THE GHOST MAP


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"By turns a medical thriller, detective story, and paean to city life, Johnson’s account of the outbreak and its modern implications is a true page-turner." The Washington Post

author of EVERYTHING BAD IS GOOD FOR YOU

STEVEN JOHNSON
A hundred yards west of the Broad Street Pump, in the dark alley of Cross Street, a tailor lived in a single room at number 10, sharing the space with his five children, two of whom were fully grown. On warm summer nights the heat in their cramped living space could be unbearable, and the father would often wake after midnight and send one of the boys out to fetch some cool well water to combat the sweltering air. They lived only two blocks from the pump at Little Marlborough Street, but that water had such an offensive smell that they regularly walked the extra block to Broad Street.

The tailor and his twelve-year-old boy had been struck in the first hours of the outbreak, and both were dead by Saturday. Snow had found their address listed in the inventory of deaths that Farr had supplied him. Several other deaths were recorded on Cross Street as well. The location had caught Snow’s eye when he first arrived back at the
pump to survey the surrounding streets, armed with the addresses of the dead. Almost half the deaths Farr had recorded were linked to addresses within his line of sight; and half the remaining ones came from residences that were only a matter of steps from Broad Street itself. The Cross Street deaths were unusual, though: to make it to the Broad Street pump from there, you had to wind your way through two small side streets, then take a right onto Marshall Street, then another left, and then walk a long block down Broad Street. To get to the Little Marlborough pump, though, you simply strolled down the alley, walked two short blocks north, and you were there. It was within your line of sight if you stood at the very end of Cross Street.

Snow had noticed another element while scanning Farr’s records: the deaths on Cross Street were much less evenly distributed than the ones in the immediate vicinity of the pump. Almost every house along Broad Street had suffered a loss, but there were only a handful of isolated cases on Cross Street. This is what Snow was looking for now. He could see at a glance that he’d be able to demonstrate that the outbreak was clustered around the pump, yet he knew from experience that that kind of evidence, on its own, would not satisfy a miasmatist. The cluster could just as easily reflect some pocket of poisoned air that had settled over that part of Soho, something emanating from the guilty holes or cesspools—or perhaps even from the pump itself. Snow knew that the case would be made in the exceptions to the rule. What he needed now were aberrations, deviations from the norm. Pockets of life where you would expect death, pockets of death where you would expect life. Cross Street was closer to Little Marlborough, and thus should have been spared in the outbreak, according to Snow’s theory. And indeed, it had largely been spared, but for the four cases Farr had reported. Could those cases have some connection to Broad Street?

Sadly, by the time Snow arrived at 10 Cross to interview the tailor’s surviving children, he was too late. He learned from a neighbor that the entire family—five children and their father—had died in the space of four days. Their late-night thirst for Broad Street water had destroyed them all.

In his mind Snow was already drawing maps. He’d imagined in overview of the Golden Square neighborhood, with a boundary line running an erratic circle around the Broad Street pump. Every person inside that border lived closer to the poisoned well; everyone outside would have had reason to draw water from a different source. Snow’s survey of the neighborhood, based on Farr’s initial data, revealed ten deaths that lay outside the boundary line. Two of them were the tailor and his son on Cross Street. After a few hours of conversation, Snow determined that three others were children who went to school near Broad Street; their grieving parents reported that the children had often drunk from the pump on their way to and from school. Relatives confirmed that three other casualties had maintained a regular habit of drawing water from Broad Street, despite living closer to another source. That left two remaining deaths outside the border with no connection to Broad Street, but Snow knew that two cholera deaths over a weekend was well within the average for a London neighborhood at that time. They might easily have contracted the disease from a different source altogether.

