

From

THE EXAMINER,

GUARANTEED RAILWAY ACCOUNTS,

Madras,

To

No. _____

Dated _____ 189 .

No. of Enclosures _____

SUBJECT.

Very Urgent
Public Works (1899) Department.

RAILWAY BRANCH.

G.O., No. 1487-88 *200 Rs. 400*

DATED 19th Decr 1899

[Despatch Abstract.]

*Haskin's Process of preserving
timber for railway sleepers*

*Directing that the correspondence on the
subject of the — be forwarded to the Dy. Secy.
for info. & a copy of the Pro forwarded to the Dy. Secy.
for info. & a copy of the Pro forwarded to the Dy. Secy.
Forwarding a copy of Pro embodying
the correspondence on the subject of the —*

Government {1899} of Madras.
PUBLIC WORKS.

Draft G. O. for

H. E.'s approval

Enclosures

Spare copies

1899.

Flu

G.O., Nos. 1487, 1488 Ry., 19th December 1899.

DECEMBER.

Haskin's process of preserving timber for Railway Sleepers

Forwarding a copy of the Proceedings embodying the correspondence on the subject of the —.

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R. 19.12.99

No. 1487 Ry., 19th DECEMBER 1899.

GOVERNMENT OF MADRAS.
PUBLIC WORKS DEPARTMENT.

Railway.

Read the following papers:—

G.O., Nos. 373-374 Ry., dated 5th March 1898.

ABSTRACT.—Communicating, for the information of the Railway Administrations, a note by the Senior Government Inspector of Railways, Madras, on the HASKIN PROCESS for preserving timber.

G.O., No. 841 Ry., dated 21st June 1898.

ABSTRACT.—Communicating, for the information of the Railway Administrations, a note on the HASKIN PROCESS by the Inspector-General of Forests, India, and a note by the Consulting Engineer for Railways, Madras, on the subject of timbers for railway sleepers.

Read also Proceedings of Government, No. 53 Ry., dated 11th January 1899, which, besides various correspondence on the subject of timber sleeper supply, contain the following references to the Haskin process.

EXTRACT FROM "INDIAN ENGINEERING", DATED 1st OCTOBER 1898.

Letter from the Manager, Haskin Wood Vulcanizing Co. (Ld.), 2 Dean's Yard, London, S.W., dated 9th September 1898.

Our attention has been called to an article in your issue of 11th June, headed as above, referring at some length to our process. Without encroaching too much upon your space, we might remark, for the benefit of your readers, that our works at Millwall (London) have been in full working order for some time, and that we have treated large quantities of sleepers for various English Railway Companies to their entire satisfaction, and at the present time have several contracts for Haskinized sleepers on hand. A large consignment of Haskinized sleepers and crossings has also been shipped to South America.

Considerable quantities of Haskinized wood paving-blocks have been, and are being, laid in the principal streets of London, and various large provincial towns in all parts of the country, during the past month or two.

The process is much cheaper and far more effective than creosoting, as, besides preserving the timber from decay, it hardens, indurates and strengthens it, and renders the sapwood as serviceable as the heartwood.

Pieces of Haskinized wood that have been sent out to India and placed in white ants' nest have absolutely withstood the ravages of these little destructors, while similar pieces of untreated wood which accompanied them have been thoroughly honeycombed.

The process is also suitable for the preservation of timbers for bridge-work, piling timbers, decking, platforms, etc., and being inodorous may also be used to considerable advantage for indoor work.

We shall be most happy to give any of your correspondents, or readers, any further information they may desire.

No. 1487 Ry., 19th DECEMBER 1899.

From—The Consulting Engineer for Railways, Madras.
To—The Manager, Haskin Wood Vulcanizing Co. (Ld.), 2 Dean's Yard, London, S.W.
Dated—Madras, 18th October 1898, No. 2872.

I beg to enclose for the information of your Directors copies of Madras Government Proceedings, as marginally-noted.

Nos. 373-374 Ry., dated 5th March 1898.

No. 715 Ry., dated 12th May 1898.

" 841 Ry., " 21st June "

" 1141 Ry., " 16th Sept. "

From a perusal of these papers you will see that the provision of sleepers of a class suitable for the climatic conditions to which they are exposed on the Southern Indian railways is a large and difficult problem; and yet there are unlimited quantities of various timbers which, so far as I can judge from what I have read of your process, would, if "Haskinized," be quite suitable. It is scarcely necessary for me to explain to you that to send timber to England to be treated in order to re-ship it to India would, commercially, be quite prohibitive. It suggests itself therefore that your Directors might perhaps see their way to entering into a correspondence having for its object the establishment of works at one or more central places within reach of the larger Southern Indian forests. Whether such works should be managed by the Government Forest Department, direct, under some arrangement for paying you a royalty, or by the Railway Companies, or by your own agency through the medium possibly of one or other of the large Madras firms of mercantile Engineers, would be a matter for consideration and settlement by correspondence. What the State Railways and the Companies' Railways require is a metre gauge sleeper 6' 6" x 9" x 4½" for less than three rupees, and a broad gauge sleeper 10' x 10" x 5" for less than five rupees, which will live in the road for fourteen to eighteen years.

I shall be glad, in my official capacity, to enter into a correspondence with you on the subject, and to lay your views before the Railway Engineers and before the heads of the Forest Department.

From—The Secretary, Haskin Wood Vulcanizing Company (Limited).

To—The Consulting Engineer for Railways, Madras.

Dated—2 Dean's Yard, Westminster Abbey, S.W., 25th November 1898.

My Directors have now considered your letter and memoranda of the 17th ultimo, and instruct me to reply as follows.

They think a plant, say, half the size of that now working at Millwall, would probably best meet your requirements, and they estimate the cost of such a plant, delivered f.o.b. Liverpool, will be about £12,000. Such an installation could be fixed at the centres you might consider desirable and each installation should enable you to treat, say, 450 standard size sleepers per day.

Our terms for assenting to your installation of such a plant in India would be the sum of £2,000 paid down so soon as our negotiations are completed, and a royalty of 3d. per sleeper of ordinary gauge and 2d. per sleeper of metre gauge and 1d. per cubic foot for any miscellaneous timber that might be treated in the vessels.

Should the Government wish to pay a capital sum down, in the first instance in lieu of the proposed royalty, this would be a matter for negotiation.

It would be stipulated that the apparatus would only be employed for the treatment of material supplied by the Forest Department for the use of the railways or other Government departments, and the Company would also specially stipulate that all the machinery should be made and supplied by their sole licensees, Galloways, Limited, Manchester, who have constructed the whole of the machinery at the Millwall works to our entire satisfaction, and which machinery can be seen at any time by any representative of the Government.

Enclosed is a short specification of plant half the size of that at Millwall.

ENCLOSURE.

Specification of Haskinizing plant proposed to be supplied.

This plant to consist of two treating chambers each about 114 feet long by 6' 6" diameter, to be made of best quality of Siemen's Martin steel plates; the back ends of these vessels to be of a dished shape, and the front ends to be formed of a steel door mounted on substantial hinges with balance weights and arrangement for rapid automatic jointing, the whole being readily operated by one man. The vessels to be fitted inside with an arrangement of pipes for heating, and a set of rails for trolleys upon which the timber to be treated would be carried.

These vessels to be supported by an arrangement of rollers carried in substantial framing to allow of expansion and contraction taking place without putting any strain on the vessels.

100 Trolleys as before mentioned, to be formed of wrought iron or steel framing, and each fitted with four wheels suitable for running upon the rails referred to.

1 Horizontal non-condensing air compressing engine, with air cylinder having a bore of 18" and a stroke of 2' 6", and with steam cylinder of suitable dimensions; this engine to be complete in every way and of the most substantial design in every detail.

1 Horizontal non-condensing air circulating engine of the proper size and strength.

2 Patent Galloway boilers each 28 feet long by 7 feet diameter, made of best annealed steel plates with complete set of fittings, valves, etc.

The whole of the pipes and valves for actuating the vessels, machinery, etc., as above described including steam, feed, exhaust, and air circulating pipes with feed pump for feeding boilers, air receivers, heaters and coolers as required, all of the best material and workmanship throughout, delivered f.o.b. steamer in Manchester.

Read also the following:—

From—The Director of Railway Construction.
To—The Consulting Engineer for Railways, Madras.
Dated—Simla, 26th April 1899, No. 596 R.S.

I have the honour to acknowledge the receipt of your letter No. 257, dated 24th January 1899, forwarding for information a copy of each of the marginally-noted proceedings of the Government of Madras, regarding (i) * * * * * and (ii) the preservation of timber for railway sleepers purposes by the Haskin process of preserving timber.

2. In reply, I would suggest the advisability of sending home a few sample sleepers of the various kinds of wood available for sleepers, to be Haskinized; after which they may be subjected to trial in this country and the results noted.

3. I shall be obliged by your furnishing me with 35 spare copies of each of the following proceedings:—

No. 53 Ry., dated 11th January 1899,

(if they are available) for purposes of circulation and record in this office.

No. 53 Ry., dated 11th January 1899,

(if they are available) for purposes of circulation and record in this office.

No. 53 Ry., dated 11th January 1899,

(if they are available) for purposes of circulation and record in this office.

From—The Consulting Engineer for Railways, Madras.
To—The Director of Railway Construction, Simla.
Dated—Ootacamund, 11th May 1899, No. 24/O.

I beg to acknowledge receipt of your letter No. 596 R.S., dated the 26th April 1899, and to say in reply that 35 spare copies of the Proceedings asked for shall be furnished as soon as fresh copies have been printed.

2. I am advised by forest experts, including Mr. Ribbentrop, that to send specimens of timber to England to be Haskinized would not be likely to be successful, because the essence of the process is that the fresh sap of the wood should still be fully permeated through its fibres before treatment; for it is the sap itself which when chemically changed by heat forms the preservative, and it would largely evaporate or change its nature during a voyage to England.

3. I am disposed to advise that a small grant be allotted to a Locomotive officer likely to take an interest in this idea. He could perfectly well convert an old rejected boiler and arrange to heat the air to be pumped into it, one end of the boiler being removable as in the plague-disinfecting apparatus at railway stations. Any old Worthington pump would serve for an air pump, for the purpose of the experiment.

4. As to test the sleepers will take eight or ten years, and as there seems to be good technical evidence that the process is a good one, it might perhaps be worth the Government of India's while to risk getting out a small set of the Haskin apparatus.

Memorandum by the Locomotive Supdt., Madras Railway, dated 11th October 1899.

Mr. Moss spoke to me yesterday about Haskinized wood, and said that you had promised to send me any information you possessed with regard to it. Mr. Stoney has lent me a copy of Haskin's pamphlet; but, although interesting, it gives no practical information as to what the process is; and before I could give an opinion as to the possibility or otherwise of making a plant for Haskinizing wood locally I should want to know more about it. Can you give me any further details as to what the process is, or refer me to any publication in which I can look it up?

2. I think I remember reading some year or two ago in some Engineering paper a description of the process; but, as it did not interest me, I did not make any note of it.

3. I gather from the pamphlet that I have read that the process is a patent one, and if so, I do not suppose we could, in any case, put down plant here without permission of the patentee.

Memorandum by the Consulting Engr. for Rys., dated Madras, 14th October 1899.

Please read the above. Also the enclosed copy of G.O., No. 373, dated 5th March 1898. Also enclosed copy of G.O., No. 841 Ry., dated 21st June 1898. Also a copy of my letter No. 24/O., dated 11th May 1899, to the Director of Railway Construction.

My proposal is not that you should at once set up a Haskinizing plant on a commercial scale, but that you should set up a small experimental plant, just to prove whether the thing is likely to be successful chemically.

Can you, I presume, rig up an air pump, with a heating chamber full of tubes, so that the air should be delivered at 400 degrees temperature and 180 to 200 lbs. pressure into the sleeper receptacle. This latter might be an old boiler shell, with a removable end like those used by the plague people.

If the thing proved, or seemed likely to prove, successful, we could probably get out a big plant hereafter, sufficient for each railway's own annual renewals. You see you will have 600 or 700 miles of wooden road in the future, and anything that knocks one rupee per sleeper off the price, by rendering the cheap outlying forest timbers available, ought to pay well.

Details about royalty, on the few sleepers turned out by the small experimental plant, can doubtless be easily arranged with the patentees.

Memorandum by the Loco. Supt., Madras Ry., dated 28th October 1899, No. B. 1076.

