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When Old Technologies Were New

Thinking About Electric Communication in the Late Nineteenth Century

Carolyn Marvin

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This is the simmering of the electrical imagination, which fairly bubbles in the notion that in time the race may develop a special electrical sense.

—Park Benjamin

Introduction

". . . you must admit that whatever you and your civilization are, is due to me—insomuch that if I had not had this dream you would have had no existence whatever."

—Julian Hawthorne, "June, 1993"

New technologies is a historically relative term. We are not the first generation to wonder at the rapid and extraordinary shifts in the dimension of the world and the human relationships it contains as a result of new forms of communication, or to be surprised by the changes those shifts occasion in the regular pattern of our lives. If our own experience is unique in detail, its structure is characteristically modern. It starts with the invention of the telegraph, the first of the electrical communications machines, as significant a break with the past as printing before it. In a historical sense, the computer is no more than an instantaneous telegraph with a prodigious memory, and all the communications inventions in between have simply been elaborations on the telegraph's original work.

In the long transformation that begins with the first application of electricity to communication, the last quarter of the nineteenth century has a special importance for students of modern media history. Five proto–mass media of the twentieth century were invented during this period: the telephone, phonograph, electric light, wireless, and cinema. This period is not the usual starting point for the social history of Anglo-American electric media, which is generally assumed to begin only with the institutional birth of film and broadcasting and the development of large audiences in the twentieth century. The present study modestly attempts to push back those beginnings to the late nineteenth century, when Anglo-American culture was fascinated by the communicative possibilities of the telegraph, the telephone, and the incandescent lamp—choices that may come as a surprise to contemporary sensibilities focused on twentieth-century mass media.

For media historians, the phenomenon of twentieth-century electronic mass media lies like a great whale across the terrain of our intellectual concern. Asked to explain what sort of phenomenon it is, most of us will unhesitatingly point to the hundreds of millions of radio and television sets that are bought by consumers and promoted by vast industries. This artifactual notion is pervasive and not much debated, for it seems simple, obvious, and convenient. But it has rendered invisible important aspects of electric media history, and perhaps of mediated communication generally. It does this in part by fixing the social origin of electric media history at the point when media producers began to service and encourage the appliance-buying demand of mass audiences. Everything before this artifactual moment is classified as technical prehistory, a neutral boundary at which inventors and technicians with no other agenda of much interest assembled equipment that exerted negligible social impact until the rise of network broadcasting. But a great deal more was going on in the late nineteenth century. New electric media were sources of endless fascination and fear, and provided constant fodder for social experimentation. All debates about electronic media in the twentieth century begin here, in fact. For if it is the case, as it is fashionable to assert, that media give shape to the imaginative boundaries of modern communities, then the introduction of new media is a special historical occasion when patterns anchored in older media that have provided the stable currency of social exchange are reexamined, challenged, and defended.

The present study is not, therefore, an effort merely to extend the traditional time line of electric media. It introduces issues that may be overlooked when the social history of these media is framed exclusively by the instrument-centered perspective that governs its conventional starting point. It argues that the early history of electric media is less the evolution of technical efficiencies in communication than a series of arenas for negotiating issues crucial to the conduct of social life; among them, who is inside and outside, who may speak, who may not, and who has authority and may be believed. Changes in the speed, capacity, and performance of communications devices tell us little about these questions. At best, they provide a cover of functional meanings beneath which social meanings can elaborate themselves undisturbed.

If artifactual approaches foster the belief that social processes connected to media logically and historically begin with the instrument, then new media are presumed to fashion new social groups called audiences from voiceless collectivities and to inspire new uses based on novel technological properties. When audiences become organized around these uses, the history of a new medium begins. The model used here is different. Here, the focus of communication is shifted from the instrument to the drama in which existing groups perpetually negotiate power, authority, representation, and knowledge with whatever resources are available. New media intrude on these negotiations by providing new platforms on which old groups confront one another. Old habits of transacting between groups are projected onto new technologies that alter, or seem to alter, critical social distances. New media may change the perceived effectiveness of one group's surveillance of another, the permissible familiarity of exchange, the frequency and intensity of contact, and the efficacy of customary tests for truth and deception. Old practices are then painfully revised, and group habits are reformed. New practices do not so much flow directly from technologies that inspire them as they are improvised out of old practices that no longer work in new settings. Efforts are launched to restore social equilibrium, and these efforts have significant social risks. In the end, it is less in new media practices, which come later and point toward a resolution of these conflicts (or, more likely, a temporary truce), than in the uncertainty of emerging and contested practices of communication that the struggle of groups to define and locate themselves is most easily observed.

Electrical and other media precipitated new kinds of social encounters long before their incarnation in fixed institutional form. In their institutionally inchoate manifestations, they inspired energetic efforts to keep outsiders out and insiders under the control of the proper people. Chaotic and creative experiments with new media and thought experiments with their imaginary derivatives attempted to reduce and simplify a world of expanding cultural variety to something more familiar and less threatening. That impulse fixed on one-way communication from familiar cultural, social, and geographic perimeters as a preferred strategy to two-way exchange, with its greater presumption of equality and risks of unpredictable confrontation. Classes, families, and professional communities struggled to come to terms with novel acoustic and visual devices that made possible communication in real time without real presence, so that some people were suddenly too close and others much too far away. New kinds of encounters collided with old ways of determining trust and reliability, and with old notions about the world and one's place in it: about the relation of men and

women, rich and poor, black and white, European and non-European, experts and publics.

Discussions of electrical and other new forms of communication in the late nineteenth century begin from specific cultural and class assumptions about what communication ought to be like among particular groups of people. These assumptions informed the beliefs of nineteenth-century observers about what these new media were supposed to do, and legislated the boundaries of intimacy and strangeness for the close and distant worlds they presented to their audiences. How new media were expected to loosen or tighten existing social bonds also reflected what specific groups hoped for and feared from one another. Finally, concerns about how practices organized around new media would arbitrate the claims of antagonistic epistemologies contending in the public arena were rooted in group-specific beliefs about how the world could be known, and how other groups than one's own imagined it to be. Those who wrestled with these puzzles did not think in terms of the articulated mass media we know, since these inventions were still experimental and their exact shapes vague in the public and expert mind. They thought in terms of devices doing duty in familiar surroundings: the telephone, electric light, phonograph, cinema, wireless, and, always in the background, the telegraph.

This study focuses especially on two inventions on this list that have been regarded as least relevant to twentieth-century media history. The first is the electric light, which is ordinarily not thought of in connection with communication at all. The second, the telephone, has not been considered a medium of *mass* communication. Nevertheless, the telephone was the first electric medium to enter the home and unsettle customary ways of dividing the private person and family from the more public setting of the community. The electric light was the great late-nineteenth-century medium of the spectacle, dazzling its audiences with novel messages. In much social imagination, it was the premier mass medium of the future. Because the telephone and the electric light were the most technically and socially developed communications devices in the last quarter of the nineteenth century, experts and laymen found them good to think, to paraphrase Lévi-Strauss, about what media systems of the future and the societies that supported them might be like. They were also the most widely experimented with.

It is impossible to separate public discussion of innovations in communication in the late nineteenth century from public fascination with the fruits of electrical possibility generally. This is partly because

"electricians" and their associates were the earliest users and closest observers of electric media. Media historians have scarcely noticed this convergence. Focused on the point of mass production, artifactual communications history has failed to recognize that electricians were as deeply involved in the field of cultural production as in the field of technical production. Technological historians also have treated electricians exclusively as technical actors, accepting mostly at face value the boosterism of their professional rhetoric. As citizens with attachments to families, communities, and social amenities as strong as any that connected them to their profession, their role was somewhat different, however. The stamp of society on them was nowhere more visible than in their uneasiness about the impact of new media on family, class, community, and gender relations. The ambivalence that so much characterizes contemporary regard for electronic media did not originate with twentieth-century radio and television, but in threats to social interaction set up by their nineteenth-century prototypes.

The temptation to derive social practice from media artifact has also supported another notion, common to media analysis, that separate media embrace distinct and self-contained codes, or spheres of interpretive activity. Concrete arenas of communication are always more complex than this. In the late nineteenth century, oral-gestural and literate codes were both projected onto electrical devices and events in the struggle to claim and label these new and important objects for social consumption. In general, literate practices were the self-consciously exclusive domain of electrical experts. To be an expert was to have knowledge based on technical texts. We can learn a great deal about how electricians and other social groups constructed the social world by observing their uses of texts, and their evaluation of others' uses as well. Groups without recourse to special textual expertise approached the electrical unknown directly, learning with their bodies what it was and what their relationship to it should be. Though deeply distrusted by experts as an instrument of naïve empiricism or folk wisdom, the body was a popular probe for making strange phenomena familiar. Even experts found it difficult to resist.

Many of the stories that constitute the evidence for this study describe real events. Others do not, but were treated by contemporaries as if they did. Still others are unselfconsciously extravagant media fantasies. This is as it should be, since fantasies and dreams are important human products that define limits for imagination. Fantasies help us determine what "consciousness" was in a particular age, what thoughts were possible, and what thoughts could not be entertained yet or any-

more. The point frequently has been made that private dreams are systematic in content and impulse. Dreams and fantasies created, exchanged, and reworked in the public forum are systematic as well. They develop their own traditions in the conversation society has with itself about what it is and ought to be. Such dreams are never pure fantasy, perhaps, since their point of departure is a perceived reality. They reflect conditions people know and live in, and real social stakes.

This exercise in communications history is not, in sum, a history of media in the usual Laswellian sense of the set of sluices through which societies move messages of particular types. Media are not fixed natural objects; they have no natural edges. They are constructed complexes of habits, beliefs, and procedures embedded in elaborate cultural codes of communication. The history of media is never more or less than the history of their uses, which always lead us away from them to the social practices and conflicts they illuminate. New media, broadly understood to include the use of new communications technology for old or new purposes, new ways of using old technologies, and, in principle, all other possibilities for the exchange of social meaning, are always introduced into a pattern of tension created by the coexistence of old and new, which is far richer than any single medium that becomes a focus of interest because it is novel. New media embody the possibility that accustomed orders are in jeopardy, since communication is a peculiar kind of interaction that actively seeks variety. No matter how firmly custom or instrumentality may appear to organize and contain it, it carries the seeds of its own subversion.

If new communications devices were vehicles for navigating social territory in the late nineteenth century, it is clear that some of the maps constructed for them are fabrications we have sought to dismantle in the twentieth. It is useless to scold nineteenth-century engineers for their failure to be twentieth-century feminists or champions of civil rights, but it may be useful to understand how electrical experts and their publics projected their respective social worlds onto technology in the late nineteenth century, and what justifications and fears motivated them in this. It is also important to notice that communications technologies that prepared the way for twentieth-century media were built to uphold a scheme of social stratification that has attracted sustained contemporary challenge. This, as much as anything else, is a measure of how we have changed.

1

Inventing the Expert

Technological Literacy as Social Currency

> The poem is a standardised one, in that it is passed on in a particular context; by selected people and in a special style, people are encouraged to listen to and then recite the myth and a premium or reward is given to those who can do this well.
>
> —Jack Goody, *The Domestication of the Savage Mind*

> "Any opinion mankind has held that has not been through the crucible of science is probably wrong."
>
> —A[mos] E. Dolbear, "The Science Problems of the Twentieth Century," *Popular Science Monthly,* 1905

Electrical professionals were the ambitious catalysts of an industrial shift from steam to electricity taking place in the United States and Western Europe at the end of the nineteenth century. According to Thomas P. Hughes, Alfred Chandler, and others, that shift was made possible by key inventions in power, transportation, and communication, and by managerial innovations based on them that helped rescale traditional systems of production and distribution.[1] The retooling of American industry fostered a new class of managers of machines and techniques; prominent among them were electrical professionals. The transformation in which these professionals participated was no class revolution, as David Noble has pointed out.[2] Their job was to engineer, promote, improve, maintain, and repair the emerging technical infrastructure in the image of an existing distribution of power. Their ranks included scientists, whose attention was directed to increasingly esoteric phenomena requiring ever more specialized intellectual tools and formal training, electrical engineers, and other "elec-

tricians" forging their own new identity from an older one of practical tinkerer and craft worker. Servingmaid to both groups were cadres of operatives from machine tenders to telegraph operators, striving to attach themselves as firmly as possible to this new and highly visible priesthood.

Electrical experts before 1900 were acutely conscious of their lack of status in American society relative to other professional groups.[3] The American Institute for Electrical Engineers (AIEE), founded early in 1884, was the last of the major engineering societies to be organized in the nineteenth century.[4] Professional societies had already been organized by civil engineers in 1852, mining engineers in 1871, and mechanical engineers in 1880. The prestige of other groups in the engineering fraternity, especially civil and mechanical engineers, came less from membership in professional societies, however, than from other circumstances. Their practitioners hailed from the upper and middle strata of society, were often products of classical education, and had developed distinctive professional cultures of their own well before the formation of their national organizations. This gave them an established and even aristocratic niche in society.[5]

None of this was true for electrical engineering, which had emerged only in the decade before the founding of the AIEE, and which by the time of its organization had achieved no clear consensus about the meaning of the term *electrical engineer*. The broader title *electrician* was equally vague.[6] It appeared as a distinct census category for the first time in 1860, but despite a flourishing telegraph industry, only 12 practitioners were reported. Not until 1900 were electricians mentioned separately again, when 50,717 workers were so classified.[7]

Before 1900, as Robert Rosenberg has written, the electrical work force comprised a motley crew from machine tenders to motor designers and from physicists to telegraph operators, all sharing in some fashion the title *electrician*.[8] Anyone interested in electricity might claim it, and many did. "It is doubtful whether any man present over thirty years old selected any application of electricity, with the exception of the telegraph, as a means of livelihood in the sense that a youth would select a trade or . . . professional avocation," one of those professionals reminded his colleagues at the first annual meeting of the Electric Club in New York in 1887.[9] His exception for telegraphy was not much of an exception, since telegraph operators enjoyed scant occupational prestige compared with other electrical professionals.

A number of trade and technical journals were witness to the occupational and status anxieties of electricians. The first general weekly electrical paper for professionals in the United States was *Electrical Review,* founded in 1883. *Electrical World,* perhaps the major electrical industry journal in the United States in the late nineteenth century, claimed the largest circulation and boasted more than seventeen thousand readers by 1895. These and other journals like *American Electrician, Electrical Engineering, Western Electrician,* and, to a lesser degree, popular science journals like *Scientific American* kept readers abreast of the latest in electrical innovations and scientific findings bearing on their craft, promoted and recorded professional meetings and activities, and commented on affairs of industry and politics that affected the electrical profession. In contrast to the loftier AIEE *Transactions,* these journals addressed not only academic and practicing scientists and engineers, but also foremen, superintendents, designers, managers, entrepreneurs, and other workers in the field of commercial electrical application. Without exception, these journals subscribed to the argument that electrical experts were entitled to greater social position and respect, a quest officially framed as the pursuit of proper standards and career experiences for training future electrical workers.

