Chapter Three

Most Electrified City

The setting was Delmonico's, one of the best restaurants in town. The occasion was a testimonial banquet. Several big ironies hung in the air. First, the man being honored was not at the threshold of retirement. He was hardly in the 30s and was at the early stages of his career. A second irony: although this was New York City, birthplace of the Pearl Street powerhouse and effectively the headquarters for world electricity, the young man was about to move away. And he would take the grid with him.

Few would have recognized this event as a passing of the guard. Although he had decades yet to live, Thomas Edison had largely shifted his interest from centralized electricity to the problem of extracting iron from ore. Later he would turn to developing and marketing an early form of cinema. Meanwhile, George Westinghouse, having bested his great rival in the battle of the currents, was getting more interested in developing electric locomotives. As for Nikola Tesla, he would spend more and more of his creative time exploring the possibility of transmitting power not along wires but through the air.

What these three men had done was instrumental: Edison had invented the grid, invented the *system* of wire, socket, plug-in bulbs, feeder cables, and the dynamos to power it all. Actually what had powered everything was Edison's own personality. He had maneuvered among politicians, bankers, and engineers to create the massive, flexible organism we now call the power network. Westinghouse then reinvented the grid by resorting to pulsing alternating currents and transformers, those hulking machines that jack voltages up and down. Tesla then rewired everything all over again with his multi-phase circuits and his motors that harbored internal blizzards of magnetic force. And the new man? What did he do? Well, what he did will fill up the bulk of this chapter.

Parting Shot

This book is short but the grid is long. Blithely bypassing the dozens of other names who in a longer account would have merited a place in the history of the grid, this narrative has so far concentrated on three founding fathers: Edison, Westinghouse, and Tesla. To this short list there now comes a fourth. He was an inventor like the others, but he probably did more to establish electricity as an industry and as a way of life in home and office, factory and city street, in settings both rural and urban, than any other person. Actually, he's already come on stage. He played a significant part in the saga of volts but you wouldn't have noticed. He was there when the first current sprang forth from Pearl Street. Although only 23 years old at the time, he was indispensable to Edison and Edison's plans. Now he had plans of his own.

Not well known at the time by press or public, Samuel Insull made all the parts of the Edison machine work in synchrony. Having arrived in New York from Britain only the year before Pearl Street, he was hired to be Edison's personal secretary, but his work quickly expanded to include organizing the office, overseeing finance, arranging loans, running errands, and generally keeping up with Edison through work periods that made no distinction between night and day.

In the wake of the Pearl Street debut, business had boomed and Edison directed Insull to consolidate and move the various manufacturing ventures, many of them scattered around New York City, up the Hudson River to Schenectady. The Edison vision of universal electricity had adroitly been brought into reality---but the sudden call for electrical service and electrical apparatus had overwhelmed the Edison company. It simply could not keep up with demand. That is, until Insull created a small revolution in the mass production of parts (and this long before Henry Ford was to get credit for the concept), which allowed the volume of shipped products to go way up and the price per part to go way down (ref 3.1). When the Edisonized central grids for cities all over the US---Boston Edison, Detroit Edison, and so forth---had their own Pearl Street debuts, many of the parts came from Insull's factory.

There seemed no limitation to Insull's ingenuity or energy or resourcefulness. After making a great success of the Schenectady operation, he was stuck in the middle of the incorporation melodrama surrounding the creation of General Electric. He had foreseen the need to consolidate companies, but had also been loyal to Edison and was sorry to observe his mentor eased out of control and the "Edison" removed from the name of the new company.

Things had turned sour. Indeed, after serving at Edison's side for a dozen years and coming to like the bustle of New York City, Insull resolved to leave town. The instigators of the corporate makeover had recognized Insull's skills and designated him as the prospective first vice president---in effect the number three man at GE---but he preferred to be the number one man at another company, even if this meant receiving only one third the salary. Go west, young man, to Chicago. And he was young: having already had the equivalent of several full-length business careers, he was still only 32 years old.

At the Insull farewell banquet all of his "most intimate friends and most intimate enemies" were present (ref 3.2). Who knows if it was the wine or an undercurrent of bitterness, but that night an uncharacteristic small cloud of unguarded speech was to pass Insull's lips. His new employer, a utility company called Chicago Edison, was less than 2% the size of GE, and yet Insull brashly boasted that despite this disparity, he and his new company would overtake GE someday (ref 3.3). He would overtake everyone. Many in the room would have laughed uneasily at this awkward moment because they knew of Insull's steely resolve and his plentiful ability. Certainly they weren't laughing a few decades later when this young immigrant from Britain had indeed built his own electrical empire and was one of the most powerful men in America.

Insull does not now command much attention in the history books, which is a pity. For consider: he probably has had more to do than any other individual with the way in which your home is wired, with the variety of appliances you own, the nature of the electrical bill you receive at the end of the month, the manner of your morning commute on mass transit, even the process by which power is produced and distributed, financed and regulated. And then, at the heights of American power, he suffered a coming-down of epic proportions.

Turbocharged Grid

Those who suppose that the intensity of technological change during their lives will never be equalled are probably wrong. Compare the 1990s with the 1890s. Consider, for example, the 1990s' electro-tech innovations with large worldwide impact: ever more compact personal computers, wireless communications, email, Internet, and optically-read compact disks for music and video storage. An impressive list. But look at what was happening ten decades before: radio signaling, diesel engines, motion picture cameras, x rays, AC induction motors, radioactivity, and automatic telephone switchboards. One could probably locate many decades when the comparative change in technological life was quite noticeable.

The Columbian Exposition, as you have already seen, was a showcase for industrial innovation, reflecting the buccaneering competition for the high-tech market in 1890s' Chicago, especially in the battle of the currents, and in the separate fight for light. What, didn't Edison's smooth-glowing bulbs settle the issue? No, they didn't. Arc lights, too bright to bring indoors, were still to be found illuminating city streets. Furthermore, good old gaslight had by no means gone away. We talk nowadays about miracle "smart materials," but they had them back in the 1890s too, and the most important of these was the introduction of a new kind of mantle, a little piece of fabric in which the gas jet combusted and threw out its light with much greater efficiency than before. If anyone had thought the electric grid would quickly put gaslight out of business, they were wrong. Gas was still the cheapest way to light a room. The mains were already there under the streets and the fixtures were firmly attached to the walls of people's homes. Why should anyone switch to electricity? This issue of cost was to be Samuel Insull's greatest challenge.

