

Uncle Tungsten

Memories of a Chemical Boyhood

OLIVER SACKS



VINTAGE CANADA

UNCLE TUNGSTEN

“Good prose is often described as glowing: luminous, numinous, glimmering, shimmering, incandescent, radiant. Sacks’s writing is all that, and sometimes, no matter how closely you read it, you can’t quite figure out what makes it so precisely, unsparingly light. Apart from its stylistic wattage, *Uncle Tungsten* is about light of many sorts ... above all, about the light of the human mind, the capacity of human beings to discern pattern and organization and nature’s caprice.”

—*The New York Times Book Review*

“A bittersweet memoir ... [of] a mind and life as fascinating as any that Sacks has ever profiled.”

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“His prose wheels and swings, dips and rolls with excitement and majesty.... His tone is compassionate, his style graceful; the effect on the reader is almost mystical.”

—*Chicago Sun-Times*

Oliver Sacks

UNCLE TUNGSTEN

Oliver Sacks is the author of *Awakenings*, *The Man Who Mistook His Wife for a Hat*, and many other books, for which he has received numerous awards, including the Hawthornden Prize, Polk Award, and a Guggenheim Fellowship. He is a member of the American Academy of Arts and Letters, and lives in New York City, where he is a practicing neurologist.

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UNCLE TUNGSTEN

Memories of a Chemical Boyhood



OLIVER SACKS



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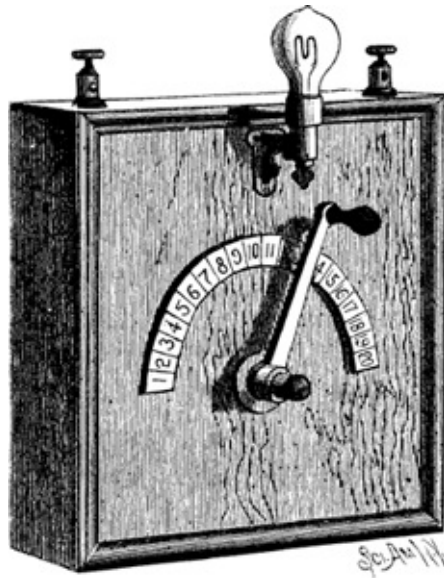
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UNCLE TUNGSTEN

Many of my childhood memories are of metals: these seemed to exert a power on me from the start. They stood out, conspicuous against the heterogeneousness of the world, by their shining, gleaming quality, their silveriness, their smoothness and weight. They seemed cool to the touch, and they rang when they were struck.

I loved the yellowness, the heaviness, of gold. My mother would take the wedding ring from her finger and let me handle it for a while, as she told me of its inviolacy, how it never tarnished. “Feel how heavy it is,” she would add. “It’s even heavier than lead.” I knew what lead was, for I had handled the heavy, soft piping the plumber had left one year. Gold was soft, too, my mother told me, so it was usually combined with another metal to make it harder.

It was the same with copper—people mixed it with tin to produce bronze. Bronze!—the very word was like a trumpet to me, for battle was the brave clash of bronze upon bronze: bronze spears on bronze shields, the great shield of Achilles. Or you could alloy copper with zinc, my mother said, to produce brass. All of us—my mother, my brothers, and I—had our own brass menorahs for Hanukkah. (My father had a silver one.)

I knew copper, the shiny rose color of the great copper cauldron in our kitchen—it was taken down only once a year, when the quinces and crab apples were ripe in the garden and my mother would stew them to make jelly.

I knew zinc: the dull, slightly bluish birdbath in the garden was made of zinc; and tin, from the heavy tinfoil in which sandwiches were wrapped for a picnic. My mother showed me that when tin or zinc was bent it uttered a special “cry.” “It’s due to deformation of the crystal structure,” she said, forgetting that I was five, and could not understand her—and yet her words fascinated me, made me want to know more.

There was an enormous cast-iron lawn roller out in the garden—it weighed five hundred pounds, my father said. We, as children, could hardly budge it, but he was immensely strong and could lift it off the ground. It was always slightly rusty, and this bothered me, for the

rust flaked off, leaving little cavities and scabs, and I was afraid the whole roller might corrode and fall apart one day, reduced to a mass of red dust and flakes. I needed to think of metals as stable, like gold—able to stave off the losses and ravages of time.

I would sometimes beg my mother to take out her engagement ring and show me the diamond in it. It flashed like nothing I had ever seen, almost as if it gave out more light than it took in. She would show me how easily it scratched glass, and then tell me to put it to my lips. It was strangely, startlingly cold; metals felt cool to the touch, but the diamond was icy. That was because it conducted heat so well, she said—better than any metal—so it drew the body heat away from one's lips when they touched it. This was a feeling I was never to forget. Another time, she showed me how if one touched a diamond to a cube of ice, it would draw heat from one's hand into the ice and cut straight through it as if it were butter. My mother told me that diamond was a special form of carbon, like the coal we used in every room in winter. I was puzzled by this—how could black, flaky, opaque coal be the same as the hard, transparent gemstone in her ring?