Scattered throughout the technical reports and documents that constituted the primary focus of this literature was a secondary content of social news, editorial comments, and short anecdotal articles that provided a less earnestly self-conscious arena of discussion. Its ostensive subject matter was the movement of an expanding and varied culture of electricity through the larger society. It included excerpts from the lay press, material quoted incestuously back and forth from other journals—a widely acknowledged and generally accepted practice—and tales attributed to every imaginable source. The casual tone and location of this material, at the interstices of the strait-laced technical and professional documents which announced that electricians were busily engaged in their calling, made it ideal for expressions of the concerns closest to their hearts.

The industry in which these workers labored, and to which their concerns were directed, was significant and growing. At the beginning of 1890 one journal estimated that $600 million had been invested in the electrical industry of the United States, 250,000 people depended on it for their livelihood, one million miles of telegraph wire had been strung ("enough to circle the globe 40 times," crowed one expansionist metaphor), and 1,055,500 telephone messages from 300,000 instruments were daily buzzing over 170,000 miles.[10]

Electrical Textuality

Brian Stock has given us the term *textual communities* to describe groups that rally around authoritative texts and their designated interpreters.[11] Stock's work addresses certain realignments of medieval discourse, in particular what he regards as an original divergence between popular and high culture. His notion provides a useful starting point for considering other textual communities, their spokespersons and interpreters, and their relationships to less lettered communities. In the late nineteenth century, aspiring electricians placed scientific textuality and certified interpreters of scientific texts at the center of their claim to public authority, and attempted to persuade those less technically lettered of the validity of that strategy.

The notion of scientific textuality appeared over and over in discussions of professional standards. The editors of the *Electrical Review* praised the young American Institute of Electrical Engineers for the "large number of valuable papers touching upon almost every branch of the electrical industries," and expressed concern that the level of discussion at meetings of that and other societies, including the New York Electric Club and the older New York Electrical Society, was rarely up to the level of the papers themselves. They urged technical societies to bear in mind "that the proceedings are read and studied by electricians the world over."[12] Documentary procedures were so central to electrical engineering practice and research that it is not inaccurate to use the term *technological literacy* to describe a range of professional competencies that at their core valued skill in interpreting technical documents. Electrical engineers and researchers fully intended that these literate skills and the theoretical knowledge they embodied replace the skills of the tinkerer and craft mechanic, skills governed by an authority of the body that arrives at truth from the direct experience of the senses.

Broadly speaking, four communities accepted the expert authority of electricians and their texts in the late nineteenth century, or at least were addressed by electricians as if they did. Together these communities were organized around a presumptively shared, but distinctively practiced, epistemology of texts and interpretive procedures that were sanctioned by certified authorities arranged in roughly concentric circles of expertise. First was the select readership of theoretical and entrepreneurial electricians addressed by every kind of professional and technical literature. Professional societies were important to this textual community as well, since most of their meetings were referenced to texts around which the mutual interests of their members revolved. A second textual community collected around the literature of popular science that aped conventions of expert presentation, and sometimes the mantle of professional and scientific authority as well. This was the group, explained the authoritative British *Electrician,*

> whose earnest efforts give a far greater publicity to our notes and to many of our articles than we ever contemplated. These people are more accustomed to wield the paste and scissors than the pen, and we presume it is due to their lack of familiarity with the latter auxiliary that they so seldom mention the title of the paper to which they are indebted for their matter.[13]

Suspiciously monitored by the professional press for sensational tendencies, this community aimed primarily at a popular audience of enthusiasts. The circle of interpreters it accepted as legitimate was larger, looser, and less differentiated than in the more strictly accountable professional press.

A third community was constituted in the flow of information, characteristically in one direction, from electrical experts as accredited interpreters directly to lay audiences, generally of the middle class. It made itself heard in the oral channels of lecture and lyceum, and in articles written for middle-class literary journals like *Fortnightly Review*. This was the audience idealized in a description of a standing-room-only crowd at the Royal Institution on the occasion of a lecture on wireless telegraphy by Guglielmo Marconi:

> As usual, the assembly was a mixed one, from our neighbour who regretted he had not had time to read up the subject in the "Encyclopaedia Britannica" beforehand, to the scientist who came with the hope of hearing the announcement of a new discovery. The audience also included a large proportion of the fairer sex, a number of whom were old *habituées*.[14]

These exchanges were disseminated to a still larger audience by the popular press, which often reported on these occasions, but rarely in a manner satisfactory to expert eyes. To the dismay of electrically literate elites, the popular press embraced colorful charlatans as enthusiastically as it did certified experts. This popular press and its electrically unlettered audience constituted a fourth textual community. From time to time the professional electrical press offered the gatekeepers of the popular press suggestions for improvement. "Although we have never been enthusiastic advocates of science for the multitude," wrote

the *Electrician* in 1882, "we would certainly make an exception in favour of newspaper editors. In the interests of the public, for whom the journalist professes to live, he might, one would think, include a smattering of science in his professional training."[15]

Of special interest is Stock's account of the challenge to religious orthodoxy mounted by heretical and reforming communities that took the principle of textual authority to heart, but applied its logic in new and unanticipated ways. Debates over competing interpretations of sacred text brought the communities sponsoring them into conflict. Their disagreements were rarely about the priority of textual authority, or even about broad principles of legitimate interpretation. Their differences concerned substantive points of interpretation and the doctrinal implications of these differences, not least among them disagreement about the valid sources of religious authority in this world.[16] If the community of electrical professionals had less at stake than the medieval church, it too was challenged by the very groups it hoped to convince of its unassailable textual authority, and this for the simple reason that it had made electricity too fascinating a topic for popular culture to leave alone.

A recurring theme in the study of literacies past and present is how skills and techniques for performing particular literate practices are transferred from communities of adepts to less skilled communities. What is not so easily transferred is the specific cultural setting and world view that gives significance to these practices from the point of view of the bequeathers.[17] This is part of the historical irony by which medieval religious elites were beset by the very groups they had intended to control. Borrowing elite rules of interpretation, these less powerful groups constructed a textual exegetics shaped to their specific needs and experiences of the world. Wherever their interpretations were resisted by established textual communities, believers in textual authority took on, often fiercely, those who had taught them the importance of the principle. Confronting a similar if less intense challenge, late-nineteenth-century electricians stood guard over popular efforts to interpret electrical phenomena in ways that seemed to undermine the credibility of scientific experts. Though generally convinced of both the magic efficacy of electricity and the authority of the magicians who manipulated it, popular interpreters drew their own conclusions when it suited them.

But this is the limit of the analogy. Where Stock's concern is with a world in which reverence for textual authority inspired those who were disbarred from membership in elite textual communities to invent

a *popular* textual culture, our concern is with the effort of electrical professionals to invent themselves as an *elite* in the late nineteenth century. To this end, much of the literature of electrical mission was occupied with sorting and labeling insiders and outsiders in electrical culture. Technological literacy, in the sense defined here, was critical evidence for such distinctions. The proper naming of persons, gadgets, and concepts in their electrical contexts and relations was among the most important performative indicators of technological literacy, even though contemporaries coined no distinct term for this skill. What it meant to possess the skill of electrical naming and understanding was worked out in thousands of examples in the literature, all of which explored codes of meaning attached to electricity in society. Absent this contemporary effort to take the *social* measure of technological literacy, specific technical skills and performance criteria could have no real existence or application.

Occasionally, those outside the boundaries of textual demarcation fashioned by experts refused to defer to those limits or recognize the social and professional privileges attached to them. When this happened, deception of the less by the more literate was considered an acceptable and even necessary option to keep these boundaries secure. The professional literature exhibited scant interest in whatever ethical questions might be involved in deceptive manipulations to achieve power over the less expertly informed. Most of the time, such maneuvers were not even explicitly defended, since knowing when and how to execute them was a marker of group solidarity, the more so the more restricted and exclusive the level of electrical literacy.

Insiders and Outsiders

Much of the electrical literature described above and a significant portion of the technical literature it supplemented explored social relations between electrical insiders and outsiders around textual concerns. Electricians were wont to indulge a powerful impulse to identify aliens and enemies, those suspect in electrical culture and perhaps dangerous to it, in terms of their textual competence. Outsiders were defined as those who were uneasy and unfamiliar with technical procedures and attitudes, especially literate ones. By a supplemental logic of explicit social control, any additional marginality of race, class, gender, or lifestyle was taken as confirming alien status. The effort to identify outsiders by textual cues naturally raised the reverse issue, namely,

who had legitimate claim to the title *electrical expert,* and by what literate deeds they could be recognized and certified in the expert arena and in society at large. The literature of electrical mission also occupied itself with the problem of what legitimacy to confer upon an admiring public's efforts to interpret the world of electrical science and engineering, especially when the conclusions it reached ranged far afield of textually disciplined expert notions, and especially when experts' own goals were to harness public adulation to improve their own social and professional standing while keeping public admirers at arm's length. One official boundary at which electrical insiders and outsiders met was negotiated in a currency of promises given by insiders to outsiders, that is, by experts to publics, and equally in expectations held by laymen concerning their right to share in an electric prosperity made possible by public recognition and indulgence of expert ingenuity. Expert and popular literature alike monitored the rhetoric of reciprocity, watchful for any breach in the vague but binding bargain between experts and their publics in behalf of electrical progress. Experts, for their part, frequently took their erratic publics to task, as often for believing too little as for believing too much.

Electrical experts attended to several gross indices of technological literacy. An ad for an "Experienced Electrical Engineer" in one journal sought an aspirant "well up in Electro-Mechanics, good at experimenting and technical reports." Documentary skill was thus cited as a fundamental professional qualification, and being "well up" on electromechanics implied an ability to follow the latest technical literature. "Only one person out of every two thousand in this country reads the electrical journals," *Electrical World* estimated in 1889, surmising as to what the size of the community of electrical literates might be.[18] The *Electrician* portrayed a fictional proprietor praising his newly hired engineer for both his electromechanical skill and the command of literate procedure that flowed from his specialized textual knowledge.

> "How does your electrical engineer go on?"
>
> "Oh, very well, we never know what a break down is since he came, and if we want to make any alterations or to put up any new apparatus . . . he brings me the order to sign, or gives his estimate, and that is all I know till I see the thing working."[19]

Claims to expertise on the basis of textual credentials could be challenged if the claimant were clearly a social outsider, since textual cues were expected to signify appropriate social circumstances. "A

dirty-looking young man once called upon us," the London *Telegraphist* wrote, "handing a well-thumbed type-printed card, bearing the unwashed one's name, followed by the word *Electrician.*"[20] The young man had presented textual evidence worthy of consideration, but nothing else was consistent. His appearance made his claim suspect, and his name did not connect him to a network of familiar insiders. The verdict of these signs was confirmed in the final test, which revealed the young man's conversation to be technically improficient. He was an electrician by textual pretense alone, utterly lacking the extratextual finish assumed to accompany authentic technological literacy.

Even laymen were expected to possess some literate skills for coping with electrical technology. Those who were socially positioned to know this assumed inventive poses if their skills were not up to par. A "quite respectable-looking young woman" asked the receiving operator to write down her telegraph message for her, since she could not do it herself with her gloves on. Her ruse implied a minimum standard of literacy expected of an enlightened citizenry for coexisting with the practical aspects of electricity, and clearly associated with other visible signs of class. This story also portrayed telegraph operators as a highly literate lot, admirably sensitive to these class cues by virtue of their occupation, and possessors of an admirable humanity that provided a showcase for technical prowess:

> It is quite a common thing for people, both men and women, to ask us to do their writing for them. I guess anyone would be astonished to find out how many people there are who are hardly able to spell their own name, much less write a legible letter or telegraphic message. These are principally English people of the working classes, who have only been in this country a short time. Nearly all born Americans can write. They tell me that in England the laboring people are very seldom able to read and write, especially in the mining and manufacturing districts. . . . They will pretend . . . they have sprained their wrists, or have their gloves on, or can't write with our pens, and we have to look serious, while all the time we see through their dodges perfectly.[21]

Stigmatizing the Unempowered: Rural, Female, Nonwhite

The professed goal of authoritative discourse in electrical journals and at conventions was to debate technical problems and to discuss whatever social and professional concerns might bear on them. Electricians

did not hesitate, however, to extend their concerns beyond the boundaries of professional culture, though they did not consider their own preserve equally permeable to opinion from without. To electricians, other social groups were faintly contemptible, definitely so if their members ventured into unfamiliar expert territory.

Criteria for distinguishing electrical insiders and outsiders were clearest in jokes of internal cohesion that provided light features and filler in the electrical press. They poked fun at how outsiders attempted to navigate codes and procedures electrical insiders took for granted. The usual targets of this humor were black, foreign, rural, or female, despised groups in the system of caste that experts shared with the larger society. Persons of rank and privilege were capable of earning the hostility of electricians, but never appeared quite so ridiculous as those who provided a readier target for social scorn. An official of the Edison General Electric Company recalled that he and Thomas Edison had once called on one of New York's "biggest" millionaires to discuss installing electric lights in the millionaire's mansion. During the conversation, the millionaire asked whether Edison could install an electric motor to run the steam engine that operated his passenger elevator.[22] This was a joke, but a mild one. Its narrator was only bemused by what "the outside world knows about electrical matters"; comments about less exalted groups were more likely to elicit complaints about the futility of expecting marginal groups to understand and appreciate what electricity could offer. In their efforts to reorganize a social hierarchy with no definitely settled place for them, experts sometimes measured themselves against those whose power they expected to decline in a world of new forms and correspondingly new structures of influence. The trade journal *Lightning* pilloried diplomatic verbosity, a traditional signifier of aristocratic social class and high political authority, as incongruous in the telegraphic domain, into which diplomacy had begun to pass from the more dignified arena of oral and written exchange:

> What a magnificent thing it would be for the Post Office if everyone telegraphed at the same length as certain Emperors and Princes. "William" contrived to get 112 words into a simple message to Bismarck to the effect: "Only just heard of your illness. Come and put up with me"; and Bismarck broke his record by telegraphing in 206 words the reply: "Thanks. Sorry it cannot be managed."[23]

Still, jokes in the electrical press were aimed mostly at those with little social power, occupying either the conditions of misery that electrical progress was supposed to alleviate or positions that would have to move aside to make room for electrical success. In asides and anecdotes, electrical experts thus defined themselves as much by the groups from which they chose to disassociate themselves as by those with whom they sought alliance. The *Albuquerque Journal* narrated the story of Royal Wilson, a black man elevated, by the sudden illness of the headwaiter in the hotel where he worked, to his boss's post. When it was time to extinguish the electric lights in the dining room, Wilson, a man cast loose from his social moorings, found himself in a state of "painful uncertainty." He decided, explained the *Journal* with malicious irony, "that the simplest way out of a difficulty is always the best."[24] Leaning precariously from a chair perched on a table, he blew "until his eyes bulged out and the sweat trickled in rivulets from his features." This image was a familiar racial stereotype, and these were the desperate gestures of one to whom a technology based on something besides muscle power was an impenetrable mystery.