I have read with considerable interest the papers you were good enough to send me with regard to Haskinized wood. I have also read the article in the *Engineer* quoted in the papers.

2. I shall be very glad, indeed, to do anything possible to further what seems to promise to be a profitable undertaking; but I am afraid, before any experiments could be made, considerable expenditure would be necessary in plant.

3. Air at high pressure and temperature is difficult to deal with, and all joints, etc., would have to be most carefully and specially made; ordinary packing or joint material would not stand the high temperature, and I fancy nothing but asbestos would do.

4. Our old boilers were originally built to carry a working pressure of 120 lbs. This they did as long as they were considered fit for it, and when thought no longer safe to be allowed to work at this pressure, they were condemned. Therefore, even if the difficulties as to the ends and the door could be got over, I should not care to run the risk of now working one of these condemned boilers at a pressure far in excess of that for which it was originally intended when new. I have not worked out the matter thoroughly, but roughly speaking a boiler to carry this pressure would probably have to be made of at least 9/16 or 5/8 plate and double rivetted all over, instead of as are our boilers, or rather were originally, 7/16 with single rivets.

5. Even assuming we had a barrel, there would still be a good deal of trouble in the ends, as it would not be an easy matter to make an absolutely air-tight joint for the high pressure and temperature required, excepting by turning the whole thing up and making a proper workmanlike job of it.

6. To compress the air a pretty powerful engine would be necessary, and such engine would further have to be provided with an arrangement for circulating water round the cylinder in order to keep it cool. A stove of some sort would also be wanted to heat the air; but in this there would probably not be very much difficulty.

7. Personally, I scarcely see how it would be possible to rig up an experimental plant save, as I have said, at considerable expense. If, however, you would like me to go into it further, I will write to the Haskin people and try and get drawings or particulars from them and see what can be done.

8. I first thought of heating the air by passing it through steam, but the equivalent pressure of steam at 400° temperature is 235 lb. which would need a still heavier boiler to carry it.

Memorandum by the Consulting Engineer for Railways, dated 30th October 1899.

I think it would be a good thing if, as you suggest, you were to write to the Haskin people, telling them that, on account of the large mileage of wooden sleepers now coming into your Company's hands, it had become desirable to ascertain experimentally whether the process is suitable to Indian woods and Indian conditions, before going in for a large and expensive installation. You might mention what your difficulties are, in the way of making even a small experimental plant, and ask them what they could do in that way and at what price, explaining that if the experiment should prove successful it might possibly lead to very heavy business in a few years. You might enquire about a plant fit for, say, 100 sleepers per day 10' x 10' x 5'.

From—The Secretary to the Government of India, Public Works Department.
To—The Secretary to the Government of Madras, P.W. Dept., Railway Branch.
Dated—Calcutta, 10th November 1899, No. 2096 R.S.

The undermentioned papers are forwarded to the Consulting Engineer for Railways, Madras, for information with reference to correspondence ending with his letter No. 1686, dated 29th May 1899.

ENCLOSURE No. 1.

NOTE ON THE HASKIN PROCESS OF VULCANIZING TIMBER.

BY DR. J. NISBET, CONSERVATOR OF FORESTS.

This process resembles the preservative processes introduced with regard to timber by Mr. Kyan, Sir William Burnett, Mr. Bethel and others, only in so far that all of these processes are classifiable as antiseptic. It differs, from them *in toto*, however, with respect to the means of sterilising the woody tissue; for, whereas the other methods attain this by injection of antiseptic substances, Haskin's process aims at direct sterilisation under the immediate operation of heat and pressure.

Apart from the disintegrating and wasting influences to which timber is liable, and which it shares with iron, steel, etc., in the shape of disturbance of molecular and other forces, the main causes of its more or less speedy decay are of purely organic origin and arise from attacks of fungi and insects or other animals. Some kinds of timber have a better natural protection than others against attacks by fungi and insects through the tannic acid, etc., contained in their tissue (e.g., oak, cutch, pyinkado); others have essential oils distasteful to most insects (e.g., teak, deodar); and others again are more or less protected by natural processes of resinification (e.g., larch, pine). Adopting a broad generalisation, it may be said that the durability of timber *per se* is in the inverse ratio of the amount of albuminoid matter present in the wood in a form which can be utilised as food material by fungi and insects or other wood-consuming animals. Rapid alternation of dampness and draught, or the combined action of dampness and high temperature, will facilitate attacks on wood by both of these classes of destroyers; but for the sustenance of life in the vegetation of fungi or in the alimentary processes of insects, albuminous food is an essential requisite. If the albumen can be sterilised and rendered unfit for utilisation as food, by being made to undergo a permanent change rendering it unassailable to fungous and insect attacks, the woody fibrous tissues of timber must benefit both directly and indirectly. They gain directly by offering practically no points of attack to saprophytic fungi and insects, and they gain indirectly by becoming thereby exempt from the destructive and disintegrating processes induced and hastened by the fermentation which accompanies the action of fungi and insects.

As a temperature of about 160° Fahr. effects the coagulation of albumen, this fact was practically adopted as the basis of the Haskin process of vulcanization. Further use was at the same time made of the well-known fact that many of the transformatory and perfecting processes of nature are carried out under the application of great heat and enormous pressure. Such natural processes have been imitated, and the vulcanization process may be briefly described as a new method of rapidly seasoning timber by hermetically sealing it in powerful iron vessels and exposing it under a pressure of about 13½ atmospheres (200 lb. per square inch) to the influences of dry air superheated to between 200° and 300° Fahr., the precise temperature being the secret of the process. If the amount of heat be inadequate, the full advantages obtainable by warmth and pressure are not obtainable; while on the other hand excess of heat might induce dry distillation that would weaken the quality of the timber for technical purposes. This principle seems perfectly sound.

At the same time other organic changes take place. Through the heat and pressure applied, the constructive potentialities of the sap are utilised, the transformed portions being apparently incorporated into the woody tissue in the form of antiseptic substances. The changes that take place in this respect appear to resemble such as occur in the transformation of sapwood into heartwood, a change which enhances the durability of timber.

In coniferous woods a process of resinification is also very distinctly noticeable as the result of treatment, the production of resin in large quantity no doubt being due to the action of heat and pressure on the sap and also on the less durable portions of the cell-walls; for it is known that the chemical transformation of the latter assists in the natural production of resin.

The vulcanization process is said practically not to alter the weight of the timber to any considerable extent, and but little water is given off during the treatment. This seems to prove that the sap contained in the wood is for the most part transformed and incorporated into the sterilised woody tissue.

The method adopted is simple. The timber to be operated on is brought in from the yard

Method adopted.

on a narrow tramway and run into one of the cylinders in which vulcanization takes place. There are four such cylinders, each 112 feet in length (consisting of four sections of 28 feet each), so as to admit of treating the largest size of telegraph posts. The timber being operated on at the time I visited the yard were sleepers, of which some 1,410 cubic feet or 28 tons could be railed on little waggons into each cylinder. When deals are dealt with, the feeding consists of from 1,000 to 1,145 cubic feet according to the way they pack on the small trollies.

The cylinders are built of boiler plate and are anchored at the top end, while the bottom portions are supported by rollers on runners to allow play for the expansion of between $1\frac{1}{2}$ and 2" due to the hot air applied within.

When the load of timber has been trolled into one of the cylinders, the open end is hermetically closed by means of an enormously heavy steel lid hinged at the top and heavily counterpoised (weighing in all about 9 tons), which is opened and shut by means of a cog-wheel worked by the leverage of a hand-wheel. On the lower end being brought into position, the complete closure against air-leakage is effected by means of numerous curved levers radiating like the spokes of a wheel from the centre of the lid, whence the levers are actuated, and pressing powerfully on the lid so as to seal it hermetically against the air pressure of 200 lb. per square inch from within. To facilitate air-tight closure, the lip of the cylinder is coated with asbestos packing. There are 40 of such spoke-like levers, and each fits into a strong steel socket or slot. The opening or closure of the lid can take place in less than two minutes, only two men being required to work the wheel and apply all the requisite leverage. The lid having been closed on the filled cylinder, steam is turned into the pipes and surplus moisture from the outside of the wood is expelled and run off through cocks at bottom of the cylinder. The cocks being again shut, superheated compressed air between 200° and 300° Fahr. is then driven into the cylinder. This is provided by an air-compressing machine in an adjoining chamber. The air-compressing engine weighing about 35 tons has steam and air cylinders, each 18" in diameter, and with a 30" piston stroke in which the air is compressed to a pressure of 200 lb. per square inch, while a spray of water is at the same time injected into it to absorb the heat evolved by compression. This moist compressed air is next filtered through a water separator which dries it thoroughly, after which it is pumped by the circulating engine — also of about 35 tons weight — first through cylinders containing tubes heated by steam and then through a kind of pipe stove heated by a coke furnace, whence it is conducted to the cylinders where vulcanization takes place. It is essential that there should be constant circulation of the superheated air in the vulcanizing cylinders, and each complete stroke of the piston of the air-circulating machine displaces 35 cubic feet of air. Fresh superheated air is forced into one end of the vulcanization cylinder and a corresponding quantity drawn off from the other end. From the cylinder the air passes to a tubular cooler and is conducted thence to the circulating pump for redistribution. Any loss of air-pressure due to circulation is replaced by the occasional use of the air-compressing machine. Both the air-compressing and the air-circulating machines are worked at a slow rate.

The process of vulcanization depends of course on the dimensions of the timber to be operated on, but for sizes like sleepers it occupies about 8 hours; and no advantage has been found to accrue from continuing the treatment beyond this time. As the plant is not yet fully employed, the cylinders are fed in the morning, operated on during the day and allowed to cool at night, the load being taken out early next morning and replaced by fresh wood for treatment. If worked under pressure of a large business, cooling could be facilitated by gradually lowering the temperature of the air pumped into the cylinders.

Effects claimed for Vulcanization.—The effects claimed to be produced on wood by vulcanization are—

- (1) That it will not decay.
- (2) That the cheaper kinds can be utilised for sleepers, mineprops, piles, &c.
- (3) That the technical properties of wood become enhanced by strength being added and shrinkage diminished.
- (4) That the resinous, oleaginous, and other properties of the sap within the cells and fibre become solidified.
- (5) That the germinative principle inherent in the fluids is destroyed.
- (6) That all "fungi," "germs," or "insects" are killed.
- (7) That wood is indurated, strengthened, perfected and rendered less inflammable.

Numerous certificates and reports of physical tests are quoted by the Company to prove that the technical properties of the wood are enhanced, and detailed statistics are given in the pamphlet issued by them. Avoiding statistics, which can only be satisfactory to those

who are acquainted with all the circumstances of the experiments for testing and comparing the treated and the untreated wood, the following remarks by Professor Myers of Stanford University, California, United States, America, appear to be fairly stated:—

As vulcanizing changes the sap from the liquid to the solid or semi-solid state, does not char or make the wood brittle, saturates and seals up the pores of timber with solid matter instead of liquid soluble matter which nature provides, considerable strength and durability are added, the wood being rendered more cohesive, harder and denser.

Effects visible.—Samples of pine sleepers, said to have been in the ground for about 10 years, were shown to me in a thorough state of preservation; and if they really are what they are said to be, they form a striking proof of the utility of vulcanization. During my visits to the works I had opportunities of examining Baltic pine baulks and sleepers under treatment for the Natal Government and of comparing them with the unvulcanized wood; and I could not but remark the highly resinous condition of the vulcanized wood in comparison with that awaiting treatment. This resinification, this transformation of sap and of the less durable portions of cell walls into substances which become incorporated into the woody tissue, must increase considerably the resistance which the saturated fibres are able to offer to the natural processes of decay.

While it is easily intelligible how the transformation of albuminous substances, sap, and portions of cell-walls capable of undergoing transformation under heat and pressure can and probably must increase most of the technical properties of timber, yet it is almost impossible to accept in its entirety the statement put forward that vulcanization renders wood less inflammable. Certainly for non-resinous woods this will be so, but in the case of conifers resinification must produce greater inflammability; and in all woods operated on the heating power must become enhanced. "Inflammability" and "heating-power" are not, however, synonymous terms; and for the practical uses to which vulcanization may be applicable with regard to Indian forest produce, this point may be left out of consideration.

