CHAPTER XLIX.

Poles on the French Telegraph Lines—Their Preparation—Injection with Sulphate of Copper—Size, Cost, and Durability of the Different Kinds of Wood

POLES ON THE FRENCH TELEGRAPH LINES.

In France, on the early established lines of telegraph, the posts were ordinarily about twenty feet high, except at railway crossings, and through villages, where they were some thirty feet. These lines were upon the railways. In 1854–'57, I noticed on the railway from Paris to Versailles, very small poles, not more than fifteen feet high, and some two and a half inches in diameter at top. These poles had some two or three wires on them. Comparing this line with the others of France, it was clearly to be seen that it was not even the ordinary line, as to substantiality. As a general thing, however, the poles on all the telegraph lines in France, are small, straight, and slender, nicely barked, planed, and often neatly painted, having on one set of poles sometimes as many as twelve wires.

When the lines were constructed on the public highways, or common roads, the minimum height of the pole was established at twenty-five feet, and through villages at from thirty to forty feet. The wood employed for telegraph poles is mostly pine saplings; on some lines alder and poplar, and other kinds of white wood, are used. The alder is different from the American wood or bush known by that name. There are no fixed dimensions for the poles. The prices paid for poles are as follows, viz.:

Height.	Diameter 40 inches from base.	Diameter at the top.	Price.
40 feet.	10 inches.	5 inches.	15 francs.
36 "	9½ "	5 "	12 "
32 "	8 "	4 "	4½ "
27 "	7 "	4 "	3½ "
25 "	6 "	3½ "	3 "
20 "	5 "	3½ "	2 "

In sections of the country where wood for fuel is cheap, the earth end of the pole is charred; in other sections it is coated

with tar as far up the pole as forty inches above the surface of the earth. In latter years, the poles are generally impregnated with a solution of sulphate of copper, for the particulars of which I am indebted to Mr. Blavier.

The process of injecting the posts is simple, and easy of execution on any route of the telegraph. To repeat, in part, what I have stated in the preceding chapter, wood, exposed to air and moisture, very soon decays, first the white or sap wood, and then follows, but in a less rapid degree, the dark wood, or the heart. The alteration is the result of the soluble substances contained in the wood, which, under the action of moisture and heat, ferment, decompose, and form acids. Rottenness is, also, produced by worms and insects which feed upon the soluble substances, and gnaw the woody fibres. Wood containing the greater quantity of sap, the earlier decays; while, on the contrary, wood with little sap, such as red-cedar, black-locust, &c., remains solid for a very long time. It has been found that by causing the wood to be penetrated, in every direction, by a solution of a metallic salt, the sap is forced out, and the imperishable substances, precipitated into the cavities of the wood, penetrating its fibres, so as to form in the interior an unalterable compound, renders the wood more permanent. The principal cause of destruction being thus removed, the wood remains unchanged for an indefinite time, even under the most unfavorable circumstances.

Mr. Blavier gives great credit to the success of Dr. Boucherie, who has given the subject much study and particular attention; and from the facts gathered on my repeated visits to France, I am led to suppose the great desideratum has been attained. He has made many experiments, and he has announced his preference for the material known as the sulphate of copper. The best solution he found to consist of one pound of copper to one hundred pounds of water. Among the materials which he tried were the pyrolignite of iron, sulphate of zinc, and acetate of lead, but none of these equaled the sulphate of copper.

The mere soaking of the wood in the solution does not answer the purpose. The sulphate must penetrate into all the pores, and take the place of the sap and other liquids in the wood. In order to properly inject a cubic metre, or about three and a half cubic feet of wood, about five and a half kilogrammes, or about twelve pounds of sulphate of copper is required.

All parts of the wood are not susceptible of undergoing an injection to the same and equal extent. A tree is formed of two parts, the heart and the sap-wood. The sap-wood is trav-

ersed by the solution with facility, but not so with the black-wood, or the heart of the tree. The post-oak absorbs the solution beyond the sap-wood, with difficulty, if at all. Wherever the sap runs, the solution will penetrate. Cedar and locust are durable in the earth, because they are mostly free from it, the fibres being too compact to admit of the passage of the water, except around the surface, and, on this account, there can be no fermentation, either by the sap, or water absorbed from the earth, for neither can penetrate its compact mass. Woods best adapted to injection are the pine, spruce, alder, poplar, cotton-wood, and, in general, all the white timbers, which are mostly formed of sap-wood.

