1881.
NEW ZEALAND.

PROCESS FOR PRESERVING TIMBER
(CORRESPONDENCE RESPECTING THE).

Presented to both Houses of the General Assembly by Command of His Excellency.

No. 1.

The Under-Secretary for Public Works, Wellington, to Mr. W W Evans, New York.

Sir,— Public Works Office, Wellington, 8th November, 1880.

The Thilmany process of preserving timber having been brought under the notice of the Minister for Public Works as useful for railway sleepers, and for wharf and other works exposed to the teredo, it is desired to practically ascertain whether the process is as advantageous as the published accounts represent. With this view it is proposed to send to America say six logs, each about 7 feet long, cut up in the manner shown in the margin,* and afterwards bound with hoop-iron, together with a similar number of logs in their original solid state, for the purpose of being experimented upon. And I am now to ask you whether, if the above are sent by the mail steamer to your agent at San Francisco, you would arrange for their transmission to the works at Defiance, Ohio, or elsewhere, as may be necessary, and return them to Wellington when they have undergone the preserving process.

In your reply, the Minister will be obliged by your making any suggestions and enclosing such information as you may think useful, together with an estimate of the probable cost of the apparatus complete.

I have, &c.,
John Knowles,
Under-Secretary for Public Works.

W W Evans, Esq., New York.

No. 2.

Mr. W W Evans, New York, to the Under-Secretary for Public Works, Wellington.

Sir,— New York, 6th January, 1881.

I have received to-day at a late hour in the evening, your esteemed favour of the 8th November, 1880, in reference to Thilmany process for preserving timber. I have no confidence or expectation that this letter will reach California in time for the steamer that leaves there on the 15th instant with mails for New Zealand, so shall not write much. I will attend to your wishes in reference to the timber with pleasure. Please ship and consign the logs to Messrs. J J Wallace and Co., of International Forwarding Company, 108, Leidesdorff Street, San Francisco, California, advising them of the shipment, and I will write them instructions as to what they are to do with the logs. I will by the next mail write you full particulars in reference to the Thilmany process, and also bring to your notice and explain the Boucherie process, a French process—and in my estimation the most simple, the least expensive as to apparatus, the most scientific, and by all means the best ever invented. You would do well, however, to experiment on all the different processes, under the eye of an experienced engineer, and record in print the results for future reference.

I have, &c.,
W W Evans.

John Knowles, Esq., Under-Secretary for Public Works,
Wellington, New Zealand.

No. 3.

Mr. W W Evans, New York, to the Under-Secretary for Public Works, Wellington.

Sir,— New York, 31st January, 1881.

I had the honor, under date of January 6th, to acknowledge receipt of your favour of 8th November, in reference to the preservation of some logs of timber that you propose to send here to be treated by the Thilmany process. I doubt if my letter caught the steamer of the 15th

* *i.e.*, The log (diameter about 18 inches by 21 inches) first sawn longitudinally into half; each half subdivided by four cuts, forming ten pieces of timber, each piece thus comprising heart, sap-wood and bark.

January, from San Francisco; and, now that the whole country is under deep snows, and railway trains much impeded, there is a chance of this not catching the steamer of the 12th February from San Francisco.

In my last, I advised the shipment of the logs you mention to Messrs. J J Wallace and Co., of the International Forwarding Company, 108, Leidesdorff Street, San Francisco. I will direct them as to where they are to be forwarded to—namely, Defiance, Ohio, which are the nearest works to San Francisco. I will see that these logs are treated by the Wood Preserving Company, and returned to you as you may direct.

I intended writing for you a professional paper on the preservation of timber, the causes of decay, &c., but other pressing duties, and not being well during the past month, has prevented my getting this paper ready to send to you. I will send it by the next mail. I think I can satisfy you that it is not necessary to procure an expensive and cumbersome apparatus, which must be local, and use expensive chemicals, to be able to preserve timber in the best way yet discovered, invented, or designed by man; and, at the same time, I will satisfy you that by the use of a simple apparatus that you can have easily, quickly, and cheaply built, and by the use of chemicals you can manufacture yourselves, you can at small expense preserve all your timber, so that fungi will not destroy it when used for railway sleepers. The *Teredo navalis* and the *Limnoria terebrans* will not eat it when exposed to salt water in warm climates, and fire will not burn it when used in buildings.

By treating timber as I will explain to you, your colony will save many thousands of pounds sterling every year.

I have, &c.,
W W Evans.

John Knowles, Esq., Under-Secretary for Public Works, Wellington, New Zealand.

No. 4.

The Under-Secretary for Public Works, Wellington, to Mr. W W Evans, New York.

Sir,— Public Works Office, Wellington, 19th March, 1881.

I am directed by the Minister for Public Works to acknowledge receipt of your letters of the 6th and 31st January, and to thank you for the same.

The Minister looks forward with much pleasure to the further communication you intend making on the subject of preserving timber, and in the meanwhile does not propose to take the contemplated action in reference to forwarding logs to America for experiment, until he has received the same.

I have, &c.,
John Knowles,
Under-Secretary for Public Works.

W W Evans, Esq., New York.

No. 5.

The Agent-General to the Hon. the Colonial Secretary, Wellington.

Sir,— 7, Westminster Chambers, London, S.W., 26th January, 1881.

Herewith I enclose for the information of Government, prospectuses, &c., relating to dredging, and the seasoning of timber.

I have, &c.,
Julius Vogel,
Agent-General.

The Hon. the Colonial Secretary, Wellington.

[Acknowledged 27th March, 1881.]

Enclosure to No. 5.

Messrs. Connor and Co. to the Agent-General.

Sir,— 11, Queen Victoria Street, E.C., London, 25th January, 1881.

We beg leave herewith to bring to your notice Blythe's system of preserving timber for all purposes, but especially for railway, harbour, and other works where the wood would be exposed to the alternating action of the weather, or the ravages of insects. The process is acknowledged by every one who has seen it to be the most scientific and perfect method of preserving timber; and it is so complete in its effects, and renders the wood so durable, that it is of even more than usual importance to a country like New Zealand. Its importance in relation to the public works now being constructed by your Government has caused us to address you upon the subject, and we therefore venture to submit the enclosed prospectus to your notice.