Insull had grown up in London. When he later came to New York he felt that his adopted city was raw by comparison and too full of energy. Later he changed his mind and came to embrace the vitality of New York, a sentiment many share to this day. When next he moved further into the continent, to the prairie city of Chicago, Insull encountered even more rawness and more energy. Here, stuffed with stockyards, railroad sidings, granaries, and smoking factories, was the fastest growing city in America, a metropolis in the process of doubling its population in a decade. Dismayed all over again by the barbarian coarseness, Insull had shrewdly inoculated himself against taking fright and flight by signing a multi-year contract with his new employer. As a conspicuous act of good faith, he also invested a lot of money in company stock. He would force himself to make a go of it in Chicago. No matter what happened this was now his home.

If Thomas Edison was the Invention Wizard of Menlo Park, Insull was about to be become the Organizational Wizard of Chicago: he would build several of the world's largest generators and usher in new forms of rolling mortgages, a form of perpetual borrowing much used ever since in industry. He would silently revolutionize rate-making and load smoothing. His approach to advertising and mass production helped to create the high-consumption culture we have today and the ubiquitous presence of advertisements that comes with it.

When Insull arrived in the summer of 1892, Chicago Edison had about 5000 customers, in a city with a population of a million. His generators were pouring out a respectable 2800 kilowatts of electricity, not enough for a really ambitious man. He needed more power, in several senses of that word. More power from bigger generators, more power over his retail environment, more political power. His first natural advantage---his ante into the great card game of electrical sweepstakes in Chicago---was the exclusive rights to the strategic patents on Edison equipment such as bulbs and switching equipment. With these Insull started to elbow his competitors out of the way. If you can't buy the machines and parts you need because of patent limitations, you're not going to have much of a chance. Insull had started by competing with his rival electrical companies, but his preferred method was to buy them out, one by one. Like the fictional smart-aleck Charles Foster Kane outdoing his newspaper rivals by buying up their best writers, Insull bought himself power stations, patents, licenses, and customer contracts until his was the only grid left.

Chicago Edison's earliest central station---its equivalent of Pearl Street---had been the Adams Street plant, built in 1887. Insull's first order of business after settling into the job was to build something much bigger, the biggest power plant in the world, the mighty Harrison Street Station, where multiple 1000-horsepower generators disturbed everyone in the building with the sound of a hurricane and the shaking of an earthquake. Being there was almost like being at Niagara Falls, but without the beauty of the Falls. The old Adams Street station didn't go to waste because Insull built himself there the world's largest battery in order to have the extra power ready at rush hour or times of peak electrical need, a problem that worried grid operators then and that worries them still (ref 3.4).

Another problem confronting Insull, and all other grid operators too, was AC-vs-DC. That’s right, this was another issue that hadn’t fully gone away. AC could travel, AC was the current of the future, AC could be used at lots of different voltages. But oftentimes DC was what you had. Chicago Edison, bearer of that famous name, had obviously begun life providing DC electricity. The dilemma now was how to use the go-anywhere ease of AC without having to tear out all the DC wiring. Choosing between AC and DC was painful. Insull's masterstroke was to use both, using a handy new invention called a rotary converter. Was Insull the first to use this device for turning AC into DC? No, but he was the first to use it in a big way. You could make current in the old DC style, turn it into AC, then send it through a transformer where it could be boosted up to much higher voltage. In that condition it could travel farther and cheaper than DC. Later, in some farflung neighborhood, send the current through a transformer and down to the lower voltage. Finally, just before shipping it to the customer, you could convert it back to DC (ref

3.5).

Now the company could concentrate on building fewer and bigger power plants. Insull even found a good use for all the obsolete power plants he closed down: they became substations, plants where power is not generated but merely converted and distributed. AC is turned into DC or vice versa or transformed from high to low volts. Was Insull the first to use substations? Again, no, but he was the first to use them on a big scale (ref 3.6).

More efficient generation lowered the unit price of electricity and this brought in more customers. More demand, however, necessitated more generators. In this way, even the colossal Harrison Street plant was quickly pushed to its limit. The mighty piston-driven steam machines already filled every available berth in the building. These electrical leviathans already shook the ground, pushing the parameters of mechanical and electrical engineering to the utmost. Insull needed a new masterpiece of engineering, and this would cost money.

Even in the middle of a national economic slump, things in Chicago were humming. Many businesses were failing, but not Insull's. He had made himself a master of money as well as a master of metal. He succeeded in the loan market, often by using his extensive connections in Europe. By 1898, six years after Insull had taken over, Chicago Edison's load, the aggregate amount of electrical gadgets receiving current, had jumped by a factor of ten. For a man of Insull’s ambition this was still too small.

The load had jumped tenfold, yes, but the number of customers had only doubled, to 10,000. Insull had the monopoly he wanted, but he still acted as if the competitors were at his heels, and in a way they were. Gaslight was alive; many homes were still getting along with gas lighting. Electricity was something fancy hotels and restaurants had but not ordinary homes. Electricity was desirable, fashionable, modern, but it was not yet a necessity. For many citizens electricity was still too expensive, and this bothered Insull.

In the hands of Samuel Insull, the existing reciprocating steam engine design had reached its size limit at about 4000 kilowatts (4 megawatts), and something new would have to be found. The name for the new thing was turbogeneration. In the old reciprocating engines, the horizontal motion of a piston is converted through linkages into the rotary motion of the generator shaft. Picture a giant steam locomotive that doesn't go anywhere. A turbine is different. There the roiling steam presses against blades mounted on the shaft itself. There would be no back-and-forth motion, only the rotary movement of the shaft. A turbine is a sort of windmill in which the force comes not from wind but from steam. The turbine shaft, bristling with blades, is of course confined in a chamber so that the steam cannot escape. Instead, the steam strikes one set of blades after another, cooling down as it does. Before it exits it will have imparted much of its energy to twirling the turbine shaft.

Was Insull the first to use turbine generators? No. Turbines had been used on a small scale---to propel ships and power small grids---but Insull was going to be the first to use turbo on a big scale. He didn't just want turbines, but unprecedented turbines. General Electric, which was in the business of eagerly supplying utilities like Chicago Edison, had to be coaxed into filling Insull's request because it seemed like a risky venture at the time (ref 3.7). The result, the world's first large turbogenerator, cranking out five million watts, 5 megawatts of power, was emplaced in its own palace of power, the newest and most grandiose generating station in the world, on Fisk Street in downtown Chicago. On the big day, when it came time to throw yet one more of those switches that mark the growth of the grid, Insull's chief engineer told his boss to stand back, lest there be an explosion.

"There is just as much reason for you leaving here as my leaving here," Insull said.

To which the engineer replied, "No. My being here is in the line of my duty."

