suddenly begins to float across the screen. Noxious fumes pour out of the beakers and flasks. Shanti begins to feel ill, but she ignores the feeling and moves to the kitchen, where she prepares a meal for Ravi. The superimposed gases return, reminding the viewer of the previous scene. Shanti begins coughing violently. Hearing her cough, Ravi wakes from a nap and races to her side. As he embraces her, she coughs up blood onto his shirt. There is no need for words. In the tradition of Indian melodramatic cinema, her body has already expressed the truth of its condition. X-rays only confirm what Ravi, and the viewing public, already know: Shanti has tuberculosis. The bloody cough, coupled with the X-ray, provide a definitive means of visualizing tuberculosis, and of distinguishing it from cancer.[99]

In a film otherwise unremarkable for its editing, the use of superimposition produces a specific vision of science. It is, after all, lab equipment that floats across the screen. This superimposition signals a scientific imaginary that runs counter to the triumphalism of the Madras Study. Rather than science leading to cure, the gendered labor of scientific research instead leads to illness. In diagnosing Shanti, Ravi declares, "The *vyathi* [disease] has gone inside of her, making us all fools." Quite literally, the chemical fumes have made her ill by entering her body, and shown us that we are foolish for failing to see the iatrogenic aspect of science, of domestic love, and of duty.

In the wake of Shanti's diagnosis, cancer is pushed aside in favor of tuberculosis, and Ravi turns away from cure and toward care. He takes on the labor of nursing, brushing Shanti's hair, spooning soup into her mouth, and applying vermillion to her forehead. Shanti is clearly upset by all of this—not by his love, but by his misplaced priorities. She forces him to return to the hospital to continue his research. Unbeknownst to her, when Ravi arrives at the hospital, he finds a small box from Switzerland, labeled simply *TB Medicine*.

99. Notably, in V. Sridhar's 1968 Hindi remake of the film, *Saathi*, Shanti's disease actually shifts from tuberculosis to heart disease, while Ravi remains a cancer researcher. For a reading of *Saathi* in terms of female sacrifice—in particular, the sacrifice of conjugality for science—see Banerjee, *Enduring Cancer*.

Ravi is overjoyed. But when he returns home with the box, he finds that Shanti has departed. She leaves him a note explaining that she left so that he could focus exclusively on his research. In the only other use of superimposition in the film, Shanti's face appears above the note, reading its contents: "If I stay here, you won't reach your goal. . . . My soul will only achieve peace if you go about your business."

The film cuts to Shanti sitting on a train, coughing and staring out the window. By chance, the man sitting next to her is a former patient whom she had nursed back to health in the hospital, a Muslim businessman. He's shocked by her appearance. "Elenja pettiye! [You've become thin!] Unga udambukku enna acche? [What's happened to your body?]" he asks. "TB," she responds. "TB!" he exclaims.

Her former patient puffs on a cigarette, distraught. "Where are you going with this body?" he asks, as if the idea of traveling in such a condition were incomprehensible. She responds that she doesn't know. Unfortunately, the decision seems to be taken out of her hands. The following sequence alternates between shots of two trains edited together to give the impression of an impending collision. The trains are shown colliding. The newspapers and radios report the accident and announce the death of Shanti, the wife of a Madras-based cancer researcher.

Ravi throws himself back into his work, distraught but determined to honor Shanti's final wishes. His family is not so sanguine about the matter. They insist that he marry Nalini, the daughter of a family friend whom they had wanted him to marry before he had decided upon Shanti.

"I know nothing about love, only about curing cancer," he explains to them. "That's why I married Shanti. She understood that. Only afterwards did love emerge." He tries saying all of this to Nalini. "I have to pursue a cure so that her soul can achieve peace," he tells her.

But Nalini insists. "I too will help you in your lab work." And with that, they get hitched.

Little do they know that Shanti did not, in fact, die in the train crash. Her former patient, the Muslim businessman, finds her lying in the wreckage. "Let me be as if dead," she tells him. On the brink of death, Shanti exiles herself from life. Like Kamala Nehru (as we have seen), and like Kasturba Gandhi (as we will see), Shanti's death would allow her husband to continue to serve others.[100]

100. On Kamala Nehru, see chapter 2. On Kasturba Gandhi, see chapter 5.

But the Muslim businessman has other ideas. "I'm going to Switzerland for some work," he says to her. "Listen to what I'm saying: if you come to that country, *that* nature itself will cure you, okay?" (notably, the curative nature in question is specifically Swiss).[101]

Shanti and the businessman discover, of all things, a Tamil doctor in Switzerland. A pair of wide establishing shots of the pristine waters and magnificent hills of Switzerland sets the scene. The camera moves in closer to reveal the interior of a chalet, bathed in sunlight from a window in the back.

