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Temporalities of Instantaneity: Electric Wires and the Media of Immediacy

Florian Sprenger

Translated by Erik Born

On a warm summer day in 1729, a copper wire was suspended across a garden in the south of England. When one end of the wire came into contact with an electrified glass cylinder at the other end, in the very same moment, little pieces of brass leaf began to dance along the wire and settled down on it like butterflies. The person who had electrified the wire was Stephen Gray, a passionate researcher and a dyer by trade. In doing so, Gray was able to create an “elecktrick virtue” (Gray 1731a, 27)—an attraction, an electric force—from one side of the garden to the other, a result confirmed only by the sound of his friend Granvile Wheler’s voice and without any visual confirmation. It even sufficed to hold the glass cylinder near the wire without touching it. Sometime later, Gray would suspend a schoolboy horizontally and electrify him, in turn, with a glass cylinder, thereby making little sparks shoot out from the boy’s fingertips to the onlookers. At this stage, the invisible force still did not have the power to decide over matters of life and death, even if it could already be used to kill small birds. It was still not possible to distribute anything more than undifferentiated sparks, or even to charge them with meaning and code. Transmission was still entirely without meaning or application—a medium without a message, or rather, a medium whose message consisted in the fact that it existed, that it had an effect where there should be none. The wire filled a distance, a space between cause and effect, with its materiality. Electric action transmitted through the wire seemed to be instantaneous, simultaneous, immediate.

And it communicated. Gray called the wires "lines of communication" (Gray 1731a, 27). He did not have a concept like "cable" at his disposal. He knew nothing of insulation, states of electrical charge, or electrons. Communication, for the physical knowledge of his times, meant the connection between cause and effect. Between them, a transmission took place: the necessity of a causal link. Every process in the universe, according to the physics of the time, must have a cause from which it can be explained. For electricity to be able to "communicate" in this sense, three conditions are necessary: two separate elements communicating, one at each end, and an in-between. The transmitter and the receiver have to differ from each other, or else there would be no channel and no connection. There have to be "two" in order for there to be a "one." However, these two require a "third": the medium. Communication presupposes a difference, an abyss between sender and receiver (see Peters 2000 and Chang 1996). Connection requires separation. The aim of communication, speaking generally, is to overcome this temporal or spatial difference, to make it disappear. Yet, electricity does not merely jump across this abyss; in Gray's experiment and in many other instances of the sciences of electricity, it appeared to eliminate this abyss entirely. The transmission of electricity displaces space and makes temporal differences imperceptible, thereby leaving both space and time immeasurable, while also inserting a piece of wire into them. Although cause and effect had been separated from each other, they still appeared to be simultaneous—and connected through a lengthy copper wire.

Gray was not able to say whether electricity has a speed. To him, it appeared not to require any mediation or any code. It was just there, appearing simultaneously at both ends of the channel, which was consequently no longer a channel but still opens up a space between seemingly simultaneous events. The people communicating over the wire did not have to be present at the same place to be connected. But their present coincides. What happened on Gray's end of the cable appeared to happen at the same time on Wheler's end of the cable. Between the ends of a cable, there can be an entire garden—soon, the entire world, measured out in copper wire—but there can be no minute, no second, no moment, no blink of the eye, no delay. The cable and its communication lead to an investigation of communicability itself. It spans gaps, and, as a medium, it is presupposed by the connection. What Stephen Gray transmitted in that garden in the south of England in the summer of 1729 was transmissibility; what was communicated in this communication was communicability.

The Materiality of Temporality

Cables connect the world. They are everywhere—crossing, branching, and interconnecting—wherever electricity, whether as energy or signal, should be conducted. Our world is universally connected and linked together, on a small scale as on a large scale. Cables are hidden inside every housing, behind every wall, in every ocean. Whether overground or underground, they connect cities and settlements, continents and colonies. As ubiquitous as cables may be in our current media-saturated world, rarely do they come into view, so concealed is their history.[1] So inconspicuous as to be frequently overlooked, the cable, as a medium underlying other media, can contribute to our understanding of our own time and its spaces. Its history is a history of connections and disconnections, of temporalities and spatialities, and it involves a history of mediation and of immediacy. Thus, the history of the becoming of cables to be told here is a history of the overcoming of distances in durations so short that they are deemed nonexistent, though mediation depends on them. The media history of the cable is a history of the phantasm of immediacy.

Cables, as Nicole Starosielski (2015) has shown, carve up geographic and architectonic spaces, but they are localizable and limited. They overlay geographies and architectures with their own relations by redefining places in terms of the beginning or the end of a material link. The interconnection of cables creates new "spaces of address," a collection of all the distant places that can be reached from a single place, medially, via cable. In different historical stages, these "spaces of address" are developed with technical means of connection and disconnection from cable networks over wireless transmissions to digital networks. The basic fact, though, remains constant: The cable addresses because it connects. From the time of Gray's experiments on, the history of the cable is bound to the history of addressing (see also Peters 2006). The cable creates a relation between transmitters and receivers, be they human or technical, thereby bringing about their addressability, perhaps even their identity (Siegert 1999), though at the very least their ability to be spoken to in that they bear an address. Every cable has a beginning and an end, and with that, a goal in and of itself.[2] The materiality of the cable, with its two ends, implies two addresses. Transmitter and receiver are functions of the cable, and consequently, writing this history implies writing the history of these addresses, even before they turn into a network. If every hardwired transmission implies a destination, this place is located at the end of a cable.