Not knowing how to turn off the lights was a familiar comic theme. A cartoon in an illustrated paper showed Uncle Hayseed in a New York hotel inverting his large, rude boot over the lamp after many futile attempts to blow it out.[25] In another story, a puzzled rancher at a Seattle hotel finally succeeded in uncoiling the wire from which the lamp in his room hung, so that he could stuff it into a bureau drawer to extinguish it.[26] Humor at the expense of powerless groups established a social floor above which electricians felt comfortably smug. The professional journal-reading community could bask in the social assurance of their own society pages, since their journals were read by a small, mutually acquainted community.

Other stories contrasted rural credulity with urban sophistication, and satirized practitioners of mechanical technology who seemed unable to accommodate electricity:

> The telephone is a puzzling mystery to the rural mind that tackles it for the first time. For instance, a countryman approached a telephone man in Boston the other day with the following interrogation: "Now, mister, what makes the thing work? Thar's yer wire and thar's that 'er trumpet and all that, but ain't thar suthin' aside o' that? Whar's the steam, the *push* to the thing? What makes the talk go 'lang so? *What greases the derned thing?*"[27]

The joke is on the bumpkin who clings to his anachronistic mechanical model of technology in a world where reasonable people know better. His status as an outsider is manifest in this error. To underline that

status unmistakably, his ungrammatical dialect appears in pointed contrast to an elite facility with genteel language and expression, and it is implied that electrical experts, as readers of the story, belong to this more desirable group.

The outsider as stock rural character appeared in the *Sacramento Record-Union* as a "raw California granger" in a story about the social mischief of technological ignorance. The story is presented by an omniscient narrator who occupies a logically impossible vantage point for observing the mutual frustration of granger and expert without either's knowing the full set of story events. The story is a moral fable of social relations borrowing the dramatic force of a putatively factual account. A reluctant granger found it necessary to use the telephone. He approached it "timidly," eyed it "cautiously," and, taking a pencil, began to write on a piece of paper.

> He then rolled up the paper and tried to push it in the aperture in the transmitter. Failing in his attempt with his finger, he took his lead pencil and jammed it in, destroying the vibrating plate. With an air of satisfaction he took his seat and awaited a reply. After about ten minutes he became discouraged, and thinking he perhaps had not sent the message on the right line, he wrote another and jammed it into the hand telephone, and to make sure work, rammed it home as he would a ball in a rifle.[28]

The puzzled granger departed after another half-hour wait, and a secretary entered the room. He discovered the telephone "stuffed full of manuscript and ruined." When the instrument was dismantled and all messages had been removed, they were all found to read: "Bakker and Hammeltonn—Send me to the Pavillion a six inch long munkey rench. Yurs Trully J. E."

The granger signifies an economic order attached to the land and wedded to inelegantly mechanical procedures unsuited to the complexities of electricity. The granger is doubly illiterate, and this makes him dangerously destructive in a technically sophisticated world. Not only are his actions premised on an incorrect analogy between written literacy and the telephone; he is not even proficient in the written literacy on which his actions are modeled. He is also a threat to property, though the electrical order is ultimately victorious, since he must pay for the damage he causes. The proprietor of the telephone fences it off with a "Beware of the Dog" sign to deceive functional literates who, like the granger, lack the critical capacity, associated with more sophisticated literate skill, to question what they read. By an unspoken

principle that informs all this literature, the technologically marginal are deemed deserving of deception at the hands of those with greater skill.

Along with textual competence, other gross indicators of technological literacy included skill in operating electrical machinery and, always, sensitivity to the social conditions and constraints surrounding the exercise of those skills. Unhesitating appreciation of the virtues of new electrical technologies and the experts who oversaw them completed the list. In the realm of electric communication, this last condition implied an absolute belief in its uniqueness, and the refusal to entertain any notion that electric communication merely extended or speeded up oral and written communication, or was an equivalent substitute. By its very nature, in other words, it was not subject to existing social rules. It was truly new, and rules for using it owed nothing to the past, but only to engineers bent on creating the future. It was a short step from perceptions of electrical communication as a phenomenon outside the realm of personal or cultural values to the conclusion that expert-prescribed instructions for its use were not the mutable product of human custom, but given in nature itself.

To agree with these facts as electricians understood them was to embrace a model for prosecuting electrical communication with brevity and efficiency. Obedience to it distinguished those whose "correct" perceptions encompassed a larger, more sophisticated world of technology from those whose imaginations played on smaller, less impressive stages. Typical was the story of a baker's assistant whose wife was gravely ill, and who seized on the telephone as just the thing to persuade his sister-in-law to come home at once. He rushed to his former employer's establishment and asked to use the instrument there. This detail emphasized the main point, the social distance between the technologically initiated and uninitiated. Permission granted, the butt of electrical amusement stepped up to the telephone. "Then without ringing up the central station and getting connection, without taking down the ear tube, he just hallooed into the hole: 'Kitty, come home! Mary's sick!' and vanished before anybody could stop him."[29] It developed that Kitty could not be reached by telephone where she worked, but such had been her brother-in-law's faith in the telephone that he thought "all he had to do was to speak into the instrument and it would carry the message anywhere he desired."

Electricians were amused at the miraculous powers vested in devices for electrical communication by the technologically naïve. These powers displayed the features of the oral and written models they were

based on, few of the unique capacities of electrical communication, and additional magical capabilities that to experts were inconceivable for *any* mode of communication. A popular misconception was that telegraph and telephone messages were written down and physically transported over the wire. In the earliest days of telegraphy, "even fairly educated people believed that the paper passed along inside the wire," reminisced a British railwayman in 1890.[30] Now, he implied, only the most socially marginal could make this error.

Some enthusiasts imagined that electrical communication was mysteriously enhanced oral discourse in which speakers and listeners were seen as well as heard, just as if their conversation were face-to-face. In one story, an office boy in a business house in Aberdeen, a "raw country youth" speaking the patois of humble station, was minding the telephone in his master's absence.

> When first called upon to answer the bell, in reply to the usual query, "Are you there?" he nodded assent. Again the question came, and still again, and each time the boy gave an answering nod. When the question came for the fourth time, however, the boy, losing his temper, roared through the telephone:
>
> "Man, a' ye blin'? I've been noddin' me heid aff for t' last hauf 'oor!"[31]

Featured in many stories was the frustration of the technologically unempowered, expressed as anger, fright, or other loss of personal control. These displays contrasted with the cool bearing of the professional, whose perfect awareness was accompanied by an equally flawless emotional control that suggested social and moral superiority. Uncontrolled emotion was displayed by men who were victims of their own technological ignorance, who had somehow shirked their responsibility to be technologically informed.

The Special Case of Women

Women's ignorance, on the other hand, was ignorance even of the extent of their electrical incapacity.

> A gentleman, talking with a young lady, admitted that he had failed to keep abreast of the scientific progress of the age. "For instance," said he, "I don't understand how the incandescent light, now so extensively used, is procured." "Oh, it is very simple," said the lady, with the air of one who knows it all. "You just turn a button over the lamp, and the lights appear at once."[32]

Technical ignorance as a form of worldly ignorance was a virtue of "good" women, as they invariably were in the professional literature, where encounters with "bad" women were not discussed. Unlike men, women in the stories related by professional journals rarely learned from their mistakes in using technology, or corrected their misconceptions. They were sheltered from all such practical demands by an old and sturdy code of chivalry that required the protection of their ignorance by men. Beneath this habit of indulgence was the more important and even insistent point that women's use of men's technology would come to no good end. In keeping with the general portrait of women as impotent, even their most exasperating errors usually had little more consequence than inconvenience to themselves, of which they were varyingly aware, and some slightly larger measure of frustration and inconvenience for their male protectors.

In the picture painted by electrical journals, the model of electric communication that came naturally to women and led them astray was the loquacious oral sociability of their everyday lives. Talkative women and their frivolous electrical conversations about inconsequential personal subjects were contrasted with the efficient, task-oriented, worldly talk of business and professional men. A hypothetical telephone conversation between two women in the *Electrical Review* of 1887 demonstrated the incomprehensibility of the telephone to a feminine construction of the world. The conversation began this way:

> Mrs. Wary (at the telephone)—"Hello, hello, Exchange." After waiting some time without a reply, Mrs. Wary, in more vigorous tones, pipes out "hello." Still no reply, whereupon Mrs. Wary softly murmurs so that the telephone will not hear her, "Well, I declare, if I don't believe I forgot to ring. How stupid." Which was a fact. Mrs. Wary then rings with a vigor and persistence without doubt intended to make up for her previous omissions, and is answered by the exchange.
>
> "Connect me with number—number" (in an aside) "bless me but I've forgotten the number," (she so informs the exchange, but is finally put in communication with her friend, Mrs. Prim, when the following conversation ensues):
>
> Mrs. Prim—"Is that you, Mrs. Wary?"
>
> Mrs. Wary—"Why, of course, it is. How did you happen to call me up, I was just going to call you up. Isn't it nice."[33]

The women discuss the good looks of several local pastors and gossip about fashion and dressmaking. To experts their conversation is trivial and uninformative, and could be as easily managed face-to-face. At

the end of the conversation their failure to understand the urgent and serious nature of telephone talk is especially clear.

> Mrs. Prim—". . . But what a nice talk we've had. It's a wonder that the horrid girl at the exchange has not shut us off before this time."
>
> Mrs. Wary—"So it is. I've forgotten now what I called you up for, but I guess it's of no consequence, so good-bye."

Women appeared as the parasitic consumers of men's labor in most stories of their electrical ignorance. Many of these stories turned on wives and girlfriends instructed to send telegrams or make telephone calls to reassure those charged with their care of their safe arrival at distant destinations. Predictably, these women failed to understand electrical messages the way their male protectors did, as scarce and expensive commodities. To women, electrical talk was a delightfully extravagant extension of face-to-face intimacy, almost a free good. Men found themselves caught by their obligation to a traditional code in which women were not supposed to understand the stern masculine world of electrical knowledge, while men were supposed to live by its rules. Men were forced either to choose the displeasure of the women they loved or to pay profligate sums incurred by wives, girlfriends, and sisters for lengthy telegrams and phone calls. Chivalry bade them choose the second alternative, and this financial sacrifice, characteristic of modern knighthood, was appreciated least of all by the women for whom it was made.

In contrast to men, women valued conversation that was redundant, frivolous, playful, and abundant. Such excess bespoke an affectionate devotion to their partners, manifested in a generous willingness to communicate. In return, they wanted their male partners to speak to them the same way. For women, instrumental information about the world outside the personal relationship that was the real subject of any electrical conversation was irrelevant. Women regarded the brief, efficient transmissions prized by men as an evasion of the relationship that they assumed it was the point of any communicative exchange to cement.

Men, by contrast, wanted control of all communication conducted through the technology that belonged to them. Rules of expertise that invested the knowledgeable with power over the less knowledgeable transformed stories of women's electrical ineptitude into homilies that justified men's control of women's communication. *Chambers's Journal* published a story from the "infancy" of the telegraph about one

elderly lady's conviction that telegraphy should follow the rules of propriety familiar to her from a lifetime of nontelegraphic communication. The telegraphist at the counter of London Central Station, "to whom it really occurred," received from this lady a sealed, addressed envelope containing the message she wished to send. She was indignant when the clerk opened the envelope, even when he explained that he could not send the message without seeing it. "'Then,' replied the female, in evident ire, 'do you suppose I'm going to let all you fellows read my private affairs? I won't send it at all;' and therewith she bounced out of the office in high dudgeon."[34]

From a male perspective, the usual puzzles of communication between the sexes were exacerbated by technological codes that bound men but that women did not respect. Put another way, male control of female communication was justified by women's ignorance, and should have guaranteed it as well. But women often frustrated it anyway. Annie Bifkins Blank, newly wedded and visiting her mother outside Philadelphia, composed and sent her first telegram to her husband, ten dollars collect:

> Frog Center, Pa., 2 p.m.—George Washington Blank, 43 Blank Street, Philadelphia—My Dear George: I have just arrived safely without any accident at all; not the slightest. The train slowed up at Jinks crossing and whistled, but I don't think anything serious was the matter. It made my heart jump to think how you would feel if anything had been the matter, you know, but there wasn't, not a thing, so far as I could find out. I got to thinking of you and might have been carried past my station if Cousin Will, the one you used to be so jealous about, you know, hadn't been on the train. He is visiting at mother's, and is handsomer than ever. He says he hates you, but of course, that's only fun, you know. I forgot to say that my trunk came through all right. It was no trouble at all. Cousin Will took my check and arranged to have it (the trunk, you know) hauled up to the house. It will have to be taken around by the mill because the other road is blocked up, you know; but, you know, that will only take a few minutes longer than by the other road—the one that is blocked up, I mean. Well, I must close this dispatch, because telegrams have to be short, you know.
>
> Your loving wife,
>
> Annie Bifkins Blank[35]

A similar story in the *New Orleans Times-Democrat* chronicled a broken engagement that resulted from a telephonic misunderstanding. It was told, as most of these stories were, from the masculine point of view:

> "I was in Atlanta a few weeks ago and called up my fiancee in Macon to let her know when to expect me. The service costs 50 cents for three minutes, and I calculated I could deliver my message in about 14 seconds. But after I gave the dear girl the date she insisted on holding me while she told about a lawn fête that some of the young people were getting up for the next day. I wriggled and writhed, and after she had imparted $2.50 worth of details I broke in and told her that somebody else wanted to use the 'phone. 'O no, they don't,' she replied, 'the operator here says you may have it as long as you wish,' and on flowed the legend of the lawn. She told me how all the girls were going to be dressed, what they had cooked for lunch, and how Annie Jones had refused to go with Billy Smith, because it was rumored that Billy played cards on Sunday. I groaned. I had been stuck for about $7, and time was flying at the rate of 16 2/3 cents a minute. 'What's the matter?' she asked anxiously: 'you don't seem interested.' 'Yes, I am,' I said, with perfect truth: 'I am weighing every syllable.' 'Then repeat what I have been saying,' she ordered; 'go all over it and don't miss a word.' That was too much. I yelled: 'Ring off!' and banged the receiver on the hook. Next day I got a package from Macon, returning the engagement solitaire. There was a sarcastic little note in which she said she thought my suggestion about the ring was excellent and had acted upon it at once. Plague take long-distance 'phones! I never want to see one again in my life."[36]

If women of fallen reputation did not exist in the electrical press, women of uncertain reputation did. Not by accident, most of them held jobs in which they operated new technology. Women were most acceptable in the labor force as austere heroines in the pioneer mold, or as devoted servants of indulgent male overseers. Otherwise, they appeared as intruders of dubious ability and fragile reputation. Either they were obedient and servile, no threat to the male world in which they moved, or they skirted the very edge of sexual propriety, a condition that released the men around them from responsibility for their welfare.

