THE NEW TELEPHONE SYSTEM OF PARIS.

Despite its novelty, since the establishment of the first telephone lines dates back scarcely more than fifteen years, there are few industries of which we have had to record so numerous and so radical transformations as that of telephonic communications. These incessant modifications, of which it is difficult to see the end or even the retardation, are due in part to the special exigences of cities and states, in part to the unexpected increase in the number of subscribers and communications, and in part to the accessory services that are daily grafted upon the main service and peculiarly complicate the organism thereof.

The system, limited at first to a few subscribers not far distant from the center of the city, has become extended. It has been necessary to subdivide it by dividing the city into a certain number of districts, connected by an equal number of offices, which are themselves connected with each other by auxiliary lines arranged in a stellate polygon, that is to say, that permit of connecting any two subscribers in passing through two auxiliary offices at a maximum. After the city service, the progress made in telephony has permitted of rendering the communications interurban, and then, in a certain measure, international. Let us mention, too, the public telephone booths, the multiple subscribers on one line in common, the theatrophone, etc., which have, each of them, special exigences.

All these complications of service, the necessary consequences of the very success of telephony, have brought to the surface hard problems, of which the solution has not always followed the new needs with sufficient closeness. In many cases, even, such or such a rational solution has quickly lapsed into desuetude, and, until a new order, it seems as if a perfect telephone service of a nature to give full and rapid satisfaction to the public will constitute an ideal as irrealizable as the philosopher's stone and perpetual motion.

Such difficulties, upon which we cannot dwell too long, for the public is generally ignorant of their existence or does not sufficiently appreciate the importance of them, are particularly numerous at Paris.

The public and the administration have fallen into habits that they will renounce with difficulty and that naturally render the service more complicated and consequently less rapid.

In the majority of the large European and American cities, the subscriber is called up by the number of his apparatus. In France, we have still, and have had for a long time unfortunately, the call by proper name, with a telephonic population of from 13,000 to 14,000 subscribers, including one hundred mutations per week, a somewhat floating personnel, voluminous indices that are kept open with difficulty, etc. It will be seen that the researches in the index lead to loss of time or to errors, especially when one asks for Mr. Durand or Mr. Levy without specifying the title of the subscriber with the too common proper name in question. The calling up of the office by the subscriber and of the subscriber by the office is effected by a battery, while in other countries magnetic calls that lead to more simple arrangements are employed.

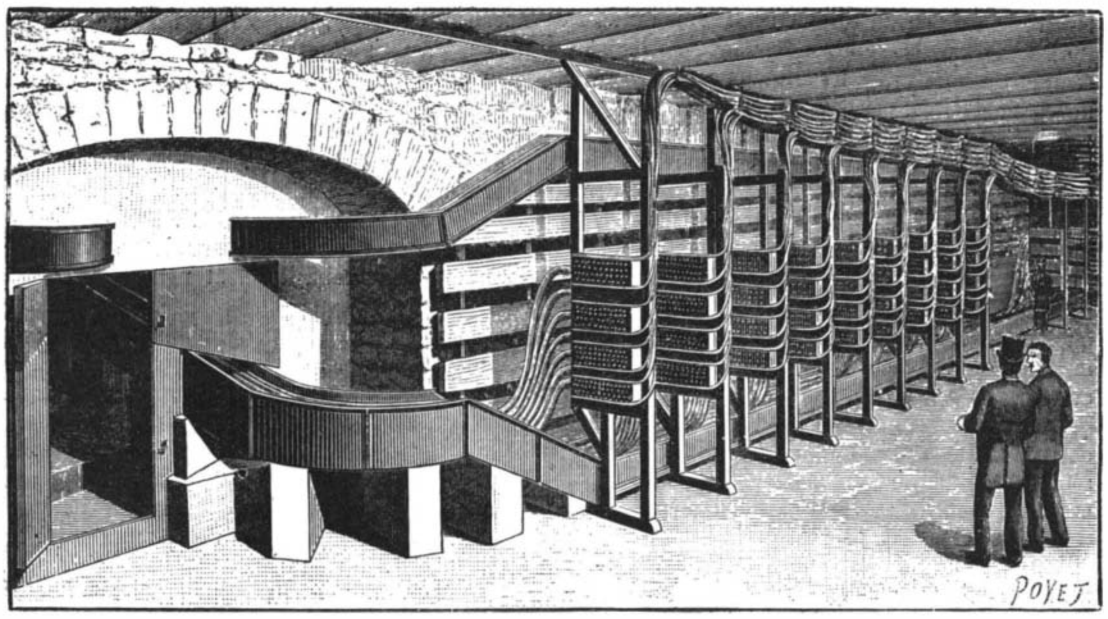


Fig. 1.—ENTRANCE OF THE CABLES OF 104 CONDUCTORS INTO THE CELLAR OF THE GUTENBERG STREET TELEPHONE OFFICE.