Insull, who had not only pressed the mechanical designers to a feat of extreme contrivance (the contraption exerted itself at the equivalent of 6600 horsepower) but had rallied his investors and board of directors to the breaking point, had the last word. "Well, I am going to stay. If you are to be blown up, I would prefer to be blown up with you as, if the turbine should fail, I should be blown up anyway" (ref 3.8).

The machine occupied a tenth the space and weighed a tenth the as much as its predecessor. It not only worked, but very quickly was generating 10,000 horsepower, more than double the power produced by any steam-driven generator ever built.

Energy Multiplication

What is 10,000 horsepower? How impressed should we be by Insull’s new turbine? It’s no use providing a number like that without giving you a sense of what it means. Already at this point in the narrative, the generators have gotten pretty big, and they’re going to grow even bigger. Actually, 10,000 horsepower is already too big. We should start small. In fact, let’s start with a fraction of one horsepower.

In examining the energetics of food production and energy use in Colonial America, sociologist David Nye begins with this simple proposition: a man grinding wheat is exerting himself (spending energy) at a rate of about one tenth horsepower. One horsepower is the work that can be performed by one large draft horse or two ordinary horses (ref 3.9). In other words, a draft horse pulling a shaft that rotates a millstone can do the work of about ten men. Ever since Adam first earned food by the sweat of his brow, the struggle to acquire food has been just about the most important daily imperative for humans, as indeed it is for the rest of the animal kingdom. Animals will always be hunter-gatherers, whereas humans at least are able to employ their cerebral circuitry to develop, first, agricultural methods and, later, technological implements to enhance the available musclepower.

Nye gives several examples of multiplication of effort through mechanical contrivances. Wind power, for example: in the year 1500 the sails used to propel a 100-ton ship would produce perhaps 500 horsepower (hp), a factor of 50 times the collective muscle power of the human crew of that ship (ref 3.10). Water power: a typical river-driven mill in Colonial times was about 4 hp. Is it any wonder that often a mill was built before the town was built? The 4-hp mill could grind the wheat that would occupy 40 men. With a mill on the job, flour could be made and those 40 men could be freed up for other jobs. If the mill employed a turbine rather than a wheel, the power could be doubled.

So, how much energy does the great Energy Pharaoh, Samuel Insull, command with his 10,000 horsepower? Answer: the equivalent of 10,000 draft horses pulling at the yoke or, even more stupendous for the mind's eye to fathom, the labor of 100,000 people toiling away on hand cranked mills converting grain to flour. By the way, "horsepower" is still a term used in association with engines, especially automobile engines, where mechanical drive or torque is important. It's not a term used much anymore to describe the output of an electrical generator, so we'll often stick with kilowatts (one thousand watts, which is a little less than one horsepower) or megawatts (one million watts).

Sociology of the Grid

Once the principle of large turbogenerators had been established, the old power limitation seemed to disappear. It was like the transition from propeller to jet aviation. Chicago and utilities around the world starting building bigger and bigger turbines. First 5 megawatts, then 10, then 35. With this kind of capacity, increased demand could easily be met. For that reason, generation, for the moment, will be of less interest to us than other, more subtle, aspects of the electricity business.

Insull, the engineering juggler, could easily convert between alternating and direct currents, between high and low voltage, and replace piston with turbine. All of the new hardware innovations contributed to a vast economy of scale: generally speaking, the larger and more flexible the machine the more efficiently it would perform. With certain operations, and the grid is a good example, the overhead costs of doing business can largely stay the same, so the more product that is sold or customers serviced, the more the cost of overhead can be amortized. But this by itself didn't make electricity cheap.

There are other, more subtle, but no less profound, ways to make electricity cheaper. We therefore move from the Engineering Insull to the Management Insull. He started by looking at how society used the grid. How much energy was extracted from the grid, at what hour, and to what end was it put? How could this information be obtained? In the early days of the grid, in the customer's meter, a tiny metal strip was slowly consumed by the flowing current. Weighing the strip at the end of the month was how the utility company charged for its services.

Insull wanted more than that. He desired to know what you were up to in the middle of the night, and the morning, and at hours in between. The metering scheme first introduced into the US market by Chicago Edison was able to get readings every half hour, and this revealed the fascinating anatomy of power around the clock. Department store usage, for instance, was big during its open hours, between 8 AM and 6 PM, and almost nil for the rest of the diurnal period. Garages where electric vehicles were charged up had a usage schedule almost opposite: its charging operation stretched from 8 PM until 7 AM. Manufacturers' power needs were pretty well distributed across the workday, with a noticeable dip at noon when workers broke for lunch. For homes, the peak was in the evening when the family was actively together.

Was Insull the first to use such a meter? The answer again is no. Insull got the idea for a time-sensitive meter while inspecting a power station during a vacation in the British seaside resort of Brighton (ref 3.11). When he got back to the US, he made a better meter. The device allowed him to look at his own grid in a new way. In a smoothly run power network, the generating apparatus would be used efficiently around the clock. But this was obviously not the case for the Chicago grid. For big chunks of the day, the dynamos were operating far below capacity.

A graph of the usage during the day is called a load curve. Insull gave as much loving attention to this curve as a cardiologist would give to an EKG readout. If the grid and its users can be thought of as a living organism, then the load curves for subsidiary sectors---homes, factories, mass transit, etc.---provided all the vital signs a shrewd utility operator would need for determining the health and profitability of his franchise. Electricity was still too expensive, and Insull could see why. The load curve revealed all. A generator only working for a few evening hours when homes wanted electricity for lighting was an underperforming capital investment, an underused piece of equipment. That machine's "load factor," the fraction of the time it was actually being useful, was poor.

Here are some examples. A generator in the basement of a high-rise building, servicing an elevator only a minute at a time, maybe a few times per hour, sits idle much of the time. It has a bad load factor. Over in the factory where they make ice (in the days before refrigerators) steadily around the clock, a generator will be well used. It has a good load factor. Some of the load-factor disparities will be smoothed out by virtue of the fact that a centralized generator---in this case Chicago Edison---is there churning out power to a spectrum of customers.

Insull illustrated this point in a lecture before the YMCA by analyzing one particular block in Chicago. The little cross-section of Chicago contained 193 apartment customers and 34 garage customers, for a total of 227 electrical meters. Here is Insull speaking before the Young Men's Christian Association:

> *If you take each customer by himself, that is, each apartment by itself, the use of energy in each separate apartment is so slight that the investment to take care of that particular customer, if you trace it back to the generating station where the power is produced, would not be used on average more than between six and seven per cent of the time. But so varied are the ideas of human beings, and they so seldom do the same thing at exactly the same moment that, if you take the whole 193 apartments together, and then find out how much energy as a whole they use at one particular moment, the fact is developed that the diversity of their demand is so great that instead of using your investment only between six and seven per cent of the time, they use your investment, when taken as a whole, twenty per cent of the time (ref 3.12).*

And if you were to add in the stores around the block, you would find that the investment was being used at the 30% level, which is better than 6% but still not as good as 100%.