An article that instructed readers about how to recognize women telegraph operators out in the Wild West, the symbolic boundary of civilization, where the pressures of savagery against the social virtues represented by women were strongest, typified stories of women workers with selfless and saintly characters:

> Far out on the western plains, wherever there is a road station, almost invariably the traveler sees a pretty lace or muslin curtain at the window, a bird cage hanging up aloft and some flowering plants on the narrow sill, or a vine trained up over the red door . . . and if he looks out as the train stops he will be nearly sure to see a bright, neatly dressed, white-aproned young woman come to the door and stand gazing out at the train and watching the passengers with a half-pleased, half-sorry air. This is the local telegraph operator, who has taken up her lonely life out here on the alkali desert amid the sage brush, and whose only glimpse of the world she has left behind her is this brief acquaintance with the trains which pass and repass two or three times during the day. These are true types . . . of our brave American girl.[37]

The woman who, nunlike, renounced the world or chose to remain isolated in her profession distanced herself from ordinary talkative women, and also did not interfere with men.

Equally virtuous was the woman who joined the electrical work force on account of reversed circumstances, who had something better in mind for herself but was the victim of a fate beyond her control, a situation ripe for rescue by men. A common theme in popular magazine fiction was the lone woman forced by circumstances, met bravely and with cheerful pluck, to make her way as a telephone or telegraph operator. At this labor she captured the heart of a good man who wooed her from that unsheltered and risky occupation to become his wife. Mention was often made of her aspirations to a more dignified station, though she seemed powerless to achieve it herself. "But surely," a Western Union manager in an 1897 short story advised a young woman who had applied for work to support herself and her widowed mother, "with your accomplishments you do not need to be a telegraphist." His applicant, a lady of the better class, replied, "My accomplishments, although expensive to buy, are not very saleable on the market."[38]

Women entered the technical world at the sufferance of men. Over and over it was made clear that they were not the help they should have been. A characteristic anecdote in the *Somerville* (Massachusetts) *Journal* concerned an imaginary conversation between Mr. and Mrs. Brown on the subject of telephone operators, the most visible female workers in the electrical industry. Why, asked Mrs. Brown, predictably the less well informed of the two, were telephone operators usually women? Mr. Brown answered:

> The managers of the telephone companies were aware that no class of employees works so faithfully as those who were in love with their labor, and they knew that ladies would be fond of the work in telephone offices.
>
> "What is the work in a telephone office?" Mrs. Brown inquired further.

"Talking," answered Mr. Brown, and the conversation came to an end.[39]

According to male testimony, women workers could not cast off the orality to which they were inclined and which made them unfit for responsible work in serious environments, though their failings were tolerated with more or less good humor by the men around them. "With a telephone and a wife a man ought to hear all that's going on," joked the *Danbury News* in England.[40]

"Telephone girls in Chicago look black over an order to dress in uniforms of that sable color," said the Judge.

"No wonder they object to black. Yeller would be more appropriate for a telephone girl's uniform," replied the Major.[41]

The exchange room of the Hudson River Telephone Company was where, the *Albany Journal* exclaimed, "15 girls chew gum and chatter all day long. What noise they make!"[42] The oral behavior of these women was the only topic of note, despite their manifest skills as exchange operators performing a range of social and mechanical tasks. Chief among them was speaking to subscribers, accusations of frivolous speech to the contrary. These workers seemed to be doing what women did best and what, judging from the way they were presented, was the only thing they could do in any case—talk. Such stories confined women's skills to an oral arena that at no point encroached on the male prerogative of technological literacy.

The power of the female telegraph operator was also carefully circumscribed. "She will sometimes have about her a number of subordinates of the opposite sex in the form of callow youths and messenger boys," explained the *New York World,* "over whom she queens it with a right royal will and an air of authority that is charming to behold." So long as it was charming. The *World* could indulge the female operator in her command of males who were not yet men, but drew the line at exhibitions of genuine power. "Generally these young women are very pleasant and obliging; only occasionally will one come across a terror, whose very look will freeze him to the marrow."[43]

A contemporary portrait of the telephone girl described her as "pretty—of course she is—she dresses with nice taste." On account of her lovely smile, she did not deserve the wrath of the "old fossil" she had inadvertently connected to an undertaker when he asked to speak to someone at the bank. This story, and many like it, cloaked the verdict that the telephone girl did her job badly in compliments to her femininity. And why not, since her job skills were less important

than the persuasiveness of her feminine charm. Unable to be taken seriously for her technical skills or her "curious" political comments (which were not, it seemed, her own conclusions, but gleanings of overheard conversations), what she did know derived as usual from her special oral skills:

She can tell you if she wants to on what night last week young Smith's baby was taken sick with the colic, and how the worthy *pater* could not be found, but was finally discovered with a congenial party indulging in the fascinating game of draw-poker. But she won't tell you this if she is a sensible girl—which she is.[44]

Put to proper use, her skills guaranteed the social order desired by males. An exception was the domain of male language, where the telephone girl was an impediment to the male fraternity. If she were unable immediately to discharge an impatient request, "the man who is in a hurry swears softly to himself, forgetting that he is near the transmitter." Such transgressions resulted often enough in fines, or, if the culprit persisted, the withdrawal of the instrument by the phone company.[45] Male expectations of both linguistic freedom and efficiency yielded to the delicate sensibilities of women, whose technical clumsiness was the physical equivalent of moral unworldliness.

The telephone girl was generally not so fragile, and more often depicted as a woman of ambiguous social status. Though frequently in need of protection from predatory males, she was also bound to be at their mercy by the service nature of her work. On the other hand, she was independently employed, saucy in her pursuit of the slightly racy recreations of the young and unobligated, and possessor of a free-floating social identity that was particularly suspicious in women. In short, she was in need of control. Her voice, symbol of both her work and her gender, was the handiest extension of her for that purpose. "A gentleman of fine ear, who uses the telephone frequently, suggests to us that it would be a good thing to give the exchange operators a few lessons in elocution, so that they might reply to calls with less nasality, shrillness and snappiness of utterance," cautioned *Electrical World* in 1885, doubting that the class of women employed could speak correctly, or up to the standards of middle-class subscribers.[46] Such lessons might have the additionally desirable moral effect of enticing vulnerable operators from that "special detestation . . . the attractive skating rink."

If working women managed not to transfer inappropriate oral models to electrical communication or to make ignorant or careless mistakes

as telegraph and telephone operators, their decision to enter the world of electrical technology was sure to disappoint them in some other way—unless they were rescued in time to return to their appropriate role outside it. In the early nineties, a platonic friendship between a telegraph operator stationed at Banning, California, and another at the small desert outpost of Yuma, Arizona, blossomed into a romance when the Yuma operator fell ill and the Banning operator arrived by train to nurse him back to health with traditional female skills. "I, like a fool, had always taken it for granted that she was a man," the male half of the drama and the voice of the story explained. Marriage followed, and the Yuma operator's comment: "The Southern Pacific has lost an operator, but I calculate that I am ahead on the deal."[47] Loss of love was an occupational hazard for less fortunate women. An English version of the French play *La Demoiselle du Téléphone* turned on the fantasy of "a telephone girl in the execution of her duties overhearing her lover making an appointment with a music hall 'artiste.'"[48]

The drama of women's place on the stage of men's technology was constructed and reconstructed as consistently in electrical journals as elsewhere in society. Much of the romantic poetry featured as light filler in electrical journals metaphorically identified women with technological objects, both of them properly under male control. Graceful tributes flattered women to assert male dominance, in marked contrast to cruder displays of verbal or physical force that kept in line other underclasses, less likely to cohabit with men and requiring a different strategy of control. Called upon at a Minneapolis meeting of the National Telephone Association to acknowledge the ladies escorted by the male membership, W. H. Eustis, a prominent Minnesota lawyer, telegraphic entrepreneur, politician, and philanthropist, lavishly praised "woman the perfect telephone, the gift of gods to man." Both woman and the telephone were "inventions" second only to man himself. Sent down to please man, both woman and the telephone were mistaken for toys and turned out to be necessities. Just as a man filed a caveat and then a patent on his invention, "So when a man becomes interested in one of the fairest of American belles he becomes 'engaged' or 'files his caveat,' and 'serves notice' on all the rest of the fellows to 'hands off.' By and by the priest gives him his 'patent' and then he thinks he is all right for life."[49]

Endless stories of women's unpreparedness and incapacity in a world of technical expertise time and again demonstrated the reassuring conclusion that women would always depend on male prowess to conquer the world for them, however irritating their ignorance as the price of male mastery. The achievement by women of technological power, however modest, was shown repeatedly to have gone astray. Electrical journals depicted a stable sexual social structure in an otherwise uncertain, competitive world in which expert men might expect to bear the more difficult burden, but also the greater privilege of power, for a long time to come.

Endless variations on women's capacity to disorder a mode of communication thought to be ordered by an ineluctable natural law that males observed and enforced did have complementary comic relief in stories about nonexpert males who were befuddled by electric communication. Unlike expert men, they had no special information to communicate by telephone. Unlike women, they had no reserves of small talk on which to draw. *Tit-Bits* printed a story in 1897 about two male friends who found the telephone puzzlingly superfluous:

> "Halloa Fletch! Do you hear me?"
> "Yes."
> "This is Sid. Thought I'd call you up."
> "Glad to hear from you, Sid. How are you?"
> "First-rate. How's things?"
> "Calooshus. What's new?"
> "Oh, nothing especially. Hadn't anything to do, you know, and thought I'd call you up."
> (Pause.)
> "Yes." (Another pause.) "Everything going on about as usual in the old town?"
> "Yes, about as usual." (Pause.) "Awfully warm up here to-day. What kind of weather are you having?"
> "Fine. Splendid weather."
> (Pause.)
> "Get the letter I wrote to you the other day?"
> "Why, yes. Don't you remember I answered it?"
> "So you did. I forgot." (Pause.) "Do you have any trouble hearing me?"
> "Not a bit. Can you hear what I say?"
> "Oh, yes." (Pause.)
> "Well, how are you getting along?"
> "First-rate. Anything—er—new going on?"
> "No. Things are about as usual. It's—h'm—beastly warm here. Weather's fine where you are, is it?"
> "Splendid."
> (Pause.)

"Well, I must be going now. Awfully glad to have had a chance to talk to you, old fellow."
"Glad you called me up."
"Good-bye!"
"Good-bye!!"[50]

Electrical Deception and Coercion

A proud and public component of professional identity was the integrity of the electrician who served no master but truth. Earnest stories of exceptional personal and professional honesty abounded in electrical journals. This important theme was rarely challenged, for intentional deception by professionals charged with responsibility for complex technical systems could imperil both human safety and public trust in the expert knowledge on which that safety rested. The belief that orderly nature would exact swift and unerring retribution from any electrician who ignorantly misjudged or arrogantly misrepresented his expertise was thought to guarantee professional probity. Electricians disciplined by science, it was claimed, could not be misled by personal or political motives. On the contrary, the lofty standards of their profession endowed them with general moral authority in human affairs. In 1898 E. G. Prout expounded on this theme to the newest graduates of Stevens Institute of Technology as they prepared to tackle the world's tasks:

> For some generations . . . natural depravity has been left to ministers, lawyers, editors, teachers, the mothers of families, to anyone, in fact, but the engineer; and this is where society makes a mistake. The best corrector of human depravity is the engineer. . . . Nature, calm and unrelenting, always stands looking at him. No other man in the world has such stern and unceasing discipline, and so it comes about that no other man is so safe a moral guide as the engineer, with his passion for truth and his faculty of thinking straight.[51]

Though experts appealed to the purity of professional integrity to justify their claim to public trust, they did not feel bound to exercise that integrity in their relations with stigmatized groups. Nor were they concerned about the contradiction this posed to their claims of scrupulous professional honesty. Unselfconsciously reported instances of deception and intimidation were treated as humorous and even praiseworthy when practiced by experts on outsiders, but were outrageous and intolerable impertinences when exercised in the opposite direction.