Since that summer in 1729, cables span the world due to two main improvements. The first was in terms of the amount of time that passes during a transmission. Transmission time is extremely quick, supposedly even instantaneous. Eventually, significant debates in physics will revolve around its duration. The second was that the cable establishes a material connection between the places at the two ends of the cable. Laying a cable does not merely open up a space; it also connects points in space. A cable is never only "here," but always also "elsewhere."

Consequently, from the perspective of media studies, the cable makes evident the phatic level of the relation between transmitter and receiver—the fact that there will always be a channel between them before there is any message. The materiality of the cable influences what can be transmitted "over the wire." It organizes space and time in that it separates transmitter and receiver, spatially and temporally. The cable itself contains a dimension of connection. Disturbances of the cable make it into the object of research, generating knowledge about its potentials including charge, delay, and transmission (see Hunt 1994). The space and time and the phantasms bound to this first electric medium are the subject of this essay.

Sciences of Electricity, Practices of Wiring

At the time of Gray's experiments, electricity was commonly understood as an attribute of objects that would attract other objects after being heated or rubbed (see Heilbron 1979). Accordingly, the concept of electricity designated a quality that had to be produced through manual labor. Interest in electricity was focused on researching corpuscles and effluvia, the smallest little bodies that were imagined, according to the most widespread mechanistic theories, to mediate electric and magnetic effects. Space, so people assumed, was filled with these imperceptible bodies, which were the cause of every effect, every phenomena, including that of electricity. Although electricity would gradually emerge as a well-defined field of study, it was not institutionalized for the time being, since the results of experiments with electricity were too dispersed and the uses of electricity too vague, hardly extending beyond spectacular experiments with illuminating balls, floating brass leaves, and sparking glass—all of which was an end in itself. Responsible for this delay were the precarious and unclear status of electricity and the insignificance of electric phenomena. Nobody "mastered" electricity; producing it demanded a lot of talent, dexterity, and patience (Schaffer 1997, 464).

The rules for making electric phenomena appear were largely rules of instrumentation. In the experiments conducted by William Gilbert around 1600 or Francis Hauksbee around 1710, which had marked out the field of electricity before Gray, all the components in the experimental setup were located within a single room and they all had to be visually perceptible. With Gray, however, the framework changes: the spatial “co-presence” of a “transmitter” and a “receiver” is no longer necessary. Attraction no longer takes place where the electrified objects are located, as in the model of attraction discussed in the context of magnetism. If electricity itself can be transmitted and “communicated,” as Gray’s experiments would subsequently suggest, then the site of its production would no longer necessarily be identical with that of its effect. Electricity, it turns out, can be sent and transmitted. To do so, wires have been bent, hung, compressed, extended, and knotted in a variety of forms.

Substances of Communication

The path from the wire to the cable leads through several detours. As early as 1708, Gray had written a letter to Hans Sloane, the secretary of the Royal Society, the most influential scientific institution of its time. As a simple craftsman, Gray did not have the privilege of access to the expensive instruments of the Royal Society, falling back instead on simple glass tubes, feathers, and brass leaves. In the letter, Gray describes how he made a glass tube, which had been electrified by rubbing it, attract a down feather at a distance of a meter—nothing less than a world record in terms of electrical action at a distance:

> If when the feather is come to the Glass it be held at about 6 or 8 inches Distance from the side of a wall edge of a Table Arme of a Chair or the like it will be drawn to it and thence to the Glass again and that for 10 or 15 times together without ceasing it flies to object at a greater Distance but then does not soe often Return. (quoted in Chipman 1954, 34)

Gray’s unpublished letter lays the theoretical foundation for the space and time of transmission that the cable will come to occupy. In the letter, he sets himself the challenge of explaining how effluvia that have been made to radiate outward due to rubbing can attract things back to themselves. However, Gray is unable to present a solution to this problem of attraction. He even tries to refer back to phenomena of repulsion, which had long fallen out of the typical framework of observation:

> When the feather is come to the Glass and thence Reflected if you follow it with the Glass twill flee from it and will by noe means be made to touch it till driven near to the next wall in the Room or some other solid object by which twill be attracted and freely return to the Glass again Repeating its Reflections. (quoted in Chipman 1954, 35)

Whenever the feather touched the glass, according to Gray, it was repelled first to the bodies surrounding the glass, and would only then come back to it. Gray’s conjecture here was that all bodies emit effluvia, mutually interacting with one another (see Heilbron 1979, 234), and his later view would be that these effluvia transmit so much electric force through the air that any receiving objects would likely become electric. Since these effluvia were imagined to be something like an atmosphere surrounding an object, they should have affected any surrounding object. As the effluvia were flowing outward, any surrounding body was also supposed to become temporarily electric: “as all bodies Emitt soe they Receive part of the Effluvia of all other bodies that Inviron them and that the attraction is made according to the current of these Effluvia” (quoted in Chipman 1954, 36). For Gray, this exchange of smallest bodies fills the entirety of space and creates a network out of effluvia flowing between separate objects. In this conceptual framework, there is immediately a connection between anything that winds up within electricity’s sphere of influence. This space is open but it extends only a few centimeters.