I loved light, especially the lighting of the shabbas candles on Friday nights, when my mother would murmur a prayer as she lit them. I was not allowed to touch them once they were lit—they were sacred, I was told, their flames were holy, not to be fiddled with. I was mesmerized by the little cone of blue flame at the candle's center—why was it blue? Our house had coal fires, and I would often gaze into the heart of a fire, watching it go from a dim red glow to orange, to yellow, and then I would blow on it with the bellows until it glowed almost white-hot. If it got hot enough, I wondered, would it blaze blue, be blue-hot?

Did the sun and stars burn in the same way? Why did they never go out? What were they made of? I was reassured when I learned that the core of the earth consisted of a great ball of iron—this sounded solid, something one could depend on. And I was pleased when I was told that we ourselves were made of the very same elements as composed the sun and stars, that some of my atoms might once have been in a distant star. But it frightened me too, made me feel that my atoms were only on loan and might fly apart at any time, fly away like the fine talcum powder I saw in the bathroom.

I badgered my parents constantly with questions. Where did color come from? Why did my mother use the platinum loop that hung above the stove to cause the gas burner to catch fire? What happened to the sugar when one stirred it into the tea? Where did it go? Why did water bubble when it boiled? (I liked to watch water set to boil on the stove, to see it quivering with heat before it burst into bubbles.)

My mother showed me other wonders. She had a necklace of polished yellow pieces of amber, and she showed me how, when she rubbed them, tiny pieces of paper would fly up and stick to them. Or she would put the electrified amber against my ear, and I would hear and feel a tiny snap, a spark.

My two older brothers Marcus and David, nine and ten years older than I, were fond of magnets and enjoyed demonstrating these to me, drawing the magnet beneath a piece of paper on which were strewn powdery iron filings. I never tired of the remarkable pattern that rayed out from the poles of the magnet. "Those are lines of force," Marcus explained to me—but I was none the wiser.

Then there was the crystal radio my brother Michael gave me, which I played with in be

jiggling the wire on the crystal until I got a station loud and clear. And the luminous clocks—the house was full of them, because my uncle Abe had been a pioneer in the development of luminous paints. These, too, like my crystal radio, I would take under the bedclothes at night into my private, secret vault, and they would light up my cavern of sheets with an eerie greenish light.

All these things—the rubbed amber, the magnets, the crystal radio, the clock dials with their tireless coruscations—gave me a sense of invisible rays and forces, a sense that beneath the familiar, visible world of colors and appearances there lay a dark, hidden world with mysterious laws and phenomena.

Whenever we had “a fuse,” my father would climb up to the porcelain fusebox high on the kitchen wall, identify the fused fuse, now reduced to a melted blob, and replace it with a new fuse of an odd, soft wire. It was difficult to imagine that a metal could melt—could a fuse really be made from the same material as a lawn roller or a tin can?

The fuses were made of a special alloy, my father told me, a combination of tin and lead and other metals. All of these had relatively low melting points, but the melting point of the alloy was lower still. How could this be so, I wondered? What was the secret of this new metal’s strangely low melting point?

For that matter, what was electricity, and how did it flow? Was it a sort of fluid like heat which could also be conducted? Why did it flow through the metal but not the porcelain? This, too, called for explanation.

My questions were endless, and touched on everything, though they tended to circle around, again and again, to my obsession, the metals. Why were they shiny? Why smooth? Why cool? Why hard? Why heavy? Why did they bend, not break? Why did they ring? Why could two soft metals like zinc and copper, or tin and copper, combine to produce a harder metal? What gave gold its goldness, and why did it never tarnish? My mother was patient for the most part, and tried to explain, but eventually, when I exhausted her patience, she would say, “That’s all I can tell you—you’ll have to quiz Uncle Dave to learn more.”

We had called him Uncle Tungsten for as long as I could remember, because he manufactured lightbulbs with filaments of fine tungsten wire. His firm was called Tungstalite and I often visited him in the old factory in Farringdon and watched him at work, in a wire collar, with his shirtsleeves rolled up. The heavy, dark tungsten powder would be pressed, hammered, sintered at red heat, then drawn into finer and finer wire for the filament. Uncle’s hands were seamed with the black powder, beyond the power of any washing to get out (he would have to have the whole thickness of epidermis removed, and even this, once suspected, would not have been enough). After thirty years of working with tungsten, I imagined, the heavy element was in his lungs and bones, in every vessel and viscus, even the tissue of his body. I thought of this as a wonder, not a curse—his body invigorated and fortified by the mighty element, given a strength and enduringness almost more than human.

Whenever I visited the factory, he would take me around the machines, or have his foreman do so. (The foreman was a short, muscular man, a Popeye with enormous forearms—a palpable testament to the benefits of working with tungsten.) I never tired of the ingenious machines, always beautifully clean and sleek and oiled, or the furnace where the black powder was compacted from a powdery incoherence into dense, hard bars with a grey sheen.

During my visits to the factory, and sometimes at home, Uncle Dave would teach me about metals with little experiments. I knew that mercury, that strange liquid metal, was incredibly heavy and dense. Even lead floated on it, as my uncle showed me by floating a lead bullet in a bowl of quicksilver. But then he pulled out a small grey bar from his pocket, and to my amazement, this sank immediately to the bottom. That, he said, was *his* metal, tungsten.