The more alien a particular technologically unempowered group seemed to electrical experts, the more blatantly coercion and deception could be exercised over it with the tools of electrical knowledge. As race, class, and station converged between experts and the technologically nonconversant in stories of their encounters, coercion and deception were less and less prominently featured. The general tenor of these stories nevertheless reflects the strain of class relations between electricians and their less technologically sophisticated social peers, subordinates, and superiors. In formula stories, marginal and despised groups were the focus of humiliating tricks by more powerful experts. The *Electrical Review* reported that Harry B. Cox of Cincinnati and his brother, an Episcopal clergyman "having charge of the city missions," had made "amusing" tests with an electric speaking trumpet devised by Harry Cox:

> They experimented upon an old darky, and completely frustrated the old fellow, who was walking up the road. Using the bell end of the horn, they began talking to the colored man as he walked along.
>
> The peculiarity of sound transmitted by the trumpet is that, to the person hearing it, it appears to come from some one near him, and not from a distance. The old darky hearing the voice was at first annoyed, then puzzled, and finally so badly frightened that he started up the road on the dead run, no doubt attributing his adventure to some supernatural agency.[52]

Thomas Edison was said to have startled a guest in his home, presumably a social peer, with a phonographic clock that announced the time to the unsuspecting visitor at 11:00 P.M., and the next hour called out, "The hour of midnight has arrived! Prepare to die."[53] A story in *Electrical World* touched on the tension between the worlds of practical and high culture. A French tenor visiting a telephone exhibition with an "electrical friend" was persuaded that he had been telephonically connected to his boss, the director of the Opera. Posing as the director, from the next cubicle the friend insulted the tenor's voice and threatened to halve his salary. The terrified tenor rushed out to confront the director in person, and counteroffered a one-third cut before the joke was revealed.[54]

In 1897 the *American Electrician* published a series of stories about electrically improvised pranks. "It requires practical experience in such matters . . . to appreciate them fully," one of the authors wrote, transforming the hostility these pranks expressed toward their irritating but powerless victims into a sophisticated mark of membership in the electrical fraternity. A stray dog was cured of his habit of stealing lunches

by a charged wire baited with a juicy piece of meat.[55] At an electric plant, engineers wired knobs on doors and cupboards so that a full turn would give a shock to street urchins prowling "where they had no business whatever." Another station was troubled by youngsters who passed the time looking in the windows at "inconsistent and unreasonable hours," and who stood with their fingers hooked to the netting that prevented their entry, but not their persistent observation. Annoyed station operators electrified the netting with a charge strong enough to keep the youngsters from yanking their hands loose until the current was turned off. A portion of this story was devoted to a detached discussion of the risk of electrocution from this trick improperly done.[56]

The barbarity of these schemes made an impression on a few readers. A correspondent from Attleboro, Massachusetts, preferred electrical sport "with men who are my equals, and hav[e] more of a chance to get even than innocent animals and children." *His* target was dozing night watchmen. He devised an electrical apparatus to catapult a pail full of bolts, tin cans, and stones from the rafters near an unsuspecting guard at precisely the moment a strategically located alarm clock went off.[57]

Not all pranks were performed on lower-status victims, but those inflicted on victims of higher status were often more considerate, with less physical pain and fewer unpleasant surprises.[58] Generally, the humbler the station of a prankster relative to his victim, the less outrageous the deception permitted him. The nasty prank attributed to Edison, a figure of exceptional status, stood in sharp contrast to milder deceptions practiced by telegraph operators on a fickle public whose good will they required. Poking fun at those with no access to the special code of which they were masters was a way operators cemented the bonds of comradeship and laughed at the public without attracting its ire, unlike the hapless victims of electricians' pranks, whose resentment had little effect. In 1888, a scene from a play called *Across the Continent* offered an opportunity of this kind to the local telegraph fraternity. The leading actor played a telegraph operator at a railroad depot besieged by Indians. The dots and dashes he simulated were meaningless, but the audience accepted them dramatically as an electrical summons for assistance, answered offstage by another series of simulated Morse clicks. On one occasion, an authentic telegrapher manned the offstage sounder, and ticked off: "'Say, Oliver, let's take a drink.' Which was received by 'Oliver' with: 'Thank God! We are saved!'"[59]

A proud and public component of professional identity was the

integrity and honesty of the electrician, who served no master but truth. Intentional deception by professionals charged with significant responsibility for the social infrastructure could imperil critical human safety, not to mention public trust in the expert knowledge on which that safety rested, and which provided its symbolic authority. The belief that orderly nature would swiftly humiliate any electrician arrogant enough to misrepresent it was thought to be a reliable guarantee of professional probity. Electricians disciplined by science could never be misled by personal or political motives. Though experts often appealed to the purity of their professional honesty to justify their claim to public recognition, they did not feel bound to practice the same honesty in their relations with stigmatized groups. Instances of deception and intimidation that were reported unselfconsciously and described as agreeably humorous, even morally essential when practiced by experts on these groups, were considered an outrageous and intolerable impertinence of the underclass when practiced in the other direction. When some "smarty" telephoned the *Detroit Journal* with a hoax scoop of a fight aboard a vessel at Amherstburg, the *Electrical Review* printed an indignant account of the fraud written by the *Journal*'s editors: "As a hoax . . . it was neither ingenious nor clever. That is to say, it was a brutal lie." Urging the telephone company to take strong steps against future abuse, the editors lamented that so many innocents should be "at the mercy of any trickster or scoundrel that may place himself at the other end of the wire."[60]

A markedly double standard of professional honesty applied in the use of electricity to communicate with "savage" cultures. In the late nineteenth century of British imperial diplomacy, the expert electrician was a hero whose art subdued colonial troublemakers geographic and social worlds away. The famous electrical scientist and entrepreneur Werner von Siemens "found it necessary to intimidate the natives" while building the Djulfa-Tabriz portion of the Indo-European telegraph from London to Calcutta during the 1860s. Taking advantage of rainy-season conditions,

> he brought about a gathering of the natives and persuaded one of their notables to ascend a ladder and touch the wire, saying the wire would defend itself. On doing so, the man received such a shock that he fell down the ladder, and the wire was considered after that by the natives as being bewitched.[61]

The explorer Henry M. Stanley was accused of duplicity by "petty detractors" when it was learned that he habitually wore a concealed

battery to deliver a mild electrical shock to African chieftains with whom he might shake hands. The purpose of this trick was to awe the native rulers with his "supernatural potency." This was not deception, insisted C. J. H. Woodbury, a prominent industrial engineer and spokesman who rose to Stanley's defense.

> It is beyond understanding why fault should be found with this harmless and efficient method of teaching a truth. The explorer received the identical physical effects which were imparted to the savage, the only difference being the mentality of the two races, the fact being that one was enabled by generations of civilization to ascribe the effects to material causes, while the other in his ignorance had nothing in his mental scope to apply a train of reasoning and, therefore, used the resource which ignorance always applies to the unknown, and supernaturalism was called in to fill the logical vacuum in the savage mind.[62]

Woodbury related another "lesson" from an incident in which a Plains Indian was electrocuted as he shimmied up a telegraph pole and chopped the wire with his tomahawk at precisely the instant it was struck by lightning several miles away. The point was not lost on the Indians assembled below, though the moral Woodbury drew for his expert audience had a different emphasis: "It is much better to use a savage to complete a circuit, than to make him serve as a target for projectiles, and the objection to this application of science for conquest is certainly more nice than wise."

Electrical World picked up a report from *La Lumière Électrique* of a "triumph of science over superstition" during British attempts to suppress the rebel leader Mahdi and his "wild followers" in the Sudan in 1884. A surprise attack at night was expected from the rebels and their Arab allies surrounding the town of Suakin, which the British held with the indifferent assistance of the "timid Egyptian soldiery, over whom the English officers had little control." The British prepared to defend their position by mounting great electric lights on towers overlooking the plain across which the attack was anticipated.

> Darkness fell, and the Arabs came on in hordes, shouting when they arrived within a few hundred yards of the walls, firing their guns at random, and waving their spears defiantly. At the right moment, the electric light plant was put in motion, the long beams of dazzling white light shot out suddenly upon the howling, rushing mass of Arabs, and in a few seconds the attack had by this means been turned into one of the strangest routs imaginable.[63]

A significant story element was the Arab failure to offer effective resistance. The British saw only random disarray as men fired guns in no apparent order and gestured wildly with crude weapons, and the futility of resistance to a superior technological, therefore civilized, order. A more subtle theme was the superior morality attributed to civilized communication over savage violence, as though the message from the British were not terrifyingly one-way, and backed up by force.

The efficacy of British terror in the Sudan was presented as a product of both scale and rationality. British lights had found their mark at a precisely synchronized technological rather than mythologically propitious moment. In a similar way, an account by Thomas Stevens recalled the "marvellous symmetry" of rows and rows of telegraph poles placed across the Persian plains "as evenly and perpendicularly as they might have been in Hyde Park." The English, he explained, "always take particular pains to have everything of this kind very superior in the East; it is a perpetual source of wonder and admiration to the natives, a standing advertisement of England's wealth, power and ability to the multitude who have no other way of learning."[64]

Criminals were another disenfranchised group over whom electrical intimidation could be exercised without qualm. Coercion in defense of the social order was the theme of a French report that electric lights had been placed in the Paris Morgue in 1888 "with the idea of increasing the effect produced upon murderers upon being confronted with their victims. Under the effect of the lights the 'confrontations' are expected to be much more effective."[65] Lights were also a deterrent to criminal activity, a substitute for more explicit control by authorities in Jacksonville, Florida, in 1895:

> If there ever was a time the city needed fewer policemen than have been necessary in the past, that time is now, since the brilliant illumination of the city by electric lights. Thieves hate light, and thugs despise it, and as a result (which the police annals will prove) there has been less thievery, less burglary and less thuggery in the city of Jacksonville since the city was lit by electricity than there had been in almost any corresponding period of the city's history.[66]

In the United States, professional electrical literature cast American Indians and Negroes as virtual members of a criminal class. The perplexity of these groups in the face of the white man's electrical machines made them easily manipulable, as when several horses were stolen in Julian, California, and suspicion fell on a local Indian.

> Some one having introduced a telephone up there, the same was being exhibited, when it occurred to the owner of the stolen horses to get the Indian to come in and hear the "Great Spirit" talk. The Indian took one of the cups and was thrilled with astonishment at being apparently so near the Great Keeper of the happy hunting grounds. After some little time spent in wonderment, the Indian was solemnly commanded by the Great Spirit to "give up those stolen horses!" Dropping the cup as if he had been shot, the Indian immediately confessed to having stolen the horses, and tremblingly promised if his life was spared he would restore the "caballos" at once, and he did so.[67]

A particularly effective technique for flaunting electrical technology was to create with it something of value to the technologically unsophisticated (the voice signifying the presence of the god, in this case) more impressively than the technologically unsophisticated could create that thing themselves. The technological seducer's next move was to unveil the iron fist in the velvet glove. We will see this tactic used again in campaigns by scientists and engineers to discredit practitioners of magic and the occult, their nearest competitors for public interest and loyalty.

Four years after the Julian incident, a group of Apaches gathered before a telephone in St. Louis to hear another mysterious voice speak. According to the white narrator of the story, the claims these fierce warriors made to honor among their own people were based on brutal and daring exploits in battle. Primitive courage in savage exploits had not, it was noted with satisfaction, prepared them for the device white men regarded as evidence of the superiority of civilized science. The adversary culture was described:

> They were the leaders of the most implacable of savage tribes. Their hands had often been wet with the blood of murdered men and women; war-whoops of their tribe were as familiar to their ears as the cry of the wild wolf; but that intangible small voice which came to their ears from the infinite, that was a new experience to them.

The adversary culture was observed:

> One by one they listened to it; then, in silence, wrapping their blankets around them, they sat down to think. After a while their tongues were loosened, and each gave his idea of what the voice in the telephone was. The final conclusion was that it was the white man's Great Spirit, as he talked in English, and their anxiety was to find the instrument through which the Indian's Great Spirit spoke to his children.[68]

What interested the Indians was less the esoteric apparatus that fascinated their textually literate white hosts than the character of the voice they heard. In spite of the white man's contempt for the customs of traditional oral societies in the exchange of social knowledge, the conclusion reached by the Indians was astute. They had indeed heard the white man's Great Spirit. It was technology, the cause of the Apaches' anxious wish, doomed to disappointment, to find a voice of equal power of their own.

High Science and High Culture

The Perils of Popular Science

Priestly groups effect and maintain power by possessing significant cultural secrets. Training in the codes and rituals of these secrets is characteristically arduous, often lengthy, and reserved to elites. Along these lines, the restricted literacy of theoretical science and applied engineering was touted in the late nineteenth century as the exclusive property and singular responsibility of professional experts. Mastery of technical secrets was both an indicator of status and a path to it, conspicuously marked by ordeals of apprenticeship for select aspirants. Because of the esteem conferred on technological literacy by a society that reverenced it as a high secret, professionals were anxious to guard it from eager nonspecialists who might dilute it or, perhaps more alarming, possess it independently of the elites whose exclusive domain it was supposed to be.

Instant exceptions could be made for those who posed no threat to the status of electricians, especially if they lent their own prestige. John Jacob Astor's interest in developing an electric launch was praised for its promise of future projects funded by "a progressive gentleman of wealth." Astor was warmly described as "an enthusiastic devotee of the Goddess of Electricity for a number of years." It was not often, wrote a fawning electrical journal, "that a gentleman of Mr. Astor's position in the world devotes any time to electrical study," but his effort no doubt would be amply repaid in personal satisfaction.[69]

The enthusiasm of other nonspecialists was much in evidence, but not so gladly remarked. Public libraries and newspapers were the chief institutions of this enthusiasm. Electrical subjects were in high demand on the shelves of free libraries. At England's Brentford Public Library in 1892, Professor Silvanus P. Thompson's book, *Elementary Lessons*

in Electricity and Magnetism, destined to go through forty editions in his lifetime, was said to be one of the 22 most popular books in a collection of 4,902 volumes.[70] The British journal *Lightning* noted that the librarian of the People's Palace in England mentioned electricity as "one of the pet subjects with its main readers," and furnished an "odd little list" of all the most popular authors on the subject, including Jenkins, Angell, Payser, Urbanitsky, Thompson, Munro, and Fergus. "The mixture reminds one rather of the man who said that his favourite authors were Anon and Shakespeare."[71]

In the columns of their journals, electricians deplored the belief that popularly available knowledge provided a point of entry into their field, something for aspirants to dabble in before setting up in business around some dubious invention. The triumph of journalism over proper professional training deceived both the public and aspiring electricians, with disastrous effects spelled out by the *Telegraphist* of London:

> Then there is the youth who has read as much as he could understand of an elementary textbook, and who has constructed a rude electrophorus out of a dripping-tin and a cake of resin, a galvanometer by coiling a few turns of wire round a compass box, and sundry other primitive machines. This youth is the genius of the family. He has a soul above quill-driving. He must be an electrical engineer. Taking advantage of sudden demand for men with electrical knowledge, he manages to get a situation, being ready with his set phrases, in which volts, ohms, and amperes are plentifully besprinkled. We next find him in charge of a dynamo, and shortly after read the account of his death caused by shunting some of the current into his own body. The inquest follows, and the father of the genius confesses that his son was very fond of reading electrical books, but that he had never had a proper training. To read about the potent force is harmless recreation, but to play with it sometimes means death.[72]

Pseudoelectricians thinking to bypass a certified technical degree were the continuing bane of the profession. "They are electrically inclined because they are good for nothing else," explained the *Electrical Review,* which also ridiculed their false textual training:

> They are the class from whom one, once in a while, gets a letter asking for the name of some book that "tells all about electricity, as I haven't time to read a library through." They become what after a time the telephone boys call P.L. electricians. These public library electricians are wise beyond their day and generation, but it is in the wrong direction.[73]

