Preface

When I say that I have been writing a book on rayon, the initial response frequently is, “Radon? That’s radiation, isn’t it?”

My attempt at a clarifying follow-up and the ensuing exchange typically runs: “Not radon, rayon, the synthetic textile.”

“Oh, didn’t they stop making that years ago—it was invented for parachutes or something in World War II, right?”

“Actually, rayon has been around since the turn of the last century—about 1900—and it’s still being made. Maybe you know it better as viscose?”

“Viscose? I didn’t know that was rayon. I thought viscose was a green product, not a synthetic.”

“Viscose rayon is based on cellulose. That part may be ‘green,’ but the chemical used to make the viscose isn’t. It’s a toxic chemical called carbon disulfide.”

“Does that mean viscose isn’t safe to wear? I’d better go through my wardrobe!”

“No,” I reassure at this point. “It’s only the workers who make it that suffer, and maybe the surrounding environment.” Consumer angst allayed, the conversation usually turns to some other topic.

I understand fully. Occupational disease is not the standard stuff of casual conversation. Admittedly, viscose is pretty far from central to almost anyone’s
thoughts. Moreover, carbon disulfide, the toxic agent perquisite to the making of viscose, is an unknown entity to anyone but a practicing chemist. Even most physicians have never heard of carbon disulfide unless they happen to remember it from an organic chemistry lab class they were forced to suffer through in premed. But the story of viscose manufacturing and viscose-caused disease, by rights, should not be obscure. It deserves to be every bit as familiar as the cautionary tales of asbestos insulation, leaded paint, or the mercury-tainted seafood in Minimata Bay.

Throughout most of the twentieth century, viscose rayon manufacturing was inextricably linked to widespread, severe, and often lethal illness among those employed in making it. Viscose is behind another product closely related to rayon—cellophane—and both rely on carbon disulfide as their key manufacturing constituent. Viscose, a technological innovation in its day, once was a very big business. In fact, it was one of the first truly multinational corporate enterprises, having achieved this status in the period just before World War I. A bit later in the twentieth century, during the Great Depression, the viscose business did not suffer appreciably. Rather, it flourished. Viscose went on to assume a highly profitable position as a strategic matériel on both sides in World War II.

Peace finally came; viscose went from strength to strength. For the Courtaults company (phoenix of the postimperial British textile industry) and for the behemoth state-owned enterprises of the Eastern bloc, rayon was pivotal. During the same period in the United States, DuPont held on to its lucrative near monopoly on cellophane, fighting an antitrust ruling all the way to the Supreme Court. After the industry’s midcentury apogee, viscose manufacturing found itself in the vanguard of those hazardous industrial processes exported to the developing world, starting in the 1960s and continuing through the decades that followed. Even now, viscose is still very much with us. Its successful rebranding as a renewable, eco-friendly product cleverly sidesteps the inconvenient reality that carbon disulfide, whether mixed with soft wood pulp or bamboo or straw, is anything but green.

The basic industrial manufacturing steps employed in making viscose never have been much of a trade secret. Cellulose wood pulp is treated with caustic soda at a high pH; carbon disulfide is added to that solution; the mix is churned, allowed to “ripen,” and then mixed with more caustics to form a syrupy semiliquid that is the eponymous viscose of the process. The viscose syrup is forced through tiny spinning nozzles submerged in a bath of sulfuric acid, like sprinklers irrigating a Hadadian garden. It is in this unkind environment that the extruded filaments of viscose rayon fibers coagulate and grow. Replace the tiny spinning holes with a long, thin slit, and one produces
viscose-based film (that is, cellophane). Along the way there have been variations on this theme, but the basic story line has stayed the same.

Carbon disulfide has remained a constant in the mix. This chemical has the nearly unique ability to engage cellulose molecules, lining them up for guidance into a new form. Then, at just the right moment, the carbon disulfide lets go of the cellulose. Unless the process is engineered with care, the place where the “carbon disulfide lets go” is directly into the factory air breathed by viscose workers, with the rest wafted out into the surrounding environment.