Buildings and Machinery.—Both buildings and machinery are simple in construction, though the latter is solid and heavy. The former consist of two compartments and an outer shed. The shed contains the three boilers (each of 300 horse-power), only two of which are used simultaneously. In an adjoining room stand the heavy engines for compressing and circulating the air, the water pumps and reservoirs, and a centrifugal distributing pump.

The large outer compartment contains the water-separator, the heating cylinders, the coke furnace with its heating tubes, and the cylinders where vulcanization is effected.

All the machinery was supplied in 1897 by Messrs Galloway of Manchester, who are on the Board of Directors and are largely interested in the Company. There are three boilers, one water pump and reservoir, one centrifugal pump, two air-compressing and two air-circulating engines, one water separator, four hot air cylinders, one coke furnace with internal pipes, and four large cylinders for vulcanizing. At present only part of the machinery is employed, as the treatment does not yet seem to have acquired the popularity that it deserves. From the river the timber is lifted out of barges by a crane and laid on trollies running along a narrow tramline towards the compartment containing the cylinders, near the doors of which the load is shunted on to a line leading straight into any particular one of the four cylinders to be fed at the moment. The handling is therefore very simple.

Establishment.—The establishment now employed at the works (Samuda's Shipbuilding Yard, Millwall on Thames) consists of:—

- 1 Trained Engineer in charge of yard and works.
- 1 Machine man.
- 1 Stoker.
- 1 Boiler cleaner.
- 4 men for charging and discharging the cylinders and for general work in the yard.

The trained engineer and foreman exercises a general supervision over the whole business of the yard and sheds (including clerical work), and sees that the machinery and the electric lighting plant are maintained in proper condition. The boilers, of which only two out of the three are worked simultaneously, have to be cleaned out with soda once a week owing to the high percentage of lime in the water obtainable. In addition there are three men employed in barge work, but the above represents the complete staff required for the working of the yard and maintenance of the whole of the machinery.

Charge made for Vulcanizing.—The charge made for vulcanizing is 2½d. per cubic foot for soft woods and about 4d. for hard woods, a reduction being made for large quantities. It is therefore somewhat cheaper than creosoting. The difference in the scale of charges between soft woods and hard woods does not arise from any difference in treatment, but is due to hard woods being usually sent in smaller quantities and in forms (e.g., veneers, cabinet woods, sounding boards for pianos, etc.) which involve more handling in the yard and during the process of vulcanization than sleepers and baulks of pine and fir. So far as the actual treatment is concerned, the vulcanization process is identical for both classes of timber, and mixed charges can be run into the cylinders. The actual cost of vulcanizing must be very small if there are regular supplies of timber to operate on.

Suitability of process for India.—Haskin's Vulcanization seems a process deserving of careful consideration in all the forest districts throughout India, where there exist supplies of timber now unmarketable owing to liability to rapid destruction from the ravages of fungi and insects. Such conditions obtain especially in hot damp climates (like Burma, for example). There can be no doubt that the effect of vulcanization on all classes of timber is to enhance its durability. Thus even the best classes of hard-woods, like the sal of Bengal and the North-Western Provinces, the pyinkado of Burma, the nageshur (*Mesua ferrea*) of Assam, and any similar woods valuable as sleepers, etc., will remain serviceable for a longer term of years if subjected to this process; while it is quite probable that inferior classes of timber, such as the wood produced by the great majority of the forest trees throughout the wooded tracts in all provinces of India, may by vulcanization be rendered of considerable durability, and consequently of a technical and marketable value which they do not now possess in their natural condition.

This is more particularly the case when the two following facts are borne in mind:—

- (1) That vulcanization can take place to the best advantage when fresh unseasoned wood is operated on.
- (2) That the boilers used for driving the machinery and generating the electric light can quite well be simultaneously employed in working the machinery of a saw-mill. This process could therefore be carried out wherever saw-mills are erected in the forests. Even at the maximum English rate of 2½d. per cubic foot for sleepers, this would be only 3½d. per narrow gauge sleeper (1½ cubic feet); and for this increase in price, which would probably be reduced to not more than about 1 anna per foot as the actual cost on a large scale, there would be obtained not only increased durability, but also less tendency to splitting, cracking, and breaking in handling and transport.

The only European who might in India be required to look after the machinery and the work generally is the trained engineer, and even that post might perhaps be satisfactorily filled by a competent native of India after undergoing some special training in the business.

Probable effect of vulcanization on different kinds of Indian Woods.—It is hardly possible to predict what the effects of vulcanization may be on different kinds of Indian timber. If it causes increase in the amount of essential oil in teak and deodar, it will directly enhance their technical value, dependent as this mainly is on the essential oil contained in their woody substance. If it increases the amount of catechin, tannin or other valuable properties in woods like *cutch* and *pyinkado*, it must likewise enhance their market value and enable larger supplies of tanning and dyeing substances to be extracted from them. If it transforms the albuminous and oleaginous matter in *Dipterocarpus* trees in such a manner as to render their timber durable and make them offer no food-supplies to fungi and insects, then it will enable hundreds of thousands of tons of *In** (*Dipterocarpus tuberculatus*) timber to be available for sleepers and other constructive purposes. Many *Terminalia* would also yield large supplies of useful timber if treatment can be proved beneficial in their case. Finally, there are many different kinds of wood, possessing beautiful colour and fine grain, which might ultimately come into favour as furniture woods or for decorative purposes, if it could once be shown that vulcanization rendered them durable. But it is only by means of experiment and careful tests that any satisfactory conclusion can be arrived at with regard to the effects of vulcanization on each particular kind of timber.

Recommendations made.—As above stated, the system seems to me based upon thoroughly sound principles; and I am strongly of opinion that its introduction into India would enhance the durability of woods now used extensively for railway sleepers, and would probably render suitable for similar use and for various constructive purposes many other kinds which in their natural state can only be considered as inferior and unsuitable owing to their liability to rapid decay in a hot damp climate.

Before Government should commit itself to any considerable outlay in the introduction of vulcanizing plant, however, I would recommend that blocks of timber of, say, from 20 to 30 of the most abundant kinds of trees growing throughout the different parts of India and Burma, should be sent to London for experimental purposes. The best dimensions would perhaps be those of the ordinary narrow gauge sleeper. Of each kind of wood four such sleepers should be prepared, one being retained and three sent to London. Of these three, two could be vulcanized and one of the two sent back to India for submission to tests in comparison with the unvulcanized wood cut from the same block. There would thus in each case be an unvulcanized and a vulcanized sleeper (cut from the same block) in London and in India. In London and on the continental *Forstliche Versuchsanstalten* arrangements could easily be made for microscopical and physical tests regarding their respective technical properties; while in India the tests might be of a rougher nature, such as burying the wood in ants' nests, etc.

It might take a month or six weeks or perhaps even longer to have all the necessary arrangements and experiments made; but the promise which the process holds out as being of future importance to India seems to justify some time being spent in trying to ascertain its probable value in a practical manner. The company have stated to me that they will be very pleased to operate upon specimens sent with a view to testing the process.

Cost of Plant and Machinery.—Colonel Haskin informs me that the cost of the plant and machinery now erected at Millwall has been about £12,000, but he is of opinion that for plant consisting of two boilers, one air-compressing engine, one air-circulating engine, one water separator, set of heating apparatus, one heating stove, and two vulcanizing cylinders, each 56 feet in length (i.e., consisting of two compartments, 28 feet long), with the requisite short tram line, the cost would probably be from £5,000 to £6,000. Laid down *in situ* in the forest it would in this case amount to about one lakh of rupees. Mr. Bagley, late Engineer-in-Chief, Burma Railways Company, who accompanied me on my last visit to the works on 7th December, informs me he is of the impression that £3,000 was the sum previously stated in correspondence on the subject.

Each such cylinder would contain about 15 tons or 495 narrow gauge sleepers, and the two would vulcanize up to nearly 1,000 narrow gauge sleepers a day. This is considerably more than any small forest mill can produce.

Presuming that the vulcanizing plant and sheds, &c., cost as much as Rs. 1,20,000 and estimating that it was worked in conjunction with a saw-mill (from which it would be supplied with fuel), then the working would probably cost—

Depreciation and amortisation fund at 10 per cent. on		Rs.
Rs. 1,20,000	per annum	12,000
Establishment.		Rs.
1 Engineer at	350 per mensem.	
1 Machineman at	100 "	
1 stoker at	30 "	
1 Boiler-cleaner at	30 "	
4 Coolies at Rs. 12-8-0	50 "	
Cotton waste and oil, say	40 "	
	600	
Occasional repairs, &c.	= " "	800
Total		Rs. 20,000

That is to say, for about Rs. 20,000 a year any number of narrow gauge sleepers up to some 350,000 could be operated upon. Even if only less than the half of that number, or, say, 160,000 were vulcanized, this would only cost *two annas a sleeper*. Speaking from my own personal experience when in charge of the Laikgyi saw-mill, from which many lakhs of pyinkado sleepers were exported *via* Rangoon to Madras and Calcutta in the years 1882 to 1886, two annas per sleeper would have been a low rate to have paid for any toughening process which given in discharging from railway trucks and in loading and unloading the steamers. On this account, from the manufacturer's point of view alone, the introduction of vulcanizing treatment into sleeper-mills working on a large scale would pay, if experiments with Indian timbers show that Haskinized wood is tougher and less liable to split or crack; to say nothing of the great benefit to be derived by the purchaser in obtaining wood possessing greater durability than is possessed by the timber as now utilized by him.

Royalty.—I understand from Colonel Haskin that the Company would be prepared to sanction the use of vulcanizing machinery in India under very moderate conditions as to royalty under patent rights. This item has not been included under the estimate of working expenses given above, but this is more than counterbalanced by the low outturn estimated (160,000 out of a possibility of sum 350,000 sleepers).

ENCLOSURE No. 2.

REPORT ON SENILISATION OF WOOD.

BY E. E. ROBSON, F.R.I.B.A., F.S.A., F.S.I.

In accordance with instructions, I have visited the works of the *Société Anonyme pour la Senilisation rapide des bois et matières fibreuses*, and have there witnessed a series of experiments and demonstrations of the process *Nodon-Bretonneau*. It is, in reality, a method of seasoning wood by the aid of electricity. The first of its kind.

Having been familiar for half a century with the enormous difficulties which have always beset the thorough, final, and innocuous seasoning of timber, so as to render shrinkage and warping impossible, by a method not itself introducing the seeds of decay; having myself believed time to be the natural and only true medium, and having observed the failure of all the various attempts hitherto made on other lines, I may frankly premise that I approached this investigation in the full expectation of not being able, at most, to do more than admit the process to be a step in advance. Hitherto, all processes have failed to penetrate fully to the middle of the timber, or have succeeded only at the expense of impaired quality, or of converting the wood into something else—say lignite. One and all were too unnatural, too unscientific, too incomplete, and too expensive for general use.

The genesis of this new process appears to have been that during the year 1896, Mr. Albert Bretonneau, manufacturer of pipes and wind instruments, sought to effect improvements in clarinet pipes, and to that end caused experiments to be made with the aid of M. Albert Nodon, Engineer, formerly of the Observatory of Physical Astronomy of Paris, and now attached to the Laboratory of Physical Research at the Sorbonne. The first result was the production of the "Bretonneau pipes," whose superiority is admitted.

This success caused M. Nodon to suggest the application of the same principle to all woods and wood fibres. Finding a laboratory insufficient, a workshop was taken at Puteaux, 47, Quai National, where experiments were carried on with marked success. Finally, M. Nodon succeeded in effecting the removal of sap from large timbers, and their permeation with an aseptic solution, by the aid of two processes of electricity. The invention was then protected by patents. (See "Notice industrielle, etc." "Les Brevets.")

A company was accordingly, on April 29th, 1898, brought out in Paris, with a capital of 1,200,000 francs, in shares of 100 francs. These, so far as issued, are now quoted at 425 francs. Admirably-planned shops are in course of erection, which, with the necessary machinery, capable of working at 100 volts, will cost about £8,000, with a capacity of treating 2,700 cubic feet per day. The charge for treatment is to be 5*d.* per foot, while the cost price is only about 2*d.* Taking a full day's work at 3*d.*, this would give a profit of £33-15*s.* per day. It may be noted that the price will, naturally, be varied according to the bulk and character of the wood treated.