The P.L. electricians had got the point that professionalism was connected to texts, but they had not perceived the subtle and not so subtle ways in which proper electrical professionals and their texts were marked as an elite rather than popular order, in which those who earned the right to add "E.E." to their names, for "electrical engineer," would value the title that carried "so much dignity and authority . . . as they [did] their personal reputations."[74]

Newspapers and popular journals were as villainous as libraries. At a meeting of the Association for the Advancement of Science in New York in 1900, its president, Dr. Robert S. Woodward, lamented that "the elementary teaching and the popular exposition of science have fallen, unluckily, into the keeping largely of those who can not rise above the level of a purely literary level of phenomena."[75] Popular science education had failed because educational standards had been usurped by a popular press with the wrong textual skills and intellectual orientation for this function. As a result, "untrained minds fall an easy prey to the tricks of the magazine romancer or to the schemes of the perpetual motion promoter." Special ire was reserved for "schools of telegraphy," a catch term for all organizations that offered fraudulent electrical training. Regarding the crackpot theories of a "Kentucky colored preacher" who claimed that the earth was in danger of exploding from increased lightning production, and a "physician" in dread of "charging" the atmosphere with the steam and smoke of urban civilization, the *Electrical Review* editorialized, "these two scientists might be able, with the apparent knowledge they have of nature's forces, to open a school of telegraphy, somewhere."[76]

None of this was the path to true technological literacy. Experts believed that laymen were not only misled by popular scientific writing, but antitextual in general, or at least less rigorously textual than expert standards required. "In the wild dance that ushered in the electric light, the motor, and the box of electricity," a reader wrote to the *Electrical Review,* "sobriety of speech was at a discount and . . . every fellow who could invent and tell a good story of electrical feats that never occurred, pushed the student and thinker aside and took the front seat."[77] In expert culture, popular forms of knowledge such as telling tales—indeed, oral forms in general—were at war with the proper, or restricted, practices of scientific textuality. Popular standards of oral explanation could not convey the complexity or truth of science. Unfortunately, the man in the street read only occasionally, and then without diligence or discrimination. According to the *Electrician*:

> It is sometimes said that a scientific theory is not thoroughly and clearly apprehended until it is capable of being explained to the man in the street. It is a hard saying, for there is no created thing more hopelessly out of harmony with the very atmosphere and foundation of science than that same street-walking gentleman. Perhaps he is not the same in all countries, but in our own country . . . no trace of the scientific spirit seems able to permeate the mind of the average man. His interest in science begins with an experience of its application to . . . pecuniary profit, and ends with the perusal of some very light popular illustrated text-book.[78]

A true and full appreciation of scientific knowledge was off limits to all except properly schooled experts who belonged to restricted textual communities. The lofty *Electrician,* for example, despised popular science, and its editors were quite unconvinced that ordinary men could profitably share in scientific knowledge. It divided the domain of scientific writing into "pure" science, which traced out truth, "applied" science, which appealed to the pocket, and "popular" science, which endeavored to render truth "in a pleasing form."[79] Popular science was a sport for immature and gullible intellects, a cheap imitation of the form of scientific textuality without its substance. Consider these observations from the *Illustrated London News* on the characteristically brief, unskeptical presentation of the "facts" of science in popular periodicals:

> It is conveyed in brief but most attractive portions, and never hampered with details as to how the intelligence was procured, the instructions drawn, or the figures calculated. In the present issue of my favourite periodical, I read that "Icebergs last for two hundred years." One cannot help wondering how this information, doubtless gathered from trustworthy sources, has been obtained. Do you catch your iceberg young, and watch its growth, deputing the interesting task to your descendants, or do you select one from its companions on account of its vast proportions, and note from decade to decade its gradual diminution? "It takes a snail fourteen days, five hours, exactly, to travel a mile." What patience and assiduity it must have taken to record this fact with accuracy! How curious, too, to discover that all snails have the same rate of progress! . . . "Persian women have a horror of red hair." How few of us are acquainted with Persian women, or could have learnt this by other means! How enterprising must be the periodical which sends, perhaps, a special correspondent to ascertain such a circumstance. . . . No work of information has ever given me the pleasure I derive from these weekly additions to knowledge. Sometimes they surprise as well as delight me, for example: "Kissing originated in England." Heavens![80]

True technological literacy for electrical engineers could be learned only at proper professional schools, the kind Henry Floy wrote about in an *Electrical World* article published in 1894. Floy was a true man of science, a Cornell graduate in mechanical engineering whose professional reputation was based on his work on long-distance power transmission. Floy divided electrical engineering aspirants into "students" at classical or technical colleges and "artisans" working their way up from the practical end of the profession. He portrayed a field crowded with all the electricians society could use, unable to absorb many more in the near future. In this struggle the competitive edge belonged to restricted textuality, to students equipped with high technological literacy instead of to craft artisans, throwbacks to a preprofessional age. "The college curriculum cannot help but make [the students] exact thinkers in addition to furnishing them a supply of theoretical knowledge which the 'practical man' has failed to obtain." Whatever temporary advantage artisans might have over inexperienced graduates would vanish as soon as the latter acquired a modicum of practical experience. "It is but natural," wrote Floy, "that they should outstrip men who have not received the advantages of a college training, and in very many cases, not even a high school education."[81]

Who did not understand what it meant to be a professional, expertly conversant with esoteric technical literature? Who had no reliable knowledge of the need for electrical engineers, or the training they required? Who thought to bypass the stringent, textually oriented selection procedures built into professional training? Who else but the popular, that is, the nonprofessional press. The existence of a pool of aspirants without prospects was laid at the door of the "present depression . . . but more truly to the overpopularizing of this particular profession," which brought too many hopefuls flocking. Driving home the point that professional training was the prerogative of elite institutions, Floy offered catalogue descriptions of the elaborately technical electrical engineering course at Princeton, a "classical" school, and Cornell, a "high-grade technical school." He cited figures to prove that too many students were being trained even in these schools, warning that most would be forced into low-paid jobs beneath their expectations unless they were exceptionally talented or well connected.

In the sight of experts, the popular press erred equally in its wor-

shipful admiration of all things electrical, and the wizards who brought them into being, and in its wild and immoderate extrapolations from the reasonable fears experts sought to instill in laymen to keep them physically and intellectually at arm's length from electricity. Though preferable to criticism, worship made experts nervous because it raised the specter of popular dissatisfaction with electrical utopias expected and not delivered. Too diffuse a fear of electricity, on the other hand, could damage expert interests. A characteristic mixture of concern and contempt for popular misgiving was expressed by C. C. Haskins, the president of the Wisconsin Telephone Company:

> That thousand-tongued old gossip, Madame Rumor, will never lose time nor opportunity to charge the "death-dealing" fluid, as she calls it, with anything in the way of a casualty which occurs within gunshot of a dynamo or as near as forty rods from an electric lamp or motor, provided the enterprising newspaper commissary can dish up distorted facts enough to give the gossips a good square meal. Now and again when I see exaggerated accounts of some trivial affair connected with electricity . . . I am reminded of the wholesale cackling in a barnyard, when some silly pullet has accidentally run upon a toad in the fence corner.[82]

That Rumor was female and her medium oral, and that she was in league with journalists, was no accident of characterization.

Perhaps more distressing to experts was that popular authors, readers, and lecture audiences were generally oblivious to criticism. Experts lamented that popular science writing did not take seriously its responsibility to enlighten its readership. Their concern was perhaps less for the truth than for the perception that popular writers did not sufficiently school laymen in obedient submission to expert authority. Experts who complained that popular lightheartedness toward electrical science was either ill-concealed arrogance or exaggerated expectation were confronted with a predicament, since it was essential for experts to court the public in order to achieve a status based in public perceptions of merit and to secure popular acquiescence to expert judgment in matters of electrical interest. Except for the purpose of flattery, however, anecdotes in the expert literature revealed scant desire on the part of electricians to share their accumulating power with the public on whose behalf their privileges were justified. The public was that group in whom enough interest had to be shown to ensure its support, but with whom caution must be used not to promise too much.

The tireless and demanding public was ever present. At the seventh annual convention of the National Telephone Exchange Association in 1885, Angus S. Hibbard, then superintendent of the Wisconsin Telephone Company, recalled the flowering of public expectation following the "first crude experiments" in telephony. "The usual newspaper phraseology" shouldered much of the blame:

> It was almost suggested that the life of the average American would be incomplete were he to omit from his daily routine the pleasure of telephoning to his friends in Japan.
>
> Our friends in New York, over their breakfast coffee, were to have from London oral cognizance of what was most thoroughly "English," on that same afternoon, echoed—at the turn of a switch—by the midnight songs of the seals at the Golden Gate. . . . The wide-spread publication of imaginative successes has, in deceiving the public, robbed the laborer in this field of any laurels he might hope to obtain, by making his accomplishments appear tame in view of the marvels advertised for his art.[83]

Expert appeals for popular support often implied that universal electrical prosperity was not far off, especially for groups that had not been visible beneficiaries of industrialization. Perhaps so as not to assume too willingly the obligations of that promise, many of these appeals linked electrical progress to the necessary contributions of all who possessed useful skills and ideas. In the technological society of the future, all talents would be impartially judged and rewarded. Literally construed, this appeal made expert exclusivity hypocritical, and fomented ideological instabilities of which the emerging expert elite was uneasily aware. The more glowingly the public consented to the efficacy of expertise and desired some demonstration of its largesse, the more firmly were the barriers raised against it.

Despite the best efforts of electrical professionals to keep the crowd from the door, occasionally one or another got in. But where the outsider had penetrated the circle and could not be expelled, vigilance against intrusion was matched by other strategies to assimilate him and make him an insider. Within the professional electrical community, Guglielmo Marconi's introduction of wireless telegraphy in England in 1896 provides a particularly clear example. Marconi was not a product of the British scientific establishment, or even a Britisher, but a youthful Italian, an amateur experimenter whose claims threatened to make publicly and professionally ridiculous several prominent British electricians and scientists. He was, in other words, a threatening outsider.

The expert press at first reacted suspiciously. Marconi was accused of having done nothing that British scientists had not done already. A British journal sniffed that at the Royal Institution, where he was presented by his mentor, William H. Preece, chief engineer of the British Post Office, he was addressed as "Signor Marconi," since he "has hardly been in this country long enough to entitle him to be referred to as 'Mr. Marconi,' though Mr. Preece does so."[84] Worse, Marconi had gained the lavish favor of the popular press. "It is a pity that Signor Marconi should choose to give his information first to the lay press," complained the expert press, "and thereby insure that his grain of wheat should be hidden in a bushel of chaff."[85]

When the importance of Marconi's achievement finally could not be denied, efforts were made to efface the damaging accusation of outsider, and almost overnight Marconi became an insider. In 1899, he was described as follows in the *Western Electrician:*

> Although Italian on his father's side and by birth, Marconi's mother was an Englishwoman, and in general appearance, complexion and manner the inventor is seemingly a young and clear-complexioned Englishman. Signor Marconi is a man of medium height and slender, with blue eyes and clean-shaven face, except for a slight mustache. He is of a retiring disposition. As might be expected, he speaks English like a native. The Herald described him most aptly: "Signor Marconi looks like the student all over and possesses the peculiar semi-abstracted air that characterizes men who devote their days to study and scientific experiment."[86]

Controlling Language

Conflict between exclusive certification and diffusive popularity turned on the more basic debate about whether the skills of electricians were really practical or theoretical, manual or textual, craft or scientific. The aura of elitism enjoyed by professionals, with its canon of exclusivity, underlay the argument that sophisticated textual and linguistic skills were the mark of the professional electrician. Not from imitating skilled electrical craftsmen, but only from the diligent study and informed discussion of technical books and papers and professional journals, could the secrets of electrical science be learned. This made correct technical language correctly used essential to the expert's claim to professional authority.

In 1898 the great Elihu Thomson wrote a letter to the *Electrical World* concerning an error in a technical procedure reported in its pages

by the young Reginald Fessenden. "I have to thank Professor Thomson for correcting me in the matter referred to," Fessenden replied. He pointed out that the standard written authority on the subject had given the same account. "The fact that even such a standard work as 'Watt's Dictionary' though devoting a half-page, Vol. III, p. 888, to iron amalgams, and describing three ways of making them does not mention this method, is, I believe, a sufficient excuse for my mistake."[87] A recommendation by William Crookes had led him to his original method, he continued. The young scientist defended himself by showing that he had consulted the proper experts and that his error had not exceeded that of the most authoritative text. Finally, he submitted graciously to the authority of an expert more credentialed than himself.

While this example of science at work had little homiletic value for a popular audience, electrical journals delighted in anecdotes about how technical knowledge was misunderstood and misapplied by amateurs, charlatans, and even students. Such anecdotes were part of the ritual for excluding charlatans and the inadequately schooled, while reminding legitimate community members how difficult the subject of their study was, even among the hard-working technical literati. "The young electrician asks for information," explained the *American Electrician* in 1898, "and finds that his misconceptions are so ludicrous that he gets roundly laughed at. To avoid ridicule, he forbears to ask again, and unless he dissolves his difficulties by strength of intellect, they remain a continuous puzzle and protest against the accuracy of science."[88] Perhaps the classic story in this vein was about the student who, asked to define electricity, said he used to know but had forgotten. "How sad," replied his weary professor, "the only man who knew what electricity was has forgotten."[89]

Popular literature that treated electricity with cheerful irreverence never failed to arouse the suspicions of the sober scientific and professional press. The *Electrical Review,* for example, fulminated at doubtful electrical gimmicks of plot devices in light fiction. Most authors "make absolutely incorrect use of electrical terms, a few seem to grasp the meaning of the simpler elements of science, while others deal with glittering generalities to avoid positive errors."[90] To convey accurate technical information was rarely the purpose of electrical terminology in popular fiction, of course. It did greater service by imparting an air of up-to-date excitement. It fulfilled, if only for a moment, the fantasy that the much admired electrical magic could be possessed by the simple act of calling its name.

A children's story in *Harper's Round Table* illustrates the point. A piece of light fiction, it appropriated scientific content, or something like it, for entertaining ends. Its central characters were Jimmieboy, a kind of Everychild, and an imp whose home was the telephone instead of a magic lamp. In the course of their adventures, the imp showed Jimmieboy a pushbutton-controlled electric dictionary containing all knowledge. The dictionary defined *battery* in an esoteric technical fashion.

> "Understand that, Jimmieboy?" queried the Imp, with a smile, turning the Dictionary button off.
>
> "No, I don't," said Jimmieboy. "But I suppose it is all right."