"I never thought I would come this far to meet a Tamil doctor," the businessman exclaims in delight. Discussing Shanti's condition, the Tamil doctor remarks rather poetically, "The one who was thought to be unable to walk can now walk. The cure," he says, using the English word, "is now complete." He then repeats himself in Tamil, "Udambu gunamaaku aayitru." The body has been cured or restored.

When Shanti thanks him, the doctor replies that her cure wasn't caused by medicine or pills. Rather, the curative agent was nature itself.[102] As we will see, cure is intimately tied to the act of its enunciation—yet the Tamil doctor disclaims any therapeutic power of his own. His poetic words, unlike the words of the poet-saint Sambandar with whom we began this chapter, carry no sovereign force, no divine sanction. His proclamation of cure, then, is merely descriptive, not a performative act but a statement that nature has completed its therapeutic task.[103] Although Shanti is cured, the doctor insists that she remain resting in bed to avoid the possibility of relapse. Whatever the Madras

101. In the 1989 Hindi film *Chandni* (directed by Yash Chopra), we have a similarly romantic triad, although in this case, it is a disabled man who pursues his cure in Switzerland, and it is his wife who is on the verge of marrying another man. In both films, the original couple is separated by illness, their romantic restoration made possible only by a prior physical restoration in Switzerland. And in both films, the intervening third party is easily dispensed with. On the development of Switzerland as a site in the Tamil filmic imaginary, see Pandian, "Landscapes of Expression." On the place of Switzerland in Bollywood, see Schneider, *Bollywood*.

102. On the therapeutic power of nature, see chapter 1.

103. Whether the declaration of cure constitutes merely a description or a performative kind of statement, it finds a particularly apt parallel in the juridical verdict, which both confirms and produces the truth of guilt. On scenes of enforced waiting in Hindi cinema, particularly in relation to the hospital and the courtroom, see Cohen, "Foreign Operations."

Study might have demonstrated, the sanatorium and its vocabulary remained alive in the imagination of 1960s Tamil cinema.

Back in Madras, Ravi's new wife, Nalini, has proven to be more interested in going on excursions in town than doing lab research. "Don't you have any other thought than this research?" she cries. In a fit of rage, she grabs a beaker of *vesham* (poison) that she intends to drink, but Ravi knocks it from her hand. The ensuing chemical fog robs him of his eyesight, this time, without superimposition.

When the fully recovered Shanti finally returns to Madras, she learns that Ravi has remarried and lost his vision. She pretends to be a nurse and offers her services to Ravi's family. None of them had met her before her "death," so no one suspects a thing—except for Ravi, that is. When Ravi meets Shanti, he immediately thinks that she's the ghost of his dead wife. She insists that she is not. He grudgingly accepts that his mind is playing tricks on him.

In a dramatic twist, Ravi's older brother Shekhar returns from Harvard University, where he had performed many eye surgeries. He restores Ravi's vision. In gratitude, Ravi offers to arrange a marriage between Shekhar and his nurse, whom he has yet to see. On the morning of the wedding, he comes to learn from a suspicious relative, played by the actor M. K. Radha, that his nurse is actually his first wife. He runs to the marriage hall, where he learns that the marriage has already been halted. It seems that the Muslim businessman had come to the house to check on Shanti and, in the process, divulged her secret. Ravi's family decided not to worry him before his eyes had fully healed, so they kept the truth from him.

The romantic triad is resolved and, in fact, turns out to be a pentad: Ravi and Shanti are reunited; Nalini files for divorce and sets off to (of all places) Switzerland to join the Red Cross, and Shankar is married to Shanti's sister, who happens to be visiting from Ceylon. The film ends on a happy note, with the exception of poor Nalini, who speeds away on a bus, sunglasses covering her tears.

There are many fascinating twists and turns in the film. Yet I'm left wondering: what was in the box that Ravi received in the hospital? Certainly, we are meant to imagine cure—but when we imagine cure, what precisely is it that we are imagining? *Paalam Pazhamum* did not simply attempt to displace the brave new world established by the Madras Study. Lab equipment floated above noxious fumes, medicine in boxes arrived too late, and cure was discovered elsewhere, in a Swiss sanatorium operated

by a Tamil physician. Juxtaposition is taken to an extreme as images—and imaginations—are overlaid and yet remain visible. The scientific imagination of *Paalam Pazhamum* represents a superimposition upon the Nehruvian rationalism of the time, which might leave us wondering: which image is the more real?[104]

104. For an important discussion of the greater degree of reality ascribed to the imagination over what might be thought of as material reality in the Tamil tradition, see Shulman, *More Than Real*.

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Chapter Four