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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 210,

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THE FUTURE OF THE TELEPHONE.

There is nothing more characteristic of the present age than the avidity with which it seizes upon and puts to practical use the discoveries of science and the infinite marvels of invention. To-day the experimental student wrests from the secret treasures of the universe a new truth, a new law, a new manifestation of force. To-morrow a countless host of printing presses spread a knowledge of the discovery to the earth's remotest bounds. Directly it is made a working factor in the world's best thought and action; in a little while some practical mind puts the harness of utility upon the new truth, and straightway the world is the richer by another useful invention. What would formerly have taken centuries to accomplish—or what the most fearless minds would scarcely have dared to dream of undertaking—is now done in a day. The invention is achieved, and finds a world pre disposed to receive it with gladness, even though its adoption should necessitate many and radical changes in the whole range of national and social customs. It took the steam engine centuries to pass from the stage of science un applied to that of practical utility. The telegraph was not so many years in rising from the level of scientific experiment to that of a useful factor in the daily affairs of nations. What the telegraph accomplished in years the telephone has done in months. One year it was a scientific toy, with infinite possibilities of practical use; the next it was the basis of a system of communication the most rapidly expanding, intricate, and convenient that the world has known.

One of the most notable occurrences of our Centennial year was a little gathering of scientific men from various parts of the world to test the performance of a new scientific invention of which wonderful stories had begun to be told, especially with regard to what it was going to do. To the astonishment of all it did do marvelous things. A little disk of metal could be made to speak; still more, the operator might be miles away, and exerting power only through his vocal organs. With a couple of magnetic cups and a slender wire spoken messages were transmitted through considerable distances and delivered in tones so like those of the speaker that his personality could be detected by the sound of his voice, if it had ever been heard before. Though far from perfect, the speaking telephone was an assured fact, and a new era in social and business communication had dawned. Scores of active minds at once set to work upon the problems to which the telephone gave rise, and hundreds soon joined them. In a little while the telephone in various forms was in the hands of progressive men in every part of the world.

It was tried as a means of uniting more or less widely detached portions of business houses, as the salesroom and the manufactory, and proved a great success. As a means of social and professional communication it was equally satisfactory. The next step was to form little clusters of telephonic communicants; the wider and more varied the business callings of the members of the group and the more numerous its membership the greater was found to be the utility of the system. But it soon outgrew manageable proportions without some system of centralization. The telephonic exchange, or central office, was a natural and necessary result.

Thus a new business sprang into existence almost in a day, with no end of scientific and practical problems to solve. The machinery and working methods of the telephonic exchange are sufficiently explained and illustrated in another portion of this issue of the SCIENTIFIC AMERICAN. With the information there given one can form some idea of the present and prospective development of the system. From the little room figured, as many as six hundred lines (with an aggregate mileage of 650 miles) reach out to the offices and homes of as many subscribers in various parts of New York, Brooklyn, Jersey City, Newark, Orange, and connections are making or in immediate prospect with all other ad jacent towns of any size. New lines are being added at the rate of five a day, and every new wire widens the range and increases the value of every other wire in the system. Very soon the Philadelphia exchange will be connected with that of New York, and then any subscriber in either city or its suburbs will be able to communicate directly with any sub scriber in the other. Already from four to five thousand calls are made upon the exchange daily, during business hours, and the system has scarcely begun to occupy the vast field that lies open for occupation as rapidly as telephones and connecting wires can be set up.

The limits of our space forbid any attempt even to summarize the infinite range and variety of possible telephonic communication. Its scope is as wide, as limitless indeed, as is the range of communication possible between men. Any question that a business man may have occasion to ask of another, any instruction he may wish to give to a distant subordinate, any message that a boy can carry, and that may be written, falls within its province. Even at the low average of a mile for the distance between the widely separated subscribers in this city the five thousand daily communications mean five thousand miles of travel saved for somebody. And the time gained by the saving of those five thousand miles of travel means not less than a thousand hours of the most valuable portion of the day, an average of over an hour and a half daily to each subscriber. The increase of business efficiency due to such savings of time and trouble is beyond computation.