The Imp lectured on batteries and electricity in terms practical and accessible:

> ". . . a battery is a thing that looks like a row of jars full of preserves, but isn't, and when properly cared for and not allowed to freeze up, it makes electricity, which is a sort of red-hot invisible fluid that pricks your hands when you touch it, and makes them feel as if they were asleep if you keep hold of it for any length of time, and which carries messages over wires, makes horse-cars go without horses, lights a room better than gas, and is so like lightning that no man who has tried both can tell the difference between them."[91]

In popular stories, effects of announcements were "electrical,"[92] and ideas came to characters "like an electric shock."[93] Puns were widely used, since they were effective even when audiences grasped only dimly the technical language involved. "George, dear, what kind of fruit is borne by an electric light plant?" asked the *Terre Haute Express*. "Electric currents, of course."[94] "There's music in the electrical air," the *Electrical Review* prefaced another pun that satisfied its primmer standards of veridicality: "When the intelligence of a disaster is flashed over the wires electrically, a newspaper very properly calls it 'shocking' news."[95] London ladies "are becoming interested in our science," wrote the *Electrical Review*, "and are fast abandoning the afternoon sewing bees and 'high tea,' and taking up 'electricitee' instead."[96]

It was commonly observed that electricity had introduced a remarkable number of words into the language. The *San Francisco Chronicle* compared the fecundity of electrical language to the inventiveness of terms and discourse about patent medicines, which popular language and culture revered with a similarly expansive and uncritical

enthusiasm.[97] New words permitted those who were richer in awareness and imagination than in educational or technical resources to have their own special entry into electrical culture. The process of selection by which some words and ideas were popularly embraced and others were rejected certainly had little to do with expert judgment. New words were like new inventions, explained *Cosmopolitan*. "If they prove popular, they hold their own, like a derby hat, or ice-cream soda, or electric lights or telephones."[98] Although experts used humorous, playful language to deny status to outsiders, and appropriated what they regarded as comical aspects of the dialects or vocabularies of outside groups to disparage them, they fretted, without noticing the contradiction, about whether popular play with technical language was morally sound. Playful expressions of lay scientific interest were disturbing to editors and readers of journals like the *Electrician*, since any linguistic breach in the dike of high science had unpredictable potential for diminishing expert claims and opening up electrical culture to those who lacked credentialed membership.

Stratifications of rank required demarcation not only between members of textual communities and outsiders, but also within textual communities. Pure scientists wished to be distinguished from applied engineers, and engineers wished to convince scientists, one another, and the public of their indispensability in the management of crucial social problems. Facility in manipulating technical symbols was therefore a jealously wielded instrumentality. Cadres of operatives also had to be coaxed to accept the delicate bargain in which they identified with the technological enterprise that required their participation, but were clearly set apart from those upon whom greater decision-making authority was conferred by dint of their superior command, among other things, of powerful technical language. To be a professional, and particularly to be authentically discriminable from the large class of pretenders to professionalism, required symbolic distinctions that experts believed only they could appreciate and, more to the point, enforce. Control of technical language was a means for experts to establish themselves as arbiters of the domain of technological reality and, from that strength, to seize the larger domain of social reality. Every bit as crucial as correct professional education, therefore, was the orderly invention and development of a technical language in which experts modeled and polished the world that belonged to them.

Technical language was not easy to control. Efforts to standardize and rationalize it on the model of the lawful universe it ostensibly described were continually frustrated by its expanding variety and

complexity. "There is scarcely a single term employed in electrical literature upon which different writers thoroughly agree," commented *Electrical World* in 1885.[99] *Western Electrician* observed that the second edition of a dictionary of electrical terms by professor Edwin J. Houston, a well-known electric lighting entrepreneur, had five thousand entries and as many cross references. Published in 1892, it was completely revised from the original text that had appeared three years earlier.[100] The progress of new words and phrases was tracked with interest and often with controversy. Erratic and erroneous usage occasioned expressions of distress and flurries of proposals for formal regulation. Professional bodies like the International Society of Electricians and the English Society of Telegraph Engineers and Electricians appointed committees to consider what could be done about the lack of uniformity in electrical terms and usage.[101]

In 1893 Professor E. Hospitalier, a Frenchman, chaired a Committee on Notation for the International Electrical Congress, which recommended wide-ranging standards for electrical language and systems of notation. Hospitalier deplored the divergence of views and usage among electrical authors, which stemmed in his view from "the absolute lack of method" in scientific and electrical notation, the principal purpose of which, he declared, was "to enable engineers to understand the formulas published in the works of different countries."[102] The editors of *Electrical World* welcomed his system of forming compound words and naming units as being "logical throughout and based on correct principles," as well as internationally uniform.[103]

Other electricians relished the anarchy of countless small debates, complaints, and case-by-case proposals for specific usage that filled the pages of professional journals. In response to an inquiry about the best word to express "execution by electricity," the *Electrical Review* reported a variety of suggestions, including *elektrophon, electricize, electrony, electrophony, thanelectrize, thanelectricize, thanelectrisis, electromort, electrotasy, fulmen, electricide, electropoenize, electrothenese, electrocution, electroed, electrostrike,* "and finally joltacuss or voltacuss."[104]

The *Electrical Engineer* took a lively interest in such matters and framed the problem in these terms:

> The charge is made against this country that slang is too freely adopted here and that new words are welcomed simply becase they are novel, and despite their hybridity and barbarism. In some respects the charge is true, but with a new society, living under new conditions and acquiring every day new implements of industry, how is the check on base word coinage to be applied and who is to enforce it? If the stock of old true coinage is sufficient, who will be capable of proving it to be so? And if the old coinage has to be melted down in order that new true coins answering to new wants may be furnished, who will do the minting?[105]

An instructive debate concerned an attempt by George W. Mansfield of Greenville, New Jersey, to introduce the word *motoneer* to designate "the man running the electric motor." In a fraternal letter to the editor of *Electrical World* in 1884, he cited precedents for this use in "several articles" and an "interesting little work," presumably popular, called "Wonders and Curiosities of the Railway."[106] Though in appealing to textual precedents Mansfield followed a form cherished by professionals, these particular precedents were unpersuasive. Indignant opposition reared its head in the letters column. In the view of Thomas D. Lockwood, an electrician for the American Bell Telephone Company, coiners of new technical terms already had much to answer for. Lockwood scorned *cablegram,* a word whose existence implied a need to dignify in separate words the existence of different proportions of submarine to land-line cables in message transmission, and *electrolier,* a pretentious analogue to *chandelier. Motoneer* he regarded as "the worst specimen yet launched upon a long-suffering public."[107]

Despite his claim to have popular interests at heart, Lockwood's arguments appealed to elite expertise and to the preservation of a social order based on it. The word *motor,* he argued, was inaccurately used already to describe "the engine by which the electric energy is utilized, and should only be applied to the electric energy so employed." If the attendants of electric engines could be motoneers, "the attendants of gas engines, steam engines, air engines, etc., are entitled to the same distinction." The articulated premise of his argument was that unnecessary words should be avoided; its tone took offense at the use of professional terms to describe the laboring classes.

Also put off was "Ampere," an anonymous correspondent who scorned *motoneer* as a dubious analogue to *engineer,* even taking into account the corruption of the latter term in everyday use. Originally, according to "Ampere," *engineer* had meant exclusively

> "a person skilled in the principles and practice of engineering, either civil, military, mechanical, marine," etc. According to this definition the man who designs or builds an engine is an engineer. . . . In Amer-

> ica, however (and I believe nowhere else), the meaning of the term has been extended so as to make it apply as well to the person who drives or manages an engine. Indeed to many persons in this country the word engineer possesses no higher meaning than the latter.[108]

In England a more orderly and less popular usage was current, he claimed. There, *engineer* retained its elite meaning and the terms *engine-man* and *engine-driver* covered the case for which *motoneer* was proposed. In a tactical appeal to high culture, "Ampere" quoted Macbeth ("Take any other form but that, and my firm nerves shall never tremble") and invoked class solidarity:

> The man who manages the switches seems perfectly satisfied to be called a "switchman;" the man who manages the brakes is content to be called a "brakeman;" the man who manages the boilers does not object to being called a "fireman," and the correct term for one who manages an engine is "engineman." Pray, then, why not stop inventing new words and adopt "motorman." It is short, and to the point. It speaks for itself. . . . It is, indeed, a perfectly legitimate word, with a long line of pure Saxon ancestry—tradesman, workman, footman, etc.—and a full line of relations, sisters, cousins and aunts, like cabman, hackman, boatman, etc.

While both protagonists claimed that only the loftiest considerations governed their objections to *motoneer,* their arguments made sense only within a framework of elite distinctions. The dike could be broken at no point. Engine operators must be verbally located in the sturdy "Saxon" class of tradesmen and laborers; elite terminology must be derived from Latin or French, and not the slightest linguistic hint should elevate operatives to the status of engineering professionals.

Builders of a future inherit a past that they reshape. To justify their claim on the future, electrical experts never tired of comparing themselves with cultural ancestors whose achievements they regarded as exactly parallel to their own. Experts, too, had created a priestly language and an authoritative textual tradition. They styled themselves as the continuing link in a cultural tradition charged with preserving Western civilization for future generations. Other elites had guarded and extended the textual canon of Western culture in specialist languages that made civilized life possible and invested it with its distinctive character in different eras. Talented electricians were likewise stewards of a trust to develop electrical science in specialist languages and texts best suited to that task. In expert eyes, the important difference between the great tradition and electrical science was historical

need and occasion. "Those who spend their lives among the dreams of the ancients, knowing nothing of the powers and achievements of modern man, may be pardoned for proclaiming their own inferiority," wrote *Scientific American* in 1876, "but they have no call to speak for the real men of the real world about them, the men who are doing the world's work, at the same time steadily lifting humanity to higher and yet higher planes of capacity and power."[109] Many hoped that the humanist languages of the past, testament to grand but fading glories of previous human achievement, would yield to the more serviceable and progressive language of high science. "The fables and fairy tales of old pale before the facts of the present day," proclaimed President Wilmerding at the opening of the Electric Light Association convention in New York in 1896.[110] Students of the practical application of electricity, observed *The Telegraphist,* "find in it more real enjoyment than any puzzling over the vagaries of the modern poet or poring over the meaning of ancient cynics can afford."[111]

An incident on the occasion of the first annual meeting of the New York Electric Club in 1887 encapsulates these tensions between scientists and humanists, and the logic by which electrical experts aspired to equal status with culture heroes of the past and made their own bid for historical superiority, since the task of salvation was now theirs. The meeting's program featured a performance by club poet William "S(hakespeare)" Hine of his original and flowery work, "Electrical Nomenclature."[112] Borrowing themes from the Bible and classical mythology, Hine invented amusing parallels between electrical terminology and the elegant language of classical discourse.

With the self-deprecating modesty of one secure in his social station, but also in terms intended to suggest effortless familiarity with the canon of high culture, the poet described himself as being as

> well-trained as most
> (And I do not wish to boast)
> As a second Ananias in plain prose

and offered his thesis that

> Searching mythologic tome
> We find the cause from which our troubles flow.

The trouble in question was the proliferation of awkward, cacophonous, and obscure electrical terminology, language many found unworthy to succeed the dignified and graceful language of the great tradition. In explanation, the poet recalled the Promethean theft of fire

that first brought punishment from the gods upon mankind. He reported that Jove the Thunderer had watched in alarm as mortals examined pieces of amber from some ancient Vesuvian eruption and discovered the properties of "Electron." Assembling the gods, Jove warned that mortal

> fame would wrest from us our mighty powers,
> And make the elements their servants like to ours,
> And seek to give the widest of publicity
> To all the hidden powers of electricity.

Reminding them, in a reckless mixture of traditions, that the Tower of Babel had once before thwarted mortal emulation of divine power, he urged the gods to

> try it on again; it worked well then,
> and kept us still above the herds of men.

And this was why, the poet claimed, the gods created the vocabulary of electricity expressly to confuse men:

> . . . the words came crowding thick and fast,
> And each more harsh and puzzling than the last.
> Watt and erg and dyne and ohm,
> Gauss and ampere and coulomb,
> Armature and commutator,
> Secondary generator,
> Inductorium, insulation,
> Permanent magnetization,
> Pole and arc and dynamometer,
> Field of force and electrometer,
> Anions, ions, cell and cation,
> Radiophony, amalgamation,
> Agonic, isocinic lines,
> Coils and shunts, circuits and sines,
> Rheotrope and galvanometer,
> Polarization and rheometer,
> Molecule and atomicity,
> Currents and cosmical electricity,
> Endosmose, osmose, diaphragm,
> Electrolysis, A. J. Dam,
> Amplitude and declination,
> Micro-tassimeter, retardation,
> Resinous, vitreous, chlorous, switch,
> Phlogiston, solenoids "and sich,"

> Zincode, platinode and relay,
> Calorimeter, inertia,
> Diamagnetism, fusion,
> Resistance, equivolt, occlusion,
> Dielectrics, actinism,
> Foucault, helix, crith and prism,
> Nascent, tension, rheostat,
> Equivalent, Leyden jar, Joulad,
> Equipotential, consequent pole,
> Just here they stopped—God bless my soul,
> The gods themselves had e'en gone mad,
> The scheme that they for others had
> Contrived had done its fatal work,
> Try as they might, they could not shirk
> The fatal consequence; that's why
> They quit the realms of earth and sky,
> And sought out home in other spheres. . . .

Claiming that electrical inventors had taken upon themselves a task that had defeated even divine intelligence, he concluded:

> Each and every inventor, both early and late,
> Seems doomed, by an incomprehensible fate,
> To follow serenely the deities' plan,
> Of clothing each new scientific idea
> In garments ungainly and ancient and queer,
> Until what knocked the gods out proves fatal to man.

This fable of the origins of technical language made a clear point. Electricians believed the time was long past for a shift of cultural reference from the authority of the humanities to the authority of science. Despite their professed regrets about the unwieldiness of the textual torrent loosed on the world by science, they were as proud of it as if it were divine revelation, which in some sense they thought it was. Notwithstanding ritual genuflection to humanism on official occasions, they felt their own endeavors were far more likely than elaborate systems of false myth to unlock the secrets of the cosmos.