Snow knew that his case would also revolve around the inverse situation: residents who lived near the pump who survived, because, for one reason or another, they had opted not to drink from the poisoned well. He reviewed Farr’s list again, looking this time for
telltale absences. There were a handful of deaths reported at 50 Poland Street. On its own, this was a predictable number: Poland Street lay immediately to the north of the pump, well within Snow's imagined border. But in scanning the list, Snow realized that the number was strikingly low, because 50 Poland Street was the address of the St. James Workhouse, home to 535 people. Two deaths was routine for a household of ten living off of Broad Street. A population of five hundred living close to the pump should have seen dozens of death. As Whitehead had already learned from his daily rounds, the workhouse—despite its destitute and morally suspect inmates—had been something of a sanctuary from the outbreak. When Snow interrogated the workhouse directors, an explanation immediately jumped out at him: the workhouse had a private supply from the Grand Junction Water Works, which Snow knew from his earlier research to be one of the more reliable sources of piped water. The workhouse also had its own well on the premises. They had no reason to venture out to the Broad Street pump for water, even though it lay not fifty yards from their front door.

Snow noticed another telling absence on Farr's list. With seventy workers, the Lion Brewery at 50 Broad was the second-largest employer in the immediate vicinity. Yet not a single death was recorded for that address in Farr's list. It was possible, of course, that the workers had gone home to die, and so Snow paid a visit to the Lion's proprietors, Edward and John Huggins, who reported with some bafflement that the plague had passed over their establishment. Two workers had reported mild cases of diarrhea, but not a single one had shown severe symptoms. When Snow inquired about the water supply on the premises, the Hugginses replied that, like the workhouse, the brewery had both a private pipeline and a well. But, they explained for the benefit of the teetotaling doctor, they rarely saw their men drink water at all. Their daily rations of malt liquor usually satisfied their thirst.

Later, Snow would visit the Eley Brothers factory, where he found the situation much more dire. The proprietors reported that dozens of their employees had fallen ill, many of them dying in their own homes over the first few days of the epidemic. When Snow noticed the two large tubs of water that the brothers kept on premises for their employees to drink from, he scarcely needed to ask where the water had originated.

Snow had heard through the grapevine that the Eley brothers' mother and their cousin had recently perished of cholera as well, both of them far removed from Golden Square. The coincidence must have immediately struck Snow; perhaps he even thought back to the experimentum crucis gauntlet thrown down by the London Medical Gazette so many years before. No doubt, considering Snow's discretion, he posed the question delicately: Had Susannah Eley by any chance consumed some of the water from the Broad Street pump? It must have been an anguished moment for Snow: how to extract the information he needed without revealing that the brothers' thoughtfulness had been the agent of their mother's demise. Snow's taciturn demeanor would have helped him as the brothers described their regular deliveries of pump water to Hampstead; a more volatile investigator might have responded to the revelation of that crucial clue with more emotion. But whatever emotion he showed the Eley brothers, when he stepped out of the factory into the bright light of Broad Street, he must have thought to himself with some satisfaction that the case was coming together quite nicely indeed. The miasmists might finally have met their match.
There is a kind of mythology that stories like this one tend inevitably to drift toward: the lone genius shaking off the chains of conventional wisdom through the sheer force of his intellect. But in explaining Snow's battle against the miasma theory and the medical establishment, it's not sufficient to point to his brilliance or his tenacity alone, though no doubt those characteristics played a crucial role. If the dominance of the miasma model was itself shaped by multiple intersecting forces, so, too, was Snow's ability to see it for the illusion that it was. Miasma was the intellectual equivalent of a contagious disease; it had spread through the intelligentsia with an alarming infection rate. So why was John Snow immune?