We may mention that Sir John Hawkshaw, Sir John Coode, and Mr. G Berkeley have all inspected the process on behalf of the Crown Agents for the Colonies, and, having approved of it, we are now doing work for the Crown Agents. Amongst those for whom we have done work, we may mention the Great Western; London, Brighton, and South Coast; and Metropolitan Railways; the Victoria, and East and West India Docks; Newhaven Harbour; Bilbao Iron Ore Company; Postal Telegraph Department; Metropolitan Board of Works; London Gas Company, &c., &c. We are also on the list of firms who are invited to tender for sleepers by the India Office.

If your time permitted, an inspection of the process at our works would probably best enable you to form an opinion as to the merits of this system.

We are, &c.,
Connor and Co.

Sir Julius Vogel, K.C.M.G., Agent-General for New Zealand, 7, Westminster Chambers, Victoria Street, Westminster.

Sub-Enclosure to No. 5.

Blythe's Process for Timber Seasoning and Preserving.

Blythe's process, termed "carbolizing," is now generally acknowledged to be the most scientific and efficacious method of treating timber that has ever been invented. Under this system, the antiseptic properties of carbolic and other tar acids are carried through the heart and the innermost pores of the largest log, by means of superheated steam, and chemically combine with the component parts of the wood, so that their preservative action is complete. All the free water and fermentable sap are extracted during the above operation, which is prolonged while there is any outflow of them. A tree felled one day can be treated the next, and then needs only to be allowed to cool down, carefully protected from draught for a few days, and thereafter there will be no contraction, warping, or decay. The fibre is strengthened; the colour not injured, often improved; no smell is given off; the wood is not made more combustible; it will take paint or varnish as readily as before; the sapwood is made as good as the heart. Newly imported timber, thus not only seasoned but preserved from dry rot, can be sold at the same price as weather-seasoned timber, and delivered on any work in one-twentieth of the time usually taken; and architects and surveyors will readily perceive the advisability of specifying in future for beams, joists, flooring boards, rafters, &c., to be carbolized by Blythe's process; while joiners will appreciate the great benefit of working up wood that can be relied on not to shrink, warp, or crack. An elaborately-carved sideboard, made from fresh oak so prepared, was shown in the Austrian department of the last French Exhibition, and obtained a high prize. Oak, American cherry, walnut, and other fine woods intended for cabinet work, joinery, panelling, and parqueterie, have been successfully prepared. Hornbeam and apple-tree have been made fit for millwrights' purposes in a few weeks. Beech has been made as hard and as rich in colour as exotic woods. Poplar, Scotch fir, and other trees of quick growth, can be applied to purposes at present unthought of; they have been pressed into shapes and made as dense as boxwood. Carbolising has been proved to be a better preservative for sleepers than creosoting under the old system, kyanising, or any other method of protecting them. Beech in moist ground is very perishable, but some beech sleepers thus treated in 1872, and subjected to the very heavy traffic on the main line of the Northern of France Railway between Amiens and Paris, still show no signs of wear under the seat of the rails, nor of decay; and the very general application of Blythe's process throughout France, now extending to many millions of sleepers annually, proves the appreciation of its superiority by the engineering profession in France. Wood, thus treated, is especially adapted for founders' patterns and such like purposes. Paving-blocks would thus be made much more durable. Ash and elm, prepared for railway carriage and wagon building, will be found superior to the same wood otherwise treated, and equal to good oak.

Creosoting for Dock and Harbour Piles, Railway Sleepers, Telegraph Poles, Paving Blocks, Park Fencing, &c.,

Timber intended to be immersed in water, or buried in the soil like railway sleepers, and piles under buildings, may with advantage be subjected to a supplementary bath of creosote, which, under Blythe's system, is mixed with tar. This is applied in the same cylinder, while the wood is hot and soft from the carbolizing process, and it is forced in by steam at a high pressure, diffusing itself through the sapwood, and leaving a varnished surface more impenetrable than mere creosote, which exudes when in excess. The old process of creosoting depends for its partial efficacy on the wood being thoroughly seasoned—under the contract system this is rarely effected. By sealing up the unextracted sap juices, and free water, their liability to ferment and cause the growth of fungi is increased, and then the surface of the wood that has been impregnated is found to be the only sound portion. Whenever that surface is adzed or worn away the exposed parts are open to the attack of fungi or insects. These defects in the old system have caused it to be altogether discarded by many, who are now adopting Blythe's double process; as by it the wood is made so much harder, that the hammering of the traffic does not destroy the chair seatings, nor the holes for the fastenings, and the life of the sleeper is therefore prolonged considerably One most important feature in the Blythe process calls for special remark. The preserving plant can be carried to the spot desired, instead of the timber being brought to the plant. Thus time may be saved as well as outlay, and the finished pile, plank, or sleeper, drawn in convenient quantities to the place, and at the time it is wanted. Mr. Blythe employs in France several such sets of ambulant apparatus, which, being built on trucks, move from station to station, wherever there is a sufficient number of sleepers to be creosoted. The cylinders can be joined to admit also of long timber being treated in the same way Sets of apparatus on this principle will be ready for such service in England. Parties interested in the above are invited to pay a visit to the works, which will give them the advantage of seeing for themselves the results and obtaining all further information on the spot.

No. 6.

Mr. W W Evans, New York, to the Under-Secretary for Public Works, New Zealand.

Sir,— New York, 27th February, 1881.

I had the honor to receive your communication of the 8th November, in reference to the Thilmany process for preservation of timber.

Since writing to you I have had a correspondence with Mr. Young, General Manager of the Wood Preserving Company under the Thilmany patents. I have sent to you one of their circular pamphlets. I have not yet been able to see him, as he went to Boston, and has not yet returned or answered my inquiries as to cost of apparatus and cost per cubic foot for preserving timber. I have no doubt but that this Thilmany process will preserve timber: chemically it is correct; mechanically it is wrong, and not, in my opinion, the equal of the Hayford or the Boucherie process. The latter has been in successful operation for nearly thirty years, and is the most philosophic of any ever invented I have used it in the preservation of sleepers in Chili, South America, and speak knowingly I will explain it: but, first, allow me to explain the philosophy of the preservation of timber; second, to describe some of the various processes that have been patented; third, to specify the objections to the Thilmany process; and, fourth, to describe the Boucherie process.

The Philosophy.