How do objects become electric beyond a distance of several centimeters, Gray was asking himself, without touching? How do things, whether glass tubes or planets, have an effect at a distance? This question was central to physics since Aristotle, who put forward the principle that there must be spatial and temporal contact between cause and effect (Aristotle 2008; see Hesse 1955). If a cause and an effect are related to each other in spite of the distance between them, then they have to be connected by a medium. As a tenet of medieval Aristotle reception has it, "Every action happens through contact, which is why nothing acts at a distance, unless through some medium" (*Omnis actio fit per contactum, quo fit ut nihil agat in distans nisi per aliquid medium*).[3] In this economy of causality, an *immediate* effect at a distance, relating two places to each other without time, is strictly forbidden. To circumvent this prohibition and to explain phenomena like electricity and magnetism, various media have been introduced as "argumentative resources" (Cantor 1981, 152), including ethers, spirits, corpuscles, or effluvia. These media ensure continuity even at a distance, conjuring up a connection even without contact—*actio in distans.*

Gray's experiments also followed this powerful theoretical guideline of the physics of that time, though he would be the first to build an electric medium. However, his theses about attraction and repulsion did not initially find any resonance. His next publication would appear only twelve years later, an interim during which he worked in the laboratory of Newton popularizer John Theophilus Desagulier. After another ten years of silence, Gray's publications and influence began to build. In 1731, he demonstrated his experiments to the Prince of Wales, whom Desagulier served as the court physician, and the Royal Society awarded him with the first ever Copley-Medal, which is still given out today, and did so again in the following year. Gray's work was part of a larger change in scientific practice—a movement toward professionalization that would have challenged his authority as a poor dyer had his experiments been conducted only a few decades later. However, it was precisely this manual dexterity, "the dyer's knack," (Schaffer 1997, 464) that was decisive for the success of his experiments. As the historian of science Simon Schaffer has shown, Gray's exceptional dexterity enabled him to conduct many experiments that would have been difficult for those lacking in practice.

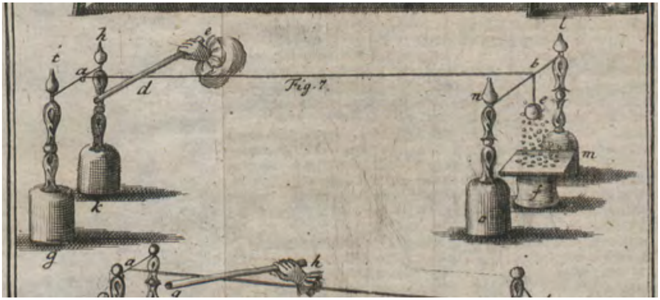
Action at a Distance

Gray's first, short published statement about electricity of 1720, though not influential in the scientific community, opens with an important observation. After conducting several experiments with glass tubes and a down feather attached to a stick, Gray had come to a crucial realization: even without the glass tubes, the feather would still be attracted to the stick, "as if it had been an Elecktrick Body, or as if there had been some Electricity communicated to the Stick or Feather" (Gray 1720, 104-5). Gray's precise description of the phenomena of charge and discharge, which at the time were still not defined as such, was the precondition for his thesis that electricity can be made communicable. The focus of his research changes here from attraction to transmission—namely, transmitted attraction—and thus continues the concern with electrification at a distance that the published letter only hints at. Among the objects Gray was able to electrify was himself, as his fingers attracted feathers or hair. At first, Gray was working with threads and paper, "finding them, after they had been well heated before rubbing, to emit conspiciously their Elecktrick Effluvia" (Gray 1720, 106). If many effluvia gather together, Gray thought, they could be passed on through communication, without any corresponding loss or exchange.

In his next report, published in 1731 though referring to events of 1729, Gray begins with a mention of more experiments with glass tubes, but then, after several changes of scene, goes far beyond them, and describes electricity in terms of transmission (Gray 1731a). At this moment the cable takes the stage. To prevent dust from entering the open tubes, which were about a meter long and a few centimeters wide, Gray had stopped them up with pieces of cork. To his surprise, the corks at the end of the tubes did not change the effect of the tube, but precisely the opposite: the corks themselves proved to be attractive. In the prevailing order of science, this should have been impossible, since the corks themselves were not electrified.

At first, Gray was not studying action at a distance but action close up, an effect that would be explained today as “induction.” He went on to replace the corks with all kinds of other materials, or he would touch these materials to the corks, thereby transferring electricity from one object to the next without having to rub it. Consequently, the cork became a carrier, whereas the transmission, in previous experiments, had occurred through effluvia in space. Gray was able to transmit electricity from one object to another, even if a wire was attached to a cork perpendicularly. In this manner, diverse objects could be attached to the tubes hanging in the air, and together they formed a new kind of experimental setup. The space of transmission now reached, with the cable, from the tube to the object.

This is precisely why Gray was able to electrify things—because he did not intentionally touch them with his hand, as had always happened up till then. In Gray’s setup, objects are, to use our current terms, “isolated against discharge.” First, several materials had to be constructed as a continuous line. If the effect (which had only been present where something had been electrified) appears now at the end of the experimental setup, then the object in the space between can also be electrified, and it should function as a suitable carrier. The in-between object becomes the medium of communication. Gray would try out diverse carriers of communication, such as a fishing spear made of Spanish cane, stovepipes, fireplace tongs, as well as whale bones and other sticks or rods, copper and iron wire, cords, a tea kettle, even vegetables. Since the transmission works best with copper wire, the questions arise as to the maximum possible length of this kind of conductor, and the potential distances it might overcome—an early signal range test, as it were.