Using the investment fully and gainfully was vital not only to staying in business but to expanding. Moreover, with Insull efficiency seemed to have been not just a business imperative but also an intellectual pleasure and moral attainment, as if by wringing out the last drop of electrical utility from a pound of coal one were fulfilling a quest, begun when the coal was first fabricated in the earth eons before and finished with the exertion of a motor or flash of a welder's arc.

"So varied are the ideas of human beings..." Insull saw that he could use human diversity to help smooth out his load curve. The way to increase productivity was to diversify his customer base. To get customers to use electricity whenever possible in off-peak times, Insull offered rate incentives. In the old days the customers were charged a flat rate, so many cents per kilowatt-hour, a kilowatt of power consumed for the space of an hour. Later this was changed to accommodate the really good customers: the more you used, the cheaper the rate got. This was fine for the big spenders, but what about new users?

To solve this rate problem there was a new policy. The new algebra worked this way: rates would be made of two parts, a fixed charge proportional to the size of the user's load (a simple home with but a few bulbs would benefit because if was only a flyspeck on the system as a whole) plus a decreasing variable rate above a certain minimum (this rewarded big users---the more they used the more they saved). In effect, Insull's grand scheme was to increase profits by *lowering* rates. Go after a larger market share, or in this case building the market in the first place, in the hope that increased volume of sales would make up for the lesser charges per unit of production

One of the biggest boons to making all this work was winning contracts for powering the trolley business in Chicago. Formerly these electric trains had had their own power supplies, but Chicago Edison essentially made them an offer they could not refuse. With Insull's electricity providing the traction for pulling trolleys up and down long boulevards, all these expensive underused turbines suddenly had something to do during two formerly slack periods---the time just before the work day began, when people were commuting to their jobs, and the time just after the work day ended, when people went home.

These two segments in Chicago's daily rhythm, what we now call the morning and evening rush hours, greatly helped to straighten out the grid's load curve. Trolleys, at least for a time, were the biggest users of electricity in the US; they accounted for two-thirds of Insull's load (ref

3.13). And what had all the electricity replaced? Well, a few decades before, the way workers got to their jobs was on foot or in omnibuses pulled by 100,000 horses, at an average speed of 5 miles per hour, and leaving behind on the streets a millions pounds of manure every day (ref 3.14).

The price of electricity kept falling. Chicago Edison had built more efficient turbine generators, had through the use of AC transmission and substations brought the grid into many new neighborhoods, had through astute metering come to a familiarity with the hourly habits of the grid, and had instituted a creative tier of rates to induce customers to sign up. But yet they resisted. Electricity for the average citizen was still too expensive. Samuel Insull never gave up. In fact, he was just getting started.

Faustian Bargain

In 1898 Insull was elected president of the National Electric Light Association (NELA). Speaking at their convention he proclaimed his evangelical message of lower rates as the way toward higher profits. He had been one of the greatest proponents of the necessity for monopoly, and indeed had arrived at that condition in Chicago when his final competitor succumbed (ref 3.15). His argument? Utilities, to deliver energy at the lowest rates, had to be free of wasteful duplication of expensive wiring and heavy equipment. He was far ahead of his brother utility operators in recognizing, however, the need for public regulation of privately-owned utilities. Yes, he would say, you heard me right. The customer, and just as importantly potential investors, will have greater trust in the course we steer if our operations and our profit margin are negotiated in public view.

Commonwealth Edison, as the company was known by 1907, had done as much as it could on the production side. Now what needed work was the demand side of the grid equation. Insull did not, and never would, have enough business. When he started in Chicago, he had 5000 paying customers. By 1898 it was 10,000; by 1906 50,000; by 1909 100,000; by 1913 he had 200,000 ratepayers. Commonwealth Edison was larger than New York Edison, Brooklyn Edison, and Boston Edison put together (ref 3.16). His company had become the model for utilities all over the US. Trolleys were electrified, factories increasingly had powered equipment, and electric lights illuminated the streets, train stations, and the better hotels and restaurants. But for ordinary people, electricity was still special. Reaching into homes, getting people to change their habits, would take time.

Insull's first attempts at advertising the benefits of home electricity were aimed primarily at rich folks. These included a monthly magazine, *Electric City*, and a store specializing in electrical appliances. "Buy something electric for Christmas" was the slogan one year. He toured a portable "Electrical Cottage," displaying various impressive wares. Then came the ploy that started to change things and which earned Commonwealth Edison a place in the history of the early golden days of mass advertising. It worked like this: a cart would be sent through residential neighborhoods. The cart was piled high with electric irons and the man in charge was offering a bargain that would rival the tasty apple offered Eve in the Garden of Eden: ladies, allow electricity into your home---installation charges spread out over two years, with no financing charges applied---and you could replace your old, heavy, cumbersome flatirons with modern electrical irons. We have ten thousand new irons to give away (ref 3.17).

Here at last was temptation difficult to resist. Electric toasters or electric fans: these were luxuries, symptoms of a pampered life. But ironing---well, everyone needed clean clothes. After lighting, the next most used electrical contrivance in the home was to be the iron. Heating and maneuvering the old flatirons from stove to flat surface to shirt, back to stove for reheating and then more shirts, was muscle-aching and finger-blistering work, especially in summer. With the electric iron, there was still plenty of work to be done, but the energy arrived in thin wires. There would be much less hefting and less sweat.

In this way electricity gradually came into Chicago homes. It didn't happen all at once but in stages. The utility kept building more power plants, kept extending its lines into more neighborhoods, kept lowering its rates. Electrical current was no longer some novel, invasive vine but something more like a native species. Even if you didn't yet take the service, you knew people who did, and you were aware of the wires strung overhead from those poles. You looked at them every day and wondered how exactly the system worked. You couldn't see the current flow and there wasn't any detectable smell as there was with gas. Now and then an associated low hum could be sensed, but otherwise it didn't have much of a sound.

What the utility was offering was highly attractive and for many increasingly affordable. Not that a housewife would be overly indulgent with her electricity. No, it would be doled out sparingly. Just as she would continue to use gaslight in the evening, saving the electric lights for when company was over, so the lady of the house would often go on using the flat irons in winter---you had the stove going anyway, so why not use the irons---and save the electric irons for use in summer. Electricity in your home was a thing to be noticed and nourished. It was not taken for granted, at least not yet.