All timber is composed of fibre, and albumen or sap. The fibre, separated from the sap and volatile parts, is nearly pure carbon, consisting of small continuous tubes or capillaries, constructed parallel, and laid up more or less compactly according to the hardness or density of the species from which it is taken. This can be seen by taking thin sections from woods of different density, and subjecting them to view under a microscope. The tubes vary in diameter as the wood becomes more or less dense. The sap or albumen consists of acidulous, resinous, glutinous, saccharine, and other matters in liquid form, and is carried through these tubes by capillary action. Besides the above, timber has among its constituent elements oxygen, hydrogen, and nitrogen. The elements of decay are in the juices of the wood, such as are named above, and are at the time the timber is cut always in solution. They are the food on which timber lives, grows, and thrives, and are assisted in all their functions by the oxygen that is chemically combined with them, as it is with nearly everything in nature, assisting vitality in life and decay in death. This principle belongs to all organic matter, and in nearly everything of inorganic matter, in use by man, until it returns to the normal condition from which it sprung. Pure carbon is indestructible by the effect of time. The strength and value of timber used for constructive purposes belongs to the fibre, the carbonaceous part—and none to the juices, which contain all the elements of decay, and the carbon or fibre none. This being the case, the chief point to be gained is to get rid of the juices and retain the fibre intact. How is this to be done? Surely not by letting the sun or artificial heat take from it the oxygen and hydrogen, the watery parts, that held these elements of decay in solution, and leaving them in a dry state, to resume their functions connected with decay as soon as they can absorb, from rain or moisture in the air, the elements that had been driven out by heat; also, it is not reasonable to suppose that we can get rid of this deleterious matter by subjecting timber to pressure on all sides and ends at one time, as is done by most of the modern processes and patented inventions—the apparatus for which is all costly, cumbersome, and expensive in its manipulation, besides being slow and uncertain in its application, on account of the difficulty of getting any liquid containing an antiseptic to reach the centre of a piece of timber of any size. When the density of the wood is considered, and the pressure is equal on all sides and ends, the liquid used as a preservative cannot go in until there is a vacant place provided for it to go into. So nearly all of the patent processes depend on—or, more properly, are based on—treating seasoned or partially seasoned timber, or timber that has been artificially desiccated by a costly and slow process, which vaporizes the water, and leaves all the deleterious matter caked on to and sticking fast and hard to the walls of the capillary tubes of fibre, and leaving some minute spaces into which chemicals in liquid form can be made to penetrate by great force; and then the greatest, and in fact the only, hope that can be entertained is, that the chemicals can and will dissolve the deleterious elements, combine with or coagulate them, and act as an antiseptic.

All the processes, except the French process of Boucherie, are designed to act as above described, and most all of them leave the capillary tubes filled or partially filled with soluble matter, to be dissolved and dried again by every hygrometric and climatic change. If the tubes in which the strength lies are of carbon, if carbon is indestructible, if the tubes are continuous and without lateral connections from one end of a stick of timber to the other, and are channels in which a liquid is made to run by an act of nature—is it not best to first wash out these tubes, and clear them of all, or nearly all, of the albumen, sap, or juice that contains the seeds of decay? We will see if this can be done, when we come to speak of the very clever process of the eminent chemist, Dr. Boucherie. Maxime Poulet, a French chemist, in a work on timber preservation published in 1879, refers to over 170 different kinds of apparatus and processes in connection with timber preservation that have been invented, and described in scientific journals, since 1700. Let us look at some of the patented processes of the last fifty years, and see what inducements they offer for adoption.

Bethell's Patent.

The Bethell process, by the use of creosote, was the first brought to public notice after the commencement of the railway era, and was for many years, considering cost and results, the best of all the patented processes; and is to-day—with Hayford's improvements, which I will refer to—the best of all, depending on immersion and pressure in a huge cylinder, as a preservative for timber for railway purposes against decay, and against the ravages of the teredo and other animals in salt water; but it will not answer for preserving timber for ships and houses, on account of its increasing the flammability of the timber, and also giving it a pungent and acrid smell. The creosote oil used is merely coal-tar, deprived of its ammonia and retaining its carbolic acid. This oil has certainly antiseptic qualities, and can preserve timber from decay for many years, as it combines with the albumen, and destroys or neutralizes the effects of the seeds of fungi; it also has great penetrating power, and is insoluble in water.

Mr James Abernethy, our present President of the Institution of Civil Engineers of England, creosoted the timber he used in the works of the harbour of refuge at Blyth, some thirty years ago, and I am in the belief that the teredo has not touched it to this time. The timber in Leith Pier, creosoted in 1850, was not injured by the teredo in 1862. I have seen this day a creosoted sleeper, from the track of the Great Western Railway of England, that had been in service for twenty years and was perfectly sound.

The objections to this process are that it requires a costly apparatus, a huge metal cylinder, a railway track to run through it, railway cars, boilers, engine, pumps, pipes, houses, &c., and must necessarily be local. Great difficulty has been experienced by the old process in getting the creosote oil to penetrate to the centre of a railway sleeper, and is only accomplished at the expense of much time and great force; this difficulty increases as the timber to be treated is more and more dense.

The operation is first to create a vacuum, by exhausting as much as possible the air from the capillary passages in the timber, this takes from four to five hours; then the creosote is turned on, and a pressure of 150 pounds per square inch applied for six and sometimes for ten hours; so that, with the loading and unloading the car, closing in the cylinder, exhausting and pumping, more than a whole day is consumed in treating one cylinder full of timber. The great objection to this process, and to all others depending on enclosing timber in a huge cylinder, is that the pressure must take place on all sides and both ends of each stick; there is no washing out of the timber, and there can be no benefit except what results from a chemical reaction that takes place in the timber when the creosote oil or other chemical comes in contact with the albumen, and combines with or in some way neutralizes the elements of decay in it.

The Hayford Patent.