Uncle loved the density of the tungsten he made, and its refractoriness, its great chemical stability. He loved to handle it—the wire, the powder, but the massy little bars and ingots most of all. He caressed them, balanced them (tenderly, it seemed to me) in his hands. “Feel it, Oliver,” he would say, thrusting a bar at me. “Nothing in the world feels like sintered tungsten.” He would tap the little bars and they would emit a deep clink. “The sound of tungsten,” Uncle Dave would say, “nothing like it.” I did not know whether this was true, but I never questioned it.

As the youngest of almost the youngest (I was the last of four, and my mother the sixteen of eighteen), I was born almost a hundred years after my maternal grandfather and never knew him. He was born Mordechai Fredkin, in 1837, in a small village in Russia. As a young man he managed to avoid being impressed into the Cossack army and fled Russia using the passport of a dead man named Landau; he was just sixteen. As Marcus Landau, he made his way to Paris and then Frankfurt, where he married (his wife was sixteen too). Two years later, in 1855, now with the first of their children, they moved to England.

My mother’s father was, by all accounts, a man drawn equally to the spiritual and the physical. He was by profession a boot and shoe manufacturer, a *shochet* (a kosher slaughterer), and later a grocer—but he was also a Hebrew scholar, a mystic, an amateur mathematician, and an inventor. He had a wide-ranging mind: he published a newspaper, the *Jewish Standard*, in his basement, from 1888 to 1891; he was interested in the new science of aeronautics and corresponded with the Wright brothers, who paid him a visit when they came to London in the early 1900s (some of my uncles could still remember this). He had a passion, my aunts and uncles told me, for intricate arithmetical calculations, which he would do in his head while lying in the bath. But he was drawn above all to the invention of lamps—safety lamps for mines, carriage lamps, streetlamps—and he patented many of these in the 1870s.

A polymath and autodidact himself, Grandfather was passionately keen on education—and most especially, a scientific education—for all his children, for his nine daughters no less than his nine sons. Whether it was this or the sharing of his own passionate enthusiasms, seven of his sons were eventually drawn to mathematics and the physical sciences, as he was. His daughters, by contrast, were by and large drawn to the human sciences—to biology, to medicine, to education and sociology. Two of them founded schools. Two others were teachers. My mother was at first torn between the physical and the human sciences: she was particularly attracted to chemistry as a girl (her older brother Mick had just begun a career as a chemist), but later became an anatomist and surgeon. She never lost her love of, her feeling for, the physical sciences, nor the desire to go beneath the surfaces of things, to explain. Though the thousand and one questions I asked as a child were seldom met by impatient or peremptory answers, but careful ones which enthralled me (though they were often above my head). I was encouraged from the start to interrogate, to investigate.

Given all my aunts and uncles (and a couple more on my father's side), my cousins numbered almost a hundred; and since the family, for the most part, was centered in London (though there were far-flung American, Continental, and South African branches), we would all meet frequently, tribally, on family occasions. This sense of extended family was one I knew and enjoyed as far back as memory goes, and it went with a sense that it was our business, the family business, to ask questions, to be "scientific," just as we were Jewish and English. I was among the youngest of the cousins—I had cousins in South Africa who were forty-five years my senior—and some of these cousins were already practicing scientists or mathematicians; others, only a little older than myself, were already in love with science. One cousin was a young physics teacher; three were reading chemistry at university; and one, a precocious fifteen-year-old, was showing great mathematical promise. All of us, I could not help imagining, had a bit of the old man in us.



(illustration credit [2.1](#))

“37”

I grew up just before the Second World War in a huge, rambling Edwardian house in northwest London. Being a corner house, at the junction of Mapesbury and Exeter Road, number 37 Mapesbury Road faced onto both, and was larger than its neighbors. The house was basically square, almost cubical, but with a front porch that jutted out, V-shaped at the top, like the entry to a church. There were bow windows that also protruded on each side, with recesses in between, and thus the roof had a most complex shape, resembling, in my eyes, nothing so much as a giant crystal. The house was built of red brick of a peculiar soft, dusky color. I imagined this, after I learned some geology, as being old red sandstone from the Devonian age, a thought encouraged by the fact that all the roads around us—Exeter, Teignmouth, Dartmouth, Dawlish—themselves had Devonian names.

There were double front doors, with a little vestibule between them, and these led onto a hall, and thence to a passage that led back toward the kitchen; the hall and the passage had a floor of tessellated colored stones. To the right of the hall, as one entered, the staircase curved upward, its heavy bannister polished smooth by my brothers sliding down it.

Certain rooms in the house had a magical or sacred quality, perhaps my parents' surgery (both of them were physicians) above all, with its bottles of medicine, its balance for weighing out powders, the racks of test tubes and beakers, the spirit lamp, and the examining table. There were all sorts of medicines, lotions, and elixirs in a large cabinet—it looked like an old-fashioned chemist's shop in miniature—there was a microscope, and bottles of reagents for testing patients' urine, like the bright blue Fehling's solution, which turned yellow when there was sugar in the urine.