[Figure 1.1]. Gray's Cable. Source: Johann Gabriel Doppelmayr, *Neu-entdeckte Phaenomena von bewunderswürdigen Würckungen der Natur* (Nürnberg: Fleischmann, 1744), Table II.

How these pieces of wire were connected to each other is not mentioned in any of Gray's reports. At the time, production methods made it possible to create pieces of wire that were at most a few meters long, and these could then be tied to each other to increase the overall transmission distance. However, Gray was not interested in finding a practical use for his experiments. They are not precursors of telegraphy, however much they may be appear to be. After proving that a certain range was attainable, Gray did not continue the experiments. Although a transmission distance larger than a few hundred feet appears to have been theoretically possible, Gray initially had no desire to test it. Alongside the fascination with attraction without a visible cause, there was also fascination with action at a distance that would eventually overcome distances too great for the eye to see. There are spatial limits to this desire. At first, only a few meters. For longer experimental setups, Gray's room was too small. His first experiments with a horizontal suspension failed, because he was using the same material for attaching things and as a conductor. Only a trip to the countryside in Ottenden Place in the county of Kent, in the presence of his friend Granvile Wheler, a clergyman and Fellow of the Royal Society, allowed Gray to continue his research in spaces larger than those of his room in the city, and subsequently to present them to the public of the Royal Society upon returning to London.

Gray's accounts of these garden experiments show the significance of narrative patterns for anchoring epistemic innovations. What could be more unlikely, in this idyllic setting, than the annihilation (or, at the very least, manipulation) of space and time? Since no one from the Royal Society was able to be present for the experiments, Gray's narration made the reader of the *Philosophical Transactions* into a virtual witness. Gray and Wheler began by hanging the tubes vertically, which would then attract brass leaves lying on a wooden stool or a glass pedestal. They were able to continue this sequence by attaching other materials to the tubes and introducing a rod with a piece of ivory at the bottom end. Since Wheler's house was equipped with a balcony and even a clock tower more than ten meters high, they were able to experiment with longer setups, yet even this height was not enough to exhaust the effect. For his return to London, Gray planned to hang a tube from the highest point of the cupola of St. Paul's Cathedral, which would have then attracted a brass leaf in the altar sanctuary. However, this plan proved unnecessary when Wheler proposed attaching the conductor to the roof and having the setup proceed horizontally rather than vertically. The advantage of the horizontal setup was that no disturbance was possible through "discharge" on any supporting object, which could itself be a conductor, though not in the right direction. Gray did not supply a reason for this hypothesis, which would become enormously important for further electricity research.

Only after several trials did it turn out that the decisive factor was not the thickness of the carrier but its material composition. The experiment succeeded only with silk threads as suspension. This discovery was crucial because insulation—which Gray was still not able to name as such—makes of a wire something more than it is: the wire becomes a cable. Insulation is the necessary condition of the cable, since nothing will flow through an uninsulated wire, and the wire will not function as a carrier. The shift in Gray's experiment from a copper suspension to silk threads implies a distinction between conductors and nonconductors, and, with that, a description of insulation in which the wire turns into a cable. As Gray describes the experiment,

> Then the Cane being rubbed, and the Leaf-Brass held under the Ivory Ball, the Electrick Vertue passed by the Line of Communication to the other End of the Gallery, and returned back again to the Ivory Ball, which attracted the Leaf-Brass, and suspended it as before. The whole length of the Line was 147 Feet. (Gray 1731a, 27)

In this context, the theories of effluvia that had been influential for centuries are at their limits, since they can no longer explain these occurrences. Nothing can flow from a glass tube over several hundred feet without a connection.

The same experiment was continued in open air. Starting at Wheler's estate, they built a conductor crossing silk threads stretched between two rods. On July 14, 1729, the length reached 666 feet. The return channel, which would allow one experimenter at the end of the "line of communication" to report what happened to his friend at the other end, consisted of the human voice. Wheler and Gray called the results of their tests back and forth to each other. The time delay of this return channel was insignificant: Gray would not have been able to be at both ends of the setup at the same time to confirm what happened or to determine its speed.

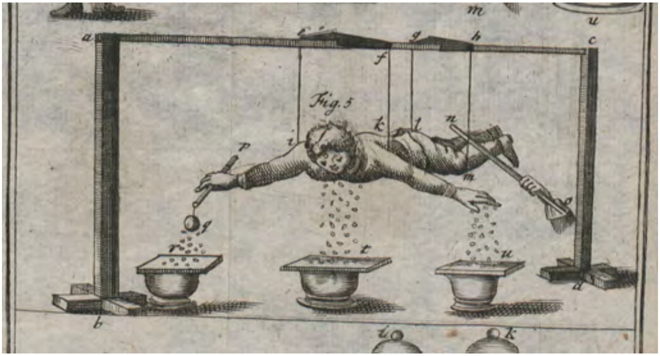
From a single source, Gray and Wheler created two, even three different conductors, which led off simultaneously in various directions. However, time eventually caught up with the two researchers:

> We began about Seven o'Clock, or some little Time after, but before Eight the Attraction ceased: But whether this was caused by the Dew falling, or by my being very hot, we could not positively say, but I rather impute it to the latter. (Gray 1731a, 31)

There are no reports of any continuation of these experiments. Instead, there was a shift from experimenting with lengths to surfaces: in what may be called an unintentional anticipation of the global village, Gray and Wheler electrified a twenty-seven-square-foot world map. They also found that a suspended circular wire would attract brass leaves located below it, provided that it was not too far away. While they were able to determine that the attraction worked to the same extent in all parts of the circular wire, they were not able to determine the location of electricity in the circle. What all these experiments have in common is that, no matter how long they attempted to make the connection, the effect was already there.

If electrifying objects requires the presence of the experimenter, who rubs the objects to achieve an effect, the transmitted effect must also happen in his absence—that means when there is no separation in the connection with the cable. Presence is no longer the condition of possibility for making both ends touch but rather the necessary result of the transmission. Because electricity is present at both ends at once, it is present everywhere. The cable has become not only a medium but, more specifically, a medium of immediacy—which is impossible in the framework of the physics of that time.

Bodies no longer merely receive electricity—they conduct it. In addition to corpuscles, these bodies can also be human bodies. In April 1740, Gray conducted a spectacular experiment that would fascinate audiences throughout Europe and would be demonstrated in numerous derivations in the form of an "electric kiss." In the experiment, Gray would suspend a schoolboy horizontally from the ceiling, put brass leaves on the floor under his hands and his hand, and then touch his feet with a charged tube. At the opposite end of the boy's body, the brass leaf would float up to his head. In the electric kiss variation, replacing the brass leaf with another human being would make the latter get hit with a discharging spark. Indeed, as Gray would find out, the schoolboy does not even necessarily need to be suspended from the ceiling; it sufficed



[Figure 1.2]. Gray's Transmissions. Source: Johann Gabriel Doppelmayr, *Neu-entdeckte Phaenomena von bewunderswürdigen Würckungen der Natur* (Nürnberg: Fleischmann, 1744), Table II.

to put him on a wax pedestal. As in the case of the silk threads, Gray was using the principle of insulation without knowing it. Even when two boys were put on wax pedestals and connected with a wire, they would each exert a force of attraction. The discharging spark eliminated distance, wiping out difference and stressing discontinuity. However, only contact electrifies: "I then bid one Boy put his Finger upon the other Boy's wrist, and then he immediately became electrical" (Gray 1731b, 402).

If human beings are able to conduct electricity, then the experimenter becomes part of the experiment. The presence of an experimenter's body can explain many failures of the performance of similar experiments, such as when experimenters would touch the electrified tubes with their hands and cause the electricity to get lost at these human outlets. The body no longer functions as an electric receiver, but as a conductor, and, with that, enters into a state of excitement.

Two different forms of transmissions come together in Gray's experimental setup. On the one hand, electricity acts as a mediator, without any apparent medium, between one object and another, whenever these are approached or touched. On the other hand, electricity gets transmitted to a distant place, making other objects become electric and, with that, conductors, transforming the wire into a cable. This distance opens a space. In passing something on from one object to another, a "line of communication" communicates, as in another meaning of this concept, designating military supply lines. But the instances of transmission in this "line of communication" are tripled: from one object to another at the starting point; through an object in the middle; from this object to another at the other end. The middle term can be extended to almost any desired length.

In London during the winter of the year following his first experiments, Gray would continue his research in this direction, finding out that the objects "communicating" with each other did not need to be connected to each other directly. There was an effect even at a little distance: no contact was necessary. It was sufficient to bring an electrified tube in the proximity of a conductor: "communication" would succeed even without contact. As Gray realized, the conductor would even attract a brass leaf at a distance:

> By these Experiments we find that the Electrick Vertue may not only be carried from the Tube by a Rod or a Line to distant Bodies, but that the same Rod or Line will communicate that Vertue to another Rod or Line that is at a Distance from it, and by that another Rod or Line the Attractive Force may be carried to other distant Bodies. (Gray 1731b, 404)

It is not necessary for the conductor to "immediately touch" the body at the end, for the ball to transmit immediately, as the French physicist Charles de Cisternay Dufay would report about the same experiment (Dufay 1733).

Hence, Gray's work marks two shifts in electricity research: first, it demonstrates that certain materials are able to transport the force of attraction over long distances when they are insulated; second, it shows that a conducting third can be switched in between two objects. These two shifts allow Gray to create effects that have never existed before. The communicability of electricity constitutes a new challenge because it detaches the object of research from cosmology and theories of substances (see Ben-Chaim 1990).

Nonetheless, this communicability of electric effects does not exhaust itself in research on physical conductivity. The early history of electric transmission cannot be described solely in terms of the history of physics. It depends equally on the stubborn materiality of the cable. The wire leads an experimental life of its own. As a medium, it is open to diverse ways of being used—above all, as a medial binder. It intervenes in experiments because it breaks, is resistant, or leaks energy. A wire can be bent into spirals and circles, squares and cubes. It opens up spaces and times, makes connections possible, and allows for connections to disappear immediately (on the history of wires, see Blake-Coleman 1992).