In its infancy, with the inertia of custom to overcome, the system has developed a capacity for growth that has distanced the expectation of the most sanguine, and its utility as well as its capacity for further development increases with every new wire, more especially with every new connecting link between central stations. Who, then, can have courage to predict even the immediate future of the system, or to attempt to forecast the social and commercial changes which the annihilation of time and trouble, and the doing away with the mediation of forgetful or erring servants, will bring in their train? Soon it will be the rule and not the exception for business houses, indeed for the dwellings of all well-to-do people as well, to be interlocked by means of the telephone exchange, not merely in our cities, but in all outlying regions. The result can be nothing less than a new organization of society—a state of things in which every individual, however secluded, will have at call every other individual in the community, to the saving of no end of social and business complications, of needless goings to and fro, of disappointments, delays, and a countless host of those great and little evils and annoyances which go so far under present conditions to make life laborious and unsatisfactory. The time is close at hand when the scattered members of civilized communities will be as closely united, so far as instant telephonic communication is concerned, as the various members of the body now are by the nervous system.

PROGRESS OF ARTIFICIAL ILLUMINATION.

The new year opens with unusual promise in regard to the future lighting of our homes and places of entertainment and business. Two novel and radically distinct systems of interior illumination are now before the public, both agreeing in offering strong assurances that relief from the inconvenience and imperfection of illumination by means of kerosene and gas is not very far away. Whether either or both will fulfill the promise of the day only time can tell. Both display a high degree of experimental success; but it is a different matter to meet successfully the more exacting requirements of every day use at the hands of all sorts of people.

One system is based on the division of light, however generated, the other on the division of the electric current and its conversion into light by incandescence. The first is the system experimentally developed by Messrs. Molera & Cebrian, of San Francisco, and illustrated in these pages some months ago. These gentlemen undertake to distribute radiant light, not the means of making light, such as gas or electricity. The system involves a central generator, whence light is transmitted in parallel beams through tubes to the places to be illuminated, and there thrown out by prismatic reflectors, and dispersed by proper lenses. In this way, the inventors claim to be able to disseminate the radiant energy of light with no greater loss of power than is experienced when the electric current is divided or when gas or oil is burned in separate lamps or jets. The system has been tried in San Francisco, and is said to work well. The inventors propose to light city streets and houses, as well as isolated dwellings, shops, churches, and the like, and are sanguine of success. To our mind, however, the system seems likely to exhibit its highest utility and economy in places where a single building is to be illuminated, and no facilities are offered for the economical employment of incandescent electric lights; this, of course, under the assumption that what is possible in laboratory experiments is practicable on a large scale and under the varying conditions of every day use. The sanitary and other advantages offered by this method of distributing light are such as to justify the strongest wishes for its practical success.

The other promising system of domestic illumination is that just brought forward by Mr. Edison, as described and illustrated on another page of this paper. To all appearances, Mr. Edison has got the lamp he has so long been searching for, and curiously it is not at all what he thought it would be a few weeks ago. In other words, the light is generated in a strip of carbonized paper and not in a spiral of platinum or other refractory metal. The light produced is perfect; the lamp is inexpensive and apparently durable; the economy of the general system in which it is used is tolerably clear; and all its details seem to have been worked out with Mr. Edison's usual cleverness and practical skill. The only question that remains undetermined at this writing is whether the lamp will stand the test of time. It seems almost incredible that a slender thread of carbon can withstand the intense heat of the lamp, even in a perfect vacuum, without volatilization or fracture; but the lamps are stated to have stood action of the current, both in ordinary and in extraordinary strength, long enough already to upset all reasonable opinion as to the behavior of carbon under such conditions, and there is now nothing to be done but to wait for time to determine what the ultimate issue will be. The fact that all its predecessors in the field of incandescence have sooner or later come to grief is the chief, if not the only one, compelling a suspension of judgment in the present case. We sincerely hope that no hidden flaw may discountenance the inventor's confident assurance of victory. The light is exactly what the world wants to see; and if it will only wear long enough to pay for itself, both the inventor and the public at large are to be heartily congratulated.

At this point it is proper to note the extreme simplicity of the new lamp and the lack of any startling novelty in its materials or construction. If the lamp justifies present expectation, it will have but one radical peculiarity, and that is success. And success, in a field beset with so many difficulties which men of science and practical experience have pronounced insurmountable, is the highest as well as the final proof of a great invention.