This injection may be effected in different ways. It takes place more or less rapidly according to the nature of the wood, its age, and the time of the year. The most favorable season is when the sap is ascending. The periods of the year when the least favorable, are July, August, and the winter, when it freezes.

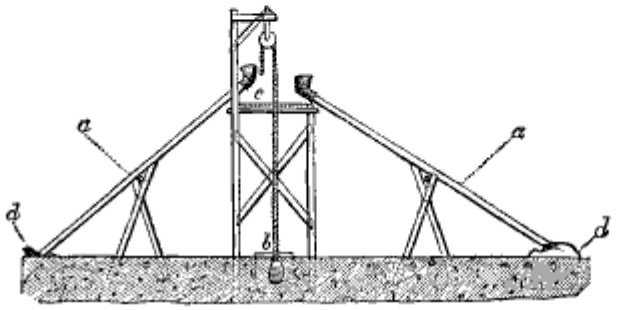
Mr. Blavier considers the preparation as one of the most beautiful and useful discoveries of the century; and much credit is due to the administration of the telegraphs in France, for adopting it, and causing its general application. It has well subserved the purposes desired, although the extent of its usefulness has not yet been established, as will be seen from the results hereinafter explained.

In France small sheds or shanties are constructed near the forest where the poles and water are easily obtained. The process of injection, however, is not required to be under a shelter, and may be done with none other shelter than the broad-spread canopy of the heavens.

The tree being cut and stripped of its branches, is carried to the sheds, where it is prepared for the injecting process. The wood should not be cut more than three or four days before the time of injection; the sooner after being cut the better. At first the solution was made to penetrate by its own weight, aided by the ascensional force of the sap. In the shanty was placed the reservoir of the liquid, at a certain height, so as to give to the solution a considerable pressure. This first method is still in use, the arrangements being very simple, and answering the wants of the administration, particularly in places where but a small number of posts are to be prepared.

For the purpose of injecting posts, the dimensions of which exceed twenty-five feet long, a scaffold is erected about thirteen feet high, from three to seven feet wide, and of a length vary-

Fig. 1.



ing according to the number of posts to be prepared at one time, as seen in fig. 1.

Against the two sides of this scaffold, the poles *a a* are leaned at such an inclination, that their upper part may be within easy reach on scaffold floor *c*. The small or upper end of the pole rests in a little ditch of the earth, *d d*, sloped to fit the angle of the pole. This ditch may be a trough made of plank or iron. This trough empties the liquid coming through the posts into casks.

On the side, and above the scaffold, is a framework with a pulley and a bucket, by means of which is drawn up the solution from a reservoir, *b*, situated on the earth.

The posts are drawn up with their bark on. The summit of the tree, or the top end of the pole, is placed at the ground, and the large end on the scaffold, so as to give the movement of the liquid the natural course with the sap. A thin slice is sawed off the butt or foot end of the pole, to give a free egress for the liquid. The butt end is given the form of a frustum of a cone, to which is fitted a lead receiver made of two frustums of cones united. The axis of the upper cone is always vertical. These caps or receivers made of lead, about four fifths of an inch thick, must fit perfectly tight to the pole, so that the liquid can not leak out and waste; and in order to accomplish this, the butt end of the post is surrounded with soft clay before the liquid is put in the receivers. This capping of the post is generally done before they are raised upon the scaffold. As soon as the posts are placed as indicated in the figure, the injection commences.

The lead caps are filled with a solution of the sulphate of copper taken from the reservoir.

This liquid must contain one pound of the sulphate to one hundred pounds of water. In order to make the solution easily,

it is best to first prepare in a special cask a concentration of the liquid, having about two and a quarter pounds of the sulphate for about twelve gallons of water. It is sufficient to take from the cask ten parts for one hundred parts of water, which is put into the reservoir situated at the foot of the scaffold.