Just as the basic process for making viscose is well established, the most dramatic effect of carbon disulfide on humans has been long appreciated. For more than 150 years, considerably in advance of rayon’s invention, the chemical’s potent and special toxicity has been clearly recognized. Carbon disulfide’s industrial debut was as a vulcanizing agent in the rubber trade, back in the middle of the nineteenth century. Trouble was noted very soon after the chemical was first introduced. The effect was hard to miss: carbon disulfide exposure led to acute insanity in those it poisoned.

In the many years that followed, more and more medical evidence documented in exquisite detail the many ways in which carbon disulfide adversely affects the nervous system. Besides frank insanity, poisoning can be manifested in subtler personality changes. Carbon disulfide causes toxic degenerative brain disease and acts by damaging the sensory capacity of nerves (including those responsible for vision). After years of exposure, even more insidious carbon disulfide damage appears through increased risk of heart disease and stroke. Only in recent decades have these latter effects been established conclusively. Sophisticated epidemiological investigation was required to confirm the unusual pattern of individual cases that were occurring among viscose workers: disease that was happening both too frequently and among those at too young an age typically to suffer from these problems.

Despite its shocking legacy, viscose’s history is almost completely unknown. Even those otherwise well versed in issues of public health are largely unaware of this story. Yet it is a history hiding in plain sight. In Fake Silk, I want to shine a bright light on this terrible story. In large part, I am motivated by a desire to memorialize the terrible suffering that has occurred. Almost everyone not only knows about radon—unlike rayon—and many can even name a specific victim: Madame Curie, who succumbed to leukemia, almost assuredly due to her occupational exposure to radiation. I want those who paid the full price for carbon disulfide’s use to be as well remembered.

And I intend to name names. This may not be possible for the unrecognized thousands whom carbon disulfide made ill, although here and there
personal traces of individuals can be detected. It is far easier, however, to identify the perpetrators. Indeed, some of them are still in business today, albeit after having been renamed, acquired, spun off, and then remerged through a string of new, also-known-as names and business acronyms. I also believe that this past history is highly relevant to other manufacturing innovations of today and tomorrow, processes that, like viscose production, may endanger worker health, threaten to degrade environmental quality, or compromise consumer product safety.

As I dug deeper into the story of viscose, one question that I was forced to consider over and over again was this: when a new technology leads to disease or even death, how high does the body count have to be before any protective steps are taken? One could imagine that slowness to act might simply be due to delayed recognition. After all, if no one suspects that there is a cause-and-effect relationship between an exposure and a new outbreak of disease, why would any prevention be undertaken?

It did not require extensive research for me to find out that when it came to carbon disulfide, lack of knowledge about its dangers has never been the problem—far from it. From nearly the earliest days of its discovery and first use, the toxic actions of carbon disulfide were observed, documented, and disseminated widely. This record was primarily recorded through medical reports and monographs appearing initially in French, then in German and English, and later in Italian, Japanese, and any number of other languages. Wherever and whenever carbon disulfide was used, reports of its adverse effects did not take long to appear. Occasionally, notice would spill out from medical reports into the popular media, including newspapers and newsmagazines.

While following this long chain of evidence, I encountered a curious pattern. The path was not linear, but rather ran almost in circles. There were places where the trail went cold, only later to emerge again as a new outbreak of illness caught the attention of a medical practitioner or a public health worker previously unfamiliar with carbon disulfide’s toxicity. Each time, the neophyte seemed to rediscover the problem all over again, going back to square one. It was as if a kind of cyclical amnesia had come into play in which all that had been learned was soon forgotten, or nearly so, and the knowledge had to be reconstructed. These recurrent memory lapses were particularly prolonged just as carbon disulfide use fell off in the rubber industry and began to pick up again with the new technology of viscose.

By early in twentieth century, a considerable body of shared knowledge, acquired in fits and starts, delineated the dangers of carbon disulfide. Even so, this had virtually no effect on preventing exposure in the ever expanding
viscose industry. Effective action on the part of the labor force most affected could not have been expected. Workers have always had limited leverage to protect themselves from health hazards on the job. Carbon disulfide exposure in the nineteenth-century rubber industry preceded the existence of organized labor, and over most of the twentieth century viscose manufacturing workers have been either nonunionized (especially in the United States and in many locales where the industry was exported overseas), under state control, or, at best, in a position far less advantageous than that of their employers. The globalized, multinational corporate nature of viscose manufacturing almost since its inception further exaggerated such power imbalances.