Less successful workers in the same field have been prompt to say: "Mr. Edison is mistaken: the thing cannot be done as he claims to do it." To which Mr. Edison replies: "The problem appears to be solved; time only can tell whether the solution is final."

The next objection is: "The lamp presents no new discovery; its elements are old, and everything in the system has been suggested or tried before."

To this Mr. Edison may as justly reply: "Grant that the lamp involves no discovery, that its elements are old; nevertheless, in combining old elements, I have produced a new product, an incandescent electric lamp which does what no other lamp has done; it will work and does work. Other men may have tried to do the same thing by the same means; they have failed; I have succeeded. Therefore, the lamp is fairly mine."

If Mr. Edison's success is verified by time and use, the world will frankly accord to him the credit which is his due. But whether he is successful or not, the field is still open. It is not possible that there can be but one solution to so complex a problem. Such an event never yet occurred in the history of invention. Whatever Mr. Edison's success may prove to be, it should serve as an incentive to other workers in the same field to take heart and go on to like achievements; and the greater his success the greater the assurance that others can do likewise, or possibly better.

ALEXANDER STUART.

In the death of Alexander Stuart, at his residence in Chambers street, Tuesday, Dec. 23, the city of New York lost one of its best known and respected citizens.

For more than forty years, Alexander Stuart, with his surviving brother, Robert L. Stuart, carried on the business of refining sugar on an extensive scale, under the widely and honorably known firm name of R. L. & A. Stuart. Their enormous refinery adjoined the residence of the deceased, and was within a block of the house in which the two brothers were born. Alexander Stuart had particular charge of the manufacturing part of the business, and gave his personal attention to the improvement of the machinery and to processes. He expended time and money freely, employing experts of the highest rank, such as Professor Torrey, a famous chemist in his day. By means of their skill and his own ingenuity the manufacture was carried to so high and pure a point that the firm's sugars commanded a better price in the market than those of any other manufacturer

During the last twenty years of its existence the firm employed from 250 to 300 men, and made from 35,000,000 to 40,000,000 pounds of sugar annually. In 1872, R. L. & A. Stuart retired from the refining business with ample means, and converted their enormous refinery into warehouses, the rentals of which afford a large income.

Since relinquishing the refining business the two brothers have spent their time and money in good works, contributing some years as much as a hundred thousand dollars to benevolent purposes. One of their last acts in this direction was the purchase of the magnificent Potter estate, at Princeton, New Jersey, and after refitting the mansion throughout, and making ample annual provision for its maintenance, they set the whole apart as a private residence for the President of Princeton College, Dr. McCosh.

Alexander Stuart was a man of marked character, genial in his manners, and of great benevolence of spirit, his gifts to religious and philanthropic objects being numerous and generous. By a long life of honorable enterprise and superior business capacity, he amassed a large fortune, and never failed to use it wisely.

EXCLUSIVENESS OF ENGLISH MANUFACTURERS.

One of the first things usually remarked by a foreign mechanic coming to this country is the readiness with which he obtains admission to any of our manufacturing establishments. To suppose he will be allowed, as is usual here, to freely walk about the premises and enter the different shops and departments of almost any large factory, simply as a visitor, without the intervention of some influential friend; without the necessity of feeing the "gateman," and not needing to assume any disguise, is so entirely different from his preconceived ideas, and the habits and notions in which he has been brought up, that he is generally greatly astonished. At first, too, especially if he be an Englishman, he is apt to think such liberty of inspection may be meant as an especial distinction, conferred upon him under the supposition that he is a person of more importance than he rates himself, until he becomes sufficiently well acquainted with the usages of the country to understand that such freedom is hardly counted any especial privilege.

The customs of European manufacturers generally, and of those in Great Britain particularly, are all against this way of doing business. To obtain admission to almost any of the large manufacturing establishments is generally a matter of a great deal of difficulty, to effect which it is often necessary to consult the head of the firm, present formal letters of introduction, and have passes come down from one to another through several different functionaries. It is difficult to see why this should be so marked a peculiarity in all kinds of business in England, except it be on the principle that many of the long established houses rather arrogate to themselves, from their age and financial strength, a position somewhat similar to that which the accident of birth gives to their aristocracy—thus making an "aristocracy of trade," as it were.