The application of the process is very wide and far-reaching, including railway sleepers, street paving, school desks and fittings, block floors, parquetry, all kinds of carpentry and joinery, cabinet making, wheels, oaks, shipbuilding and fitting, works of art, organs, pianos, violins and other stringed instruments, pipes and wind instruments, and, in short, every purpose to which wood of any kind, size or quality is, or can be, applied. The results claimed are—

- (1) Saving of time. One month's interest on capital, instead of years. In the case of hard woods, such as oak and yew, many years.
- (2) Power of utilizing cheap or damaged woods, hitherto almost useless, and of applying them to new purposes.
- (3) Facility of dyeing woods to prescribed colours throughout their entire thickness, and rendering painting unnecessary.
- (4) Gain in treating green woods without loss of time. The greener the wood, the quicker the action of the process.
- (5) Complete freedom from shrinkage, twisting and warping.
- (6) Immunity from damage by the insect or the animalcule.
- (7) Great reduction in inflammability.
- (8) Increased strength and better surface.
- (9) Resistance to damp or moisture.
- (10) Extraordinary increase in the resonance and fine tone of music instruments.
- (11) Economy of application.
- (12) Enormous diminution in the destruction of forests so far as arising from premature rot in the quantity actually sold.

(13) Practicability of rendering wood fireproof, if required, at a very small additional cost, by one further process. (See "Notice Industrielle, etc." "Les Procédés.")

The experiments witnessed by me were made in the temporary shops, with a portable engine of seven-horse power and a small dynamo.

Process No. 1. A piece of ordinary Norway red pine was put into a quadrangular shallow tank of soapy water, immersed to rather more than half its depth, and the electric current was applied through a metallic conductor so arranged as to distribute it throughout the area. In

the space of four minutes the sap commenced to exude visibly at the lower part of the end of the wood, forming a line of viscid froth. In the space of six hours the sap was seen, by the ceasing of exudation, to be entirely extracted. The wood was then taken out.

Process No. 2. (Capillary.) The second process took place immediately after the first, and while the wood was wet. The septic solution was forced from below into the pores denuded of sap by an electro-capillary method. Duration three hours.

After the two electrical processes have been completed, the wood undergoes two drying processes: (1) By being placed for two or three, or more, weeks in covered sheds, provided with a constant through current of fresh air. If of large, scantling, or obstinate nature, a longer period is allowed. (2) By being placed for three or more days in the hot, dry rooms. The processes are then all complete, after lasting about a month.

ILLUSTRATIONS.

(No. 1) I was shown a piece of ash 3' 4" x 1' 2" x 4 1/2" which had been fully treated six weeks previously. In appearance, it presented only the ordinary characteristics of the wood, without any change. Although actually heavier and harder, it presented no appreciable difference in facility of being worked by chisel, plane, saw, or other tool.

(No. 2) In the case of a piece of oak, also fully treated, it was pointed out that the discoloured outside portions, such as are commonly called "sappy," and hitherto invariably rejected as liable to speedy rot, were here sound and capable of use, although their discolouration remained. This feature applies to all the kinds of wood treated.

[*Note.*—During these experiments, M. Locher, Engineer in charge of the streets of Paris, was present. He expressed himself perfectly satisfied as to its suitability for use in the wood pavement of the streets of Paris.]

(No. 3) I paid a visit to M. Schneider, Furniture manufacturer, 2, Rue de la Roquette, who explained the differences he had found, for furniture uses, between woods seasoned in the ordinary manner and those treated by the new.

(No. 4) Table-tops had ordinarily required five consecutive layers or thicknesses of wood to secure a surface not liable to shrink or warp. As a contrast, he exhibited one made two years ago, in which the wood had undergone the process, and which was absolutely true and satisfactory, although made in only one thickness.

(No. 5) He then produced an ordinary framed house door, in which all the usually rejected "sappy" edges had been retained, because he had confidence in their durability and fitness.

(No. 6) Also, he showed a piece of oak plank from Lorraine 1 1/4" thick, which, although green in March last, had been rendered, after a treatment of two months, perfectly dry and fit for use.

(No. 7) M. Amédée Thibout, head of the celebrated firm of Henry Herz, Pianoforte Makers, 28, Rue Victor Masse, explained the great advantages which his pianos had derived from the use of the process. Among others, that soft woods, when "senilised" are proved to be better than hard woods seasoned by ordinary methods. Without going into the history of the gradual development of the piano as now we know it, or its complicated mechanism, he laid great stress on the *table d'harmonie*, or sound board, as being the vital part of the actual construction and the life and soul of the higher quality of a piano. The bridge pressure on the strings being 15,000 kilos, or about 15 tons, the *table d'harmonie* was always liable to give way.

(No. 8) He exhibited one sound board which had been made from green wood, treated for only nineteen hours, and which was found to be so dry, hard and strong, that it could be used at once. In spite of the large size, the thickness was only a quarter of an inch.

(No. 9) It was afterwards noticed, with surprise, that the use of "senilised" wood had immensely improved the quality and tone of the instruments. The softer sounds had become sweeter, the louder more resonant, the whole more penetrating.

(No. 10) In approaching the consideration of the subject in relation to violins, we tread on delicate ground. Pine, as we know, is used for the belly of the instrument, maple for the other parts. The former should come from the Valtellina, the Simmerthal, the Lac de Joux Valley, Les Brasses, the southern slopes of the Jura, Bernois, &c., while the latter should be from the southern slopes of the Carpathians or the Tyrol. Also, that all these require five or six years' seasoning at the least.

(No. 11) Finally, in spite of the innumerable processes for depriving wood of water, acid, resins, &c., which have been tried at different times, and with varying degrees of apparent success, we find, on a high and reliable authority, that "all artificial preparations, baking and tanning," only ultimately spoil the violin.

It is thus clear that the new process must create a veritable revolution in violin-making, and much sensation among the makers and players, now that electricity is brought to bear. The tests of the process as applied to so delicate and subtle an instrument as the violin are of the most

complete character, and appear to sweep away all preceding methods. No more complete demonstration as to the value of the invention, in its larger uses and more commercial sense, could, in my opinion, be made than from this apparently small one.

(No. 12) M. Audinot Leuthier, of Paris, has a celebrity known to every connoisseur of violins, and was good enough to give me, in much detail, the result of his experience.

(No. 13) Pointing to a piece of wood $2'8" \times 1'6" \times 2"$ average thickness of Hungarian Yew, he complained that, although ten years had passed since its cutting down in bulk, it was so warped and superficially corrugated during the last twelve months, that half of it was wasted, and it had cost £4. He had no personal interest in this new treatment, but it was imperative for him to have the most suitable wood for his purpose.

(No. 14) He compared specimens of wood so treated, with other wood known to be 100 years old, and declared the former to be better after a seasoning of only one month.

(No. 15) He found it to be, also, closer in texture, finer in quality, harder, more sonorous, not so liable to take stains, and, lastly, better for receiving the varnish—so important a point in violins.

(No. 16) He had the same evidence in comparing old and new Austrian pine.

(No. 17) In point of cost he considered it far more economical than any preceding process for violins.

(No. 18) Being extensively employed to restore and repair old violins, he said he could not now do without the "senilised" wood, and exhibited the upper part of an old violin in actual process of repair, which was in so bad a state that without "senilised" wood, repair would have been impossible.

(No. 19) In one violin, the wood, 100 years' old, showed objectionable roughness round any holes or borings, while those in the new wood, "senilised," were quite true and smooth.

(No. 20) In the new instruments which he had made from wood treated by the process he had succeeded surprisingly better than before, and now anticipated the production of violins of much higher tone and quality.

This practical testimony is proverbially worth a ton of theory. The acoustics and making of violins need not here be gone into. The first important point is the kind, quality and dryness of the wood used.

Other experts in wood may be expected to approach the consideration of this remarkable invention with an incredulity equal to my own.

Observation of the same experiments, and a careful consideration of the same evidence, cannot fail to be equally convincing.

Any fear that the effects may not be lasting are rather based on past sad experiences of other methods than upon any justification derived from the process or the probabilities to be deduced therefrom.

Durability is, for absolute proof, essentially a question of the future, and is inherently incapable of mathematical certainty in advance. Yet, here is, for the first time, a method of seasoning timber which is in harmony, instead of being in conflict, with nature; utilising, as it does, in a scientific manner that electricity of which we have yet so much to learn, and is eminently calculated to preserve and maintain the properties of wood, to enhance its quality and to prolong its durability.

I came to the final conclusion that the process is eminently successful, satisfactory and practical. That it can be applied with commercial advantage and profit to numerous purposes which require timber in bulk, while its use in small quantity for musical instruments requiring certainty of dryness and quality must be very profitable, and that it has scientifically solved a problem which has hitherto baffled mankind.

At a later stage it would be necessary to test large pieces of timber, one half treated, the other not, so as to determine accurately the increase of strength and of capacity for resisting strains.

October 18th, 1898.

P.S.—Since this report was in type I am informed that an enormous improvement has taken place, by which the two electrical processes are taken together and occupy five hours only.

From—The Secretary to the Government of India, Public Works Department.
To—The Secretary to the Government of Madras, P.W. Dept., Railway Branch.
Dated—Calcutta, 10th November 1899, No. 2098-R.S.

The undermentioned papers are forwarded to the Consulting Engineer for Railways, Madras, for favour of remarks, in continuation of this office No. 2096-R.S., dated 10th November 1899.

ENCLOSURE No. 1.

From—The Inspector-General of Forests to the Government of India.
To—The Secretary to the Government of India, Public Works Department.
Dated—25th September 1899, No. 1729.

I have the honour to forward, for information, a statement (see page Appendix) prepared in this office showing, as regards the Punjab and the North-Western Provinces (School Circle), the probable quantity of railway sleepers of inferior wood that could be made available annually by the Forest Department and the localities considered suitable for the establishment of factories for the impregnation of such timber.

2. In view to the quantities and species of wood available, I beg to enquire whether it would be worth while for the State Railways or for any of the Railway Companies in India to set up a central factory in the North-Western Provinces or in the Punjab for the purpose of impregnating sleepers or of treating them by the Haskin process.

3. I may point out that the prices at which sleepers could be delivered at impregnation factories, as quoted in the statement, or for delivery only and do not include royalty payable on the wood.

Note by the Consulting Engineer for Railways, Madras, dated 1st December 1899.

A reference to the Proceedings of Government above quoted, viz., Nos. 373 Ry. and 841 Ry., dated the 5th March and 21st June 1898, respectively, will show that this discussion was started by my Note, dated 21st February 1898, in which I drew attention to an article on the Haskin's process for preserving timber in *The Engineer* of January 28th, 1898. In that Note I argued that a saving of one rupee per sleeper would represent a saving of some Rs. 30,00,000 per annum on our Indian Railways, and I suggested that the Forest Department should enquire into the merits and possibilities of the process with a view to the utilisation of great areas of forest containing trees which at present we are unable to utilize for sleeper purposes. In his Note, dated 14th April 1898, the Inspector-General of Forests, while paying a tribute to the excellencies of the process, expressed a doubt whether it could possibly have the effect of saving one rupee per sleeper. In my reply, dated 17th May 1898, I tried to show how the anticipated saving might be confidently looked for, and it seems to me that my optimistic view is fully justified by the statement now received, under cover of the Government of India's No. 2098-R.S., which shows the extraordinarily low prices at which, by Haskinizing the commoner sorts of pine of the Himalayas and its lower ranges, sleepers may be obtained, to take the place of the expensive deodar which at present is almost the only pine timber which it is permissible to use for sleepers.

I am strongly of opinion that by obtaining a set of Haskin's plant and working it judiciously amongst the forests of the cheaper sorts of timber which are now entirely unavailable for the supply of railway sleepers, the Forest Department can fend off indefinitely the invasion of this country by Australian sleepers of doubtful *genus*, origin, and quality, which are just now being pressed on the attention of railway Engineers at what in the absence of any knowledge of their lasting qualities look like extremely low prices.

I suppose that the enterprise of setting up a lakh worth or two of machinery is looked on as a doubtful ~~investment~~ venture. But it is not to be compared for venturousness with the investment of money in almost any railway that might be named. I certainly think that the Madras Forest Department will be well advised to make the venture, and judging from a perusal of the above papers I should not be surprised to hear of the Punjab Forest Department making it.

MADRAS,
1st December 1899.

FRANCIS J. E. SPRING,
Consulting Engineer for Railways.

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RAILWAY.

Government (1899) of Madras.
PUBLIC WORKS.

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Enclosures

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G.O., No. 53 Ry., 11th January 1899.

JANUARY.