It was from this special room, where patients were admitted, but not (unless the door was left unlocked) my childish self, that I sometimes saw a glow of violet light coming out under the door and smelled a strange, seaside smell, which I later learned was ozone—this was the old ultraviolet lamp at work. I was not too sure, as a child, what doctors “did,” and glimpses of catheters and bougies in their kidney dishes, retractors and speculums, rubber gloves, catgut thread and forceps—all this, I think, rather frightened me, though it fascinated me too. Once, when the door was left accidentally open, I saw a patient with her legs up in stirrups (in what I later learned was the “lithotomy position”). My mother's obstetric bag and an anesthetic bag were always ready to be grabbed in an emergency, and I knew when they would be needed, for I would hear comments like, “She's half-a-crown dilated”—commen-

which by their unintelligibility and mysteriousness (were they a sort of code?) stimulated my imagination in all sorts of ways.

Another sacred room was the library, which, in the evenings at least, was especially my father's domain. One section of the library wall was covered with his Hebrew books, but there were books on every subject—my mother's books (she was fond of novels and biographies), my brothers' books, and books inherited from grandparents. One bookcase was entirely devoted to plays—my parents, who had met as fellow enthusiasts in a medical students' Ibsen society, still went to the theater every Thursday.

The library was not only for reading; on weekends, the books that were out on the reading table would be put to one side to make room for games of various sorts. While my three older brothers might be playing an intense game of cards or chess, I would play a simple game, Ludo, with Auntie Birdie, my mother's older sister, who lived with us—in my early years, she was more a play companion than my brothers were. Extreme passions developed over Monopoly, and even before I learned to play it, the prices and colors of the properties became engraved on my mind. (To this day I see the Old Kent Road and Whitechapel as cheap, mauve properties, the pale blue Angel and Euston Road next to them as scarcely any better. By contrast, the West End is clothed for me in rich, costly colors: Fleet Street scarlet, Piccadilly yellow, the green of Bond Street, and the dark, Bentley-colored blue of Park Lane and Mayfair.) Sometimes we would all join in a game of Ping-Pong, or some woodworking using the big library table. But after a weekend of frivolities, the games would be returned to the huge drawer under one of the bookcases, and the room restored to its quiet for my father's evening reading.

There was another drawer on the other side of the bookcase, a fake drawer which, for some reason, did not open, and I frequently had a fixed dream about this drawer. Like any child, I loved coins—their glitter, their weights, their different shapes and sizes—from the bright copper farthings and halfpennies and pennies to the varied silver coins (especially the tiny silver threepenny bits—one was always concealed in the suet pudding at Christmas) and the heavy gold sovereign my father wore on his watch chain. And I had read in my children's encyclopedia about doubloons and rubles, coins with holes in them, and “pieces of eight” which I imagined to be perfect octagons. In my dream the false drawer would open to me displaying a glittering treasure of copper and silver and gold mixed together, coins of a hundred countries and ages, including, to my delight, octagonal pieces of eight.

I especially liked crawling into the triangular cupboard under the stairs, where the special plates and cutlery for Passover were kept. The cupboard itself was shallower than the stairs and it seemed to me that its back wall, when tapped, sounded hollow; it must have concealed, I felt, a further space behind it, a secret passageway, perhaps. I felt snug in here in my secret hideaway—no one besides me was small enough to fit in.

Most beautiful and mysterious in my eyes was the front door, with its stained glass panels of many shapes and colors. I would place my eye behind the crimson glass and see a whole world red-stained (but with the red roofs of the houses opposite strangely pale, and clouds startlingly distinct against a blue sky now almost black). It was a completely different experience with the green glass, and the deep violet blue. Most intriguing was the yellowish-green glass, for this seemed to shimmer, sometimes yellow and sometimes green, depending on where I stood and how the sun hit it.

A forbidden area was the attic, which was gigantic, since it covered the entire area of the house, and stretched up to the peaked, crystalline eaves of the roof. I was once taken up to see the attic, and then dreamed of it repeatedly, perhaps because it was forbidden after Marcus climbed up once by himself and fell through the skylight, gashing his thigh (though once, in a storytelling mood, he told me that the scar had been inflicted by a wild boar, like the scar on Odysseus' thigh).

We had meals in the breakfast room next to the kitchen; the dining room, with its long table, was reserved for shabbas meals, festivals, and special occasions. There was a similar distinction between the lounge and the drawing room—the lounge, with its sofa and dilapidated, comfy chairs, was for general use; the drawing room, with its elegant but uncomfortable Chinese chairs and lacquered cabinets, was for large family gatherings. Aunt and uncles, and cousins in the neighborhood would walk over on Saturday afternoons, and a special silver tea service would be pulled out and small crustless sandwiches of smoked salmon and cod's roe served in the drawing room—such dainties were not served at any other time. The chandeliers in the drawing room, originally gasoliers, had been converted to electric light sometime in the 1920s (but there were still odd gas jets and fittings all over the house so that, in a pinch, we could go back to gas lighting). The drawing room also contained a huge grand piano, covered with family photos, but I preferred the soft tones of the upright piano in the lounge.

Though the house was full of music and books, it was virtually empty of paintings, engravings, or artwork of any sort; and similarly, while my parents went to theaters and concerts frequently, they never, as far as I can remember, visited an art gallery. Our synagogue had stained glass windows depicting biblical scenes, which I often gazed at in the more excruciating parts of the service. There had been, apparently, a dispute over whether such pictures were appropriate, given the interdiction of graven images, and I wondered whether this was a reason we had no art in the house. But it was rather, I soon realized, that my parents were completely indifferent to the decor of the house or its furnishings. Indeed, I later learned that when they had bought the place, in 1930, they had given my father's old sister Lina their checkbook, carte blanche, saying, "Do what you want, get what you want."