In proportion as the liquid in the lead caps passes off, it must be replaced. The workmen charged with this labor must visit them several times during the night, in order that they may not be left empty. The caps, however, may be made large enough to hold a sufficient quantity of the solution to run all night. When once the injection commences, it ought not to be stopped.

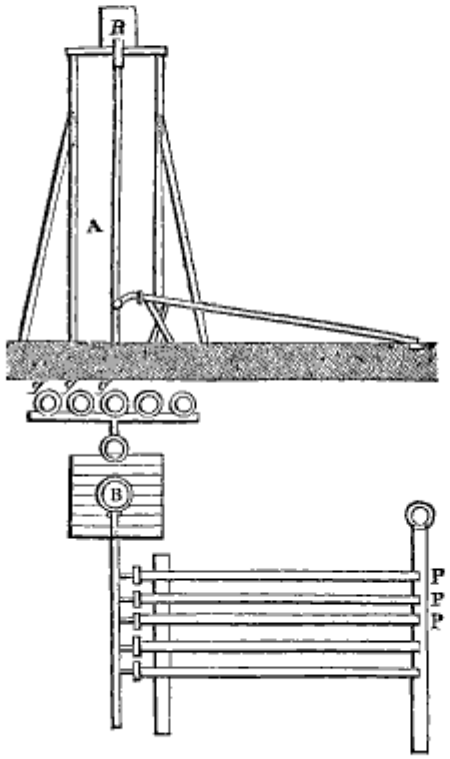
After several hours the sap is seen to flow in the little gutter or trough at the little or top end of the pole. When this is seen, the injection is not yet completed, and it is only when the sulphate of copper is seen flowing out of the pole, that the injection has been perfected. For a pole twenty feet long, the injection requires thirty-six to forty-eight hours. For a pole thirty-two feet long, at least five to six days. It frequently happens, at the commencement, that the operation of absorption does not take place, on account of the collection of the rosin of the pine at the butt end of the pole. This is easily remedied by sawing off a slice at the end, and the replacement of the lead cap. This difficulty may be avoided by allowing the end of the pole to soak several hours in a vat or pool of the sulphate solution, when the poles are brought to the shanty or shed. A slice should always be sawed off the end of the pole, before capped for injection. The liquid that runs from the gutter or trough, will answer to soak the end of the pole, as preparatory before injection.

When the post is properly injected, it is known by striking at the small end with a hatchet, and the greenish hue of the sulphate is seen. The fact can be ascertained also by employing the cyanuret of potassium. By rubbing this substance on an unbarked part of the pole, the wood will become red.

This mode is carried on to a very great extent in the provinces of France, but a new mode in the application of the sulphate has been adopted, where many poles are to be injected. This new mode requires less labor, and the injection is more rapid, the solution of copper being pressed by a considerable force, so that it will penetrate rapidly into all parts of the wood, and completely *drives out* the sap.

In figure 2, it will be seen that the reservoir R is placed upon a scaffold of about twenty-five feet high. It is fed by the casks *g g g*, in which the solution of the sulphate of copper is

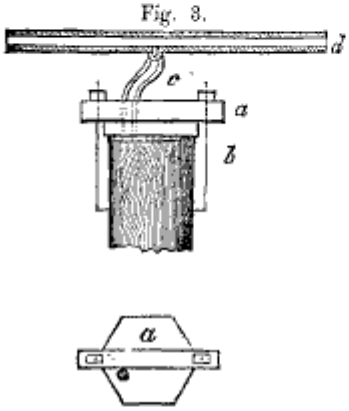
Fig. 2.



prepared. The sulphate is raised into the reservoir by means of a pump or bucket. A lead or copper pipe passes from the reservoir to another similar pipe placed horizontally. The length of the latter pipe is proportional to the number of posts to be injected, say one hundred feet for one hundred posts. From this latter pipe branch out gutta-percha pipes terminated by a copper or wooden faucet, by which the liquid is introduced into the posts.