Supply of Sleepers

Ordered that the correspondence regarding the -- to railways in the Presidency by the Forest Department, be forwarded to the officers concerned for information.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Railway.

Read the following papers :—

Proceedings of the Board of Revenue (Land Revenue), Forest No. 427, dated 6th October 1898.

Read the following papers :—

From—The Conservator of Forests, Southern Circle.
Dated—5th September 1898, No. 798.

ABSTRACT.—Submitting remarks on Board's Proceedings, Forest No. 301, dated 21st July 1898, regarding the supply of sleepers for the Calicut-Cannanore Railway.

G.O., No. 1141 Ry., dated 16th September 1898.

ABSTRACT.—Informing the Board of Revenue of the number of sleepers which are likely to be required annually for renewals on the standard and metre-gauge railways in the Madras Presidency, and requesting it to report what steps it proposes to take for supplying them.

Resolution—Forest No. 427, dated 6th October 1898.

In the Government Order read above, the Board is directed to report as early as possible, for the information of Government, what steps it is proposed to take in the matter of the direct supply of sleepers to railways in this Presidency.

2. Certain proposals were submitted in Board's Proceedings, No. 301, dated 21st July 1898, but the figures given in the Government Order now read show that there has been a misunderstanding as regards the size of the sleepers required for the Calicut-Cannanore Railway.

3. The letter from the Agent, Madras Railway, forwarded with G.O., No. 544 Ry., dated 7th April 1898, gave quotations for two sizes of sleepers, and the Board assumed that the smaller of these, viz., a sleeper of $3\frac{1}{2}$ cubic feet, was that which is required for the Calicut-Cannanore Railway and based its proposals accordingly, but from the enclosure to G.O., No. 1141 Ry., dated 16th September 1898, it would appear that the size required is either that used by the South Indian Railway, viz., $6' 6'' \times 9'' \times 4\frac{1}{2}''$ or that proposed for the Shoranur-Cochin Railway, viz., $6' \times 8'' \times 4\frac{1}{2}''$. The Board will require to have definite information on the point before commencing work.

4. It is observed that the Madras and South Indian Railways pay different prices per sleeper according to the wood of which it is made, and if necessary differential prices can be quoted, after further enquiry, with reference to the wood used and the locality from which it is supplied, but the Board would prefer an all-round rate of Rs. 3-4-0 for a sleeper $6' 6'' \times 9'' \times 4\frac{1}{2}''$ which, it is observed, is the rate that has been paid by the South Indian Railway for Irul sleepers. The price per sleeper $6' \times 8'' \times 4\frac{1}{2}''$ would be Rs. 2-12-0. Delivery would be made at Podanur from Coimbatore, at Kallai from South Malabar, at Calicut and Tellicherry from North Malabar, while those from South Canara would be delivered at any port in Malabar which might be found convenient for the Railway Company.

5. In its Proceedings of the 21st July 1898, No. 301, paragraph 7, the Board offered to supply all the sleepers required for the Calicut-Cannanore Railway if all the timbers mentioned by it were accepted and the road to the Pollachi Upper Anamalai forest were pushed on with. The present Acting Conservator of Forests, Mr. Gass, in consultation with whom the present Proceedings are written and who is also permanent District Forest-officer, Coimbatore, considers that we do not yet know enough of the Pollachi Upper Anamalai forests to justify us in offering to make any supply from there owing to the long carriage, and the difficulty of converting the prevailing timber, viz., *Mesua ferrea* or *speciosa*; he also considers that the capabilities of the Lower Anamalai forests have been overestimated. The smaller size of the sleeper required, however, makes it unnecessary for the Board to withdraw its proposal to supply 136,000 sleepers within three years using only the woods which it now appears are already approved by the Madras and South Indian Railways, viz., Karimmaradu (*Terminalia tomentosa*), Irul (*Xylia dolabriformis*) and Irumbogam (*Hopea parviflora*). Further information from North Malabar even enables it to raise its offer to 200,000 within three years, and if the smaller sleeper be used the number would be 250,000. This does not include the demand for the Tinnevely-Quilon Railway. This railway was not mentioned in the former orders of Government, and consequently full enquiries have not yet been made as to the capabilities of the Tinnevely forests. A further communication will be submitted on the point, as well as with regard to experiments which are now being made with other kinds of wood in communication with the officers of the Madras Railway Company.

6. It is also proposed to thoroughly investigate the capabilities of the Pollachi Upper Anamalai forests. A saw-mill and wire ropeway have just been successfully installed in the Lower Anamalais in which a tramway has been in work for years, and if similar arrangements on a larger scale can be made for the exploitation of the more extensive and more fully stocked forests of the Upper Anamalais, the Board sees no reason to doubt that it will be in a position largely to increase its contribution towards meeting the very large demand for sleepers which has arisen in connection with the extension of railway construction in the Presidency.

7. The most important timber in the Upper Anamalai forests being *Mesua ferrea*, the Board would be glad to be informed at the earliest possible date whether sleepers of that wood would be accepted. It does not appear that any of them has been used by the Madras or South Indian Railways, but Gamble, at page 27 of his Manual of Indian Timbers, states that it has been found to answer for sleepers equally well with Pynkadu.

G.O., No. 772, Revenue, dated 13th December 1898.

Read the following papers :—

Proceedings of the Board of Revenue (Land Revenue), Forest, No. 301, dated 21st July 1898.

ABSTRACT.—Submitting to Government, with Board's remarks, Mr. Brasier's proposals regarding the supply of railway sleepers for the Calicut-Cannanore Railway.

Proceedings of the Board of Revenue (Land Revenue), Forest No. 427, dated 6th October 1898, regarding the supply of sleepers to railways.

G.O., No. 1311 Ry., dated 21st October 1898.

Order—No. 772, Revenue, dated 13th December 1898.

Recorded. The Board of Revenue should do all they can to develop the market for railway sleepers.

2. The question of the alignment of the Anamalai ghât road is under the consideration of the Government.

EXTRACT FROM MR. GAMBLE'S BOOK ON INDIAN TREES.

MESUA FERREA.

Vernacular names: *Nagesar*, Bengali; *Nahor*, Assamese; *Nangal*, Tamil; *Naga-Kesava*, Telugu.

A large evergreen tree. Heartwood dark red, extremely hard. Pores moderate-sized, often in groups, scanty, often filled with yellow resin. Medullary rays extremely fine, uniform, equidistant, very numerous. Numerous fine, many, concentric lines of light-coloured tissue.

Eastern Bengal from the Monas eastward (though traces of its having formerly been found west of that river occur sometimes in the names of places, e.g., Nageshwarbari, or Naksarbari, a town in the Sikkim Terai on the Nepal frontier), Assam, South India, Ceylon, Burma and the Andamans, often cultivated.

The weight and transverse strength have been determined by the following experiments:—

A. Mendis	Ceylon No. 59, with bars 2' x 1" x 1" ...	weight, 72	lbs. P = 994
Brandis	Burma No. 18, 1862 ...	" 69	"
Bennett	Andamans No. 4, 1872 ...	" 70	" P = 1,053
	Assam (4 specimens) 1878 ...	" 67.5	"
Smythies	Kanara (1 specimen) ...	" 62	"
	Burma (6 specimens) ...	" 70	"

Several of our specimens, however, reached 74 to 76 lbs. per cubic foot in weight. It is very durable. It has been found to answer for sleepers equally well with Pynkadu, but the cost of cutting the hard wood, its weight, and the freight from the Tenasserim forests to Calcutta prevent its being much used, as the total cost is scarcely covered by the price (Rs. 5) per broad-gauge sleeper. It is used for building, for bridges, gunstocks and tool handles; but its more general use is prevented by its great hardness, weight and the difficulty of working it. In Ceylon an oil is obtained from the nut, and the tree is often planted for the sake of its handsome flowers.

Note by the Consulting Engineer for Railways, Madras.

In Assam *Nahor* (*Mesua ferrea*) is known to be an excellent sleeper timber.

Read the following papers:—

G.O., No. 1141 Ry., dated 16th September 1898.

Proceedings of the Board of Revenue (Land Revenue), Forest No. 427, dated 6th October 1898.

Order—No. 1311 Ry., dated 21st October 1898.

A copy of the Board's Resolution, together with a copy of the description of *Mesua ferrea* given in page 27 of Mr. Gamble's book, will be forwarded to the Madras, South Indian, and East Coast Railways, with an enquiry whether they will be prepared to accept sleepers of the timber for extensions and renewals, and with a request that they will specify the size of sleepers, standard or metre gauge, which they would be prepared to take. It is noted that in the Government of India standard dimensions the following sizes are recommended, viz., for broad gauge 9' 6" x 9" x 5", with, as a minimum, 8' 11" x 8" x 5", and for metre gauge 6' 0" x 7" x 4½" with, as a minimum, 5' 9" x 6" x 4".

From—The Agent, South Indian Railway.
To—The Consulting Engineer for Railways, Madras.
Dated—Trichinopoly, 17th November 1898, No. 1037.

I have the honour to forward a copy of letter No. C. 3204 A./2362, dated 15th November 1898, from the Chief Engineer and shall be obliged by your letting me know whether Government will be able to provide either in part or in full the number of 225,000 wooden sleepers required for the Madura-Pamban Railway.

2. I strongly support the recommendation that the rails for the line between Madura and Pamban should be of the type advocated by the Chief Engineer and should weigh 56 lbs. to the yard. The line will have to be suitable for a fast passenger service as it will form a link in the express route to Ceylon. The extra weight of rail will, I feel sure, be amply justified by lighter maintenance, longer life, and smoother running.

ENCLOSURE.

From—The Chief Engineer, South Indian Railway.
To—The Agent, South Indian Railway.
Dated—15th November 1898, No. C. 3204 A./2362.

One of the first actions I shall have to take, on the sanction of the Madura-Pamban Railway being received, will be the arrangement for providing the permanent-way material. The Madura-Pamban line will run through a district practically void of building material except at the termini, and it will be necessary to lay down a service line of railway as early as possible.

The estimate prepared by Mr. Shadbolt provides for 50 lb. rails on cast iron pot sleepers, but this class of road is quite unsuitable for a temporary purpose. I recommend strongly that the 56 lb. flat bottom rail we have in use with our 50 lb. bull-headed rail be adopted for this line and that it be laid on wooden sleepers; taking the length of line to be adopted as the same with the Sivaganga branch as the alignment of Mr. Shadbolt, we shall require 225,000 sleepers. It will be hopeless to expect to be able to get this quantity of sleepers locally, and I shall be obliged by your referring the matter to the Consulting Engineer requesting him to obtain information as to what the Government Forest Department can do.

The hitch in the supply of sleepers to the Bezvada-Madras Railway points to the necessity of an early arrangement. The size of the sleepers required is 6' 6" x 9" x 4½".

From—The Consulting Engineer for Railways, Madras.
To—The Secretary, Board of Revenue (Land Revenue—Forests).
Dated—Madras, 19th November 1898, No. 3158.

With reference to Board of Revenue Proceedings, Forest No. 427, dated 6th October 1898, and to Railway Department's Order thereon, No. 1141 Ry., dated 16th September 1898, a copy of which will doubtless have reached the Board through the Revenue Department, I have the honour to inform you that the Agent, South Indian Railway Company, has enquired whether the Forest Department will be able to provide, in part or in full, the 225,000 sleepers required for the Madura-Pamban Railway.

It is expected that funds for that railway will be available in April 1899, and the first thing to be done will be to lay a surface line down from both ends as speedily as possible so that the provision of sleepers is an urgent matter. If not available in the Presidency, the price of them must go elsewhere, as the construction of the through surface line must be pushed forward.

From—The Agent, South Indian Railway.
To—The Consulting Engineer for Railways, Madras.
Dated—Trichinopoly, 28th November 1898, No. 1072.

With reference to G.O., No. 1311 Ry., dated 21st October 1898, I have the honour to forward copies of the correspondence which has passed between the Chief Engineer and the Acting Conservator of Forests, Southern Circle. The size of sleeper we should require is 6' 6" x 9" x 4½".

ENCLOSURE No. 1.

From—The Chief Engineer, South Indian Railway.
To—The Agent, South Indian Railway.
Dated—23rd November 1898, No. S/5226-C/2419.