The Material Space of Distance

In his theory of the parasite as the "third" participating in every relation, Michel Serres attempts to grasp the place of difference, which is also the place of the cable: "A third exists before the second. A third exists before the other. [. . .] There is always a mediate, a middle, an intermediary" (Serres 1982, 63). As soon as the "line of communication" gets extended to the point that Gray can no longer hold it in his hands, the constellation changes. The channel creates a medial, material connection between two bodies, and constitutes a necessary technical condition of telecommunication. Although the effect apparently proceeds through a medium, instantaneity seems to negate this medium, since the simultaneity of cause and effect seemingly extends beyond any speed. With Gray, the fascination with simultaneity has materialized in an experimental setup for the first time. The same fascination will follow physics up to the present.[4]

There is a medium, but there is no delay in mediation. Gray makes out "no perceivable difference" in the effects of his experiment (Gray 1731a). An electrified body is seemingly "immediately" electric

(Hauksbee 1719/2004, 141; Dufay 1733, 259; Watson 1746, 727; Wheler 1739, 100)—immediately in all its parts, without any time delay or transmission time. What Gray terms a “difference” in the above statement is twofold: the repetition of an attraction that stays the same over the course of multiple tests and a temporal delay that he is unable to recognize as such. Nothing disturbs or inhibits the immediate simultaneity of transmission—and yet, the difference between the two places in the garden still represents a spatial division between them.

This relation of separation and connection is reflected in the dichotomous status of the cable: it is present in both places, but only because the other end is absent in that place. This is how the cable is able to carry proximity to a distance, and play out its function as a medium: it repeats and delays an electric effect. In this sense, transmission determines a difference because it makes a difference: the cable creates a spatial difference in terms of the cable’s ends. According to the rules of Aristotelian and Newtonian physics, any spatial distance requires time to be overcome, if speed is not to be instantaneous. However, the force overcoming space here was electricity, and nobody knew whether it required time (see Marvin 1988). Everything was pointing in the direction that it did not. Since transmission time lies below every sensory threshold, it could be eliminated without any remainder. For Gray, electric transmission appears to be timeless. The events occurring at the ends of the cable do not run in parallel; they are connected through a material medium, and not merely an effluvial or an etherial one. In turn, immediacy is projected onto this medium, which also serves to negotiate the new status of absence and presence. This physics of electricity, evident in the case of the cable, shakes the foundations of science because in its theoretical framework, instantaneous action at a distance is impossible. For this reason, writing the history of the cable and its transmissions requires casting a glance at the transformations of physical knowledge at the time of Gray’s experiments. They are also the setup in which the term “medium” is shaped in the form that became predominant throughout the twentieth century.

Although many ideas about the utopia of transmitting messages at a distance were in circulation at the time, Gray's experiments did not link up with them. "Communication," in the sense of the physical sciences, cannot simply be equated with "communication" between people, though their conceptual histories are intertwined. Gray's transmission is not a precursor of telegraphy, despite having an identical experimental system. Its content is itself—transmissibility. In Gray's experiments, there is no function or processing, either in the mathematical sense or in the sense of an application, and thus nothing is transmitted other than the transmissibility of electrical attraction. The transmission is not processed, and yet it shows, through attraction, that it exists. There is no content of this communication, which is why it refers to itself and thus exposes its properties. Transmission here means that the same action happens in the same moment at the beginning and at the end. It appears to be instantaneous, without time loss or delay. If there is no transmission speed and thus no separation despite distance, the two bodies involved in the communication are united in their electricity. In this way, electricity is able not only to arrive, "live," at the other end but also to be present at both places.

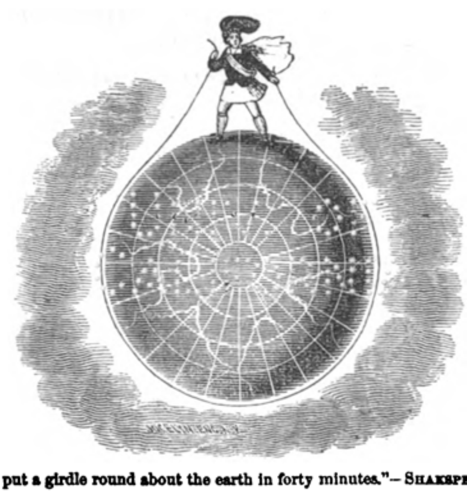
Only decades later, transmission time, as transport time or signal time, will itself become a topic of inquiry only after there are more precise measuring procedures for displaying speeds and delays. Eventually, it will turn out that every cable influences what it transmits, and that resistance is a variable of transmission. Without this knowledge, long-distance transmission is impossible. At the time of Gray's experiments, there was no way to perceive the disturbances and temporal delays of electricity, which will become functions of cables—for example, in the laying of the transatlantic cable—since these functions are dependent on measuring devices that divide time or space and make it countable. The sole basis for Gray's judgment, defining the region in which something can be determined to be "present," was sensory perception. At best, Gray and Wheler were able to shout when something happened. But as soon as they would raise their voices, it had already happened. Additionally, the experimental setups were too large for perception. As long as no measuring instruments were available, electric transmission could only be described as instantaneous: it was not possible to study its speed by the means of perception. In the end, the return channel would need to transmit just as fast as the electrical conductor (see Galison 2003). This is true even if the conductor is laid in a circle, thereby bringing both ends together into a single point that can be observed at once. The main aspiration running through all the work in physics on electrical action at a distance is to determine and to measure this time as a physical time, an objective time, a time beyond the experimenter's limited capacities of perception—and as a time of the cable.