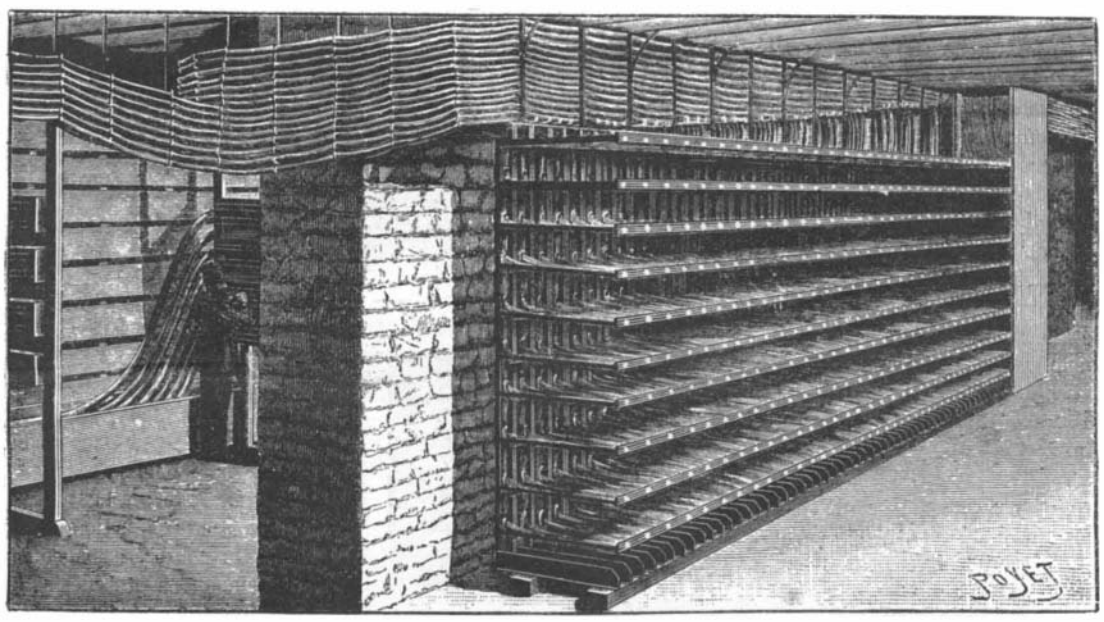


Fig. 2.—DISTRIBUTING BOARD OF THE TELEPHONE CABLES.

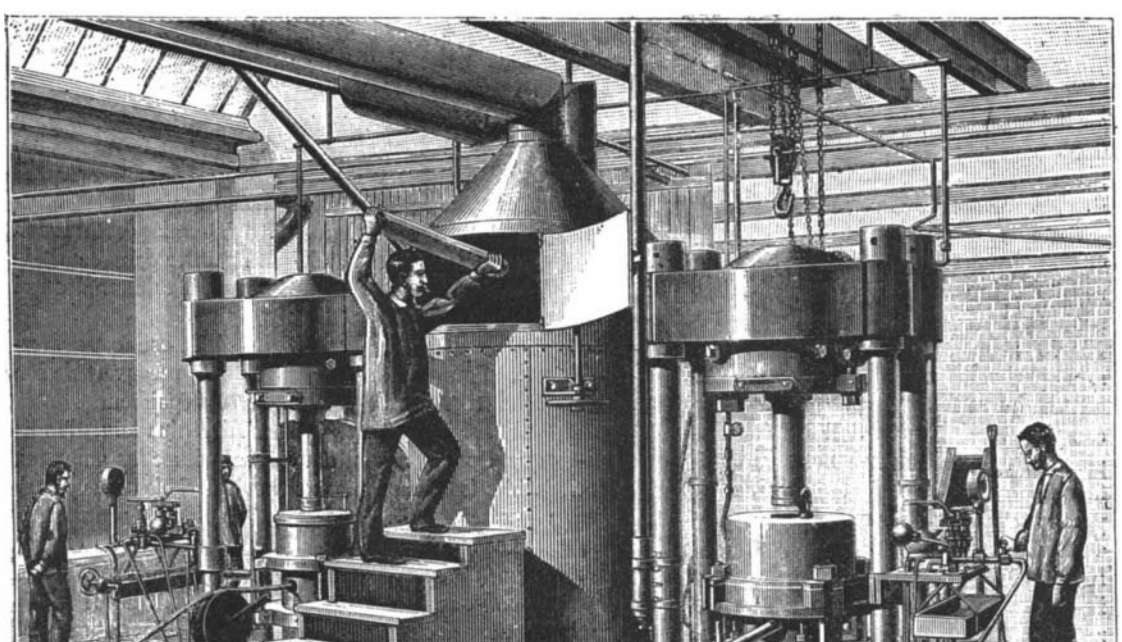


Fig. 3.—PRESS FOR COVERING THE TELEPHONE CABLES WITH LEAD.