What was electricity like in those years? Here are some particulars. The average apartment with electricity had a dozen sockets. Homes had twice as many. The cord bringing power into an appliance had to be screwed into one of the dangling light sockets since the standard plug didn't come along until the late 1920s (ref 3.18). The bulbs used were typically rated at 50 watts, but gave off only a small fraction of the light emitted by a comparable bulb now. It had taken Edison and his engineers a year or more to fix the recipe for the light bulb filament, and after that they went on improving it. It took years more for Edison to emplace the system for supplying energy to those bulbs. The next great electrical product for the home, the iron, also underwent many design changes before it was taken up by women in large numbers.

Presently we will look at the third great product of the electricity age. It took longer to develop than the bulb or the iron, but once it had been perfected it caught up quickly. Five years after it was introduced, 60% of Chicago homes had them. Five years after that it was everywhere. It was practically more popular than the grid itself.

On the Air Live

This book is about sending energy by wire. We can't yet send food or other bulk goods by wire, so the next most important thing to be transmitted electrically is information. Here are six great electrical-information inventions associated with the grid: (1) *telegraph*, the movement of binary code via wires by interrupting a simple electrical circuit; (2) *telephone*, the movement of voiced sounds via wires by vibrating a membrane with modulated signals; (3) *wireless*, the movement of telegraph binary code via waves sent through the air; (4) *radio*, the movement of voiced telephone-like sounds (and later pictures) via waves sent through the air; (5) *computers*, the programmed processing of information via wires (or optical fibers), wires that are microscopically small and integrated by the million on tiny grid platforms; and (6) *Internet*, the combination of inventions 1-5 in a globally linked network.

The first two of these came before the electrical grid. The last two came very late in the grid's history. Because the time frame in play in this chapter is the first third of the 20th century, we'll concentrate on the fourth invention, radio, which was the next big thing to come along. Actually, radio didn't just come along. It wasn't a single invention or insight. In fact, it was built on clever ideas, scientific discoveries, and investments spread across the better part of a century.

To start with, the time from Faraday's flicker of recognition of the true kinship between electricity and magnetism to the development of practical electrical generators---having the ability to crank out lots of power---was several decades. The time from Maxwell's insight that electric and magnetic forces together conspired to constitute ordinary light (full technical name: electromagnetic radiation) and, furthermore, that light comes in many varieties (such as ultraviolet and infrared) which the human sensory system cannot apprehend to the time that Heinrich Hertz created and detected some of that nonvisual radiation (what we now call radio waves) was 20 years. From Hertz to Guglielmo Marconi's throwing radio waves across the Atlantic was more than a dozen more years. And it would be another couple of decades before regular radio broadcasts came into the home. Here's how it happened.

Radio waves are, first of all, a subtle form of electricity and magnetism mixed together and able to propagate great distances. They can, under the right atmospheric conditions, even reflect off the undersides of clouds and thereby travel a fair away around the curvature of the earth's surface. To be useful for mass communication, however, the tiny electromagnetic disturbance needs to be amplified and manipulated using special circuitry. To make the transition from a *radiant thing*, a wave phenomenon moving through the air, to a *circuit thing*, a smallscale burst of electricity moving along metal wires, and finally back into a wavetrain of sound crossing the room to our ear, a whole new arm of the electrical industry had to come into being: electronics.

And now, for two or three pages, it will be useful to let the history of the broadcast grid unfold in parallel with the history of the electrical grid. It was in the early radio years that the particulate nature of electricity, in the form of electrons, was discovered. In 1897, while regular electrical service in Santiago, Chile was being launched, J.J. Thomson, in England, built himself a glass tube containing two electrodes at opposite ends, one hooked up to the positive terminal of a battery and the other one to the negative pole. Even with no wire stretching between the electrodes, and with all the air in the glass pumped out, if the negative electrode was heated up, a current would flow across nothingness toward the positive electrode.

Years earlier Edison had seen this odd behavior (now called the "Edison effect") but had made no sense of it. But Thomson did. From his simple laboratory setup several important things were learned: an electrical current consisted of tiny lightweight particles, electrons. The first true elementary bits of matter to be detected by scientists, electrons were lighter by far than atoms would prove to be, even the lightest element known, hydrogen. They were, in fact, later construed to be small detached components of atoms. Moreover, the tube with the electrodes could be modified to function as an important circuit component, a "diode," which allowed current to flow in one direction but not the other. For one thing, diodes could be used to rectify current---turn it from AC into DC.

And while the Edison Company in Milan was branching out beyond the city limits to Venice and to other parts of northern Italy, the diode was, in a manner of speaking, branching out too. By adding a third electrode to the glass tube, the current leaping through vacuum from the negative (cathode) to the positive (anode) electrode could be controlled with great sensitivity. Once again, a plumbing analogy will be useful. Picture a huge gush of water entering one end of a water main and flowing out the other end. By turning a small knob, that gush can be turned off. The knob acts like a gate, permitting a big flow or no flow. The knob also acts like an amplifier. The small motion of a human wrist turning the knob, exerting a pressure of mere ounces, can be magnified into a mighty force able to stop a water flow equalling hundreds or thousands of pounds of water pressure. So it is with the third electrode in an electron tube. A very small current sent into the third electrode can turn on or off the much larger current flowing from the cathode to the anode. The third electrode has acted like a gate and an amplifier (ref 3.9).

The glass tube in these experiments, called an electron tube or a vacuum tube, became the central component in electronics. Many years later the tube would be replaced by transistors and crammed by the million onto a chip the size of a breath mint. Instead of flying across a centimeter of vacuum, the electrons would move through a micron's worth of solid silicon. Besides acting as a switch or gate or amplifier, the electron tube (or transistor) can be used as an oscillator: it can help to convert electrical impulses from one frequency to another, from the 60-hertz time scheme of the electrical grid up to the hundred-megahertz time scheme of radio waves, or back down again to the kilohertz time scheme for audio waves. This one device, then, can act as a universal translator for converting energy pulses to suit the very different pace of the grid world, the broadcast world, and the acoustic world. It changes not only the temporal signature of the signal but magnifies, by adding oomph at the crucial moment, changing and deciphering and embellishing the practically-nonexistent energy of the radio signal arriving at a rooftop aerial into the sounds that we can assuredly recognize as a Beethoven symphony.

As soon as the full sound of the human voice or a polka band, and not just the prosaic dot-dash of the telegraph, could be conveyed on the back of an invisible wave, free of all wiring, then radio could fully break out into public use. Adventuresome local "stations" could set up and broadcast to a fraternity of nearby listeners who had built themselves receivers. Weather, crop forecasts, crime reports, Bible school, an up and coming local fiddler, election returns, a baseball game in progress: these were things that would make people gather 'round and listen. With time the programming got more ambitious, stations broadcast for longer periods and over greater distances.