In reply to the query put in G.O., No. 1311 Ry., dated 21st October 1898, I beg to state that I am not prepared to accept *Mesua Ferrea* for sleepers without some further information as regards its suitability and with a view to obtaining the information I addressed the Forest Officer, Coimbatore (copy of this office letter and his reply thereto are herewith enclosed for your information) and judging from the time which Mr. Gass says it will take to furnish me with samples of the timber referred to I do not anticipate being able to depend upon the Forest Department, for the supply of sleepers that we shall require annually either for maintenance or construction for some years to come.

ENCLOSURE No. 2.

From—The Chief Engineer, South Indian Railway.
To—The Conservator of Forests, Southern Circle.
Dated—3rd November 1898, No. S. 8403.

With reference to Board of Revenue Proceedings, Forest No. 427 of 6th October 1898, copy of which has been forwarded to this office for information.

I shall be glad to know whether you can forward sample sleepers 6' 6" x 9" x 4½" of the 4 description of timbers mentioned therein, viz.:

- | | | | |
|--------------------------|--------------|----------|---------------|
| 1. <i>Mesua ferrea</i> . | 2. Karimara. | 3. Irul. | 4. Irumbogam. |
|--------------------------|--------------|----------|---------------|

ENCLOSURE No. 3.

From—The Conservator of Forests, Southern Circle.
To—The Chief Engineer, South Indian Railway.
Dated—Coimbatore, 15th November 1898, No. 1459.

In reply to your letter No. S. 8403, dated 3rd November 1898, I have the honour to inform you that I am issuing the necessary instructions to prepare 10 sleepers of each of the 4 kinds of timber named by you and I am adding two other kinds—*Apogeissus latifolia* (Vekkali), and *Viter Altissima* (Maila) both of which I hope may prove to be suitable timbers.

2. It will take some little time to get these sleepers ready and I shall address you again on the subject and state the station at which they will be delivered.

From—The Consulting Engineer for Railways, Madras.
To—The Agent, South Indian Railway.
Dated—Madras, 3rd December 1898, No. 3320.

I have the honour to acknowledge the receipt of your letter No. 1072, dated the 28th November 1898 and with reference to its enclosures to offer the following remarks, for the information of your Chief Engineer.

2. The Madras Forest Department have not heretofore laid themselves out for doing a sleeper business. Government has not chosen that they should do so; they have been otherwise employed.

3. Lately however Government has been enquiring about the advantages of so organizing and equipping the Forest Department as to enable them to go in for the business of sleeper supply to railways. This explains to you the object of recent enquiries as to number of sleepers required for renewals, species of wood available, &c.

4. When this is explained to your Chief Engineer he will doubtless be able to realize that it is quite untair to gauge the ability of the Forest Department to supply large number of sleepers, once it is properly organized for the new business, by its capacity in its present state to turn out a few score specimens for trial. The supplying of a few score specimens now by the department, employed as it is at present in surveying and conserving the forests, is probably a far less easy business than will be the supply of some thousands per month later on, if Government should see fit to properly start it on the sleeper supply business.

5. About *Mesua Ferrea*, if your Chief Engineer wants more information than I have already given him he can doubtless get it by addressing the Forest officer, Shillong, Assam. In that province the tree is very highly valued for the thirty or forty main posts forming the supports of planters' bungalows, travellers' bungalows, &c., which are always embedded four or five feet in the ground, frequently in damp ground. Then it is usually considered to have a life, in such a situation, of 20 to 25 years.

Endt. by the Consulting Engineer for Railways, dated 3rd December 1898, No. 3320/A.

Copy forwarded to the Agent and Manager, Madras Railway for favour of communication to his Chief Engineer.

From—The Agent and Manager, Madras Railway.
To—The Consulting Engineer for Railways, Madras.
Dated—Madras, 12th December 1898, No. 10661/1194.

With reference to G.O., No. 1311 Ry., dated 21st October 1898, I have the honour to enclose for your information copy of a letter from the Company's Chief Engineer No. E. 485/1642, dated 9th instant and shall be glad if it can be arranged for this Company to be supplied with the sample sleepers referred to in paragraph 5.

ENCLOSURE.

From—The Chief Engineer, Madras Railway.
To—The Agent and Manager, Madras Railway.
Dated—Madras, 9th December 1898, No. E. 485/1642.

In reply to your endorsement No. 10661 of 22nd October 1898, on G.O., No. 1141 Ry., dated 16th September 1898, in which the Consulting Engineer asks whether this company will be prepared to accept sleepers of *Mesua Ferrea* timber for renewals and for use on the Calicut-Ballapatam extension, and to specify the size of sleepers required for standard or metre-gauge lines. I desire to point out that it is essential that sleepers to be of any practical value must be cut from timber which has been seasoned for at least a year. If therefore sleepers of this timber, when seasoned, can be supplied at more favourable rates than those now obtaining on the West Coast, they might be adopted by this Company for renewals, and on the Calicut-Ballapatam extension.

2. It should be clearly understood that sleepers supplied by the Forest Department be subject to the conditions of ordinary contracts, and should be in accordance with our specification, and be passed by officers of this department, subject to rejection if considered unfit for use, and not up to specification, and that the officers of this department should be sole judges in this respect.

3. I shall be much obliged if the Forest Department will be good enough to send to this office a sample sleeper 10' x 10" x 5" of *Mesua Ferrea*, Karimara (*Terminalia tomentosa*) and Irul (*Juga Hylocarpa*) and desire to know if they could also deliver at Podanur 10 bridge sleepers 12' x 12" x 7", 10 crossing sleepers 16' x 12" x 6", and 30 point sleepers 10' x 10" x 5" of *Mesua Ferrea* for insertion in the line on trial.

4. You can understand that this department cannot pledge itself to take a large supply of sleepers from the Forest Department without first seeing the quality they propose giving and testing this.

5. The following are the particulars as regards the probable quantity and actual dimensions of sleepers which will be required for the undernoted works:—

(1) Annual renewals on Madras Railway—

2,024 sleepers $10' \times 10' \times 5''$ for points.
576 do. $12' \times 12' \times 7''$ for bridges.
622 do. $16' \times 12' \times 6''$ for crossings.

(2) Metre-gauge extension from Calicut to Balliapattam—

134,100 sleepers $6' \times 7' \times 4\frac{1}{2}''$ for main line and sidings.
423 do. $7' \times 7' \times 4\frac{1}{2}''$
302 do. $8' \times 7' \times 4\frac{1}{2}''$
302 do. $9' \times 7' \times 4\frac{1}{2}''$ for points and crossings.
362 do. $10' \times 7' \times 4\frac{1}{2}''$
121 do. $12' \times 9' \times 6''$
2,000 do. $10' \times 12' \times 8''$ for major bridges.
700 do. $6' \times 8' \times 6''$ for minor do.
250 do. $12' \times 7' \times 6''$ for level crossings.

(3) Metre-gauge conversion from Mettupalaiyam to Calicut—

3,613 sleepers $12' \times 12' \times 8''$.

6. If however the proposed conversion from Mettupalaiyam to Calicut from standard to metre gauge is not carried out and the standard gauge is adopted on Calicut-Balliapattam extension, the probable quantity and the actual dimensions of sleepers required will be as follows:—

(1) Annual renewals on Madras Railway—

2,024 sleepers $10' \times 10' \times 5''$ for points and crossings.
576 do. $12' \times 12' \times 7''$ for bridges.
622 do. $16' \times 12' \times 6''$ for crossings.

(2) Extension from Calicut to Balliapattam standard gauge.

2,132 sleepers $10' \times 10' \times 5''$ for points, crossings and bridges.
1,633 do. $10' \times 12' \times 7''$
250 do. $15\frac{1}{2}' \times 12' \times 7''$ for bridges.
647 do. $16' \times 12' \times 6''$ for crossings.

7. In connection with this subject, I may state that while in charge of the 3rd division, south-west line, and 2nd district I frequently tried to induce Forest officers to supply me with sleepers, without any result and may add that this department would be very pleased if they could obtain from the Forest Department all sleepers required of good quality, cut from sufficiently seasoned timber, sleepers cut from green timber are useless as they crack and warp badly.

EXTRACT FROM INDIAN ENGINEERING, DATED 1st OCTOBER 1898.

The new means for the preservation of timber.

Letter dated 9th September 1898 from the Manager, Haskin Wood Vulcanizing Co., Ltd., 2 Dean's Yard, London, S.W.

Our attention has been called to an article in your issue of 11th June, headed as above, referring at some length to our process. Without encroaching too much upon your space, we might remark, for the benefit of your readers, that our works at Millwall (London) have been in full working order for some time, and that we have treated large quantities of sleepers for various English Railway Companies to their entire satisfaction, and at the present time have several contracts for Haskinized sleepers on hand. A large consignment of Haskinized sleepers and crossings has also been shipped to South America.

Considerable quantities of Haskinized wood paving-blocks have been, and are being, laid in the principal streets of London, and various large provincial towns in all parts of the country, during the past month or two.

The process is much cheaper and far more effective than creosoting, as, besides preserving the timber from decay, it hardens, indurates and strengthens it, and renders the sapwood as serviceable as the heartwood.

Pieces of Haskinized wood that have been sent out to India and placed in white ants' nest have absolutely withstood the ravages of these little destructors, while similar pieces of untreated wood which accompanied them have been thoroughly honeycombed.

The process is also suitable for the preservation of timbers for bridge-work, piling timbers, decking, platforms, etc., and being inodorous may also be used to considerable advantage for indoor work.

We shall be most happy to give any of your correspondents, or readers, any further information they may desire.

3 sp

From—The Consulting Engineer for Railways, Madras.

To—The Manager, Haskin Wood Vulcanizing Co. (Ltd.), 2, Dean's Yard, London, S.W.
Dated—Madras, 18th October 1898, No. 2872.

I beg to enclose for the information of your Directors copies of Madras Government Proceedings, as marginally-noted.

Nos. 373, 374 Ry., dated 5th March 1898.

No. 715 Ry., dated 12th May 1898.

" 841 Ry., " 21st June "

" 1141 Ry., " 16th Sept. "

From a perusal of these papers you will see that the provision of sleepers of a class suitable for the climatic condition to which they are exposed on the southern Indian railways is a large and difficult problem; and yet there are unlimited quantities of various timbers which, so far as I can judge from what I have read of your process, would, if "Haskinized," be quite suitable. It is scarcely necessary for me to explain to you that to send timber to England to be treated in order to re-ship it to India would, commercially, be quite prohibitive. It suggests itself therefore that your Directors might perhaps see their way to entering into a correspondence having for its object the establishment of works at one or more central places within reach of the larger Southern Indian forests. Whether such works should be managed by the Government Forest Department, direct, under some arrangement for paying you a royalty, or by the Railway Companies, or by your own agency through the medium possibly of one or other of the large Madras firms of mercantile Engineers, would be a matter for consideration and settlement by correspondence. What the State Railways and the Companies' Railways require is a metre gauge sleeper $6' 6'' \times 9'' \times 4\frac{1}{2}''$ for less than three rupees, and a broad gauge sleeper $10' \times 10'' \times 5''$ for less than five rupees, which will live in the road for fourteen to eighteen years.

I shall be glad, in my official capacity, to enter into a correspondence with you on the subject, laying your views before the Railway Engineers and before the heads of the Forest Department.

From—The Secretary, Haskin Wood Vulcanizing Company, Limited.

To—The Consulting Engineer for Railways, Madras.

Dated—2, Dean's Yard, Westminster Abbey, S.W., 25th November 1898.

My Directors have now considered your letter and memoranda of the 17th ultimo, and instruct me to reply as follows.

They think a plant say half the size of that now working at Millwall would probably best meet your requirements, and they estimate the cost of such a plant, delivered f.o.b., Liverpool, will be about £12,000. Such an installation could be fixed at the centres you might consider desirable and each installation should enable you to treat, say, 450 standard size sleepers per day.

Our terms for assenting to your installation of such a plant in India would be the sum of £2,000 paid down so soon as our negotiations are completed, and a royalty of 3d. per sleeper of ordinary gauge and 2d. per sleeper of metre gauge and 1d. per cubic foot for any miscellaneous timber that might be treated in the vessels.

Should the Government wish to pay a capital sum down in the first instance in lieu of the proposed royalty this would be a matter for negotiation.

It would be stipulated that the apparatus would only be employed for the treatment of material supplied by the Forest Department for the use of the railways or other Government departments, and the company would also specially stipulate that all the machinery should be made and supplied by their sole licensees, Galloways, Limited, Manchester, who have constructed the whole of the machinery at the Millwall works to our entire satisfaction and which machinery can be seen at any time by any representative of the Government.