From another point of view, the use of exclusively subterranean telephone lines, generally placed in the sewer, increases the expenses of installation in a certain measure and complicates the surveillance and the search for defects. We speak of the double line only as a reminder, for, sooner or later, the development of the electric industry will oblige all the urban lines to adopt what is known as the double wire system, and from this point of view at least the Societe Generale des Telephones has, from the outset, given a good example by establishing all its lines according to this system.

After these general considerations, let us return to the telephone system of the city of Paris, a simple and rapid expose of the successive transformations of which may present a certain interest.

From July to September, 1879, scarcely three years after the discovery of the telephone, three companies asked for and obtained concessions for the organization of telephone lines exploited according to three rudimentary systems, but sufficiently different to render the putting of the three lines in communication impossible. Soon afterward, a fusion occurred, whence arose, on the 10th of December, 1880, the Societe Generale des Telephones, which, at the beginning of 1881, had 300 subscribers. A few figures will permit of forming an idea of the truly extraordinary development undergone by the telephone system since that epoch, and especially since the somewhat unfeeling acquisition of the service by the state in September, 1889.

At the end of 1880, the Societe Generale des Telephones had but 300 subscribers; at the end of 1881, the number had increased to 1,602, at the end of 1882 to 2,692, at the end of 1884 to 3,700, at the end of 1885 to 4,054, and at the end of 1889, shortly after the acquisition by the state, there were at Paris 8,306 subscribers, and, at the end of 1891, 9,635; while the figure that it will be necessary to put down for the beginning of 1895 will be 14,000, if it does not even exceed this figure.

At the acquisition of the lines by the state, the tax was reduced from $120 to $80. and this reduction led to so rapid an increase of the number of subscribers that it became necessary to entirely modify the processes and the communicating apparatus in order to respond to the requirements, which, it must be admitted, exceeded the resources of the art and which had not as yet manifested themselves so rapidly in any other city in the world, even in America, where, nevertheless, telephony had birth, but where higher tariffs, with good reason, curtailed the number of subscribers. We say with good reason, contrary to the general public opinion, for if, in large cities, the prices were low enough to permit from 150,000 to 200,000 persons to become subscribers to the telephone, the latter would no longer render any service, in consequence of the excess of the number and the slowness of the communications. The expenses of establishment, of maintenance, and of personnel would even no longer be covered by the receipts, since all the expenses sensibly increase as the square of the number of the subscribers, while the receipts, based upon a fixed tax, increase only proportionally. Sooner or later, and by the very force of circumstances, the price of $80 will become inadequate, and it will be necessary either to increase it or to make the budget support the deficit. The subscribers to the telephone will thus become new privilegees of the state.

In 1889, at the time of the forced cession of its system of lines, the Societe Generale des Telephones, which had about 6,000 subscribers in Paris, was exploiting this system by the aid of twelve district offices connected by auxiliary lines. We described this system in its time. Its principal advantage was that of reducing the mean length of the subscribers' lines in a great measure, but it offered the great defect of giving the largest number of communications in passing through two district offices, the direct putting in communication being so much the rarer in proportion as the offices were more numerous and as each of them served a smaller number of subscribers. The number of subscribers and the length of the line, on another hand, prevent the connecting of all the subscribers of a large city with a single central office.

A selection has therefore been made of a mixed combination, and, in the general plan of the new system, the district offices have been reduced to four only: (1) An office on Gutenberg Street, near the Halles, for the 6,000 subscribers of the center, and the one that we shall more especially describe; (2) an office on Wagram Avenue for 3,000 subscribers, which has been in operation for more than a year and does service for Auteuil, Passy, and the Batignoles; (3) an office on Belleville Street for 6,000 subscribers, for Menilmontant, La Villette, Belleville, etc.; and (4) a single office for the entire left bank, as yet in contemplation.

These four offices will be able to do duty for about 20,000 subscribers, plus the auxiliary, interurban, international and accessory lines that are ingrafted upon them. The number of subscribers at present is more than 13,000. The prophetic figure of 20,000 will probably be reached even before the four constructed or projected offices are completely finished. It will then be necessary (sad perspective !) to rearrange the line and to once again modify the system, which has already ceased to meet its object exactly and is no longer abreast of the new progresses of telephonic technics. The Parisian system is the tapestry of Penelope of our telephone engineers. The continuously renewed difficulties of the task that they have undertaken ought to render us particularly indulgent toward a service that is indisputably imperfect, but which, by its nature, could not even reach mediocrity in imperfection.