While on one side of the world, in Japan, 700 separate utilities were consolidating into five large electrical conglomerates (companies which survive to this day), on the other side of the world, in the US, the first stations with regular programming were delivering the results of the 1920 presidential election: Harding beats Cox.

While the German firm of Siemens was building a large hydroelectric dam on the Shannon River in the newly independent country of Ireland (a project which constituted the largest foreign project undertaken by a German company---ref 3.20), the Radio Corporation of America (RCA) was building up a network of affiliated stations into a sort of radio grid spread across the country. This became the National Broadcast Corporation, or NBC. Electricity had certainly made radio possible, the fact that some people were submitting to having their homes wired in order to receive the broadcasts meant that radio was returning the favor.

By the early 1930s nearly every home in Chicago had a radio unit. Samuel Insull was interested from the start. His company was part owner of a local station. He could see that so great was people's eagerness to have radio that some of the last holdouts signed up electrical service in their homes so that they too could receive the broadcasts that all their neighbors were talking about. It can be said, incidentally, that the possibilities for advertising products in conjunction with radio programs that penetrated thousands and millions of parlors was not overlooked by certain enterprising individuals.

Maximal Gridification

Cities in most places were laying more wires, but the most aggressive laying was in Chicago. The 1920s was a roaring decade. The Great War was over and the Windy City was the capital of jazz, in the musical sense and the electrical. It was one of the largest urban centers in the world, partly because of the jobs that come with booming productivity. Chicago's factories, between 1900 and 1930, went from an electrification of 4% to 78% (ref 3.21). Samuel Insull had succeeded, finally, in making electricity affordable. In that remarkable 30-year period, the rates charged for power had fallen to half even as the price of the fuel used to make electricity had tripled (ref 3.22).

On an atlas of electrical history, the brightest zone, the very most intense phase, would center around Chicago in the decade from 1918 to 1929, when a majority of homes in the city were wired up (ref 3.23). Electricity in the city's suburbs grew even faster---50% growth per year over that decade. In 1925 Chicago was the most electrified city in the world, with an average per-capita annual consumption of nearly 1000 kilowatt-hours (ref 3.24). In a later chapter we observe the impressive electrification surge in China in the early years of the 21st century, but nothing can compare with the earnestness and early voltage ascendancy of Chicago in the 1920s.

This was the Jazz Age and also the Machine Age. It wasn't just electricity and radio that were jumping, but also aviation, the film industry, and especially automobiles. In 1915 one in sixty families had cars in the US; in 1925, the number was 1 in 8 (ref 3.25). And of course that fraction would grow further. One victim of this latter development? Trolley ridership fell.

And how did all this technology change things? In the catalog of energy-transforming devices, incandescence-bulb lighting had come first, changing the way people used the night and day. The next to be institutionalized were electric irons, which also altered the rhythms, or at least mitigated the sweat, of housework. And what a salubrious effect this would have on the woman of the house! One not-so-subtle ad for electrical appliances got right to the point: "How Long Should a Wife Live?" it asked (ref 3.26). Third, the advent of radios changed the way families approached their evening entertainment and the way people got and processed news. Runnersup in this electrical roster were vacuum cleaners (rugs didn't have to be whacked outdoors as often), coffee percolators, and refrigerators.

How did things change? Thomas Edison went so far as to suggest that electrical devices would accelerate human evolution. In times to come a woman, executing her home duties, would be more like "a domestic engineer than a domestic laborer, with the greatest handmaiden, electricity, at her service" (ref 3.27). The wife's brain would come to equal that of her husband's.

To say that it didn't work out that way in practice would be an understatement. Doing the family laundry, for example, had always been done by hand, an ordeal that could take many hours. Later, for many middle-class households, the wash was then given out to a professional laundry. Later still, with the arrival of electrical home washing machines, the dirty clothes stayed within the home. Net result of electrification? More labor than ever for the "domestic engineer" in the family (ref 3.28).

Had electrification come too quickly? Our technological civilization was older but was it wiser? Before rocketing ahead with the story of grid development, we need to look at this issue of grid impact. We need to build some perspective on the coming of widespread electricity. This era of the 1920s, plus or minus a decade or two, is sometimes referred to as the Machine Age, which is somewhat unfair. One could argue that the steam engine had been just as important and culture-changing in its day. Developed in the mid 18th century to help drain mines, improved by James Watt, and then applied to ship travel and railroads and finally electrical generators, steam has had an enormous impact on culture.

And if you're going back in history looking for the start of the Machine Age, don't stop with the steam engine, says Lewis Mumford, a frequent commentator on the connections among cities, machines, and social habits. Go back to the 13th century and the invention of the mechanical clock. With his clever bulbs, Edison was able to divide light into small samples. Westinghouse and his transformers divided volts. Tesla's motor design enabled horsepower to be divided, offering a refined version of powered machinery. Individual electric sewing machines became possible. But the monks of the 14th century monasteries, with their clocks, Mumford says, were able to divide the hour into minutes (ref 3.29). Time was no longer a fluid thing but something abstract and divisible. Starting with the monks themselves, with their devotions and chores dictated by a strict hourly schedule, life become much more regimented around time. Thereafter people would increasingly eat by the clock, not necessarily when they were hungry necessarily, and sleep by the clock, not necessarily when they were tired.

Mumford uses this example of the clock to illustrate how machines, and their large effect on our lives, become assimilated to our thinking and to our daily routine. We cease to think about them. Mumford had great respect for scientists like Faraday, whose work had led to new knowledge of nature. He even appreciated the development of electrical technology which made life easier for millions of workers in factories and elsewhere, and had led to cheap aluminum which, among other things, had made available affordable utensils and appliances for the public (ref 3.30). As early as his writings in the late 1920s (just about the time Insull's technological hold was supreme), though, Mumford was worrying whether technological development---the engineered products and the use to which they were put---was "organic" enough:

> *...A good technology, firmly related to human needs, cannot be one that has a*

maximum productivity as its supreme good: it must rather, as in an organic system, seek to provide the right quantity of the right quality at the right time and the right place for the right purpose...

The center of gravity is not the corporate organization, but the human personality, utilizing knowledge, not for the increase of power and riches, or even for the further increase of knowledge, but using it, like power and riches, for the enhancement of life.

The greatest contribution of science, the most desirable of all its many gifts, far surpassing its purely material benefits, has been its transformations of human consciousness, through its widening illumination of the entire cosmic and historic process, and its transfer to man of the power to participate with its whole being, in that process (ref 3.31).