Enclosed is a short specification of plant half the size of that at Millwall.

40

No. 53 Ry., 11th January 1899.

ENCLOSURE.

Specification of Haskinizing plant proposed to be supplied.

This plant to consist of 2 treating chambers each about 114 feet long by 6' 6" diameter to be made of best quality of Siemen's Martin steel plates; the back ends of these vessels to be of a dish shape, and the front ends to be formed of a steel door mounted on substantial hinges with balance weights and arrangement for rapid automatic jointing, the whole being readily operated by one man. The vessels to be fitted inside with an arrangement of pipes for heating, and a set of rails for trolleys upon which the timber to be treated would be carried.

These vessels to be supported by an arrangement of rollers carried in substantial framing to allow of expansion and contraction taking place without putting any strain on the vessels.

100 trolleys as before mentioned, to be formed of wrought iron or steel framing, and each fitted with four wheels suitable for running upon the rails referred to.

1 Horizontal non-condensing air compressing engine with air cylinder having a bore of 18" and a stroke of 2' 6", and with steam cylinder of suitable dimensions; this engine to be complete in every way and of the most substantial design in every detail.

1 Horizontal non-condensing air circulating engine of the proper size and strength.

2 Patent Galloway boilers each 28 feet long by 7 feet diameter, made of best annealed steel plates with complete set of fittings, valves, &c.

The whole of the pipes and valves for actuating the vessels, machinery, &c., as above described including steam, feed, exhaust, and air circulating pipes with feed pump for feeding boilers, air receivers, heaters and coolers as required, all of the best material and workmanship throughout, delivered f.o.b. steamer in Manchester.

ORDER—No. 53 Ry., dated 11th January 1899.

The papers read above will be communicated to the Board of Revenue, to the Agents, Madras and South Indian Railways, to the Manager, East Coast Railway, and to the Agent and Manager, His Highness the Nizam's Guaranteed State Railway, for information.

In giving effect to the order of Government, No. 772, Revenue, dated 13th December 1898, the Board of Revenue should either correspond direct with the various Railway Administrations or should put the Forest Department in touch with them.

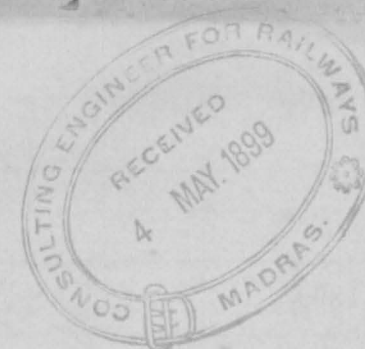
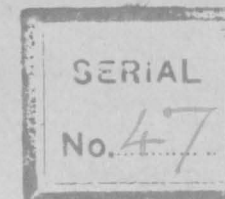
A copy of these Proceedings and of previous Proceedings on the same subject will be communicated by the Consulting Engineer to the Director of Railway Construction.

(True Extract.)

FRANCIS J. E. SPRING,
Joint Secretary.

To the Consulting Engineer for Railways.
" Agent and Manager, Madras Railway.
" His Highness the Nizam's Guaranteed State Railway.
" Agent, South Indian Railway.
" Manager, East Coast Railway.
" Revenue Department.
" Board of Revenue.
Editors' Table.

Ed. A. Rungasawmy Aiyangar.



No. 596 R.S.

FROM

THE DIRECTOR OF RAILWAY CONSTRUCTION.

To

The Consulting Engineer for Railways,
Madras.

Simla, the 26th April 1899.

Sir,

I have the honour to acknowledge the receipt of your

letter No. 257 dated 24th January 1899, forwarding for

SN 36
Nos. 373-74 Ry., dated 5th March 1898. : information a
No. 715 Ry., dated 12th May 1898. :
Nos. 841-42 Ry., dated 21st June 1898. : copy of each the
No. 1141 Ry., dated 16th September 1898. :
No. 772 Rev., dated 13th December 1898. : marginally noted
No. 53 Ry., dated 11th January 1899. :
Page 6 of SN 44
" 14
" 18
Page 15 of SN 44
" 34

proceedings of
the Government of Madras, regarding (I) the question of the
supply of wooden sleepers for the railways in Madras by
the Forest Department of the Presidency (II) the preserva-
tion of timber for railway sleepers purposes by the Haskin
process of preserving timber.

2. In reply, I would suggest the advisability of sending
home a few sample sleepers of the various kinds of wood
available for sleepers to be Haskinized after which they
may be subjected to trial in this country and the results
noted.

3. I shall be obliged by your furnishing me with 35
spare copies of each of the following proceedings:-

No. 1141 Ry., dated 16th September 1898.

No. 772 Rev., dated 13th December 1898

No. 53 Ry., dated 11th January 1899.

(if these are available) for purposes of circulation and

record

record in this Office.

I have the honour to be,

Sir,

Your most obedient servant.

Director.

Howe
28/4

Documents accompanying :-

Nil.

J.B.M.

Form No. 1
B.

Reminders.

Reply No. _____

dated _____

No. 24

SERIAL

No. 48

Prin
Coly. Madras, 11th May 1899.

From

THE CONSULTING ENGINEER FOR RAILWAYS,

MADRAS,

To

THE AGENT, S. I. D.

Director of Railway Construction. India.

SIR,

I beg to acknowledge receipt of your letter No. 596. R.S. dated the 26th April 99, and to say in reply that 35 sq. ft. of the Proceedings asked for shall be provided in some - fresh copies have been printed.

2.- I am advised by forest experts, including Mr. Ribbington, that to send ~~the~~ ^{to light} specimens of timber to be examined would not be likely to be successful, because the essence of the process is that the fresh sap of the ^{wood} ~~material~~ should still be fully impregnated through its fibres before treatment, because it is the sap itself which when chemically changed by heat forms the preservative, and it would largely evaporate or change its nature during a voyage to England.

3.- I am disposed to advise that a small grant be allotted to a locomotive officer ~~as suggested~~ ^{to take} ~~to take~~ ^{an} interest in the idea. He could perfectly well convert an old rejected boiler and arrange to heat the air to be pumped into it, the one end of the boiler being removable as in the plume disinfecting apparatus at railway stations. They also

Worthington pump could serve for an air pump, for the
pump of the engine.

As to the pump with the light on the pump
as there seems to be good technical evidence that the pump
is a good one, it might perhaps be worth the cost of having
while to ~~the~~ risk getting out a small set of the Haskin
apparatus.

I have &

F.W.S.

8/9/99

Despatched on 11/5/99

L. 129.

Enclosure

No.

4,000-5-99.

Madras Railway Company.

LOCOMOTIVE SUPERINTENDENT'S OFFICE.

Perambur Works, 11th October 1899.

Memorandum by the Loco. Super. Madras Ry of 11 Oct 1899

My dear Spring

8/9

Moss spoke to me yesterday at the meeting about
Haskinized wood and said that you had promised to send me any in-
formation with regard to it. Stoney has lent me a copy of Has-
kin's pamphlet but, although interesting, it gives no practical
information as to what the process is, and before I could give an
opinion as to the possibility or otherwise of making a plant for
Haskinizing wood locally I should want to know more about it. Can
you give me any further details as to what the process is or refer
me to any publication in which I can look it up?

2. I think I remember reading some year or two ago in
some Engineering paper a description of the process but, as it did
not interest me, I did not make any note of it.

3. I gather from the pamphlet that I have read that
the process is a patent one and, if so, I do not suppose we could,
in any case, put down plant here without permission of the patent-
ee.

P.J.E. Spring Esqre., C. I. E.,

Ootacamund.

P.A.P.

Let me have a copy of page
9-10 ref. of Serial 34.

F.W.S.

13/10

Sub. Submitted. Please see
Serial 1/4) page 2, 5/14, 5/26 page 8, 9, 10,
5/28.

Pat 47

7/11

13/10

Memorandum by the Comd. Engrs. for Phipps dated 14-10-88

Page 2 of 2 of enclosure of 11/10/99

No. 54

11/10/99

My dear Phipps,

Please read the above. Also the enclosed copy of G.O.No.373, dated 5th March 1898. Also enclosed copy of G.O.No.841 Ry., dated 21st June 1898. Also a copy of my letter No. 24/0, dated 11th May 1899 to the Director of Railway Construction.

My proposal is not that you should at once set up a Haskinizing plant on a commercial scale, but that you should ~~at once~~ set up a small experimental plant, just to prove whether the thing is likely to be successful chemically.

You could I presume rig up an air pump with a heating chamber full of tubes so that the air should be delivered at 400° temperature and 180 to 200 lbs. pressure into the sleeper receptacle. This latter might be an old boiler shell, with a removable end like those used by the plague people.

If the thing proved or seemed likely to prove, successful, we could probably get out a big plant hereafter, sufficient for each railway's own annual renewals. You see you will have 600 or 700 miles of wooden road in the future, and anything that knocks Re. 1/- per sleeper off the price, by rendering the cheap outlying timbers available, ought to pay well.

Details about royalty on the few sleepers turned out by the small experimental plant can doubtless be easily arranged with the patentees (if they have an Indian patent).

Yours sincerely,

(Signed) Francis J. E. Spring,

14/10/99.

Despatched on 16/10/99

L. 129.

4,000—5-99.

Madras Railway Company.

LOCOMOTIVE SUPERINTENDENT'S OFFICE.

Perambur Works, 28th October

SERIAL

No. 57

1899

Enclosure

131076

No.

Memorandum by the Loco. Supdt. Madras Ry No 131076
28th Oct 1899.

My dear Sir,

10 P

I have read with considerable interest the papers you were good enough to send me with regard to Haskinized wood. I have also read the article in the Engineer quoted in the papers.

2. I shall be very glad, indeed, to do anything possible to further what seems to promise to be a profitable undertaking, but I am afraid, before any experiments could be made, considerable expenditure would be necessary in plant.

3. Air at high pressure and temperature is difficult to deal with, and all joints &c would have to be most carefully and specially made; ordinary packing or joints material would not stand the high temperature and I fancy nothing but asbestos would do.

4. Our old boilers were originally built to carry a working pressure of 120 lbs. This they did as long as they were considered fit for it and when they were, it was thought, no longer safe to be allowed to work at this pressure, they were condemned. Therefore, even if the difficulties as to the ends, ^{and} the door could be got over, I should not care to run the risk of now working one of these condemned boilers at a pressure far in excess of that for which it was originally intended when new. I have not worked out the matter thoroughly, but roughly speaking a boiler to carry this pressure would probably have to be made of at least 9/16 or 5/8 plate and double rivetted all over, instead of, as are our boilers or rather were originally, 7/16 with single rivets.

5. Even assuming we had a barrel, there would still be a good deal of trouble in the ends as it would not be an easy

matter

(2.)

118

matter to make an absolutely air tight joint for the high pressure and temperature required, excepting by turning the whole thing up and making a proper workmanlike job of it,

6. To compress the air a pretty powerful engine would be necessary, and such engine would further have to be provided with an arrangement for circulating water round the cylinder in order to keep it cool. A stove of some sort would also be wanted to heat the air: but in this there would probably not be very much difficulty.

7. Personally, I scarcely see how it would be possible to rig up an experimental plant save, as I have said, at considerable expense. If, however, you would like me to go into it further, I will write to the Haskin people and try and get drawings or particulars from them and see what can be done.

8. I first thought of heating the air by passing it through steam, but the equivalent pressure of steam at 400° temperature is 255 lbs $\square$ which would need a still heavier boiler to carry it.

Yours sincerely
CR. Lush

F.J.E. Spring Esqre., C.I.E.,
Madras Club.

PAP.

Office of Consult

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Memorandum by U

of 30-10

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Under Secretary.

Documents referred to.

- (1) Note by Doctor J. Nisbet, Conservator of Forests, on the Haskin process of vulcanizing timber.
- (2) Report by Mr. E. R. Robson, F.R.I.B.A., F.S.A., F.S.I., on senilisation of wood.

2 copies each - see will follow

J.B.M.

ight mention what you diffcult
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 J.B.M.

Despatched on 30/10/98

All communications should be addressed to the Secretary.

No. 2096 R.S.
 GOVERNMENT OF INDIA.
 PUBLIC WORKS DEPARTMENT.
 RAILWAY STORES.



Calcutta, the 10th November 1899.

The under-mentioned papers are forwarded to the
 Consulting Engineer for Railway Madras, for information with
 reference to correspondence ending with his letter No. 1686
 dated 29th May 1899.