Ira Hayford, of Boston, a few years since, patented an improvement on Bethell's creosote process. It was originally intended to creosote by the Bethell process none but seasoned timber. Railway companies and contractors could not get seasoned timber, so they sent green timber, fresh from the saw-mills, and had it returned with but little creosote oil in it. Hayford's process was designed to obviate this difficulty, and provide a way by which green timber could be creosoted. The old system of subjecting the green timber to a cold vacuum would not draw out the sap in the wood, and, until the sap came out, the creosote could not go in by the system of pressure on all sides and ends. The new system of Hayford (he also using a huge and costly cylinder and apparatus similar to Bethell's) is to first subject the timber to a steaming process, by which the water in the sap of the wood is partially vaporized and carried off by a current of hot air. This adds to expense and consumes time; for it takes ten to twelve hours to make certain that, with heavy timber, all parts have been reached by a temperature above 212°, and the water in it brought to the vaporizing point. This steaming being thoroughly effected, the next step is to drive from the cylinder, by pressure and the use of air-pumps, all the steam and condensed water; this occupies an hour, during which time the heat is kept up by the coil of steam-pipes in the cylinder. The next step is to create a vacuum, the same pumps used for forcing air are now used for exhausting, by reversing the valves; this process is maintained for five or six hours, until the gauge shows 25 or 26 inches of vacuum, and during this time much of the water still remaining in the wood runs out, bringing with it much of the elements of decay that it held in solution, all of which are thrown out through the nozzles of the exhaust pump. This is the chief and valuable part of the Hayford process; by the old process little or no sap is rendered by the wood in a cold vacuum, and, of course, little or no creosote can go in until the sap comes out, or the water is dried out. The next and last step in this process is similar to Bethell's—namely, to open the valves in the pipes leading to the creosote reservoir and let it flow into the big cylinder until it is full, and then to pump a pressure on to the timber; the creosote oil, being previously heated and made limpid, readily enters the pores or tubes of the timber and fills them. For pine or fir, and other similar timbers having large pores, a pressure of 75 lb. per square inch maintained for three or four hours has been found sufficient; but, for timber that is more dense and having minute pores, 150 lb. or more per square inch is maintained for a much longer period. The surplus oil being drawn off, the process is complete; the timber is drawn out, and the cylinder again filled. This process will most undoubtedly render timber durable, and protect it against the ravages of the teredo, white ants, and other animals. The creosote oil is insoluble in water and will not readily come out of the timber, it resinifies in the outer pores, or ends of the tubes, and holds the main body of the oil in the timber; in such condition fermentation cannot take place, and lead to decay and disintegration.

The objections to creosoting under this process are as regards apparatus, the same as mentioned for the old Bethell process. Also that the process as described above is costly and occupies much time. It leaves the timber flammable; and the creosote oil cannot be obtained in large quantities—at least, in some parts of the world—unless specially manufactured, and then it becomes expensive.

The Kyan Patent.

The Kyan process, invented some thirty-five or more years ago, called for the use of chloride of mercury (corrosive sublimate), a poison, and dangerous to handle. It was not a success, and has gone out of use.

The Margary Patent.

The Margary process called for the use of sulphate of copper (blue vitriol) It also was not a success, and is not now used.

The Burnett Patent.

Sir William Burnett, a medical director in the Royal Navy, invented a process which called for the use of chloride of zinc. He was after the teredo, and thought to poison him, but it did not answer the purpose. The teredo ate timber saturated with it; grew fat, and thrived on it. The process failed.

The Payne Patent.

The Payne process was the first that called for the use of two chemicals. He used the sulphate of iron and the chloride of calcium (the metallic base of lime). These two chemicals coming in contact with each other form an insoluble salt.

Payne produced some good results, for he preserved timber so that it was almost incombustible. A factory for Payneizing timber, at Rochester, was burnt, but some prepared railway sleepers in it at the time were not burnt, and the edges hardly injured. This process, like all those before mentioned, called for a costly and cumbersome apparatus. The expense in money and time were too great to insure success to any of them. They all left the albumen in the wood, and none of them were found to have the antiseptic properties of creosote. Other patents were taken out since the commencement of the railway era, all depending on similar and costly apparatus as before named; all depending on some chemical in solution; and all fell to the ground except creosoting, which is still extensively used, and is likely to be more generally used in connection with Hayford's improvements.

The Thilmany Patent.

The Thilmany process was a German invention of twenty years ago. This process, like Payne's, calls for the use of two chemicals; the sulphate of copper (blue vitriol), and the chloride of barium (the metallic base of baryta), an alkaline earth and poisonous. These chemicals coming in contact with each other in liquid condition form an insoluble salt, and would no doubt preserve timber from ordinary decay if the capillary tubes could be filled with them. This process, as invented and used, calls for the same huge and much more expensive apparatus than the one before described, as the receiving cylinder is of copper. The chemicals are driven in in the same way, by pressure on all sides and ends. To be efficient the process must take much time, and be attended with difficulty and uncertainty in results, for it leaves all the residuum of the sap in the timber, which when dry may, and probably does, choke up some of the capillary tubes. The two chemicals have to be put in separately, as they react on each other quickly; so they cannot be mixed before the timber is impregnated. Then, if one chemical is forced in from both ends at one time, and made to fill all the capillary tubes, it is difficult to see how another ponderable liquid can find its way for any distance into the same stick of timber and by the same process. There is, however, reason to believe that this process, although tedious and expensive, does add value and endurance to timber.

Anyone taking up the preservation of timber as a subject for study and investigation, should, as far as possible, look into what others have done in former times. Evelyn, in his "Silva," written in 1644, gives much interesting matter on the life, growth, and properties of timber-trees; so did also the French writers, Duhamel and Buffon, in their papers on timber and its preservation, both writing about 1740.

The ancients had no doubt studied, and, in a measure, mastered this branch of economy, long before the thinking men of modern times first laid down the rudiments of our present systems of scientific investigation; for I have recently seen in Egypt, in the tomb of Tih, at Sakara, in the desert, among its wonders and unequalled skill in workmanship, some blocks of wood that must have been built into the corners of the walls at the ceiling at the time the structure was erected in the fifth dynasty, which, according to Mariette Bey, was over 3,500 years before Christ; these blocks of wood had circular holes in the under side to receive the upper pivot of the door-post, on which it turned; they were much shrunk and loose in the wall, but in a perfect state of preservation.

In the description of the tombs of the Emperors of China, it is shown that the stone ceilings are supported by columns of teak wood, that are said to be over three thousand years old. The wooden roof of Westminster Hall, built in 1395, of larch, chestnut, and oak, showed no signs of decay when I examined it in 1853; long may it last, for it is a most beautiful specimen of work, done five centuries ago.

