Prologue: "An Imperial Science"

In January 1889, in the wake of Heinrich Hertz's dramatic discovery of electromagnetic waves, the British physicist Oliver Lodge declared that with this experimental confirmation of James Clerk Maxwell's electromagnetic theory of light, "the whole domain of Optics is annexed to Electricity, which has thus become an imperial science."[1] Lodge had hit on a very up-to-date way to express the preeminence electrical science had achieved by the last decades of the nineteenth century. But in 1889 electricity was an imperial science in a less metaphorical sense as well: it lay at the scientific heart of submarine telegraphy, one of the characteristic technologies of the Victorian British Empire. Often described as the "nervous system of the empire," the web of undersea wires that British firms stretched around the globe in the second half of the nineteenth century carried information streaming toward London from the far reaches of the world and commands flowing back out, extending and reinforcing Britain's military, naval, commercial, and cultural power.[2] Cable telegraphy "annihilated space and time," in the phrase of the day, and cut the time it took to send a message from, say, London to Australia from weeks or months to hours or, for some messages, mere minutes. For the first time, the world was wired up, setting in motion changes in commerce, government, the dissemination of news, and the workings of everyday life that continue to play themselves out today. The advent of global telecommunications stands as one of the watersheds of modern history.

It was a watershed that transformed science as well. One of the perennial questions in the history of both science and technology concerns the

[1] Oliver J. Lodge, "Modern Views of Electricity," *Nature* (January 31, 1889) *39*: 319–22, on 322. This was the last installment of Lodge's long series of articles on the subject, collected and published later that year as *Modern Views of Electricity* (London: Macmillan, 1889); revised editions appeared in 1893 and 1907. The "imperial science" remark appears on p. 309 of the 1889 edition.

[2] See, e.g., George Peel, "Nerves of Empire," in *The Empire and the Century* (London: John Murray, 1905), 249–87.

relationship between the two. Should technology be understood simply as "applied science," with scientists, driven purely by their own curiosity, making discoveries that engineers and entrepreneurs then turn to practical use? Or is the pursuit of scientific knowledge instead sometimes shaped in fundamental ways by the technological context in which it is produced? Which way does the arrow of influence run? It is well known, for example, that electromagnetic field theory initially drew adherents only in Britain, and only in the mid-nineteenth century. But why then, and why there? The answer, as we will see, lies not just in the details of the lives and ideas of a few great men but also in the principal context in which electricity was studied in the middle decades of the nineteenth century: the telegraph industry, particularly submarine telegraphy. British firms dominated the world cable industry from its beginnings in the 1850s until well into the twentieth century, and the demands and opportunities presented by submarine telegraphy steered British electrical research into areas – particularly the study of how pulses of current travel along insulated wires – that fostered the spread of a field approach. Michael Faraday had been developing his field ideas since the 1830s, but they attracted little support until the 1850s, when physicists and engineers began to take them up in connection with submarine telegraphy. The Maxwellian field theory that grew to fruition in the next few decades was also shaped in important ways by the British cable industry, as was the whole system of electrical units and standards that is still used around the world today. By examining the links in the nineteenth century between cable telegraphy and the rise of electrical science, particularly field theory, we will be able not only to shed light on several important episodes in the history of physics but also to broaden and clarify our understanding of how science and technology interact.