But true and lasting prosperity in any line of business is not developed or sustained on any such basis. From about 1840 until within the past five years, nearly every branch of industry in England had a most wonderful growth, and great fortunes were made among representative members of the middle classes. But this growth seems to have met with a severe check, and the close competition for the world's trade during the past five years has probably caused some reduction of the wealth accumulated in more prosperous times. Who shall say how much of this comparative decline in England's prestige as a manufacturing nation is due to this narrow spirit of exclusiveness, whereby inventions and improvements are necessarily limited, and the rewards therefor confined to the few? Here, every workman, from the lowest to the highest, is not only permitted to know how the work is done in every department of his business, but he is counted of little worth who does not at the same time make diligent efforts to understand all practicable ways of doing the work in his own trade and all branches related thereto. Our manufacturers, as a consequence, do not presume upon the ignorance and want of skill of their competitors, and suppose they will be able to hold in the future any advantages they may have to-day, except as they may constantly improve their productions and introduce more economical methods. They do not shut themselves up in an assumed superiority, not [illegible] are doing, careful only to preve[illegible]doing as well, for they know full w[illegible]ress of industry, what may be to-d[illegible]rative failure to-morrow. There [illegible] of competition here, and a rapid [illegible] would be impossible within narr[illegible]og-in-the manger policy;" and it is [illegible]ed our manufacturers generally [illegible] of the rest of the world.

THE HEART AS A MACHINE.

The heart is probably the most efficient piece of physical apparatus known. From a purely mechanical point of view it is something like eight times as efficient as the best steam engine. It may be described, mechanically, as little more than a double force pump furnished with two reservoirs and two pipes of outflow; and the main problem of its action is hydro-dynamical. The left ventricle has a capacity of about three ounces; it beats 75 times a minute; and the work done in overcoming the resistance of the circulating system is equivalent to lifting its charge of blood a little short of ten feet (9·923 ft). The average weight of the heart is a little under ten ounces (9·39 oz.). The daily work of the left ventricle is, in round numbers, ninety foot-tons; adding the work of the right ventricle, the work of the entire organ is nearly one hundred and twenty-five foot-tons. The hourly work of the heart is accordingly equivalent to lifting itself twenty thousand feet an hour.

An active mountain climber can average 1,000 feet of ascent an hour, or one-twentieth the work of the heart. The prize Alp engine, "Bavaria," lifted its own weight 2,700 feet an hour, thus demonstrating only one-eighth the efficiency of the heart. Four elements have to be considered in estimating the heart's work: (1) the statical pressure of the blood column equal to the animal's height, which has to be sustained; (2) the force consumed in overcoming the inertia of the blood-veins; (3) the resistance offered by the capillary vessels; (4) the friction in the heart itself. This, in a state of health, is kept at its minimum by the lubricated serous membrane of the pericardium.

THE STRUGGLES OF A SUCCESSFUL INVENTOR.

The early struggles of Mr. E. B. Bigelow, whose recent death in Boston we have already noted, afford a lesson of pluck, energy, perseverance, and final success, which ought to be very encouraging to other young inventors, when things do not go as they would like. His whole life, too, furnished another and brilliant refutation of the untruth conveyed by the ancient saying, that a rolling stone gathers no moss; everything depends on how the stone rolls.

His father was poor, and he was early set to work on a neighbor's farm at small wages. His first invention, made when he was thirteen years old, was a hand loom for weaving suspender webbing. Next he invented a machine for spinning yarn. This brought him a little money; and at sixteen he attended an academy at his own expense. Here he became interested in stenography, wrote and published the "Self-Taught Stenographer," from which he hoped to make a fortune. But the venture landed him in debt. Then he undertook the manufacture of twine, and failed again. Later he made another failure in the manufacture of cotton, which increased his indebtedness to $1,400, a large sum in those days. Then he took lessons in penmanship, becoming so skillful that he was able to support himself by teaching the art. The work did not promise any great profit, and he thought he would like to be a physician. After taking a course of classical instruction he entered his name as a medical student.