Lina's choices—fairly conventional, except for the chinoiserie in the drawing room—were neither approved nor contested; my parents accepted them without really noticing or caring. My friend Jonathan Miller, visiting the house for the first time—this was soon after the war—said it seemed like a rented house to him, there was so little evidence of personal taste or decision. I was as indifferent as my parents to the decor of the house, though I was angered and bewildered by Jonathan's comment. For, to me, 37 was full of mysteries and wonders—the stage, the mythic background, on which my life was lived.

There were coal fires in almost every room, including a porcelain coal stove, flanked by fish tiles, in the bathroom. The fire in the lounge had large copper coal scuttles to either side, bellows, and fire irons, including a slightly bent poker of steel (my eldest brother, Marcus, who was very strong, had managed to bend it, when it was almost white-hot). If an aunt or two visited, we would all gather in the lounge, and they would hitch up their skirts and stand with their backs to the fire. All of them, like my mother, were heavy smokers, and after warming themselves by the fire, they would sit on the sofa and smoke, lobbing their wet fa-

ends into the fire. They were, by and large, terrible shots, and the damp butts would hit the brick wall surrounding the fireplace and adhere there, disgustingly, until they finally burned away.

I have only fragmentary, brief memories of my youngest years, the years before the war, but I remember being frightened, as a child, by observing that many of my aunts and uncles had coal black tongues—would my own, I wondered, turn black when I grew up? I was greatly relieved when Auntie Len, divining my fears, told me that her tongue was not really black, that its blackness came from chewing charcoal biscuits, and that they all ate them because they had gas.

Of my Auntie Dora (who died when I was very young), I remember nothing except for the color orange—whether this was the color of her complexion or hair, or of her clothes, or whether it was the reflected color of the firelight, I have no idea. All that remains is a warm, nostalgic feeling and a peculiar fondness for orange.

My bedroom, since I was the youngest, was a tiny room connected with my parents' bedroom, and I remember that its ceiling was festooned with strange, calcareous concretions. Michael had had this room before I was born, and had been fond of flicking gelatinous spoonfuls of sago—the sliminess of which he disliked—onto the ceiling, where it would adhere with a wet smack. As the sago dried, nothing but a chalky mound would remain.

There were several rooms which belonged to nobody and had no clear function; these were used to house extras of all kinds—books, games, toys, magazines, waterproofs, sports equipment. In one small room there was nothing but a Singer sewing machine with a treadle (which my mother had bought on her marriage, in 1922) and a knitting machine of a very intricate (and, to my mind, beautiful) design. My mother used it to make our socks, and I loved to watch her turning the handle, to watch the glittering steel knitting needles clacking in unison and the cylinder of wool, weighted with a lead bob, descending steadily. On one occasion I distracted her as she was making a sock, and the cylinder of wool got longer and longer, until finally it hit the floor. Not knowing what to do with this yard-long cylinder of wool, she gave it to me to keep as a muff.

These extra rooms enabled my parents to accommodate relatives like Auntie Birdie and others, sometimes for long periods. The largest of them was reserved for the formidable Auntie Annie, on her rare visits from Jerusalem (thirty years after her death, this was still referred to as “Annie’s room”). When Auntie Len came to visit from Delamere, she, too, had her own room, and here she would establish herself, with her books and her tea things—there was a gas ring in the room, and she would make her own tea—and when she invited me in, I felt I was entering a different world, a world of other interests and tastes, of civility, and unconditional love.

When my uncle Joe, who had been a doctor in Malaya, became a Japanese prisoner of war, his older son and daughter stayed with us. And my parents would sometimes take in refugees from Europe during the war years. So the house, though large, was never empty; it seemed, on the contrary, to house dozens of separate lives, not just the immediate family—my parents and my three brothers and myself—but itinerant uncles and aunts, the resident staff—our nanny and nurse, the cook—and the patients themselves, who would come and go.

EVACUATION
OF
WOMEN AND CHILDREN
FROM LONDON, Etc.

FRIDAY, 1st SEPTEMBER.
Up and Down business trains as usual
with few exceptions.
Main Line and Suburban services will be
curtailed while evacuation is in progress
during the day.

SATURDAY & SUNDAY.
SEPTEMBER 2nd & 3rd.
The train service will be exactly the
same as on Friday.

Remember that there will be very few
Down Mid-day business trains on Saturday.

SOUTHERN RAILWAY

EXILE

In early September 1939, war broke out. It was expected that London would be heavily bombed, and parents were put under great pressure by the government to evacuate their children to safety in the countryside. Michael, five years older than I, had been going to day school near our house, and when it was closed at the outbreak of the war one of the assistant masters there decided to reconstitute the school in the little village of Braefield. My parents (I was to realize many years later) were greatly worried about the consequences of separating a little boy—I was just six—from his family and sending him to a makeshift boarding school in the Midlands, but they felt they had no choice, and took some comfort that at least Michael and I would be together.