The posts to be injected, P P P, are all placed parallel, and in a direction perpendicular to the main pipe, the tip-ends rest upon the earth, on the border of the little gutter or trough into which the liquid is to pass away. The butt or bottom ends of the posts rest upon a beam raised a little over three feet above the ground, in order to enable the workmen to put on the caps or receivers conveniently. In order to cap the posts, there is placed upon the upper face, or butt end, after the slice is sawed off, to allow an early absorption, a piece of plank made from

Fig. 3.



the heart of oak, fig. 3, *a*, which is strongly pressed against a band of India-rubber at the base of the pole. This is evidently the most important part of the operation, for it is indispensably necessary that the liquid, acting under a strong pressure, shall not escape at the butt end of the pole, when in process of injection. At first this piece of oak plank was screwed on by a strong copper screw, to the post. At present a piece of solid wood is placed across the oak board, or cap, and this cross piece is fastened to the pole by two iron rods or spikes, *b*, which are driven into the posts. By lightening these rods, a heavy pressure is thrown on to the oak-board, and the India-rubber.

All escape of the liquid is prevented by a circular groove made in the head, or butt of the pole, on which the India-rubber band is put. The faucet, attached to the distribution tube by a gutta-percha pipe, *c*, is introduced into the oak plank through a hole. The liquid thus submitted at the base of the post, to a pressure of about twenty-five feet high, penetrates with great force into the wood, and at the very moment the communication with the reservoir, *d*, is established, the sap is seen to run out at the little end of the pole. The injection of a telegraph pole about twenty-seven feet long, requires, on an average, about three days.

In order that the injection should be complete, each post ought to absorb a quantity of the sulphate of copper proportioned to its solution, calculated at the rate of about twelve pints for forty cubic inches.

The metals used in the preparation of the pole for injection, should be copper or lead, or iron galvanized with zinc or copper. The object of adopting the oak-wood head-piece, is because it is impenetrable to the solution.

When the injection is completed, the faucets are closed, the caps are taken off, and the post is placed in a frame, in order to unbark it, to cut off the knots, and to shape it with a plane, as a finish.

It is well not to set the pole immediately after injection, because it will absorb a large quantity of water with the copper, and if they are placed vertically before drying, a part of the water, containing in suspension the sulphate of copper, would

descend by its own weight, and carry with it a portion of the sulphate of copper.

The expense of injection, comprehending the cost of the sulphate, the sheds, labor, &c., is as follows:

For Posts	32	feet long	50	cents.
" "	25	"	20	"
" "	20	"	20	"

The durability of posts injected with sulphate of copper, has not yet been determined. Mr. Blavier says that posts erected in 1849, are almost all in good condition, while on the other hand, poles not injected have decayed, and had to be replaced about every three years. While at Metz, in 1857, I was informed that many of the poles on that line not injected, decayed in two years. At Strasbourg I was informed that poles charred, and not injected, decayed in about three years. The same information was given me at Lille, Havre, Rouen, Nancy, and at different parts of France.

Poles from twenty to twenty-five feet long are put in the ground about five feet. Poles from twenty-seven to thirty-three feet long, six and a half feet. The holes are made ordinarily with a pick and a spade. The earth is put in the holes when the poles are set, in layers of twelve inches, and made solid with a pestle or rammer. In rocky places the holes are drilled from twenty to twenty-four inches deep, and the foot is cemented with lime.

In ordinary land the setting of posts twenty to thirty feet long, costs about twenty cents; poles twenty-seven feet, about thirty cents, and poles thirty-two feet long, about forty cents. Where the land is difficult to dig, the cost is increased. In rocky places, requiring the post to be cemented, the price is about one dollar and a half, Spanish. The tops of the poles are pointed, in order to turn off the water. Two coats of paint are put on them generally, one before they are set, and one after. The price of painting is according to size, from twenty to forty cents each.

The following are the average prices paid for the poles delivered at the shanty for injection, and for their setting and painting, viz.:

	20 ft. long.	25 ft. long.	32 ft. long
On Delivery	40	60	80
Injection	20	20	50
Setting	20	30	40
Painting	20	30	40
Totals	$1 00	$1 50	$2 10