I have a specimen of oak from Stirling Castle, said to be one thousand years old. I have also a specimen of nut wood—half wood, half charcoal—that once formed part of a window-sill of a house in Pompeii. I got it at the time it was uncovered, after being hidden from sight for eighteen hundred years. The Venetians were clever in the preservation of timber, as shown by the durability of their ships, and other structures of wood; the only system they had, fifteen hundred years ago, was to put the logs they wish to preserve in streams of running water, when fresh cut, and in doing this, they performed one of the most scientific and practically correct operations that has ever been performed by man in connection with the preservation of timber; and I have no doubt but that they understood the philosophic results to be obtained by what they did. A stick of timber laid longitudinally in running water, had, to a certain extent, a hydraulic head, a water-pressure against the upper ends of the capillary tubes, which were, the timber being green, full of the sap in its liquid state, and ready to run out of the lower end as soon as it had any inducement to do so, which inducement was the persuasive influence of water-pressure at the upper ends, in this case gentle and slow, but certain and efficacious; most of the seeds of decay, being in solution and in liquid form, are carried out and severed from the fibre of the wood; some atoms or integrant molecules have such a parasitical hold on to the fibre (it may be that they are in a state of transition from gluten to fibre) that they cannot all be severed—(It has been found, in making white gunpowder, that wood, reduced by machinery to the size of pin's heads, and then subjected to repeated washings with nitric acid, sulphuric acid, and water, cannot be reduced to pure carbon and volatile matter, the results aimed at)—but most of them are, and sent out of the lower end of the log, to vex it no more by attacks on its integrity, and threats of dissolution. A log prepared in this way, and without any chemical, is, undoubtedly, when dry, in a good condition to last a very long time; but it is far from perfect, it has in it still a large amount of vacant space, the capillary tubes are empty, and as soon as the water that drove the sap out has evaporated (dried out), the timber is in a very combustible condition; besides this, it begins to shrink and shrivel until its original dimensions are very much reduced, and, in that way, the symmetry and beauty of many things built of it are destroyed.

The great problems to solve are—

(1.) Can we prepare timber against decay (2.) Can we prepare timber so that it will not be inflammable? (3.) Can we prepare timber so that it will not lose much of its cubic dimensions by the effects of time? (4.) Can we prepare timber against the ravages of the teredo, the *Limnoria*, the white ant, and other timber-eating animals? (5.) Can we prepare timber so that it will not be dangerous to handle, and will not, when heated, send out noxious and poisonous vapours? I have great faith in covering all these points successfully

(1.) *As to Decay.*—I would answer, that by a thorough washing out of the capillary tubes of all organic matter that can be got out, and then filling them with inorganic matter in solution, we will render the timber safe against decay It will be answered, that any one chemical, any inorganic matter in solution, will go in, but it will be washed out again, or come out by changes of temperature through expansion and contraction. It will no doubt do so in time, according to locality and climate (just as sandstone lasts for ages in good condition in Egypt, and will not stand unaffected for half a century in London or New York; for in Egypt there are but few atoms of vapour of water flying about and getting in the rear of molecules of sandstone structures, and no "Jack Frost" to assist the vapour of water in its solid state to push the molecules from their position, when he takes command, as he often does, with a ruthless hand, in London and New York) I would propose to remedy this evil, of the first chemical coming out, by introducing into the pores of the timber a second chemical, one that will combine with the first, and form an insoluble salt; the water in such reactions becomes hydrated, the same as it does in mortars of hydraulic cement. I have been for a long time aware that it was a very easy matter to wash out the timber when fresh cut, and get the first chemical in by the Boucherie process; but I was not sure about getting the second in, as I was afraid that chemical reaction would take place too quick when one chemical met the other, and the capillary tubes would become choked. (Some years since, Mr. Ransome came to New York to introduce his artificial stone called "Apenite," and told me that he produced his results for stone in the same way that I proposed to preserve timber—namely, by the use of two chemicals with cementing properties when combined; he mixed the sand with one, moulded the blocks to shape, and then forced the second chemical in by pressure; the two combining, and forming an insoluble salt, cemented the grains of sand together, and formed a good durable stone. I have cut into a piece of Mr. Ransome's "apenine," to make it hold water like a cup, and then subjected it to the rains, freezings, and thawings of a whole winter, and could not disintegrate it.) Timber that has been washed free of its albumen and filled in with inorganic matter cannot decay; there is nothing in it to decay, it is made up of carbon, as inorganic salts. I allude to timber that has been brought to its utmost perfection of preservation; but this in everyday practice would be expensive and tedious, and, for most purposes where timber is used, not called for in railway practice and economy Timber, subjected to such treatment as I propose, would outlast two or more sets of steel rails, and get worn out before it would rot out.

(2.) *As to Inflammability.*—I would answer, if we can wash out timber, if we can fill the vacant spaces with inorganic matter, and if the vacant spaces in timber are of greater cubic capacity than the fibre of the wood, is it not reasonable to suppose that it cannot be easily set fire to? If we can run a red-hot poker into a barrel of gunpowder that has been mixed with sand in equal parts, and not explode it, we ought to count with reasonable certainty on not readily firing a stick that has more than half of its ingredients inorganic in composition; nor could an engineman make much steam if furnished with such wood as fuel. An engineman that tried to kindle his fire with dried pine-sticks, that had been used for any time to stir whitewash, would soon find that he was on a fool's errand.

(3.) *As to Shrinkage.*—I would answer: Timber, when first cut, has its tubes filled with a liquid representing, with other volatile matter, more than one-half of the whole. When all, say a greater part, of the volatile matter is driven out by heat and atmospheric currents, or otherwise, the particles of fibre formed in tissue tubes have a tendency to consolidate, to cling closer together, to concentrate each on itself, then in groups, and lastly on a common centre. This contraction goes on for many years, and must astonish any one that has watched it in thin sections of fir or pine, under the microscope, and measured the shrinkage with micrometers. Each year it will contract, and, when subjected to an atmosphere surcharged with moisture, it will absorb water and expand, only to lose the water again at the next hygrometric change, and shrink to smaller dimensions than ever before. Now, if we can fill these tubes, or partly fill them, with an insoluble salt, we can in a measure arrest this shrinkage—to what extent no one has as yet ascertained, for no one has carried out fully the process I would propose, namely, to wash out the capillary tubes from one end, by forcing water through them, then, by same process, force two chemicals into the timber, one after the other, the latter to act as a re-agent, combine with the first, and form an insoluble salt. Boucherie has done the washing and sending in one chemical by a simple, inexpensive, and most philosophically correct method. Payne and Thilmany have both used two chemicals, and aimed at an impregnation resulting in an insoluble salt in the wood, but by a method which is mechanically and philosophically incorrect. The representatives of the Thilmany process claim to be able to send the second chemical into the centre of large timbers, and produce the result aimed at. If they can do this by pressure on all sides and ends of a stick, the tubes of which are already filled with a ponderable liquid, it looks reasonable to suppose that the second chemical can be forced in from one end if there is no resistance at the other.