Not strive for maximum productivity? Enhancing "life" at the expense of corporate organization? Transforming human consciousness as science's greatest contribution? With attitudes like these Mumford was a thinker to be respected but seldom heeded, at least over the period of years covered in the next few chapters. Nevertheless, his viewpoint---that massed modern technology, however convenient it might be, brings with it troublesome consequences---will be a necessary counterweight to what could otherwise seem, in a history like this, to be outright boosterism. The electrical grid, and its impact on people, has its upside and its downside.

Assyrian Empire

In surveying the coming of these gridborne changes, emphasis has centered on Chicago and the role of Samuel Insull because he did so much to establish electrical modernity during his tenure at Commonwealth Edison. He not only built the largest and most efficient generators over a period of 30 years, but had extended service to strata of society (poor and rural) and outerlying towns left out of previous electrical endeavors. It's true that to achieve these ends he had sought out and achieved a monopoly over grid activity. If you wanted to be on the grid you had to come to him. His rates, however, were lower than almost anywhere else, whether New York, Philadelphia, Boston, or Baltimore (ref 3.32). For these actions he deserves to be considered a hero of the grid. This is the Good Insull.

We will also now have to review what history has come to see as the Bad Insull and to explore why in general his reputation, if he is recognized at all, is under a perpetual cloud. Insull's lone biographer, Forrest McDonald, sees Insull not as a greedy or evil man, but one whose main fault was the pridefulness to believe that he knew more than other people (ref 3.33). Past experience had taught Insull that he could solve any problem; he was better at organizing large companies or cajoling politicians into giving him what he wanted; he was shrewder at discovering cheaper and more reliable ways of getting the raw materials he needed for feeding his grid; he was abler than other merchants in procuring new customers, customers which he dearly needed for smoothing out his load curve.

Arguably he was better at running other people's businesses than they were. He helped fix and improve the Chicago transit system, both intra- and inter-city. His greatest performance in a supporting role was his action in rescuing Chicago's insolvent gas company. Against all advice that he had nothing to gain and everything to lose, Insull had taken on the role, once again, of savior and guarantor. He reorganized, refinanced, trimmed, and conserved until the firm was solvent once more. Insull's credit, and the credit of his home company, Commonwealth Edison, had the strength of granite. Investing in Insull was a sound investment. His companies always paid dividends.

As a boss he was benevolent. The wages he paid were better than those at other utilities. Insull's ethos of energy conservation and social responsibility and pride in the Company was impressed upon his workforce. His employees were encouraged to contribute time and money to charitable and civic causes. Often the senior managers were leaders in community activities. He offered his workers affordable life insurance and the company owned a resort in Wisconsin for family vacations (ref 3.34).

As World War I began the mobilization of troops, materials, and morale was essential. Appointed by the governor to head of the defense council for Illinois, Insull, the great mobilizer, approached his assignment with all the zeal he used in dealing with electricity. He raised relief funds and sold government bonds but also took on the task of organizing the state economy on a war footing. He petitioned the federal government to distribute work contracts more fairly, especially in non-eastern states like Illinois. Those such as coal companies which had, he believed, unreasonably raised their rates, he accused of war profiteering. When patriotic admonitions failed to work, he threatened to seize coal mines and jail malefactors. By the end of the war his impressive civilian war effort earned commendations from President Woodrow Wilson and congratulations from other national and international leaders. His was the only large steam-driven utility in the US not to raise its rates right after the war (ref 3.35).

What's so bad about all of this? Where is the *bad* Insull? Shouldn't crooks be made of sterner stuff? Compare, once more, the life of Samuel Insull and the sage of *Citizen Kane*. In the movie, the newspaper baron marries a singer and builds an opera house in Chicago. In real life, the utility baron married an actress and built the *actual* opera house in Chicago. In the movie, we see Kane increasingly caught up in the process of self aggrandizement: he revels in performing noble deeds and in pulling the levers of power. He desires the public to love him and he enjoys influencing events. The same with Insull. He didn't need to be mayor to be Chicago's premier citizen. The opera house, looking somewhat like a high-backed chair, became known as "Insull's Throne." "I am not a musician," he said, "nor am I in any sense an authority on grand opera, except as to what it costs" (ref 3.36).

Like the Assyrian empire, Insull's fief had started small---a minority utility, with 5000 customers, serving part of the central business district. Then with dynamos as his sword and patents as his shield he had conquered the rest of Chicago. Next was the North Shore Electric Company, a confederacy of grids lying along the rim of blue Lake Michigan as far as the Wisconsin border, as well as a few petty dukedoms to the south. Insull secured sovereignty over the northern regions by building the first 132-kilovolt transmission line, as practical and potent a symbol of imperial sway as the Roman aqueduct had been twenty centuries before.

He had bought suburban and trans-urban grids wholesale, along the Illinois River and other swaths around the area. The Public Service Company of Northern Illinois, as this venture became known, even extended high-voltage feelers into Wisconsin and Indiana. Insull's domain now covered thousands of square miles. Confident in his vision, Insull's transmission lines even went where previous grid builders had been reluctant to venture, namely rural regions. If he had heard that there were potential customers on the Moon, one suspects he would have found a way to traverse the vacuum of space and begun laying wires in the lunar dust.

Insull had himself an empire, he operated a monopoly, but its operations were regulated by the state, and his rates continued to be lower than most. He would argue that this was the greatest good for the greatest number. He encouraged his employees to buy stock in their own company, as he had done himself. They should buy stock and their friends should buy stock too. You, the employee, could earn a small commission even as you helped your friends. All would benefit from the health and advance of the company. What's bad about that?

Insull had long conducted his affairs upon several sound principles. One of these was to use available resources to the fullest. For operating a power grid this meant leveling the load curve---that is, trying to even out the delivery of current all around the day---by getting more customers with a variety of diurnal habits.. For managing the grid one also desired to amortize the company's financial investment and power delivery schedule by acquiring or cultivating new businesses in fields allied with grid work, such as gas pipelines or elevated trains. In other words, knowledge and connections in the business world were themselves valuable assets to be further invested in seeking wider growth. Nothing wrong with that, is there?

With the advent of Middle West Utilities, Insull's reach grew to the continental level. This corporation, of which he was the head, was a holding company. It advanced money or equipment or patent licenses to struggling new utility companies which in return gave stock. The early Edison company operated along these lines: the new grid affiliate in Cincinnati, say, could hardly afford to buy equipment *and* operate as a grid without surrendering some ownership to the larger company holding the patents and making the machinery. The holding company, better known and better trusted than the subsidiary operating company, could then sell *its* stock using as collateral the stock held in the operating company. Insull's holding company, came to control utilities all over the place---California, Ohio, Kentucky, Louisiana, New England (ref 3.37).