One will be able to obtain an idea of the complication of the system, of the precautions to be taken and of the difficulties to be overcome from a simple enumeration of the connections necessary to bring a subscriber's station to the board, and of the arrangements to be made in order that an accident (and the causes of accidents are numerous upon lines exclusively subterranean) may be quickly localized and repaired without the introduction of any trouble into the service of the other subscribers.

In order to simplify the explanation, we shall consider only the connections relative to an ordinary subscriber situated in the radius of the central office that does service for him. The double line of lead-covered wires insulated with gutta percha starting from the apparatus of a subscriber enters the sewer, where it meets other double lines with which it runs parallel as far as to a coupling box, which serves to connect seven subscribers with a 14-wire lead-covered cable insulated with paper. The first grouping is therefore made by sevens. Seven similar cables corresponding to 49 subscribers end at a cutting chamber whence starts a 104-conductor cable (52 lines). This chamber permits of making connections between the 49 subscribers and the 49 double lines. The three last double lines form a valuable reserve in case of accident to a wire of the 104-conductor cable.

These 104-conductor cables enter the central office directly.

The length of the two-wire cables connecting each subscriber with a coupling box is quite feeble. The mean length of the seven-subscriber cables (14 wires) at Paris is 1·2 mile, but it reaches as many as 3·5 miles for the most distant subscribers. The mean length of the forty-nine-subscriber cables (104 wires) is 5,250 feet, with a maximum of 2·4 miles.

The linear insulation required for the 104-cable conductors between each wire and the covering is at least 200 megohms to the mile, but, in practice, it reaches a much higher value, say from 10 to 30 times greater. Thanks to the construction of the cable, it is possible to blow into it air dried over chloride of calcium, which improves the insulation.

At A, in Fig. 4, is seen a transverse section of a 104-conductor cable covered with its $\frac{1}{10}$ inch thick leaden tube.

Before going farther, it will be of interest to point out the reasons that have caused the substitution of the new cables insulated with paper for the old lead-covered cables of the Societe Generale des Telephones.

The old cables insulated with gutta percha were formed of fourteen wires inclosed in a leaden sheath, whose external diameter was $\frac{8}{10}$ of an inch; the linear weight, 4 pounds to the mile; the linear resistance of each wire, 62 ohms to the mile; the linear insulation, from 400 to 5,000 megohms to the mile; and the linear capacity, 0·5 microfarad to the mile.

These cables presented several drawbacks. They were costly and had a great linear resistance, and especially a great electrostatic capacity. Moreover, they took up so much space in the sewer that they soon became cumbersome in the vicinity of the central offices, especially when the reduction in the number of such offices necessitated the introduction into each of them of a larger number of cables.

The present main cables are of the Patterson system, insulated with paper and without paraffine. Each conductor is formed of a copper wire 0·04 inch in diameter, surrounded with two bands of paper, the first of which is wound with a very long pitch in order to facilitate the passage of the air, and the second with a shorter pitch in order to maintain the first, which forms around the wire a sheath in which the air circulates freely. Two conductors are twisted with a pitch of 8 inches and then corded in regular layers wound in opposite directions, so as to form a very regular cylinder. The 104 wires (52 pairs) are afterward covered with a lead tube, of which the thickness is about 1·4 inch, and the external diameter but 2 inches.

The similar cable has a linear resistance of no more than 40 ohms per mile and 0 12 microfarad per mile of linear capacity (per wire), while its linear insulation reaches 6,000 megohms per mile, and may reach 12,000 and even 16,000 through the passage of a current of dry air.

The putting of these cables under lead merits special mention. The strand of the 52 pairs once finished is placed in a stove, where it is dried before reaching the lead presses. These latter, which are represented Fig. 3, consist of a hydraulic press whose piston exerts its pressure upon a piston that moves in a cylinder which is periodically filled with lead that has been melted in a furnace, such as is represented in Fig. 3, between the two presses for which it does duty. The molten lead introduced into the cylinder of the press is kept at a proper temperature by a row of gas burners which surround the cylinder. The cable is introduced through the back of the press into an ajutage of appropriate form and makes its exit through the front of the press. Through the play of the pressure alone the lead is introduced into the ajutage, becomes moulded around the cable and pushes it forward. The temperature of the lead is such that the paper is in nowise carbonized, and that on its exit from the press the lead covering is solidified.