As the wire becomes a cable, there are several noteworthy changes: a new time-dimension of transmission appears, and, with that, the possibility of storage. The electric cable transmits only attraction, without storage and without processing. Today, every signal that gets transmitted has to be processed in order to achieve "liveness" and "real-time" (e.g., in digital television transmissions). Even though processing time increasingly approaches transmission time, the term "real-time" remains a euphemism, and the rhetoric of "telepresence" skips over the production of that presence (see Sprenger 2015). There is transmission in "real-time." Every transmission is always mediated, and it is this delay that all technical media operate with. Real-time can only mean that signals are arriving at the speed in which they can be processed as quickly as possible: in time rather than real-time. Real-time always takes place between two points in time and is therefore not instantaneous. Skipping over this delay means ignoring its influence on how we are connected and disconnected.

Allowing the cable to come undone in processes of "instantaneity" and "acceleration" amounts to concealing the spatial relations, the spaces and times of interruption that are created by electric media. It also amounts to obscuring how these media are currently reconfiguring society. However, it is still important to keep in mind the deployment of the cable in the imaginary of its time. In the earliest discourses of telegraphy, there was a hope that the establishment of a telegraph line would do away with distances around the world, ultimately bringing people, countries, and continents closer together (for example Winkler 1750, 5). In this way, telegraphy catalyzes both new ideas about community and for communities' self-perception. As one developer of the telegraph, Carl August von Steinheil, put it:

> Communication is the strongest bond of the living creation: it connects one individual life to another, reproduces in one that which is a given for all, and thus forms out of individual beings species that emerge again as organic beings. (Steinheil 1838, 3)

The centrality of the cable for this imagination of an organic bond can be seen in an illustration of a figure, alluding to Shakespeare's Puck, alias Robin Goodfellow, who holds both ends of a cable wrapped around the globe: whenever he pulls one end, the other



[Figure 1.3]. Historical Sketch of the Electric Telegraph. Source: Alexander Jones, *Historical Sketch of the Electric Telegraph* (New York: Putnam, 1852), frontispiece.

moves. In this case, the cable is a transmitter and a receiver at the same time and, as such, does not merely connect individual places to each other but rather forms a connection that ends where it began—exactly in the sense of a line in Shakespeare's *Midsummer Night's Dream:* "I'll put a girdle round about the earth in forty minutes." The illustration comes from Alexander Jones's *Historical Sketch of the Electric Telegraph,* which appeared in 1852, before the first attempt to lay a transatlantic cable but already anticipating a wired world.

Until it became measurable a century later with elaborate devices and experimental setups, electricity appeared not to have any propagation speed but rather seemed to be at different places at the same time. In this instantaneity, electricity is related to media concepts used in the twentieth century to narrate the history of this very medium. "Past, present, and future merge into electric nowness," Marshall McLuhan will write more than two hundred years after Gray's experiments (McLuhan and Nevitt 1973, 1). For McLuhan, the instantaneous, simultaneous transmission of the "electric age" will unite the world into a new entity without an outside. For Gray, too, instantaneity no longer refers only to a constellation present before one's eyes that can be perceived with a single glance, but to the expansion of a transmission in a space no longer based on the senses. In these phantasms of immediacy, the channel recedes from the picture because the instantaneity of ubiquity creates a new entity out of individuals, as in McLuhan's global village, in which the delays and the materialities of the cable are entirely eliminated.[5]

Territories of the Cable

The geographic space of transmission, the distance from one side of a garden to the other, is not identical with the territory produced by the cable. Whereas this territory depends on the smallest possible times, or even no time at all, the geographic space of transmission remains as it is. Without electric transmission, a cable is merely a piece of wire, which nevertheless opens up a space. But once this space can be crossed instantaneously, or almost instantaneously, it ceases to be an obstacle and—simplifying things, since new problems and possibilities arise—must be conceived of anew. The separation between transmitter and receiver, between glass tube and brass leaf, ceases to be of minor importance, because the medium between them has been invisibly extended—and above all, because the length of the cable seems to be irrelevant for transmission time.[6] The spatialization of the channel plays no role for time: regardless of how long a cable may be, its end will always already be at the beginning. Opening up a territory by laying a cable creates new spaces and temporal relations. They define a space of address.

Materially, the two communicants are relegated to a position at each end of the cable, a position that, in transmitting from a distance, becomes a location within a new spatial structure that is not based on perception. This location can be addressed in both orders—in the geographic order as in the territorial order of the cable. In each order, however, the cable enters into different relations, and borders different places. While closing off geography, transmission also opens up a new space in which one end of a garden is made to border the other, insofar as both are addresses, just as Washington will later border Baltimore, or Britain will border America, with the construction of the first telegraph lines. Even if transmission is supposed to be instantaneous, its materiality opens new spatial relations that start to change the world.