This, perhaps, might have worked out well—evacuation did work out reasonably well for thousands of others. But the school, as reconstituted, was a travesty of the original. Food was rationed and scarce, and our food parcels from home were looted by the matron. Our basic diet was swedes and mangel-wurzels—giant turnips and huge, coarse beetroots grown for cattle. There was a steam pudding whose revolting, suffocating smell comes back to me (as I write almost sixty years later) and sets me retching and gagging once again. The horribleness of the school was made worse for most of us by the sense that we had been abandoned by our families, left to rot in this awful place as an inexplicable punishment for something we had done.

The headmaster seemed to have become unhinged by his own power. He had been decent enough, even well liked, as a teacher in London, Michael said, but at Braefield, where he took over, he had quickly become a monster. He was vicious and sadistic, and beat many of us, with relish, almost daily. “Wilfulness” was severely punished. I sometimes wondered if I was his “darling,” the one selected for a maximum of punishment, but in fact many of

were so beaten we could hardly sit down for days on end. Once, when he had broken a cane on my eight-year-old bottom, he roared, "Damn you, Sacks! Look what you have made me do!" and added the cost of the cane to my bill. Bullying and cruelty, meanwhile, were rife among the boys, and great ingenuity was exercised in finding out the weak points of the smaller children and tormenting them beyond bearable limits.

But along with the horror there were sudden delights, made sharper by their rarity and contrast with the rest of life. My first winter there—the winter of 1939–40—was an exceptionally cold one, with drifting snow, higher than my head, and long glittering icicles hanging from the eaves of the church. These snowy scenes, and sometimes fantastic snow and ice forms, conveyed me in imagination to Lapland or Fairyland. To get out of the school into the surrounding fields was always a pleasure, and the freshness and whiteness and cleanliness of the snow allowed a wonderful, though brief, release from the shut-in-ness, the misery, the smell of the school. Once I somehow contrived to separate myself from the other boys and our teacher and got briefly, ecstatically, "lost" among the snowdrifts—a feeling that soon turned to terror when it became clear that I really was lost, and no longer just playing. I was very happy to be found, finally, and hugged and given a mug of hot chocolate when I got back to school.

It was during the same winter that I remember finding the windowpanes of the rector's doors covered with hoarfrost, and being fascinated by the needles and crystalline forms of this, and how I could melt some of the frost with my breath and make a little peephole. One of my teachers—her name was Barbara Lines—saw my absorption and showed me the snow crystals under a pocket lens. No two were ever quite the same, she told me, and the sense of how much variation was possible within a basic hexagonal format was a revelation to me.

There was a particular tree in a field that I loved; its silhouette against the sky affected me in a strange way. I still see it, and the winding path through the fields that led to it, when my mind drifts back. The sense that nature, at least, existed outside the dominion of school was deeply reassuring.

And the vicarage, with its spacious garden, where the school was housed, the old church next door to it, and the village itself were charming, even idyllic. The villagers were kind to these obviously uprooted and unhappy young boys from London. It was here in the village that I learned to ride horses, with a strapping young woman; she sometimes hugged me when I looked miserable. (Michael had read me parts of *Gulliver's Travels*, and I sometimes thought of her as Glumdalclitch, Gulliver's giant nurse.) There was an old lady to whom I went for piano lessons, and she would make tea for me. And there was the village shop, where I would go to buy a gob-stopper and occasionally a slice of corned beef. There were even times at school which I enjoyed: making model planes of balsa wood, and a tree house with a friend, a little red-haired boy of my own age. But, overwhelmingly, I felt trapped at Braefield, without hope, without recourse, forever—and many of us, I suspect, were severely disturbed by being there.

During the four years I was at Braefield, my parents visited us at the school, but very rarely, and I have almost no memory of these visits. When, in December 1940, after nearly a year away from home, Michael and I returned to London for the Christmas holidays, I had a complex mixture of feelings: relief, anger, pleasure, apprehension. The house felt strange and

different, too: our housekeeper and cook had gone, and there were strangers there, a Flemish couple who had been among the last to make their escape from Dunkirk—my parents had offered to take them in, now that the house was nearly empty, until they found a place. One of them was Greta, our dachshund, seemed the same, and she greeted me with yelps of welcome, rolling on her back, wriggling with joy.

There were physical changes too: the windows were all hung with heavy blackout curtains; the inner front door, with the colored glass I had loved to look through, had been blown out by a bomb blast a couple of weeks earlier; the garden, now planted with Jerusalem artichokes for the war effort, was changed almost beyond recognition; and the old garden shed had been replaced by an Anderson shelter, an ugly, blocky building with a thick reinforced-concrete roof.

Although the Battle of Britain was over, the Blitz was still at its height. There were air raids almost every night, and the night sky would be lit up with ack-ack fire and searchlights. I remember seeing German airplanes transfixed in the roving searchlight beams as they flew over the now-darkened skies over London. It was frightening, and also thrilling for a seven-year-old—but most of all, I think, I felt glad to be away from school and at home, protected, once again.

One night, a thousand-pound bomb fell into the garden next to ours, but fortunately failed to explode. All of us, the entire street, it seemed, crept away that night (my family to my cousin's flat)—many of us in our pajamas—walking as softly as we could (might vibration start the thing off?). The streets were pitch dark, for the blackout was in force, and we all carried electric torches dimmed with red crêpe paper. We had no idea if our houses would still be standing in the morning.