Let us now return to the system of cables and wires of the central office. A central office for 6,000 subscribers thus receives 12,000 utilized wires and from 120 to 130 cables, without counting the auxiliary lines, designed to connect the various central offices with each other. The entrance of these cables at the office into large iron plate boxes designed to support them and especially to protect them against the gnawing of rats is seen to the left in Fig. 1. Each cable ends in a coupling box, a sort of cast iron case, the details of which are seen at B and C, Fig. 4. The 104 wire cable is introduced through one of the extremities of the box, and the wires, separated from each other, are attached to 104 terminals mounted upon the anterior wall of insulating material (Fig. 4 C). The terminals traverse the insulating partition and project from the front part (Fig. 4 B).

To these terminals are attached 104 wires forming two cables, of 52 wires each, and thus capable of doing service for 25 subscribers, the twenty-sixth conductor forming a reserve.

These wires leave the coupling boxes, as may be seen, for a part of the line (Fig. 1) and reach the distributer represented in Fig. 2. The distributer is an immense junction frame, the object of which is to permit of a direct putting in communication, without any other wire being touched, of any one of the 6,000 double conductors with any one of the 6,000 numbers of the office.

The object of this arrangement is easy to understand. The subscriber preserves the first number given him indefinitely, even when he changes his address, provided his new quarters be within the perimeter served by the same central office. This number corresponds to that of the board, and is not changed on the latter except in case of accident thereto. But we have seen that between the subscriber and the office there are interposed multiple junctions that permit of replacing any one of the sections of a line that has become deteriorated, and, particularly, of utilizing the spare lines of the 104-conducter cables. The object of the distributer is to permit of such changes of cables without a change of the subscription number or of a communication with the corresponding number of the central board.

To this effect, all the 52-conductor cables starting from the cable ends reach the upper part and the rear of the distributer (Fig. 4), and end at terminals mounted upon large uprights arranged upon the posterior face of the distributer. The double wires coming from the communicating board form cables of 42 wires, 40 of which do duty for 20 subscribers, the twenty-first forming a spare conductor. These wires are connected in front of the board, with terminals arranged upon horizontal bars methodically numbered by groups and by units.

The connection between any one of the cables and any one of the wires coming from the office is effected very simply by connecting the two pairs of terminals of a vertical bar (line) and of a horizontal bar (office) through a double wire. The inextricable confusion that would be produced by such puttings in communication and the frequent mutations that they necessitate is avoided through horizontal frames upon which the wires rest in running from the front to the back of the board, before ascending, descending and turning to the right or left in order to connect the conductor of the board with the conductor of the corresponding line. When a communication is suppressed the double connecting wire likewise is suppressed, and this renders both the number of the board and the corresponding cable free.

Finally, the following are, as a whole, the connections interposed between the subscriber's instrument and the central board: coupling box (from 7 to 50), end of cable (from 50 to 25), distributer (from 25 to 20). The 20 double conductors finally reach the telephone or multiple boards. We shall endeavor to follow them in a succeeding article.—E. Hospitalier, in La Nature.

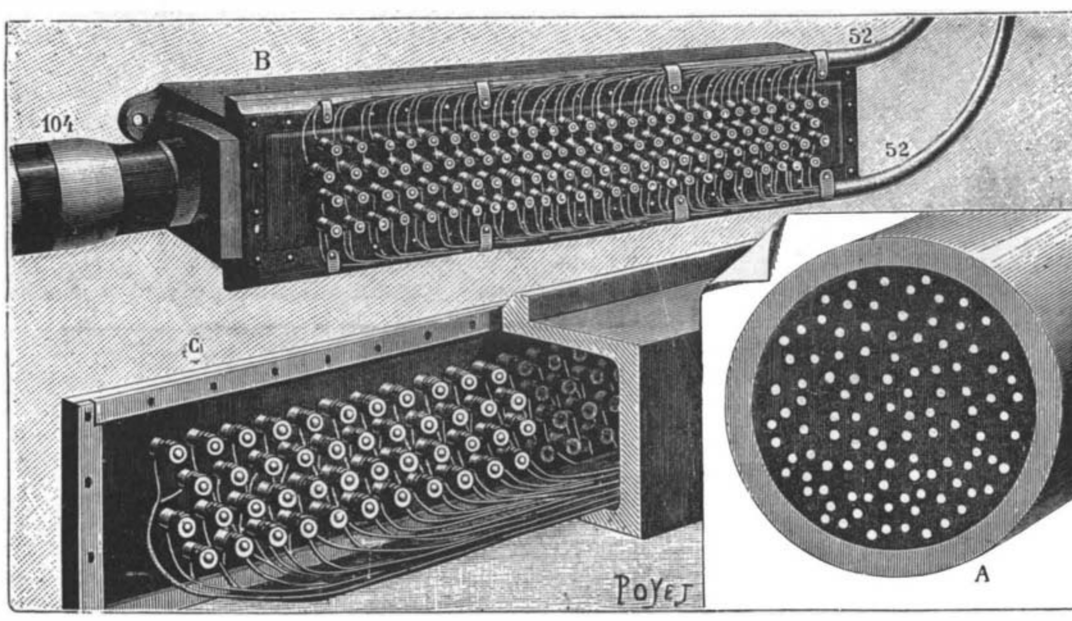


Fig. 4.—TRANSVERSE SECTION OF A 104-CONDUCTOR TELEPHONE TUBE (ACTUAL SIZE).