If the space and time of transmission are not conceived of as immediate, the duration of transmission necessarily requires space, and the distance of transmission necessarily requires time. Both are based on a delay that contradicts their presence. Conceiving of the cable in terms of immediacy makes its in-betweenness disappear, and, with that, space and time of media as well. However, the difference between the beginning and the end of a cable, qua *différance,* transforms the phantasmal unity of transmitted electricity into a duality. Communication inserts an interval into the unity, an interval that is, to take up a thought of Jacques Derrida, equally different:

> This *différance* of the *between,* this elementary *différance* of inter-position or intervals between two surfaces is at the same time the condition of contact and the originarily spaced opening that calls for technical prosthetics and makes it possible, without any delay. (Derrida 2007, 229–30)

In other words, distinguishing A from B requires determining A by determining B, and this implies a delay: temporally, A comes before B, and between them comes the cable. As a spatialization of transmission, the cable causes delays due to the fact that both ends of the cable are predetermined to be addresses of transmission. This is due to the differentiating function of space: wherever A is located, B cannot be located, and, for this reason, there has to be a distance between them, which also differentiates them from each other. In terms of time, however, B can also be A'. The phantasmal immediacy of action at a distance, in which an action can be present at two or more places at the same time, would eliminate all of this: it would make A out of B, thereby wiping out division and disconnection. Ironically, the Leipzig-based cable researcher Johann Heinrich Winkler, who continued Gray's experiments a few years later, remarked as early as 1750: “At present, the speed of communicated [or, transmitted] electricity cannot be determined due to a lack of the required space” (Winkler 1750).

Thus, the cable is a measuring tape, a stopwatch, and a carrier rolled into one. It serves not only to transmit information or energy, but also to measure these transmissions in terms of their extent, speed, and distance, and to enable research on the space of transfer. In doing so, however, the cable intervenes in the transmission, since the speed of electric transmission, as would later become evident, is relative to cable length. In this sense, the cable requires research about the places where it is laid, such as knowledge about the peaks and valleys it has to cross, or the depth of the sea it gets lowered into. The cable and its long enigmatic resistance have ensured that the effect at its end is not identical with that at its beginning; even with the best insulation, there will inevitably be a loss. At first, this was not measurable because there were no corresponding instruments and dimensions, no units transforming space and time into measurable amounts. The history of the cable as a medium between immediacy and mediation is related to a history of measuring and proportioning electricity.

After Gray, the subsequent course of electricity research would be inconceivable without the cable. What would become known as the first stable functioning electromagnetic telegraph, created by Carl Friedrich Gauß and Wilhelm Weber in Göttingen in 1833, was initially nothing other than an experimental cable system, which served their research on the galvanic chain and their attempt to validate Ohm's law. With Georg Simon Ohm, the cable appears as a medium of delay and shows a resistant materiality. Ohm would formalize the principle of electrical resistance, which, in turn, is the foundation for the worldwide rise of telegraphy. The second half of the nineteenth century will become the age of long-distance cables, not only for the purposes of transmitting information but also, starting in the mid-1880s, for transferring energy. Thanks to the telegraph network, built to a global scale, the cable will become a medium of universality. Above all, cable research will come into its own, with the laying of the undersea cables, as a unique scientific field with protagonists like William Thomson and Michael Faraday whose starting point will be disturbances of communication and not its success (see Volmar 2009).

In short, since Gray's experiments, the cable temporalizes spatialization, it overcomes space in time, thereby creating a time between two places. The cable requires, systematically and physically, a rudimentary storage function: the contents of any transmission that is not instantaneous have to be stored, at least temporarily, because they have to exist somewhere, in some state, during the duration of the transmission. Electricity and cables, and later on, signals and messages, exist only in their execution, in performance, in circulation. And electricity can be measured only in this execution. At the end of every cable, the same effect that entered into it at the beginning should ultimately arrive. In Gray's experiments with the cable, this repetition consists solely of the effect of attraction. However, with the development of better measuring instruments, more reliable sources of electricity, and, above all, the breakthrough of electromagnetism, this repetition will have become standardized only several decades later to the point that the cable can be equipped with signals, eventually making it the basis for telegraphy and finally the transmission of the binary signals that still constitute our digital cultures. Transmission relocates effects to the places determined by a wire, which, for this very reason, has already become a cable.

Notes

1 While the history of the transatlantic cable is well known and Nicole Starosielskis media ethnography has explored submarine cables in detail, the histories and uses of shorter cables, for example in the domestic context, remains opaque.

2 For a deconstruction of communication as a separation that presupposes a connection, see Chang 1996.

3 Eustachius a Sancto Paulo, *Summa Philosophiae* (1614), qtd. in Spitzer 1948, 201.

4 For more detail, see Sprenger 2012.

5 For a recent iteration of these phantasms, see (Isenstadt 2018, 14–16). For Isenstadt, instantaneity, immediacy, and action at a distance are simply given physical and technical phenomena, which is wrong: no physicist of that time would have agreed that electricity is instantaneous or that action at a distance is possible. Newton, Faraday, and Maxwell, whom Isenstadt quotes, explicitly rejected this perspective. The seeming instantaneity of all-at-onceness that was established with telegraphy nonetheless became a cultural phantasm that Isenstadt's book on lighting explores in great detail, while still adhering to the phantasmatic dimension of immediacy.

6 For experiments following up on Gray's experiments, see Desaguliers (1734).

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