Part of the answer lies in Snow's study of ether and chloroform. The underlying insight that brought him his first round of acclaim was that the vapors of ether and chloroform had remarkably predictable effects on human beings. If you controlled the density of the gas, there was very little variation in the way humans—not to mention the frogs and birds in Snow's lab—would respond to inhalation. Without that predictability, of course, Snow would have never been able to build a thriving career for himself as an anesthesiologist; the risks and unreliability of the procedure would have greatly outweighed the benefits. Ether was itself a poisonous vapor—a kind of miasma in its own right—and yet it seemed entirely indifferent to the "inner constitution" of the humans who inhaled it. If ether had followed the pattern described by some of the miasmatists, it would have triggered radically different responses, depending on the inner constitution of each patient—perhaps causing some to become preternaturally alert, while inducing laughter in others, and rendering others senseless in seconds. But Snow had watched thousands of patients be

ediated by the gas over the preceding six years, and he knew firsthand how mechanistic the process was. His whole career was, in a sense, a testimony to the predictable physiological effects of inhaled vapors. And so, when the miasma theorists invoked the inner constitution to explain why half the population of a room might succumb to poisonous vapors while the other half emerged unscathed, Snow was naturally inclined to view the theory with some suspicion.

His experience with chloroform and ether had also endowed Snow with an intuitive grasp of the way that gases disperse in the environment. Ether could be deadly in a concentrated form, delivered directly to the patient's lungs. But a doctor delivering it, standing a foot away from the patient, wouldn't feel its effects in the slightest, because the density of ether molecules in the air dropped at a precipitous rate the farther removed one was from the inhaler itself. This principle—known as the law of diffusion of gases—had already been discovered and analyzed by the Scottish chemist Thomas Graham. Snow brought the same logic to miasma: if there were poisonous elements floating in the air, emanating from the cesspools or the bone-boilers, they were likely to be so massively dispersed that they posed no health risk. (Snow was only half-right on this point, of course: the vapors proved irrelevant where epidemic disease was concerned, but they did in fact have long-term deleterious effects, in that many of the industrial fumes of the age were carcinogens.) Several years after the Broad Street epidemic, Snow would make this connection explicit, in a controversial appearance before one of Benjamin Hall's public-health committees, defending the "offensive trades" (the bone-boilers, soap and dye makers, gut spinners) that stood accused of poisoning London's air. "I have arrived at the conclusion," Snow explained to the scandalized committee, "[that the offensive trades] are not injurious to the public health. I consider that
if they were injurious to the public health they would be extremely so to the workmen engaged in those trades, and as far as I have been able to learn, that is not the case; and from the law of the diffusion of gases, it follows, that if they are not injurious to those actually upon the spot, where the trades are carried on, it is impossible they should be to persons further removed from the spot.” Call it the Sewer-Hunter Principle: if all smell truly was disease, then a scavenger descending into an underground tunnel of raw waste should be dead in seconds.

Snow was also a doctor, a trained observer of physical symptoms, and he understood that the bodily effects of a disease were likely to offer important clues about the disease’s original cause. In the case of cholera, by far and away the most pronounced change in the body lay in the small intestine. The disease invariably began with that terrible expulsion of fluids and fecal matter; all the other symptoms followed from that initial loss of water. Snow couldn’t say exactly what kind of element was behind cholera’s catastrophic attack on the human body, but he knew from observation that it invariably launched that attack from one place: the gut. The respiratory system, on the other hand, was largely unaffected by cholera’s ravages. For Snow, that suggested an obvious etiology: cholera was ingested, not inhaled.

Snow’s observational talents extended beyond the human body. The sad irony of his argument for the waterborne theory of cholera is that he had all the primary medical explanations in place by the winter of 1848–1849, and yet they fell on deaf ears for almost a decade. The tide eventually turned not because of his skills as a doctor or scientist. It wasn’t lab research that would ultimately persuade the authorities; it wasn’t direct observation of V. cholerae itself. It was Snow’s faithful, probing observation of urban life and its everyday patterns: the malt-liquor drinkers at the Lion Brewery; the late-night trips for cold water on hot summer nights; the tangled web of private water supplies in South London. Snow’s breakthroughs in anesthesia had revolved around his polymath skills as a physician, researcher, and inventor. But his cholera theory would ultimately depend on his skills as a sociologist.