The grid was now virtually everywhere, and Samuel Insull had done much to make it what it was. In the US, only some rural areas had been left out. To mark the gigantic transformation electricity had made, a special occasion was being marked. The 50th anniversary of Edison's development of a practical light bulb was to be observed in October 1929. Henry Ford had built a museum to honor Edison, and the centerpiece was a painstaking reconstruction of the Wizard's Menlo Park lab complex, the scene of Edison's greatest research as well as his enchanting encounter with Sarah Bernhardt and his dinner with the aldermen of New York. The resurrected lab was built at Greenfield Village, not far from Ford's mammoth auto factories in Detroit, and the day was memorable. Edison, now 82 years old, was lauded by the President of the United States, Herbert Hoover. Edison and one of his original assistants re-enacted the lighting of Edison's 1879 bulb (ref 3.38). The re-enactment of the historic moment of 50 years before was historic itself because it was unfolding to a trans-oceanic listenership of millions. The re-lighting of the bulb, narrated anew as if it were a championship sporting event, and the remarks made by Edison and by President Hoover, were beamed across the US and to other lands.

And beamed in the opposite direction came greetings from Germany, from President Von Hindenburg and also separately from the famous Albert Einstein. From the Antarctic came felicitations from explorer Robert Byrd. The domestic part of this "greatest hookup that radio has yet attempted" was an ensemble of more than 130 stations coast to coast, beating the previous record of 111 stations which had covered the acceptance speech of Alfred Smith at the Democratic National Convention the year before (ref 3.39).

More memorable was what happened three days later: the greatest stock market crash in American history. The economic downturn of the early 1890s had led to Edison's removal from control of his company. The great market tumult of 1907 did in Westinghouse. But these events were small in comparison to the crash of 1929. This notable episode would soon touch the entire nation, and other lands too. Consider, as part of this vast turn of events, the plight of utilities. When suddenly the price of many stocks fell simultaneously, then obviously companies that regularly borrowed huge sums of money on the strength of stock holdings were going to be nervous. Insull's empire, with utility operations in 32 states, had a total value, if you added up the assets of all the companies that he controlled directly or indirectly, to something like three billion dollars. With his index finger he controlled the flow of about one eighth of the nation's power. One million people, from laborers to millionaires, many of them enlisted through the grassroots level, were investors in Insull's companies (ref 3.40). They all waited to see what would happen. A week after the crash Insull's face was on the cover of *Time* magazine.

Holding companies, especially those that layered many corporations within other corporations in pyramid fashion, were shaky in an uncertain economy. Against terrific pressures, Insull kept his operations solvent, but many people were worried. Already the issue of public versus private ownership of utilities had become a major point of debate in American politics. Insull was seen as the leader of what had come to be called the Power Trust. The utilities, and Insull in particular, were seen as using undue efforts in influencing political affairs. Insull had long made it a policy to make generous campaign contributions, sometimes to both parties.

Entangling himself in a 1926 senatorial race, Insull had outdone (and partially undid) himself by giving a reported $125,000 to the Republican candidate. Although this was not an illegal contribution, the size of the gift and other factors at the time provided fuel for those who saw this as a grab for political power by the purveyors of electrical power. The senate voted not to seat the victorious candidate, a man named Frank Smith (ref 3.41). In our time the argument continues over what constitutes a spirited political endorsement or an outright bribe. Franklin Roosevelt, in his 1932 presidential campaign, singled out Samuel Insull by name, and the other utility holding companies, as being interested in acquisition and not service (ref 3.42).

Samuel Insull's empire finally collapsed. By June 1932 too many holes had sprung up in the dikes, too many loans were being called in, and Insull was forced to surrender his management positions by the New York bankers, the ones he had always tried to avoid. He even had to give up his beloved Commonwealth Edison. Insull, quietly taking train for Montreal, sailed for Europe, and moved into a Paris apartment. Then worse: Insull was indicted on charges of fraud, embezzlement, and other crimes related to his Byzantine holding company.

Leaving for the next chapter the question of his guilt or innocence, the story now concentrates on Insull's escape. The conqueror of the known electrical world had become a fugitive. He fled to Greece, where there was no extradition treaty with the US. There was even a possibility that he would assume Greek citizenship and be put in control of the national grid (ref 3.43). Insull, in his memoirs, tells of an even more poignant what-if scenario. Years before, he writes, Prime Minister Stanley Baldwin had secretly invited him to return to Britain and take charge of the commission that was to reorient the British national grid. After giving the matter serious consideration, Insull regretfully declined. "It seems my life would have been pleasanter and both myself and others would have been saved lots of trouble if I had accepted Mr. Baldwin's offer" (ref 3.44).

He hadn't accepted the offer but had stayed in the American arena, and why not? He had been present at the birth of the grid, standing at Edison's side on Pearl Street. Insull had gone to fashion his own powerful grid, the Chicago grid, a million times bigger than Pearl Street. But he never forgot his origins. Insull's employees referred to him respectfully as "The Chief," but for Insull himself there was only one chief. He idolized The Old Man of Menlo Park. In the bound version of Insull's most famous lectures, the frontispiece illustration is a photograph of Thomas Alva Edison (ref 3.45).

But there is also the matter of that boast, the promise made at the banquet sending him off from New York to Chicago forty years before, a vow to outdo General Electric. It was an assertion half made in jest and half in earnest, but it does seem to have captured the essence of the man and what he subsequently did in Chicago. Little Sammy Insull, Edison's secretary, had gone on to the big time. Accepting custodial duties over Britain's grid would have taken him away from a culture where governors and senators were his friends. Whole cities had electricity because of him.

Many other great men in history had suffered great reversals of fortune. Napoleon had conquered all of Europe as far as Moscow and then was himself conquered, his empire shrinking from the size of a continent to the size of his jail on St. Helena Island in the south Atlantic. Agamemnon, breaker of cities, supreme leader of the Greek army at Troy, returned home, where his rulership constricted with lethal rapidity. Stepping from the bath he was swaddled in a blanket and axed to death.

For Insull it wasn't nearly as bad. Leaving Greece and heading for Turkey, he was finally apprehended through the vigorous efforts of the United States government. Shanghaied from one ship and placed in another and suffering weeks of blazing front-page newspaper coverage, he was ignominiously transported back to New York, driven to Chicago, and remanded to a jail cell, where he spent the night. In the breadth of his career, the magnitude of his influence, and the height of his fall, Samuel Insull's saga could almost be compared to Greek tragedy, and somebody someday should write a play about it.

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