In all this, governmental “agency” was missing in action for most of the time. For example, when the plight of rayon workers became a topic of parliamentary debate in Great Britain, ministerial disingenuousness dampened any hopes for corrective action. Fifty years later, British governmental experts were still meeting, discussing compensation for injury to rayon workers, and reaching the predetermined outcome that it was premature to expand case eligibility to encompass newer medical knowledge on carbon disulfide–induced risk of heart attack. Meanwhile in the United States, the Occupational Safety and Health Administration made a feeble attempt at imposing somewhat tighter exposure controls that would have brought its standards nearer to the norms of other industrialized nations, and failed even at that. Needless to say, regulatory oversight is limited in many of the places where the viscose industry thrives today, including Indonesia, China, Thailand, and India.

My journey in attempting to unravel this complex story has led me in a number of directions, many with unanticipated findings. I began simply, working backward from current biomedical and other technical texts on the nature of viscose manufacturing and the known or suspected toxic effects of carbon disulfide. Such sources have footnotes. The footnotes identify papers, monographs, and book chapters, and all these have their own citations as well.

At a certain point, the citations repeated themselves to the point that there seemed to be nothing left to mine in a particular vein of inquiry. This seeming convergence, I learned the hard way, can be deceptive. A certain citation may be referred to repeatedly because it is indeed the definitive report. But more often than not, another rich source relevant to the very same matter may have gone ignored. This phenomenon, which I have encountered many times, was brought home to me again just as I thought I had closed out every major avenue of such bibliographic investigation for this book. A colleague called my attention to a reference in a 1960s Russian textbook on neurological illness, alluding to an outbreak of disease due to carbon disulfide in a prerevolutionary Russian
viscose factory. I tracked down the original paper. It turned out to be an important early report of worker ill health and only the second one specific to the nascent rayon industry, just as the process first was coming online (the earliest outbreak was documented in a small American factory).

Valuable as biomedical and other scientific journal publications are, they can tell only part of the story. Archival and other documentary evidence provides another piece of the puzzle. And it is surprising how personal some of these old records are. Sitting in the British national archives in Kew and opening a large-format governmental ledger of industrial illness certifications for carbon disulfide poisoning, I was struck by the realization that the inked-in names and symptoms, and especially the ages, all belonged to real people. This sense of connection across time is still there even if one is holding a photocopy or a scanned image that has been sent from a remote source: a telegram, pages from a pocket diary, or photographic images, even if only a postcard showing a factory site long out of business.

At a certain point, it became clear that even these objects and images, despite their richness, were not sufficient for the full story I needed to tell. I wanted to have more direct contact in some way. In the end, this book includes information I gathered across a range of sources, including other clinicians and researchers as well as rayon workers (mostly retired) and their families. All these sources have been incredibly generous with their time, knowledge, and memories.

Especially among those who worked in viscose, a shared value I encountered time and again was not to forget. This was brought home to me most clearly through a blog hosted by the BBC North Wales on which former rayon workers could post their memories. Courtaulds’ rayon mills in Flintshire, Wales, once the largest concentration of such production in Great Britain, have long been shuttered and all their workers laid off, or “made redundant,” in British parlance. I began an e-mail correspondence with one of the bloggers, a woman named Vicky Perfect, who had worked at Courtaulds for more than ten years. At one of the works, she remembered, women could perm their hair simply by being on the job because of the high levels of sulfur fumes in the workroom atmosphere.

