IN THE FIELD OF ELECTRICITY

Development of the Telephone.

DO YOU know that when you speak into the long distance telephone the man with whom you talk, be he fifty or 100 or 1,000 miles away, hears the sound of your voice before your stenographer who sits across the room can hear it? It is perhaps the nearest approach to the quickness of thought, this; for it takes the sound of speech as it leaves your lips and carries it on electric impulses a thousand miles in less than a hundredth part of a second.

And what does this journey of a thousand miles involve? What are the electrical waves about while the sound waves are making their way to the other side of the room? Suppose, for example, a business man in his office on the twentieth floor of a New York sky scraper talks with the manager of his exhibit at the St. Louis fair. Lifting the receiver from its hook when the long distance operator at "central" tells him "St. Louis is all ready" he says "Hello."

Through the little silk-covered wires that trail from his telephone to the wall opposite his desk, up to the molding above the window, around two sides of the room, the little word goes into the office switchboard. From there it scurries under the floor into the hallway and joins probably twenty other wires in a cable that climbs down the elevator shaft, picking up ten or fifteen more connections at each floor in its progress, passing from the basement through the wall to become a part of a larger lead-covered cable in a conduit under the street.

Here travel is not so easy as it was in the building, for 1,200 wires, each in its little covering of insulated, air-lined paper, are wrapped together in the cable and many influences from outside combine to impede the progress of the message. But one after another they are overcome and in perhaps the ten-millionth part of a second the "Hello" has entered the telephone "central." Here it encounters more impediments among the lightning arresters which stand guard over the switchboard and the other intricate apparatus that surrounds the marvelously delicate mechanism telephony employs for bringing together its sensitive filaments. But these obstacles are overcome and through the main switchboard it darts to the long distance switchboard in another part of the building.

Another downward leap and it is once more hurrying through the cable beneath a busy street. In its path to the westward lies the Hudson, but snugly wrapped in the cable it dives below the clustering river traffic and finally comes out again to the light of day in Jersey City, where, for the first time, it is brought up through the pavement and suspended from the cross-arms of huge poles.

Now its journey becomes easier, for the copper thread hung in midair offers less resistance to the passage of the message than do the crowded confines of the many-wired conduit. Indeed, such a difference does this make that whenever it approaches a large city a long distance telephone line passes around the densely populated sections so that it may stay above ground, a little switching station being provided to accommodate it. But at each station it must pass through the switchboard with its lightning arresters and other paraphernalia.

Down over the New Jersey meadows and pine lands the little word "Hello" hurries to ascend the Alleghanies. Then it shoots down again to dart across the farm lands and mining regions of eastern Pennsylvania, past Pittsburg with its furnaces and foundries and over a corner of West Virginia. On the banks of the Ohio it resorts to another cable, emerging on the farther shore in the pleasant countryside of Ohio and Indiana and journeying on over the undulating prairie state along roads which wind through great corn and wheat fields.

Now its flight is nearly over, but the mighty Mississippi still lies between it and its destination. It crosses the river on one of the wires strung on a great bridge. Then there is a plunge into a city conduit, a rush into the St. Louis "central," out and underneath the streets again, up once more to the aerial line and into the fair grounds, where, sitting at his desk in the exhibit booth, the manager sends back his answering "Hello" before the stenographer in the New York office has time to ask, "Did you get him?" It has all taken but a hundredth part of a second—an infinitesimal fraction of the time required for the conductor's warning cry of "All abroad!" to reach the hurrying people taking the express train which, traveling as fast as human ingenuity can make it, spends twenty-nine hours on its way from New York to the city of the exposition.

The word which made its 1,000-mile journey in less than a hundredth part of a second was given at the start an impulse so slight that scientists long sought in vain for a device which would detect and measure the very weak electrical current in the wires. The word as it hurries westward receives no other impetus. Repeating devices are included in telegraph lines, but the word spoken into the telephone must make its journey unaided after it has received at the beginning the impulse which is so small that it cannot be detected. But that initial impulse will carry the word many hundred miles, and in this fact is found one of the greatest of the wonders of telephony.

To the layman, who never stops to think of it particularly, getting a long distance call for a subscriber may seem just as simple a process for the company as making a local connection; but after following the New York conversation to St. Louis he can understand that it is not an entirely simple matter. If two copper wires were strung side by side without a break between the two cities and it were possible to telephone directly over them it would be less difficult. As a matter of fact, however, the message passes over five distinct circuits between the transmitter in the east and the receiver in the west—five circuits arranged in tandem. The circuits are united, like links in a chain, at switching stations just outside the cities of Pittsburg, Columbus, Indianapolis and Terre Haute. Each switching station has its switchboard and other apparatus through which the message must make its way, but these obstacles cannot be eliminated, as there must be junction points in the long distance lines, places where messages may be turned from one route to another.

The managers early saw the possibilities of long distance communication and began joining line to line and making equipment and apparatus capable of harmonious operations. The result of their efforts is a long distance system far more extensive and efficient than that of any other country. Speech has been transmitted over these lines for a distance of nearly 2,000 miles, and it has been shown that if it were possible to stretch a sufficiently heavy and unbroken wire from one side of the continent to the other the Atlantic could talk with the Pacific by telephone.

To make communication feasible over long distances it has been found necessary that all parts of the amalgamated plant, so to speak, should be of a uniformly high standard of construction, and for this reason it is not practicable to create a satisfactory cross-country telephone system by joining together a number of little local plants built in many divers ways and equipped with instruments of many patterns. It is chiefly the uniformity maintained by all the associated organizations that has made the present long distance service possible.