On another occasion, an incendiary bomb, a thermite bomb, fell behind our house and burned with a terrible, white-hot heat. My father had a stirrup pump, and my brother carried pails of water to him, but water seemed useless against this infernal fire—indeed, it made it burn even more furiously. There was a vicious hissing and sputtering when the water hit the white-hot metal, and meanwhile the bomb was melting its own casing and throwing blobs and jets of molten metal in all directions. The lawn was as scarred and charred as a volcanic landscape the next morning, but littered, to my delight, with beautiful gleaming shrapnel that I could show off at school after the holidays.

A curious, and shameful, episode stays in my mind from that brief period at home during the Blitz. I was very fond of Greta, our dog (I wept bitterly when she was later killed by a speeding motorbike, in 1945), but one of my first acts, that winter, was to imprison her in the freezing coalbin in the yard outside, where her pitiful whimperings and barkings could not be heard. She was missed after a while, and I was asked, we were all asked, when we had last seen her, whether we had any idea where she was. I thought of her—hungry, cold, imprisoned, perhaps dying in the coalbin outside—but said nothing. It was only toward evening that I admitted what I had done, and Greta was fetched, almost frozen, from the bin. My father was furious and gave me “a good hiding” and stood me in a corner for the rest of the day. There was no enquiry, however, as to why I had been so uncharacteristically naughty, why I had behaved so cruelly to a dog I had loved; nor, had I been asked, could I have told them. But it was surely a message, a symbolic act of some kind, trying to draw me

parents' attention to *my* coalbin, Braefield, my misery and helplessness there. Even though bombs were dropping daily in London, I dreaded returning to Braefield more than I could say, and longed to stay at home with the family, to be with them, not separated, even if we all got bombed.

I had had some religious feeling, of a childish sort, in the years before the war. When my mother lit the shabbas candles, I would feel, almost physically, the Sabbath coming in, being welcomed, descending like a soft mantle over the earth. I imagined, too, that this occurred all over the universe, the Sabbath descending on far-off star systems and galaxies, enfolding them all in the peace of God.

Prayer had been a part of life. First the Sh'mah, "Hear, O Israel ...," then the bedtime prayer I would say every night. My mother would wait until I had cleaned my teeth and put on my pajamas, and then she would come upstairs and sit on my bed while I recited in Hebrew, "*Baruch atoh adonai ... Blessed art thou, O Lord our God, King of the Universe, who makest the bands of sleep to fall upon mine eyes, and slumber upon mine eyelids....*" It was beautiful in English, more beautiful still in Hebrew. (Hebrew, I was told, was God's actual language, though, of course, He understood every language, and even one's feelings, where one could not put them into words.) "May it be thy will, O Lord our God and God of my fathers, to suffer me to lie down in peace, and to let me rise up again...." But by this point the bands of sleep (whatever they were) would be pressing heavily upon my eyes, and I rarely got any further. My mother would bend over and kiss me, and I would instantly fall asleep.

Back at Braefield there was no kiss, and I gave up my bedtime prayer, for it was inseparably associated with my mother's kiss, and now it was an intolerable reminder of her absence. The very phrases that had so warmed and comforted me, conveying God's concern and power, were now so much verbiage, if not gross deceit.

For when I was suddenly abandoned by my parents (as I saw it), my trust in them, my love for them, was rudely shaken, and with this my belief in God, too. What evidence was there, I kept asking myself, for God's existence? At Braefield, I determined on an experiment to resolve the matter decisively: I planted two rows of radishes side by side in the vegetable garden, and asked God to bless one or curse one, whichever He wished, so that I might see a clear difference between them. The two rows of radishes came up identical, and this was proof for me that no God existed. But I longed now even more for something to believe in.

As the beatings, the starvings, the tormentings continued, those of us who remained in school were driven to more and more extreme psychological measures—dehumanizing, derealizing, our chief tormentor. Sometimes, while being beaten, I would see him reduced to a gesticulating skeleton (at home I had seen radiographs, bones in a tenuous envelope of flesh). At other times, I would see him as not a being at all, but a temporary vertical collection of atoms. I would say to myself, "He's only atoms"—and, more and more, I craved a world that was "only atoms." The violence exuded by the headmaster at times seemed to contaminate the whole of living nature, so that I saw violence as the very principle of life.

What could I do, in these circumstances, other than seek a private place, a refuge where I might be alone, absorb myself without interference from others, and find some sense of stability and warmth? My situation was perhaps similar to that which Freeman Dyson describes in his autobiographical essay "To Teach or Not to Teach."

I belonged to a small minority of boys who were lacking in physical strength and athletic prowess ... and squeezed between the twin oppressions of [a vicious headmaster and bullying boys].... We found our refuge in a territory that was equally inaccessible to our Latin-obsessed headmaster and our football-obsessed schoolmates. We found our refuge in science.... We learned ... that science is a territory of freedom and friendship in the midst of tyranny and hatred.