B. End of cable receiving the 104 conductors. C. Rear view and section of a cable head showing the entrance of the 104 conductors of the street cable.

Tea and Coffee Culture in Hawaii.

It is not generally known that the cultivation of tea and coffee in Hawaii is rapidly becoming a matter of importance to our American markets. Fine qualities of tea and coffee are being grown successfully and it may be expected in the near future that these islands will become an important source of supply. Both tea and coffee grow luxuriantly and both, it is noteworthy, are being prepared almost entirely by machinery, instead of by hand. This it is thought will compensate for the low wages paid to the pickers and other tea workers in China and enable Hawaii to rival the Chinese market prices. The tea, for example, is picked by machine, which gathers only the young and tender leaves and never makes the mistake of picking the tough leaves, however thick they may be. Next the leaves are withered, rolled and then packed without being touched by any hand.

In preparing the coffee berry for market there are also a number of ingenious and efficient machines which do the work much more cheaply and in a more uniform manner than it could be done by hand. The disk pulper and the Gordon pulper are principally used. Several of the Hawaiian coffee planters have erected extensive drying houses and a large crop this year may be readily prepared for market. The coffee plant grows luxuriantly on the island in almost every soil. Wild coffee has even been planted among the highlands and in the forests, in some cases at an elevation of over 2,000 feet, and gives an abundant crop. It is reported that this year a number of people are applying for land with the intention of raising tea and coffee and several large plantations are being equipped.

Progress in Bacteriology.

"I believe," said M. Pasteur, many years ago, "that we shall one day rid the world of all diseases which are caused by germs." He has done much to prove his faith by his works, and so have others who are laboring in the same field. The latest achievement in that direction, the discovery of anti-toxin, appears to be one of the most important yet made. There are indubitable reports from European hospitals showing that the great claims at first made for it were not exaggerated. The use of it has cured a large proportion of cases of diphtheria, and insured immunity against the disease in others. Failures there have been, doubtless. But a comparison of the death rate among those treated with it with that among those not treated with it, but in all other respects similarly affected, satisfactorily demonstrates the value of the new remedy. And the disease thus dealt with is one of the most destructive. It has long been so familiar to us that mention of its name arouses no such horror as that of Asiatic cholera or smallpox or yellow fever. Yet its ravages, in this and most civilized countries, are incomparably greater than those of the three put together. Only two or three diseases endemic here surpass it in number of victims. A reasonably sure cure for or prophylactic against it will be one of the most beneficent inventions of modern medicine.

There seems to be reason to believe, also, that the recently devised system of inoculation against Asiatic cholera will be productive of good. It was pretty carefully tested this last fall in India, and the results have now been published. The disease was accidentally introduced into the Gaya jail, where there were 433 prisoners. Of these, 215 were inoculated. The remaining 218 were not. All were equally exposed, and, apart from inoculation, were treated exactly alike. During the first five days after inoculation no material difference between the two classes was observed. Among the inoculated there were 5 cases of cholera and 4 deaths; among the others, 7 cases and 5 deaths. The next three days, the sixth, seventh and eighth after inoculation, showed some contrast. Among the inoculated there were 3 cases and 1 death; among the others, 5 cases and 3 deaths, But after the eighth day the contrast was most marked. Among the inoculated there was not a single case of cholera, while among the non inoculated there were 8 cases and 2 deaths. It will be remembered that Dr. Haffkine said the inoculation would only be fully operative after about ten days. The actual results are two days better than he claimed. It would be premature to say that an infallible preventive against cholera has yet been discovered; but certainly this showing is significant. A third series of researches in bacteriology has marked the year. Hitherto no specific bacillus has been discovered in the lymph of cowpox or smallpox, and the failure to find it has raised some doubts concerning the validity of the germ theory itself. An elaborate series of experiments has convinced Dr. Klein that such a bacillus exists, and may be found if the lymph be examined at proper time. But at the time when the lymph is taken for the purposes of vaccination, the bacilli have already perished in the process of sporulation. Hence the lymph is found to contain no bacilli, but only spores. Dr. Klein believes he has discovered the actual bacillus, but his attempts to cultivate it have not yet succeeded. It is reasonable to expect, however, that these attempts will one day be successful, and the bacilli of smallpox, as are those of other communicable diseases, will be cultivated in an artificial medium, thus ridding vaccination of the most serious objections now urged against it.—New York Tribune.