Equally important was the social connection Snow had to the subjects he observed. It is not an accident that of the dozens and dozens of cholera outbreaks that he analyzed in his career, the one for which he is most famous erupted six blocks from his residence. Like Henry Whitehead, Snow brought genuine local knowledge to the Broad Street case. When Benjamin Hall and his public-health committee made their triumphant appearance on the streets of Soho, they were little more than tourists, goggling at all the despair and death, and then retreating back to the safety of Westminster or Kensington. But Snow was a true native. That gave him both an awareness of how the neighborhood actually worked, and it gave him a credibility with the residents, on whose intimate knowledge of the outbreak Snow’s inquiry depended.

Snow shared more than geography with the working poor of Golden Square, of course. While he had long since elevated himself in social status, his roots as the son of a rural laborer colored his perception of the world throughout his life—primarily in the sense of blocking out certain dominant ideas. Nowhere in Snow’s writings on disease does one ever encounter the idea of a moral component to illness. Equally absent is the premise that the poor are somehow more vulnerable to disease thanks to some defect in their inner constitution. Ever since he observed the Killingsworth mining outbreak as a young apprentice, Snow had long known that epidemics tended to afflict the lower orders of society. For whatever reason—probably some mix of rational observation and his own social awareness—that
disparity led Snow to seek external causes, not internal ones. The poor were dying in disproportionate numbers not because they suffered from moral failings. They were dying because they were being poisoned.

Snow’s resistance to the miasma theory was methodological as well. The strength of his model derived from its ability to use observed phenomena on one scale to make predictions about behavior on other scales up and down the chain. Observed failure of certain organ systems of the body could predict behavior of the whole person, which could in turn predict behavior in the social body en masse. If the symptoms of the cholera concentrated around the small intestine, then there must be some telltale characteristic in the eating and drinking habits of cholera victims. If cholera was waterborne, then the patterns of infection must correlate with the patterns of water distribution in London’s neighborhoods. Snow’s theory was like a ladder; each individual rung was impressive enough, but the power of it lay in ascending from bottom to top, from the membrane of the small intestine all the way up to the city itself.

And so Snow’s immunity to the miasma theory was as overdetermined as the theory itself. Partly it was an accident of professional interest; partly it was a reflection of his social consciousness; partly it was his consistent, polymath way of making sense of the world. He was brilliant, no doubt, but one needed only to look to William Farr to see how easily brilliant minds could be drawn into error by orthodoxy and prejudice. Like all those ill-fated souls dying on Broad Street, Snow’s insight lay at the intersection point of a series of social and historical vectors. However brilliant Snow was, he would never have proved his theory—and might well have failed to concoct it in the first place—without the population densities of industrial London, or Farr’s numerical rigor, or his own working-class up-

bring. This is how great intellectual breakthroughs usually happen in practice. It is rarely the isolated genius having a eureka moment alone in the lab. Nor is it merely a question of building on precedent, of standing on the shoulders of giants, in Newton’s famous phrase. Great breakthroughs are closer to what happens in a flood plain: a dozen separate tributaries converge, and the rising waters lift the genus high enough that he or she can see around the conceptual obstructions of the age.

You can see the convergence of all these forces in Snow’s regimen that Wednesday. In the midst of the most important investigation of his life, he was still a working physician, managing the diffusion of gases. He delivered chloroform to two patients: one having hemorrhoids removed, the other having a tooth extracted. He spent the rest of the day in the streets of his neighborhood, probing, questioning, listening. Yet each conversation, however intimate, was shaped by the impersonal calculations of Farr’s statistics. He drew lines of connection between individual pathology and the wider neighborhood; he shifted perspective seamlessly from doctor to sociologist to statistician. He drew maps in his head, looking for patterns, looking for clues.

Henry Whitehead didn’t possess a theory of cholera of his own, but he’d been steadily knocking down other ones for days now. He knew that the well-to-do neighborhoods around Golden Square were abuzz with sneering explanations for the outbreak: the poor of Soho, on the mean side of Regent Street, had brought this upon themselves. Either their physical crisis was the embodiment of a moral crisis, a kind of divine retribution, or they had succumbed to the fear of disease, which in turn made the cholera