(4.) *As to the ravages of the Teredo.*—I would answer: The early writers on the habits, character, and intentions of this terrible worm, appear to have all got in a fog as to why and what for he bored a hole in a stick, and not being content with one, he bored two, or a dozen, and made himself about as disagreeable and destructive as a worm could well be. Linnæus, Cuvier, Blainville, Lamarck, and Sir Everard Home, all writing before the era of creosoting and chemical preservation of timber dawned on railway economy and harbour works, appear to agree that this abominable specimen of animal life bored for a habitation, and not for sustenance. They placed "this beast" among the Vermes Testacea, and then confounded him with a genus, Tubicolœda, which does bore into timber, shells, and stone expressly for a habitation. He bores a small hole even in the hardest stone, sits in it quietly, and spends the remainder of his days in fishing; while the other fellow goes, like a "tramp," after something to eat, wandering around in the dark, and doing all the damage he can. It was left to our day and times to show that this unmitigated scoundrel bores for sustenance; and, it may be, for the fun of the thing (as a live Yankee is said to sit on a fence and whittle a stick of pine-wood by the hour, just for the fun of the thing) and to try his auger, for it is keen and sharp, and he is a clever and quick worker. I have spent days in wonder, while dancing attendance on this specimen of animated nature, digging him out of timber and watching his work and habits, in the Bay of Panama, where I also saw some beautiful specimens of Tubicolœda; so I have had an acquaintance with both of them of over thirty years, and again had to pay his majesty the teredo marked attentions when Engineer of Harbour Defences of New York, during the civil war. At Colon, on the Atlantic side of the Isthmus of Panama, the teredo cut off piles of ten inches diameter in less than one year. I have cut these worms out of piles at Tobago that were eight inches long, and could bore a hole of nearly a half-inch in diameter. It has been found that the teredo will not bore into the palmetto of Carolina, or the green-heart of Guiana; it does not appear to suit their appetite, nor does timber that has been creosoted, so we can congratulate ourselves on there being something that will arrest his devastating war on our harbour works.

(5.) *As to Preserving Timber free from Poisonous Vapours.*—I would answer, that this can easily be done by using none of the expensive and poisonous chemicals such as chloride of mercury, sulphate of copper, chloride of zinc, &c., but, in their place, inexpensive chemicals, such as can be easily manufactured by any intelligent people and in any part of the world, as the elements I would use can be found anywhere—namely, silicate of soda (silex dissolved in caustic soda, under pressure) and chloride of calcium (the basic salt of lime). Silex, lime, and soda, the inorganic elements from which these chemicals are made, can be found in quantity everywhere, can be easily and cheaply procured, and any people can be easily and quickly instructed as to their reduction and manufacture into salts.

To get these chemicals into timber I would adopt the Boucherie process, which I will now describe:

The Boucherie Patent.

Boucherie, an eminent French chemist who had long studied the nature and properties of timber, its structure and component parts, its growth and development, the results of a liquid called sap, formed of elements from the earth, gathered by the roots, and carried up in the capillary tubes to the laboratory of the leaves, where Nature directed certain changes and additions to be made, and then sent it down again to carry out the functions of building up and extending the woody structure, by depositing atoms in the fibre, and feeding all parts so they may grow, thrive, and be useful to man. Boucherie was led to experiment: he found that it was an easy matter to force any liquid through the whole length of a piece of timber that had been newly cut, and had in it its sap in a liquid state. He discovered also that the capillary tubes through which the sap is carried, and which form the strength and value of the timber, were continuous, and without lateral connections; for he could fasten a hollow ring, a cross, or a letter on to the end of a stick of timber, and then, by turning on a pressure with a coloured liquid, he could produce in the same color the same ring, cross, or letter at the other end of the timber. Long before his time, it was known that the elements of decay were in the sap, that the elements of strength and value were in the fibre of the tubes, and that they were carbon. By a simple train of reasoning, he came to the conclusion that he could, by pressure, run water through these tubes and wash out the organic matter, then fill the tubes with inorganic matter in solution, and in that way preserve the timber from decay He adopted the sulphate of copper as the chemical to use, devised a simple and cheap apparatus, took out a patent, and started it into useful operation. If he ever attempted to force in a second chemical, and make an insoluble salt in the wood, I never heard of it. His apparatus consisted of a wooden reservoir to hold his liquid chemical—this he erected some 25 to 30 feet above the ground, in the forest, or near where the timber was cut; some caps to go on the ends of the timber; some flexible tubes to connect the reservoir with the caps; some pumps to pump the liquid in the elevated reservoir, and the apparatus was complete. As far as I know, Boucherie never attempted to wash out the logs before running in the chemical, nor did he attempt to make an insoluble salt inside the timber; but what he did do was a great step in advance in the preservation of timber, leaving us to improve on what he did and perfect the system. I enclose a sketch, showing the manner in which the process was carried out. It shows Figure 1, a small reservoir, elevated on a frame made of poles held in position by lashings, and how a bed of forty sleepers can be treated all at one time. Treating a double-sleeper log is more fully shown in Figures 3 and 4. A log of double the length of a sleeper is cut transversely nearly in two, at the middle; a grumet or packing is inserted around the edge of the inner bark; a hole is bored in one piece to reach the saw-cut, a tube from the reservoir inserted, and the liquid under pressure turned on, to find its way out at the other ends by pushing the sap out first. Boucherie first experimented on live trees, while standing, by cutting off the tops; then hollowed out the upper ends, and filled them with a coloured chemical in solution, which descended in the timber, so he could see the colour and detect the salts in the lower parts of the trees.