New Foreign Postage Rates.

The new rates for foreign postage and registry have just gone into effect. The rate of letters to all parts of the world, excepting Canada and Mexico, will be 5 cents per half ounce. The rate to Canada and Mexico will remain the same as the domestic rates. Postal cards to all parts of the world will be two cents. The fee for registering a letter will be 8 cents, instead of 10 cents. Printed matter will be charged 1 cent per pound.

Correspondence.

The Russian Thistle.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to your article on the Russian thistle, issue of December 29, 1894, page 406, I would suggest the advisability of the government sending some one to the native home of the thistle to find such natural enemies as may be possible, either insect or fungoid. There must surely be one or both. The success of Koebele against scale and other similar work may indicate that even noxious weeds could be kept in check.

LINCOLN FOWLER.

Phœnix, Arizona, January 9, 1895.

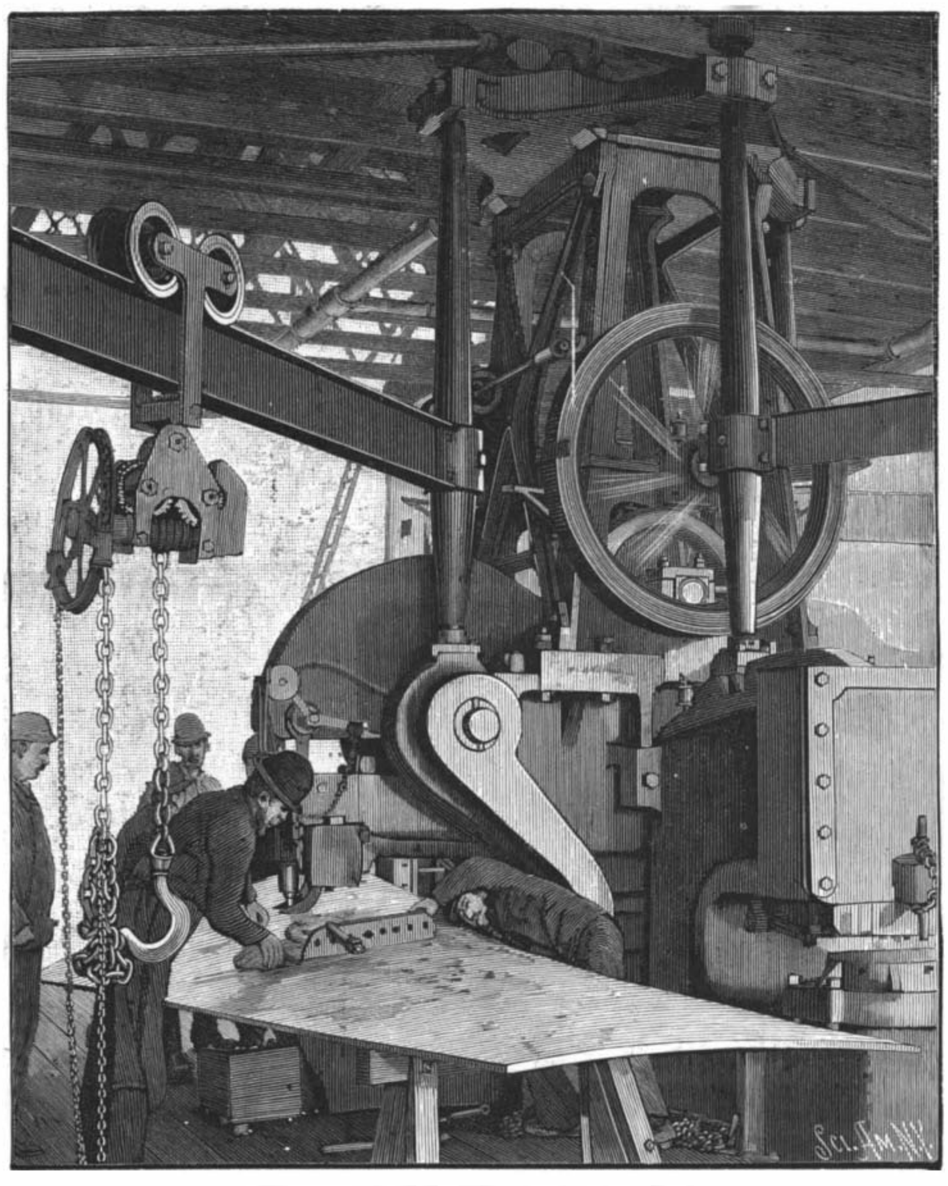
COMBINED PUNCH AND SHEARS.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 12, 1895, you give an illustration and description of a hydraulic punch used at Cramps. I would say that this punch [shown herewith] is not hydraulic, but worked by steam power, having an independent engine attached to the back of the punch. The engine makes some 170 revolutions per minute, the fly wheel of which is shown in your cut, that being the front. The machine is a combined punch and shears. That at the left of the illustration being a punch for rivets, etc., the punch in the front being for larger holes, and the shears being to the right, not shown in the picture, all of which are worked by the engine. The punch is thrown in and out of gear by a counterbalance weight, worked with a couple of ropes by an attendant.