When you telephone your customer, or your tradesman, or your friend in the suburbs, the central office with which your telephone is connected calls the central with which he is connected and it takes but a moment to establish conversation by word of mouth, so to speak. It is evident, though, that if this method were used in making long distance calls it would be tremendously expensive, and what really happens is that while somebody else is using the line for talking, the New Yorker's call—the number he wishes and the name of the individual he wants to talk with—is telegraphed over the same wires that convey the telephone messages, for it is one of the peculiarities of electricity that this can be done without either message interfering with the other.—Chicago Chronicle.

High Speed Electrical Railroad.

An interesting experiment in high-speed electric railroading is about to be made in New York City, the outcome of which will be keenly watched by electrical and mechanical engineers, for whom, if it succeeds, it will upset several theories hitherto regarded as axioms in the utilization of electric power.

The experiment is being made by the Electro-Magnetic Railway Construction company, incorporated about a year and a half ago to develop the system of magnetic railroading invented by Dr. Albert C. Albertson and hitherto never put into practice except in comparatively small models by way of experiment.

The company is about to build a two-mile stretch of elevated railroad along the shore in Staten island between Midland and South beaches, to be used solely for experimental and demonstration purposes. The contract for the construction of the road has been let to R. S. Bishop & Co., and work is to be begun at once. The road is expected to be finished by August or soon afterward.

It is not to be used for ordinary traffic—in fact, it will not lead from anywhere to anywhere else in particular. Its sole object is to be the demonstration of the practicability of the Albertson system of electric traction, about which many engineers have been somewhat skeptical, and to develop and improve the system. But when the doubtful are convinced Dr. Albertson, the inventor, says the two-mile piece of road may be used as the nucleus for a working high-speed electric railroad, and in that case a franchise will be applied for. At present none is needed.

Dr. Albertson's system has been the subject of several articles in the newspapers and the scientific press since he first made it known early last year. Briefly, it consists of the application of electric magnets to divide with electric motors the work of running a train. Other engineers assert that while the system is theoretically sound it will not work in practice.

The inventor's train is planned to run on an elevated steel structure. A small electric motor, insufficient under ordinary conditions to draw so great a weight as a fully loaded train, pulls the cars. Beneath each car, however, and attached to the car by a steel frame is suspended a double set of electric magnets connected with storage batteries under the car body. The face of these magnets is set an inch or two below the under surface of the steel girder of the elevated structure on which the train runs.

Suppose, for the sake of illustration, that the car weighs 2,500 pounds. When it is desired to start the train sufficient current is turned into the electric magnets from the storage batteries to exercise a force of, say, 2,000 pounds. This force, exerted by the magnet to reach the steel girder above it, is subtracted from the weight of the car. The face of the magnet does not reach the steel girder or it would adhere and the train would stop. But a force of 2,000 pounds is pressed upward, lightening the weight of the car so much, reducing the coefficient of friction on the wheels and leaving the electric locomotive only 500 pounds to haul.

The thing, in effect, is the principle of the captive airship to which the locomotive supplies what is practically only a guiding force. The train cannot leave the rails, for there is still (to continue the illustration) 500 pounds pressure per car upon them, and, anyway, the steel supports of the magnets surround the side girders, imprisoning the train to the track, so that derailment is impossible.

Assuming that the magnets are charged with sufficient power to exert an upward pressure equal to nine-tenths of the weight of the train, there is only one-tenth the weight to move, and a comparatively low-power locomotive can move the train at great speed—speed to which 100 miles an hour will be a trifle.

That is Dr. Albertson's theory. For a year or more he has been demonstrating it in a model in his outer office, and now the men he has interested in it and who with him have formed the Electro-Magnetic Railway Construction company, are going to test it in practical form. When this has been done they hope to interest practical railroad men in their system.

Dr. Albertson himself is president of the company. N. M. Weser, an agent of the piano manufacturing firm and a relative of several of its members, is treasurer. The directors include Sol Levy, the butcher of West Fortieth street, and several New York and New Jersey lawyers.

Scientific critics of Dr. Albertson's system, to confound whom this experimental railroad is to be constructed, say that when it is built it can never be operated successfully because, while Dr. Albertson's system is beautiful in theory, in practice it can't be carried out. That is why the enterprise will be watched with so much interest by the engineering profession.

"It looks nice," a well-known engineer told a Sun reporter, "but I am afraid it won't do in practice. If it does it will be a revelation to the engineering fraternity. In the first place the friction on the wheels, which Dr. Albertson's magnets are designed to overcome, is almost a negligible quantity when a train is in motion.

"In starting a train the comparative coefficient of friction is about .135; when the train is in motion it is only .008. That is, it has decreased from one-tenth of a pound to eight one-thousandths of a pound. The real friction is caused by the air pressure on the front and sides of the train, and though Dr. Albertson's motor and cars are constructed with a view to minimizing this the gain is very small indeed.

"There is another factor. When the train is stationary and the power is turned into the magnets the lines of this magnetic force are exerted vertically upward in straight lines. But when you move the magnets forward at a high rate of speed, say 100 miles an hour, the lines of magnetic force become distorted, causing a backward drag on the magnets and the train.

"But the most important factor is this: Magnetic force decreases in inverse ratio to the square of the distance between the magnet and the object to which it is attracted, in this case the steel rail or girder. It will be impossible, I believe, to get magnets of sufficient power close enough to the rail to exert a force strong enough to exercise a material influence on the train.

"More than that, the rail, the magnets and the whole equipment must be absolutely rigid, for if they should not be and the magnet should touch the rail for an instant the whole principle of the system fails, the train sticks and generally I think there would be the devil to pay.

"These are the weak points in the system. If Dr. Albertson can construct a railway which will eliminate them and disprove what are regarded as engineering axioms, he will have done a wonderful thing, and the possibilities of his system will be endless. We other engineers don't believe for a moment that he can."—New York Sun.