With the knowledge of Boucherie's process, and the results he obtained, before us to reflect on, experiment on, and try to improve on, I would suggest the following process for all railway timber:— To cut logs to suitable lengths, to lay them while fresh cut in beds of twenty or forty, or such number as may be found the most convenient, to fasten on one end of each a suitable cap, made adjustable to logs of different diameters, and then, with a portable pumping engine, first wash out the timber by forcing warm water through it under a pressure of 50 lb. per square inch, or more, taking care to not heat the water sufficient to coagulate the albumen. By this operation the sap will be driven out, and, with it, much of the deleterious matter. Then force in the silicate of soda, coloured, so it can be seen when the water has been pushed out; then, with another pump and pipes, force in under full pressure the chloride of calcium, the two forming, when combined, a silicate of lime. If this second chemical can be got through before the reaction takes place—resulting in the water of the chemicals being hydrated and a dry insoluble salt formed—we may count with certainty on having timber that will last for ages, that cannot be burnt in any ordinary fire, that will not shrink much, that will most probably resist the ravages of the teredo and white ant, and that will not throw out noxious vapours, for you will have timber that is partially stone. If the second chemical cannot be got through, on account of the quick reaction and the choking of the tubes at one end, choke, say stop up, the other ends in the same way, confine the first chemical in the timber, and in time it will combine with the woody fibre and become a species of semi-petrifaction.

Timber that has been washed out by hot water, and then filled in with a hot solution of chloride of soda (common salt), and sun dried, or desiccated by currents of hot air, will be preserved and in a condition to last many years. At Syracuse, in the State of New York, there are hundreds of acres covered with vats devoted to salt making by solar evaporation; these vats are of wood, and are erected on sticks driven in the ground and standing about four feet high; the salt water from leaks trickles down and saturates these supporting sticks; no one of them is ever found decayed. By pumping ordinary sea water into a barrel hoisted into the top of a tree, say 25 or 30 feet above the ground on which sleepers lay, a hydraulic head can be obtained, which if applied through a flexible tube to the end of a newly cut piece of timber will wash it out thoroughly, if run long enough, and leave it in a condition when dried to last many years; this is certainly a cheap process, and within the reach of most people.

With a coloured liquid in a reservoir elevated 25 feet above the ground, where lay a stick of poplar 10 feet long by 10 inches diameter, the two connected by a tube, I have seen the sap begin to run out in three minutes, and in five minutes more the coloured liquid came through. I see no good reason why, after timber has been washed of its bad elements, it should not be filled with hot creosote oil by the Boucherie process, without resorting to the huge and costly apparatus used in the Bethell, Hayford, Thilmany, and other patented processes. The Boucherie apparatus, besides being more philsophic in its conception and operation, has the advantage of being much less costly; also in being easily transported from one place to another, even into the forest, and close to the standing timber that is to be treated.

When elevated reservoirs and the cold treatment is decided on (it may be that such treatment would be sufficient to satisfy all ordinary demands), barrels to hold water, and barrels containing the chemicals, may be hoisted into the tops of trees, and, while hanging there, flexible tubes could be brought from them to the timber to be treated, giving about a pound pressure for every thirty inches the timber is below the hydraulic head.

If creosote oil can be forced into the centre of a heavy stick of timber by bringing a pressure on both ends at the same time, I think it will find its way into a stick under 30 or 40 feet of hydraulic head when applied at one end, while the other end is left open as a vent for the water that was left in to run out.

I have an abiding faith in the preservation of any timber that has been well purged of its albumen, and the pores filled with any inorganic matter that can be made insoluble in them. Also that some of the light, cheap, and coarse-grained woods can be made for railway purposes, by chemical treatment, about as good as the harder and more costly woods treated in the same way

I do not know the extent of your forests, or the size of your trees, but feel satisfied from specimens I have that you possess some good timber, that can be easily and cheaply preserved by the process I have named.

I will send to you with this some specimens of your woods, which I have sawed and prepared myself for use under the microscope; they should be dissolved from the papers, washed, and fastened on to glass strips, that light may be transmitted through them when viewed under the microscope, to see the structure and the form of the capillaries.

I have now written for you much more than I intended when I commenced to write, much more than you can possibly care to read; but the subject is important, and becoming more so as the uses for wood increase, the forests disappear, and we become more interested in economic arts. I beg you to refer this letter to your Engineer for observation and criticism. If due attention is paid to all I have written, it may lead to useful experiments, and result in saving to your new colony many thousands of pounds sterling.

I have, &c.,

W W Evans.

The Under-Secretary for Public Works, Wellington.

P.S.—I forgot to mention that I have seen the reports of the Commissioner appointed by the Royal Academy of Sciences, of Amsterdam, to examine into the history of the teredo, and the best means of preserving timber in marine works against his ravages. I have read an account of the experiments conducted by this Commission, and I am aware of the failure of all of them as against the teredo, except those in which they used creosote oil. I knew that they used two chemicals, in connection with the Boucherie process, and failed to keep the teredo out; but I cannot see that they attempted in the first place to wash out the albumen that filled the capillary tubes, and gave sustenance to this worm, poisoned or not poisoned. This Commission was composed of Messrs. Vrolik, Harting, Buysing, Van Ordt, and Von Baumhauer. Their reports are published in French, and it may be in English also; they should be read by all engineers in charge of harbour works.—W W.E.

No. 7

Mr. W W Evans to the Under-Secretary for Public Works, Wellington.

New York, 3rd March, 1881.

Sir,—

I enclose a paper I have written for you on the preservation of timber. I beg you to excuse its shabby appearance; my clerks have injured it in taking copies by hektograph, and I have no time to get it copied again. Since writing this paper, I have seen Mr. Young, General Manager of the American Wood Preserving Company, representing the Thilmany process. He informs me that he can treat timber for 16 cents per cubic foot, and can furnish a complete apparatus for $50,000, to have a copper cylinder 100 feet long. I have also seen Mr. Andrews, representing the Hayford improved creosoting process. He informs me that he can furnish a complete apparatus for $20,000, and that the cost per cubic foot will depend on the cost of creosote in New Zealand. He asks me if you have creosote, also, if you have extensive forests.

I have, &c.,

W W Evans.

The Under-Secretary for Public Works, Wellington.

No. 8.

The Assistant Under-Secretary for Public Works to Mr. W W Evans, New York.

Public Works Office, Wellington, 21st April, 1881.

Sir,—

I am directed by the Minister for Public Works to acknowledge the receipt of your letter of the 3rd March, forwarding a report on the various methods of preserving timber, and to express the Minister's thanks, and also those of the Engineer in Charge, North Island, to whom the report has been referred, for the very interesting and exhaustive information which you have furnished on the subject.