At this point, while lying one night under a Marseilles bed quilt, he conceived the idea that he could make a power loom to weave such fabrics. He dropped his studies for invention, succeeded, and entered upon a new course of effort, disappointment, more effort, and final success. A Boston house promised him money to set up his looms, but failed before he could get started. His father was also unfortunate in business and in failing health. He thought he could make something by means of a power loom for weaving coach lace, and having found that there was a good market for such products, he set to work to invent the required loom. It was another success as an invention; and, better for him, it resulted in financial success. It gave him both money and reputation. But he was cut out for still better work, and he found it in the invention of power looms for carpet weaving, the history and effect of which have already been told in these columns. He set up the first successful power loom carpet factory in the world; and subsequently passed on from looms for weaving ingrain to the greater invention of power looms for Brussels carpeting. In all he took out thirty-six United States patents, and ultimately acquired great wealth. It is said, on good authority, that by his inventions, the cost of weaving coach lace was reduced at once from twenty-two cents a yard to three cents; and the cost of weaving Brussels carpet from thirty cents to four cents.

LOW WATER ON MANUFACTURING STREAMS.

The comparatively small amount of rainfall in the latter part of the summer and through the fall months, in most of the States along the Atlantic seaboard, was felt to be a serious inconvenience in most manufacturing towns where machinery is run by water power. In many large establishments much trouble was caused, because the water in the streams on which they had been accustomed to depend for their power was for weeks too low to allow of running full time, and in some cases a total cessation of work for a considerable period was necessary. We do not now refer to the hundreds of grist mills and saw mills throughout the country, which are run by streams and creeks that were never expected to operate them steadily throughout the year. Leaving these out of the account, it is probably not too much to say that the builders and owners of scores of large manufactories, who had thought their water power practically constant, have this year been so seriously inconvenienced that the question of their future supply of water becomes one of great gravity. For they see in the prolonged stoppages they were compelled to make the past season something more than the mere effect of an unusual drought, which may not occur once in a dozen years.

Much has been said and written by those who have studied the subject carefully, about the diminished rainfall in countries and sections where the forests have been cut down, and how the character of the streams in such localities has undergone radical change, they being more subject to sudden freshets, while for the greater portion of the year the volume of water they carry is largely reduced. But such considerations as these seem to have had little weight with our manufacturers. They know that our timber lands are being used up with the most wasteful prodigality, but they have hardly given the matter a thought, in the light of its probable effect upon their business. They have seen the tanners cut down vast regions of woodland, to obtain the bark with which to make leather, much as the stock men in Texas and on the River Plate, in South America, used to slaughter cattle for the hide and tallow, the one not caring what became of the timber, as the other was indifferent to the value of the beef, and this wholesale destruction of the original forests has seemed to be a matter in which they had no interest.

The past summer has been particularly suggestive of thoughtful reflection and more careful calculation for the future, in regard to this whole question, by manufacturers who would avoid investing large amounts of capital in buildings and machinery whose value may at no distant time be greatly impaired by the falling off in the water supply on which they depend for their power. The entire section of country of which the Adirondack Mountains form the center has been greatly changed in the past few years by the wholesale cutting down of trees which has been pushed on every side. It is natural, therefore, that the water courses which are fed from this region should begin to show the effects which everywhere follow such causes, and it is not at all surprising that the manufacturing establishments in the Valley of the Mohawk should this year have had greater reason than ever before to complain of a deficiency of water. The character of the Delaware River, and the streams which fall into it, has for many years been undergoing a similar change, and now like causes have commenced to operate throughout the Valley of the Susquehanna, in Pennsylvania and New York, where are some of the largest tanning and lumbering establishments in the country. It behooves all manufacturers, therefore, who are dependent upon water power to run their machinery, to look this question squarely in the face. It is not very likely that any stop can or will be put to the destruction of our forests, so long as we have any, while individuals or firms can make money in this way; but those who are tying up their capital in enterprises where the amount and permanence of the water supply is a prime consideration should take heed, while they have time, of the changes they have every reason to look for.

Mr. B. C. DAVIS, in renewing his order for continuance of his advertisement in the SCIENTIFIC AMERICAN, writes: "The four line advertisement of my business in your paper has already brought to me orders to the amount of fifteen hundred dollars."

The first river steamer to adopt the electric light is the Reuben R. Springer, which left Cincinnati on her first trip to New Orleans, Dec. 17, 1879.