For me, the refuge at first was in numbers. My father was a whiz at mental arithmetic, and I, too, even at the age of six, was quick with figures—and, more, in love with them. I liked numbers because they were solid, invariant; they stood unmoved in a chaotic world. They were in numbers and their relation something absolute, certain, not to be questioned, beyond doubt. (Years later, when I read *1984*, the climactic horror for me, the ultimate sign of Winston's disintegration and surrender, was his being forced, under torture, to deny that two and two is four. Even more terrible was the fact that eventually he began to doubt this in his own mind, that finally numbers failed him, too.)

I particularly loved prime numbers, the fact that they were indivisible, could not be broken down, were inalienably themselves. (I had no such confidence in myself, for I felt I was being divided, alienated, broken down, more every week.) Primes were the building blocks of all other numbers, and there must be, I felt, some meaning to them. Why did primes come where they did? Was there any pattern, any logic to their distribution? Was there any limit to them or did they go on forever? I spent innumerable hours factoring, searching for primes, memorizing them. They afforded me many hours of absorbed, solitary play, in which I needed no one else.

I made a grid, ten by ten, of the first hundred numbers, with the primes blacked in, but I could see no pattern, no logic to their distribution. I made larger tables, increased my grids to twenty squared, thirty squared, but still could discern no obvious pattern. And yet I was convinced that there must be one.

The only real holidays I had during the war were visits to Auntie Len in Cheshire, in the midst of Delamere Forest, where she had founded the Jewish Fresh Air School for "delicate children" (these were children from working-class families in Manchester—many had asthma, some had had rickets or tuberculosis, and one or two, I suspect, looking back, were autistic). All the children here had little gardens of their own, squares of earth a couple of yards wide, bordered by stones. I wished desperately that I could go to Delamere rather than Braefield—but this was a wish I never expressed (though I wondered if my clearsighted and loving aunt did not divine it).

Auntie Len always delighted me by showing me all sorts of botanical and mathematical pleasures. She showed me the spiral patterns on the faces of sunflowers in the garden, and suggested I count the florets in these. As I did so, she pointed out that they were arranged according to a series—1, 1, 2, 3, 5, 8, 13, 21, etc.—each number being the sum of the two that preceded it. And if one divided each number by the number that followed it ($1/2$, $2/3$, $3/5$, $5/8$, etc.), one approached the number 0.618. This series, she said, was called the Fibonacci series, after an Italian mathematician who had lived centuries before. The ratio 0.618, she added, was known as the divine proportion or the golden section, an ideal geometrical proportion often used by architects and artists.

She would take me for long, botanizing walks in the forest, where she had me look at fallen pinecones, to see that they, too, had spirals based on the golden section. She showed

me horsetails growing near a stream, had me feel their stiff, jointed stems, and suggested that I measure these and plot the lengths of the successive segments as a graph. When I did so and saw that the curve flattened out, she explained that the increments were “exponential” and that this was the way growth usually occurred. These ratios, these geometric proportions, she told me, were to be found all over nature—numbers were the way the world was put together.

The association of plants, of gardens, with numbers assumed a curiously intense, symbolic form for me. I started to think in terms of a kingdom or realm of numbers, with its own geography, languages, and laws; but, even more, of a garden of numbers, a magical, secret, wonderful garden. It was a garden hidden from, inaccessible to, the bullies and the headmaster; and a garden, too, where I somehow felt welcomed and befriended. Among my friends in this garden were not only primes and Fibonacci sunflowers, but perfect numbers (such as 6 or 28, the sum of their factors, excluding themselves); Pythagorean numbers whose square was the sum of two other squares (such as 3, 4, 5 or 5, 12, 13); and “amicable numbers” (such as 220 and 284), pairs of numbers in which the factors of each added up to the other. And my aunt had shown me that my garden of numbers was doubly magical—not just delightful and friendly, always there, but part of the plan on which the whole universe was built. Numbers, my aunt said, are the way God thinks.

Of all the objects at home, the one I missed most was my mother’s clock, a beautiful old grandfather clock with a golden face showing not only the time and date, but phases of the moon and conjunctions of the planets. When I was very young, I had thought of this clock as a sort of astronomical instrument, transmitting information straight from the cosmos. Once a week my mother would open the cabinet and wind the clock, and I would watch the heavy counterweight ascending and touch (if she let me) the long metal chimes for the hours and the quarters.

I missed its chimes painfully in my four years at Braefield and sometimes dreamed of them at night and imagined myself at home, only to wake and find myself in a narrow, lumpy bed, wet, as often as not, with my own incontinence. Many of us regressed at Braefield, and we were beaten savagely when we wet or soiled our beds.

In the spring of 1943, Braefield was closed. Almost everyone had complained to their parents about the conditions at the school, and most of them had been taken away. I never complained (nor did Michael, but he had moved to Clifton College, as a thirteen-year-old, in 1941), and finally I found myself almost the only one left. I never knew what happened exactly—the headmaster disappeared, with his odious wife and child—I was simply told, at the end of the holidays, that I would not be returning to Braefield, but going to a new school instead.

St. Lawrence College (so it seemed to me) had large and venerable grounds, ancient buildings, ancient trees—it was all very fine, doubtless, but it terrified me. Braefield, for all its horrors, was at least familiar—I knew the school, I knew the village, I had a friend or two—whereas everything at St. Lawrence was strange to me, unknown.

I have curiously little memory of the term I spent there—it seems to have been so deeply repressed or forgotten that when I mentioned it recently to someone who knew me well, and

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