I have, &c.,

Charles T. Benzoni,

Assistant Under-Secretary for Public Works.

W W Evans, Esq., New York.

By Authority; George Didsbury, Government Printer, Wellington.—1881.

—Sketch—

SHEWING THE PROCESS

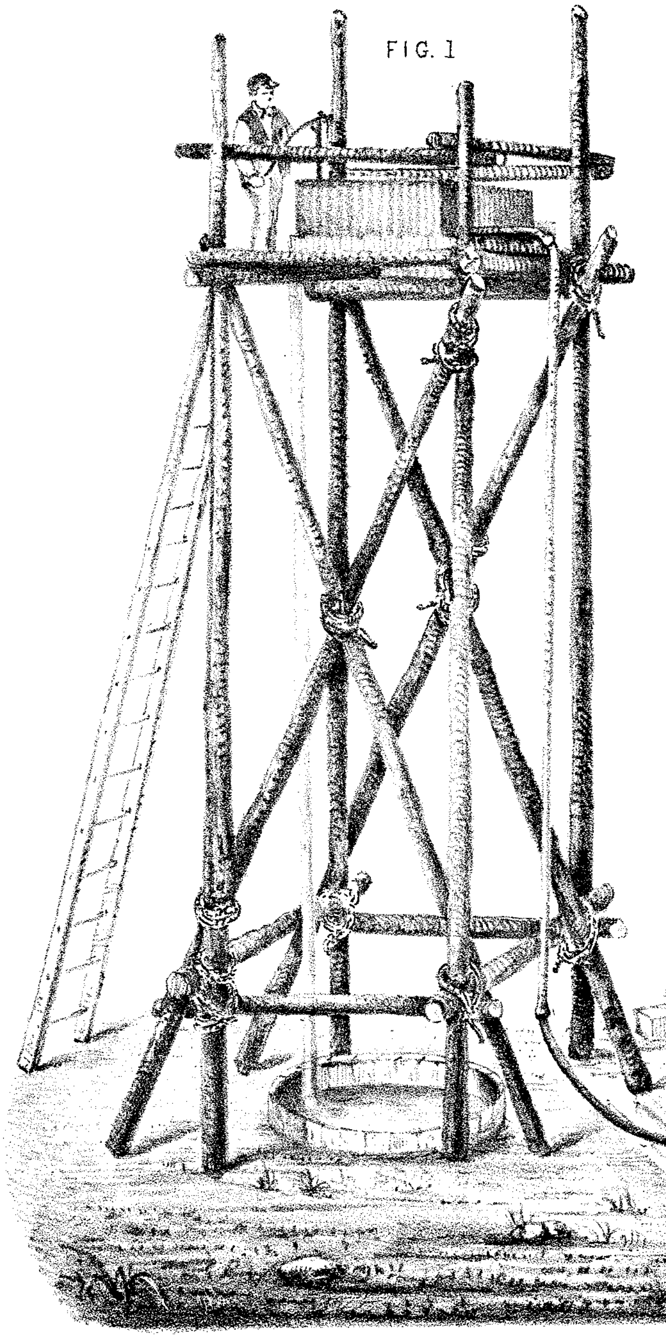
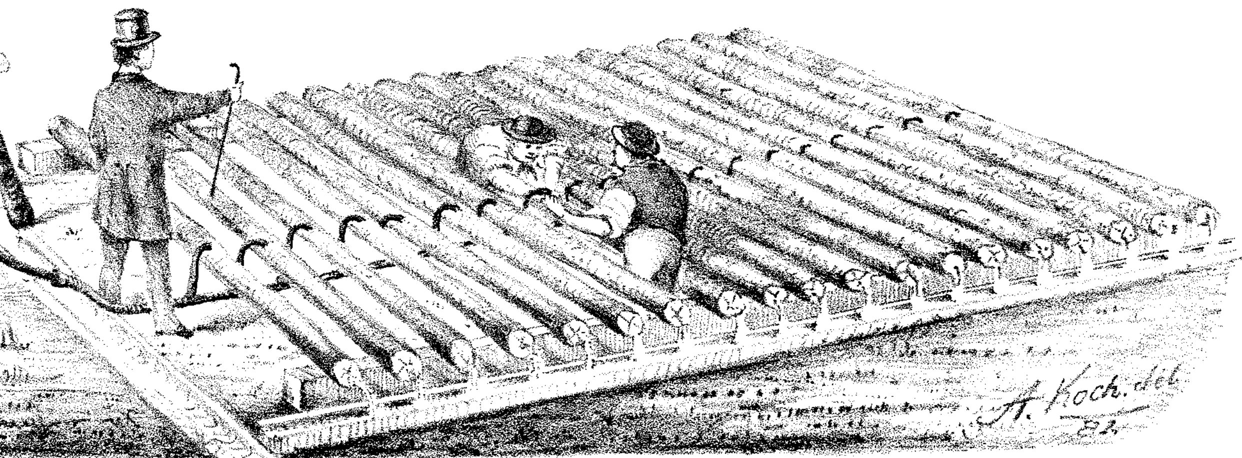
FOR

PRESERVING TIMBER

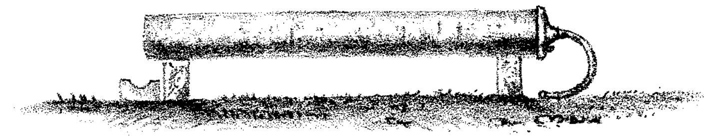
by the

Boucherie's Patent

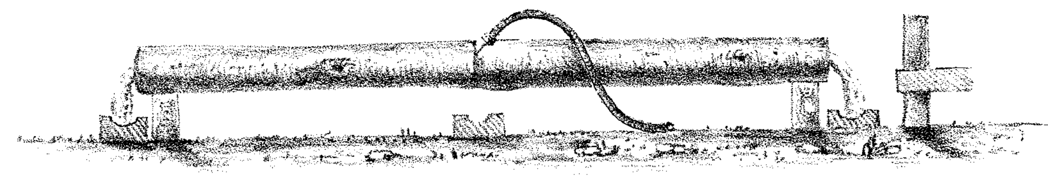
FIG. 1

F G 2.



F G 3.



F G 4