Viscose is so deeply imbedded in the history of the twentieth century that wherever one follows its many ramifications, they seem to lead out, cross over, and interconnect, unexpectedly linking together any number of otherwise disparate events and people. Even the word “rayon” itself carries meanings within meanings. It first denoted (in the late sixteenth century) a ray of light. As centuries passed, “rayon” also came to mean a military radius defined by fortifications and, in Eastern European areas under Russian influc-
enonce, an administrative region. Rayon, as a 1920s trade name for the textile synthetic, is presumed to be a riff on light shimmering off the fabric, but the word also was chosen for its subtle but intentional allusion to “radon,” so moderne at the time. No wonder people so often misunderstand the topic I have been working on.

The global interconnectedness of the viscose industry was borne home to me again when I finally had the opportunity to visit rayon plants still in operation. All were outside the United States. One of the smaller factories I visited is located in the Czech Republic, nestled in the Bohemian countryside north of Prague, in a town called Lovosice. It had been the site of a major eighteenth-century military engagement between Prussia and the Austrian Empire, the Battle of Lobositz. In the twentieth century, Lovosice was a quiet town with a modest industrial base, including rayon manufacturing. Along with many other state enterprises, the rayon plant in Lovosice was shut down after the Velvet Revolution of 1989, but then was resurrected with foreign investment.

Lovosice sits along the Elbe. By the time of my visit, I had already been to another viscose manufacturing site farther down river, at Wittenberge Elbe, in the former East Germany. The defunct Wittenberge facility, really a factory complex, had been the jewel in the crown of Deutsche Demokratische Republik state textile enterprises. Until its closure, the Wittenberge DDR operation had carried on the work of its immediate corporate predecessor, a Nazi-era component of the Phrix rayon conglomerate. I was particularly keen to visit Wittenberge because Phrix had used slave labor from the Neun-Gamme concentration camp. Delving into this dark corner of the viscose story, I began to come across more and more locations where similar arrangements had supplied forced labor to the rayon factories across the Reich. These victims suffered in double measure: first, from the terrible conditions general to their status, and on top of that, from the poisonous atmosphere of carbon disulfide–laden workrooms.

Lovosice lies in the Sudetenland, territory that was seized early by the Reich. I had not considered geography as I rode along a modern Czech highway for my day trip to the factory, accompanied by a fellow occupational medicine physician who had facilitated my entry to the rayon facility. We came to the exit for Lovosice. Another name was marked on the sign, too. This was also the turnoff for Terezín, where the Theresienstadt “model” concentration camp had operated: it was only eight kilometers from Lovosice. Follow-up correspondence with the archivist at the Terezín memorial confirmed that it, too, had supplied inmate laborers for rayon.

Fake Silk is most certainly about illness, about the disease and death that the viscose industry caused in its factories. And it is about technological
innovation, an engine fueled by carbon disulfide that churned out novel products for an eager consumer public. Fake Silk is also about economics. After all, this was an industry that helped coin a new term, "duopoly." Referring to a market with only two sellers, duopoly characterized the comfortable arrangement between DuPont and Courtaulds' U.S. subsidiary in divvying up the lucrative American viscose business. More than that, economic profit has always been at the heart of viscose's power, whether that was parlayed by robber barons, war profiteers, state capitalists, or, in our own time, savvy players in a globalized market.

Fake Silk tracks cultural history as well. Sometimes this path runs through high culture, including avant-garde nods from Gertrude Stein and the Italian Futurist poet F. T. Marinetti. More frequently, however, rayon and cellophane are the stuff of mass culture, mirroring the ups and downs of shifting popular tastes. Giving something of a fairy-tale air to rayon's shifting role in fashion, for example, Genevieve Antoine Dariaux notes in A Guide to Elegance (1964), "Once upon a time, you only had to hint that a material contained rayon in order for the customers to turn up their noses. But by now all women are aware of the miraculous advantages of man-made fibers, and the former standards of quality have been adjusted to them."

Yet most of all, Fake Silk is about people. Some of them are truly despicable, but many were honorable women and men, and more than a few were quite heroic. In just over a century of viscose's history, five generations have toiled in it and, before that, another three worked with carbon disulfide-tainted rubber. This may not be the full ten generations that traditionally mark the passage of time from Adam to Noah, but it is still a significant slice of the human experience. I know that I cannot do full justice to that, but I hope never to lose sight of the real people who lived the story told in these pages.