STEPHEN P. M. TASKER, JR.

Cramp Ship Yard.



COMBINED PUNCH AND SHEARS.

Dyed Grasses.

If natural dried flowers are scarce, the void is filled by the many beautiful grasses now used to so large an extent. Foremost is the Vera grass, with its bold and striking tree-like plumes, now very largely imported and dyed in various tints—salmon pink, canary, autumn tints, a combination of red, orange, golden brown, shades of green, pink, and magenta, the newest being heliotrope, as fashionable in artificial flowers and grasses as in those of nature; and next in importance is the Pampas grass in magnificent plumes, undyed and dyed in various colors. Some novel Japanese and African grasses are strikingly handsome; the latter are from the Congo, some in rich, dark colors, and some delicately silky: they include the "Elephant" and "Congo" reed grasses. Barley and oats are seen dyed in very pleasing colors, one being a bright bronze. Eulalia, Bromus, Briza, Erianthus, Lagurus, Panicum, and others, with dyed forms or the feather grass in abundance.

Artificial Illumination.

The Lancet, London, has lately investigated the relative merits of the various systems of illumination now in vogue, among them the incandescent gas light system of Welsbach. The following are the results: The incandescent system of electric lighting must, of course, rank first from the point of view of health, since it affords a soft, agreeable light, without giving rise to any vitiation of the air; there is no combustion, and, consequently, there are no products of combustion, complete or incomplete. From the same point of view we are bound to place next, in the face of the result of our present inquiry, the incandescent gas light in its improved form. It is even less productive of carbonic acid gas than the average oil lamp, and consumes not quite one-half less gas than the existing type of burners, giving rise, therefore, to the evolution of half the heat and half the amount of carbonic acid gas, while its illuminating power expressed in candles is more than three times as great as the best ordinary gas burners or the incandescent electric lamp, each of which does not generally exceed 16 candle power, unless a very great expense is no object to the consumer. We are far from saying that the incandescent system of gas lighting has attained to the highest pitch of perfection; still, we are well within bounds when we regard it as the system of gas lighting which utilizes most efficiently and most economically the full powers or duty of coal gas as an illuminating agent. Some have expressed fears that the burner is a delicate instrument—much too delicate—for the part it is destined to fulfill; but we have found with ordinary care—and care is well worth a little exercise in view of the enormous advantages the system affords—that these fears need not exist. We understand that in practice the average life of a mantle, taking risk of breakage into consideration, is between three and six months, but the mantles have been frequently known to last over a year, at the end of which time their lighting efficiency was still good. One more important point, already slightly touched upon, is that, in spite of its high illuminating powers, this burner does not require a gas possessing any special illuminating value itself; and as it is the maintenance of a high illuminating value which contributes in a large measure to the cost of coal gas, the general adoption of the incandescent system of gas lighting would probably lead to the production of a cheaper gas, possessing little illuminating power, but adapted equally well for the incandescent gas burner, which would then contrast more favorably with coal as regards cost for heating purposes. The production of a cheaper gas since the introduction of the incandescent system of lighting has, we believe, engaged the serious attention of engineers, chemists and others, and we may expect to hear more on this important question before very long. To hygienists this is an extremely important aspect of the incandescent gas system, inasmuch as it is obvious that the introduction of cheaper gas, by its more extensive employment for fuel, would tend to free London from the reproach of being a city which, during the greater part of the winter, is enveloped in vilely suffocating fogs. There is, therefore, we think, a future for the new system of far-reaching importance to the community.

Ornamenting Glass.

A new method of ornamenting glass has been discovered recently by Gorlitz, of Zurich. The method is not a very expensive one and the results obtained are said to be very beautiful. The design to be reproduced on the glass is first engraved on "positively" on a printing plate of rubber, and this plate after being coated with varnish is pressed against the glass. The glass is then covered with bronze powder or other suitable material. The portions forming the design will remain empty and therefore transparent. The glass is then placed in a frame which has a backing of strong paper board, over the front of which is mounted a bright sheet of tinfoil or tin plate. It will be seen that the design will therefore be shown by a reflected light through the transparent portions of the glass, while its other parts will form a background stamped in relief. The common plan for producing enameled writing and designs in relief on glass has been to apply enamel paint by means of a brush.