To demonstrate to laymen the superiority of scientific discourse even at play, electricians were forever recasting mythical language, when it intruded, in scientific terms. "Too many clever electricians," William Crookes once remarked in a discussion of the danger of alternating current, "have shared the fate of Tullus Hostilius, who, according to the Roman myth, incurred the wrath of Jove for practising magical arts, and was struck dead with a thunderbolt. In modern lan-

guage, he was simply working with a high tension current, and inadvertently touching a live wire, got a fatal shock."[113]

Proofs of Priesthood: Electrical Magic

Although an express mission of science was to kill magic and myth, electrical experts were deeply implicated in the production of both. "One miracle has followed another until we can but wonder what apparent impossibility will be accomplished next," intoned the National Electric Light Association's President Wilmerding.[114] Scientific progress was produced by manipulating mysteries known to an informed priesthood and accepted on faith by an audience to whom it was demonstrated at regular intervals. This was in spite of a powerful self-justifying belief by electrical experts versed in restricted scientific textuality that they labored exclusively for an audience of peers, and ventured into the larger world only when they could do so without compromising scientific principles in the slightest. Claiming that their work benefited the world in ways the world could neither imagine nor truly understand, they resisted every outside suggestion that they explain themselves to the masses.

As a practical matter, this insistence on a zone of elite exclusivity was only relative. Pursuit of large-scale magic, even by influential and informed minorities, always requires a degree of support from a larger, less informed community able to seriously restrict the scope of the more elite enterprise if it becomes sufficiently restive. The need of scientists and engineers for public sympathy created, first, a popular spectator audience for whom science was marvelous entertainment on instrumental, intellectual, and aesthetic grounds; second, a scientific priesthood attentive to the value this audience placed on magic, though it regarded that fascination with ambivalence; and, third, a class of performers, also sensitive to the public's affection for magic, that stood ready to challenge this priesthood for the hearts of its following. The priesthood considered this last group to be charlatans, badly informed and entirely insincere, exploiting cheap dramatic effects and debasing knowledge for its own profit.

The *Electrical Review* sent its reporter to interview Professor Hermann, nightly performing "most wonderful" tricks "by the aid of the fluid" in the Temple of the Sphinx on Broadway in New York in 1892. Informed that Professor Hermann had constructed a watch that could generate one horsepower of electricity, the reporter was astonished to discover "that there was such a machine in existence and that the *Electrical Review* had heard nothing about it."[115] To see the machine was forbidden, for it could not be replaced if lost or damaged, the professor's business manager explained. It was described for the reporter's benefit, reproducing the hollow form of a cardinal scientific rule of verifiability, if not, to the reporter's glee, its substance. "Inside of the case is an armature, some coils of wire, a few magnets, a lode stone—I suppose that you know what a lode stone is? . . . Then there are some push buttons, a dial with some numbers, some switches, and a few other things, and that's all I can remember."

It was said the professor also had invented a telephone that transmitted images. "For instance, in one of Hermann's séances, he holds a photograph at one end of the telephone while he stands in the orchestra, and a reproduction of the photograph is seen on the stage in midair." To the question of why the professor had neglected to market such a remarkable device, the business manager explained that this would rob the professor of the audience that flocked to his performances. This answer did not satisfy the reporter, who believed that the professor's motivation was economic rather than scientific. But it mimicked a scientific distrust of merely practical applications of the higher magic to which scientists were privy, as well as an appreciation of mysteries and miracles that exceeded the understanding of a less textually adept audience.

That scientists and electricians who were not tagged as charlatans also bent electrical knowledge to dramatic ends was deemed legitimate in the pursuit of truth. Instances included lectures with striking and wonderful "effects," and accounts of scientific work suspensefully constructed in written form for popular consumption. The "finale" of an electrical lecture by Edison Company representatives in Boston in 1887 was a spiritualistic séance. "Bells rung, drums beat, noises natural and unnatural were heard, a cabinet revolved and flashed fire, and a row of departed skulls came into view, and varied colored lights flashed from their eyes."[116] So impressive were these effects that a second lecture had to be repeated, for a standing-room-only audience. In 1894 the Sunday *World* attached this caption to a picture accompanying an article by Arthur Brisbane about a lecture by Nikola Tesla: "Showing the Inventor in the Effulgent Glory of Myriad Tongues of Electric Flame After He Has Saturated Himself with Electricity."[117] Magic and poetry cloaked in science satisfied the aesthetic impulse of scientists within the rules of a textual community that frowned on their more familiar popular expressions. To the scientist and engineer, magic meant not what *they* did, but nonscientific modes of discovering

and transforming reality, and especially the lack of an intellectual discipline associated with that science and mediated through literate practices.

When audiences got the metaphorical point that experts were at some pains explicitly to deny, namely, that science was a magical enterprise superior to lesser forms of magic, they were inclined to push that point to its logical conclusion. This literalness embarrassed scientists and sometimes forced them to disavow their own propaganda. The line between debased and scientific "magic" was sufficiently ambiguous to be a constant concern. Comparing Tesla's theatrical appearance at the Royal Institution in London in 1894 with a more straightforward, less enthusiastically received demonstration of Hertzian waves by Oliver Lodge, the *Electrician* weighed the need to present scientific information dramatically enough to capture public interest against the competing desire to convey a dignified appearance that would guarantee the respect of the scientific community. The difficulty in this tug of war was keeping the credibility of the priesthood intact. "It is not, of course, desirable," the *Electrician* editorialized,

> that these Friday evening discourses should, as a rule be tinged with quite so much of the dark *séance* style, but . . . had it been impressively and reiteratedly brought home to the spectators last Friday evening that what they were witnessing in the experiment necessarily involving so much shouting but resulting in a minimum of sparking, was the transmission of electromagnetic waves right through three brick walls and across the staircase and the room adjoining the theatre, it is possible that even the most uninitiated would have left the Royal Institution that night with a tolerably concrete idea of the importance of the experiment.[118]

Even less clear was the status of electrical tricks practiced by magicians for aims approved by professional electricians on those occasions when both groups were allied with political authority against subject peoples or other underclasses. Following the conquest of Algeria, the French government commissioned Robert Houdin, a celebrated conjurer, to challenge the popular authority of the native Marabout priests, whose following the French coveted in order to execute their colonial program. Houdin's object was to "convince the Marabouts that a European could not only surpass their miraculous exhibitions, but expose their fraudulent occult demonstrations, with which they continually awed the more ignorant Arabs, and excited others to discontent and rebellion." Houdin devised "The Light and Heavy Chest,"

his greatest trick, to astonish and humiliate the native necromancers. He exhibited an apparatus that he claimed would give them pain or make them weak at will. Accounts of this contrivance differed, although the incident was a staple of discussions about electricity and the control of colonial people. The device seems to have been fitted with secret pulleys and electromagnets that thwarted all attempts to lift a special iron chest displayed with it. To finish the performance, Houdin administered electric shocks through this chest "to strike terror into the soul of the native."[119]

Such efforts to subdue exotic cultures drew no criticism from electrical professionals, although not all electrical strategies were as aggressive. A German traveler, Dr. Junker, visited the area around Khartoum between 1879 and 1883 without incident by carrying an assortment of picture books, masks, musical instruments, puppets, electric toys, and other things "of which the natives knew nothing," with which he entertained them in order to win their friendship.[120]

The occasional appearance of sensational stories about the occult at the fringes of scientific and professional literature was usually legitimized by the suggestion that science was absorbing and taking over disreputable magical modes and replacing them with benign scientific ones. Stories of this kind dramatized the heroic encounter with the unknown, and the contest of power against power. As in any thrilling story, the plot of scientific proof and verification revealed what was authentic and legitimate in the eternal drama between good and evil. Good, or white, magic was science struggling against the twin enemies of the unknown and pseudoscience, or black magic.

There was, in fact, a good deal of this material sprinkled throughout expert as well as popular literature. In one kind of story, supernatural, unexplained agencies made disembodied use of electrical media, as if to symbolize the mystery of electrical communication itself. *Electrical Review,* for example, quoted the testimony of a train dispatcher fatigued from watching at the deathbed of a coworker, who neglected to direct an eastbound stock car to a siding to avoid a collision with another car carrying a party of excursionists returning from a picnic. As the clock struck twelve, and with seconds to disaster, the dying man appeared to enter the dispatching office, signal each train to a separate track, write down the order in the logbook, and depart. The presumed source of the apparition had expired in his room at exactly that moment, leaving his friend to wonder whether he had written the orders himself while dreaming or been visited by a ghostly presence.[121] Such stories were often presented without comment, simply,

as it were, for readers to mull over. Editorial comment framing some stories occasionally even hinted at their validity.

When stories about the occult concerned electricians and their work, however, the editorial presumption was that supernatural explanations were impossible. Perhaps the most characteristic debunking stories were accounts in which exotic, gaudy, spectacular manifestations of spirits appeared before emotionally credulous audiences at scientific demonstrations. Consider this 1897 report from *Popular Science News* of a remarkable Paris performance:

> In a darkened room, a gigantic luminous hand passed over the heads of the spectators, followed by a flock of luminous violins, which we are to suppose were made of glass for the occasion. Then an immense globe descended from the ceiling like a ball of phosphorus, oscillating like the pendulum of a clock. A luminous bell appeared in front of this globe and made regular bows to it. We could see its fiery tongue moving while the globe waltzed around.
>
> Suddenly at the four corners of the room the glasses appeared to become ignited; the vases were illumined and the lustres sparkled. A table loaded with cups and glasses was lighted up. Everything seemed on fire. The whole room, that was so dark an instant before, was aflame on all sides with phosphorescent light of a soft and bluish color.
>
> Then again all was darkness. Gradually a little light streamed in, and in a corner in front of a velvet portiere a human form appeared, at first vague and vaporous, hardly distinguishable. But soon its outlines became clear, and it advanced. The phantom advanced a few steps and then stopped. It was a tall woman. Her face had a greenish pallor; and what an extraordinary face it was. There were no eyes. We could only see two black holes under the eyelids. The mouth was closed, the hair was phosphorescent. A long, luminous veil enveloped this animated statue, and in the folds of the veil little sparks shone like diamonds. She raised her right arm slowly and tossed flames from her hand. A gong sounded. The apparition receded gently, and gradually faded out of sight.[122]

Following this display, a large luminous bouquet appeared in the center of the room next to a blue band upon which the inscription "X-rays" appeared. Lights were turned on. The host of the spectacle rose to explain that nothing in the previous display had an occult or supernatural origin. The entire explanation lay not in sensible appearances but in the knowledge of X rays, "invisible to our eyes." The special properties of X rays caused glass, porcelain, enamel, and diamond objects to shimmer as a beam passed through them in a dark room, while other objects remained concealed in darkness. Phosphorescent

sulfate applied to the face, but not the eyes, of a human figure dressed in fluorescent garments glowed in ghostly fashion when X rays were directed at her. The messages of this performance were several. It was clear that science could do magic better than magicians. But the deeper moral was that conclusions reached by untrained lay eyes, especially amid the distraction of mystery, spectacle, and dramatic sound effects, could not be trusted. What could be trusted was detached scientific knowledge originating in considered texts, able to produce not only the effects of the old magic, but other effects that the old magic could never produce.

Late-nineteenth-century electricians constituted a self-conscious class of technical experts seeking public acknowledgment, legitimation, and reward in the pursuit of their task. Their efforts to invent themselves as an elite justified in commanding high social status and power focused on their technological literacy, or special symbolic skills as experts. They distinguished themselves from mechanics and tinkerers, their predecessors, and from an enthusiastic but electrically unlettered public by elevating the theoretical over the practical, the textual over the manual, and science over craft. They sought to define insiders and outsiders in electrical culture, to enforce standards for professional training, and to arbitrate the use of technical languge.

As late as 1911 an article in the London journal *Engineering* collected many of these themes into a discussion of the telephone, which was reprinted for a more general audience in *Current Literature*. The article looked forward to the imminent achievement of transcontinental telephony in the United States as a prologue to the day when the spoken word could be transmitted to any point on the globe. That this day would come, explained the editors of *Current Literature*, "is the firm belief of those best qualified to form an opinion as to the possibilities of electrical science."[123] *Engineering* declared:

> The matter is one which must be left entirely to the experts. To the average individual the telephone—like the telegraph, the phonograph, electric light, the steam-engine, and many of the other commonplaces of modern existence—is still a mystery. We avail ourselves of the conveniences and facilities they afford; but how much does the man in the street, to use a convenient term, know of the why and wherefore of the hundred and one scientific miracles which he employs as a matter of course in his daily life.
>
> Take this latest improvement in telephony; what will it convey to the average man to tell him that it has been effected by putting coils of

> wire in the circuit of the submarine cable, which have the effect of setting up in the circuit an inductive action antagonistic to that already in the cable, or in the circuit; that these two neutralize each other, and in consequence conversation is rendered possible over a longer distance? . . . It is enough for him to know that the work of the electrical engineers will enable him to speak with his correspondent at Paris from Dublin or Glasgow or Edinburgh instead of from London to Liverpool.[124]

Experts also argued that the public, whose desire to share the privileges of electrical elites threatened to dilute their power and prestige, was misinformed and antitextual. Styling themselves as defenders of Western civilization, electrical experts caricatured and ridiculed the aspirations and electrical encounters of conventional scapegoat groups, including non-Europeans, Indians, blacks, women, criminals, and the poor. Deception and coercion were accepted sanctions against those who refused to recognize the authority of electrical expertise. The amount of deception considered proper was proportionate to the cultural strangeness of those against whom it was directed. Despite their willingness to exploit public credulity in pursuit of their own goals, electrical experts were deeply suspicious of magicians and performers who competed with them for public attention and loyalty in the name of science. Their answer to this challenge was to produce even more impressive magic, some of which is explored in subsequent chapters.

2

Community and Class Order

Progress Close to Home

> "Is dis Miss Mandy Johnsing?" asked the voice on the telephone.
>
> "Yas, dis is Miss Johnsing."
>
> "Well, Miss Johnsing, I done called you to de telephone to inquire if you would marry me?"
>
> "Marry you? *Marry* you? Ob course I'll marry you. What made you all think I wouldn't marry you? Ob course I'll marry you. Who is dis talkin', please?"
>
> —*Telephony*, 1906

Much of the literature on electricity in the late nineteenth century can be read as the wishful template of a world that electrical professionals believed they would create, given the opportunity. The world that looked most comfortable to them was less the egalitarian one they professed to desire in their more self-conscious public moments than one in which the stability of familiar social and class structures would be preserved, with the important exception that other people would come to recognize the wisdom of professional electricians' values, and might even think, look, and act very much like electricians themselves. With the more general application of electricity throughout society, electricians believed, the world could change only to their advantage.

For them, electricity was the transformative agent of social possibility. Through their power over it, it would be a creator of social miracles. Electricity had the vitality of a natural force; they had charge of its control and direction. Experts felt that society had yet to grant them the recognition appropriate to so weighty a social responsibility.