By Order,

C.J. Ch.
 Under Secretary.

Documents referred to.

- (1) Note by Doctor J. Nisbet, Conservator of Forests, on the Haskin process of vulcanizing timber.
- (2) Report by Mr. E. R. Robson, F.R.I.B.A., F.S.A., F.S.I., on senilisation of wood.

2 copies each - S.C. will for them

GOVERNMENT OF INDIA
PUBLIC WORKS DEPARTMENT

All communications
should be addressed
to the Secretary.

No. 2096 R.S.
GOVERNMENT OF INDIA.
PUBLIC WORKS DEPARTMENT.

~~RAILWAY STORES~~
RAILWAY STORES



Calcutta, the 10th November 1899.

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2 Currents
The under-mentioned papers are forwarded to the
Consulting Engineer for Railways, Madras, for favour of
remarks, in continuation of this office No. 2096 R.S., dated
10th November 1899.

By order,

C. J. G. G.
Under Secretary.

Documents referred to.

Copy of letter No. 1729 dated 25th September 1899, from
the Inspector General of Forests to the Government of India
with enclosure, on the question of the advisability or
otherwise of setting up a central factory in the North
Western Provinces of the Punjab for the purpose of
impregnating sleepers or of treating them by the Haskin
process.

K.P.G.

Prin 23 Sp

Copy of a letter No.1729 dated 25th September 1899, from the Inspector General of Forests to the Government of India, to the Secretary to the Government of India, Public Works Department.

-----cc@cc-----

I have the honour to forward, for information, a statement prepared in this office showing, as regards the Punjab and the North-Western Provinces (School Circle), the probable quantity of railway sleepers of inferior wood that could be made available annually by the Forest Department, and the localities considered suitable for the establishment of factories for the impregnation of such timber.

2. In view to the quantities and species of wood available, I beg to enquire whether it would be worthwhile for the State Railways or for any of the Railway Companies in India to set up a central factory in the North-Western Provinces or in the Punjab for the purpose of impregnating sleepers or of treating them by the Haskin process.

3. I may point out that the prices at which sleepers could be delivered at impregnation factories, as quoted in the statement, are for delivery only and do not include royalty payable on the wood.

23 Sp

-----cc@cc-----

Copy of a letter No. 1723 dated 23rd September 1923, from
the Inspector General of Forests to the Government of India,
to the Secretary to the Government of India, Public Works
Department.

I have the honour to forward, for information, a state-
ment prepared in this office showing, as regards the Punjab
and the North-Western Provinces (School Circle), the probable
quantity of railway sleepers of inferior wood that could be
made available annually by the Forest Department, and the
localities considered suitable for the establishment of
factories for the impregnation of such timber.

2. In view to the quantities and species of wood available,
I beg to enquire whether it would be worthwhile for the State
Railways or for any of the Railway Companies in India to set
up a central factory in the North-Western Provinces or in the
Punjab for the purpose of impregnating sleepers or of treating
them by the Harkin process.

3. I may point out that the prices at which sleepers could
be delivered at impregnation factories, as quoted in the
statement, are for delivery only and do not include royalty
payable on the wood.

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Remarks.

24 Nov

Wazirabad is considered best for Jhelum and Chenab Sleepers. The former could be railed to Wazirabad where fuel could be obtained at moderate cost from the Belas in the Chenab and from other sources; or river power might be used either there or at Kanki the head of the Chenab Canal. The quantities to be impregnated at Jhelum would not justify the ^{etc} creation of a factory there.

The Conservator is inclined for a factory at or near Masloper for water power is available at the Canal head and fuel would be obtainable whereas at Lahore it would be difficult to get fuel and the uncertainty of the arrival of sleepers owing to the stoppage of rafting on the Ravi for the greater part of the only season when it is safe on account of the diversion of the whole river into the Bari Doab Canal. If however, the Conservator adds Government would, in consideration of the undertaking being chiefly for the benefit of the North Western Railway authorities, the free or cheap carriage of sleepers to one central factory and also of coal and if further no objection were raised by the Administration to the concentration of their sleepers at one place and subsequent distribution all over the line there can be no doubt of the superior claims of Lahore for the factory site as supervision would be easier.

The Conservator remarks: "As to the Kulu Kangra wood that from Kulu may turn out to be too expensive while from Kangra the supply is insignificant. I would therefore not locate a special factory on the Beas, but would rail the timber to Soraha where the Pashalor contribution also would be impregnated."

The Conservator considers that Solva Sun & Jagadhri would also be suitable for impregnating stations. The cost of sleepers delivered at these stations would be:

Stations.	Silver Fir.		Oak.		Chir.	
	B. G.	N. G.	B. G.	N. G.	B. G.	N. G.
Solva Sun	Rs 1-6-8	11 As 7 pie	Rs 1-5-2	10 As 9 pie	Rs 1-3-4	9 As 10 pie
Jagadhri	Rs 1-4-8	10 As 10 pie	Rs 1-3-2	10 As 10 pie	Rs 1-1-4	9 As 1 pie

Form No.

PUBLIC WORKS DEPARTMENT,

RAILWAY BRANCH.

Papers to be read in Proceedings:-

G.O. No. 373-374-B. 5th March 98. Communicating for the information of the Railway Administration a Note of the Senior Joint Engineer of P. W. D. on the Haskin Process for preserving timber.

G.O. No. 841-B. 21st June 98. Communicating for the information of the Railway Administration a Note on the Haskin Process of the Joint Engineer of P. W. D. and a note of the Senior Joint Engineer of P. W. D. on the subject of timber for railway sleepers.

* Read also the following papers. Serials 22, 23, 30. G.O. 53-B. 11th June 1899 (containing the

Report of the Joint Engineer of P. W. D. on the subject of timber for railway sleepers.)

Also serials 27, 28, 53, 54, 57, 58. { Some of these are P. W. D. but some are not. }
Print also Serials 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

ORDER.

No. 1487-88 B. 9. 19. 12. 18.

Then with a Note of the Senior Joint Engineer of P. W. D. on the subject of timber for railway sleepers.

With a note of the Senior Joint Engineer of P. W. D. on the subject of timber for railway sleepers.

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Encl. No. 1488 B. 9. 19. 12. 18.

(Signature) 28/11/98

Not. of the Com. Engrs for the Indian

Dated 1st Dec. 99

A reference to the Proceedings of Government above quoted, Nos. 373. P. & 841. P. dated the 5th March & 25th June 1898, respectively, will show that this discussion is stated in my Not. dated 21st Feb. 98, in which I draw attention to a detail in the Harlan process for preserving timber in the Region of July 28th 1898. In that Not. I argued that a saving of one acre per slope would represent a saving of some Rs. 30,00,000 for America in one Indian Territory, and I suggested that the Forest Dept. should enquire into the merits and possibilities of the process with a view to the utilization of great areas of forest containing them which at present we are unable to utilize for slope purposes. In his Not. dated 14th April 1898 the Inspector General of Forests while paying a tribute to the excellence of the process expressed a doubt whether it could possibly have the effect of saving one acre per slope. In my reply dated 17th May 98 I tried to show how the anticipated saving might be safely looked for, and it seems to me that my optimistic view is fully justified by the statement now received, under cover of the Govt. of India No. 2098. P. 5

to be engaged for maintenance with the investment of money is almost any saving that might be secured. I certainly think that the Indian Forest Dept. will be well advised to make this venture, and judging from a perusal of the above papers I should not be surprised to learn that the Foreign Forest Dept. had done so.

F.R.

E.R.

1-12-99

Order. No. 1487 P. dated 19 December 1899.

(As per G.O. No. 841. P. June 21st 98) Omit

A copy of these proceedings will be communicated to the Agents, Madras, South Indian & the Highways the Mysore & State Rps, and to the Manager East Coast Railway and to the Revenue Department for information.

2. A copy of these proceedings will also be forwarded to the Govt of India and Bombay for information.

11th Dec. 1899

(Trusty)

For India Secy

Encl. No. 1488 P. 19 December 1899

Forwarded for info

Secretary

Despatched on 8/1/90

For NASH
Cc. R.
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C.R.

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which show the extraordinary low price at which, by hooking the common
 sort of pine of the Hyndrye & its lower ranges, sleepers may be obtained & take
 the place of the expensive Indian which is now almost the only material to use
 for sleepers.

I am strongly of opinion that by obtaining a set of Indian plant
 & looking at producing amongst the forest of the charge forest of trees
 which are now getting available for the supply of sleepers, the Forest Dept
 can find off indefinitely the increase of this country of Australian sleepers of
 doubtful genus, origin, & quality, which just now being found in the attention
 of the Dept. requires to what is the absence of any knowledge of their history
 questions look like extremely low price.

I suggest that the advantage of setting up a little work on the
 machinery is looked on as a doubtful & a pleasure station. But it is not
 to be compared for its convenience with the investment of money in almost any
 railway that might be named. I certainly think that the Indian Forest Dept
 will be well advised to make the venture, and judging from a perusal of the
 above papers I should not be surprised to learn that the Indian Forest Dept
 had made it.

F.R.
 E.R.

2-12-99

Despatched on 8/1/00

Order. No. 1487 B. dated 19 December 1899.

(As per G.O. No. 841 B. Jan 21-98) omit

A copy of these proceedings will be communicated
 to the Agents, Madras, South Indian, & the Hyderabad & Nizam
 State Rys. and to the Manager East Coast Railway and to the Revenue
 Department for information.

2. A copy of these proceedings will also be forwarded to the
 Govt of India and Bombay for information.

1488 B. 19 December 1899
 Forwarded (for order) Secretary
 (Sd/-) J. A. G. Secretary

WASH.
 Co. H.
 Rev. Secy.
 C.R.

*Print but
not driving*

NOTE
ON THE
HASKIN PROCESS
OF
VULCANIZING TIMBER.

BY
DR. J. NISBET,
CONSERVATOR OF FORESTS.

NOTE ON THE HASKIN PROCESS OF VULCANIZING
TIMBER.

This process resembles the preservative processes introduced with regard to timber by Mr. Kyan, Sir William Burnett, Mr. Bethel and others, only in so far that all of these processes are classifiable as antiseptic. It differs from them *in toto*, however, with respect to the means of sterilising the woody tissue; for, whereas the other methods attain this by injection of antiseptic substances, Haskin's process aims at direct sterilisation under the immediate operation of heat and pressure.

Apart from the disintegrating and wasting influences to which timber is liable, and which it shares with iron, steel, etc., in the shape of disturbance of molecular and other forces, the main causes of its more or less speedy decay are of purely organic origin and arise from attacks of fungi and insects or other animals. Some kinds of timber have a better natural protection than others against attacks by fungi and insects through the tannic acid, etc., contained in their tissue (e.g., oak, cutch, pyinkado); others have essential oils distasteful to most insects (e.g., teak, deodar); and others again are more or less protected by natural processes of resinification (e.g., larch, pine). Adopting a broad generalisation, it may be said that the durability of timber *per se* is in the inverse ratio of the amount of albuminoid matter present in the wood in a form which can be utilised as food material by fungi and insects or other wood-consuming animals. Rapid alternation of dampness and draught, or the combined action of dampness and high temperature, will facilitate attacks on wood by both of these classes of destroyers; but for the sustenance of life in the vegetation of fungi or in the alimentary processes of insects, albuminous food is an essential requisite. If the albumen can be sterilised and rendered unfit for utilisation as food, by being made to undergo a permanent change rendering it unassailable to fungous and insect attacks, the woody fibrous tissues of timber must benefit both directly and indirectly. They gain directly by offering practically no points of attack to saprophytic fungi and insects, and they gain indirectly by becoming thereby exempt from the destructive and disintegrating processes induced and hastened by the fermentation which accompanies the action of fungi and insects.

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15

As a temperature of about 160° Fahr. effects the coagulation of albumen, this fact was practically adopted as the basis of the Haskin process of vulcanization. Further use was at the same time made of the well-known fact that many of the transformatory and perfecting processes of nature are carried out under the application of great heat and enormous pressure. Such natural processes have been imitated, and the vulcanization process may be briefly described as a new method of rapidly seasoning timber by hermetically sealing it in powerful iron vessels and exposing it under a pressure of about 13½ atmospheres (200 lbs. per square inch) to the influences of dry air superheated to between 200° and 300° Fahr., the precise temperature being the secret of the process. If the amount of heat be inadequate, the full advantages obtainable by warmth and pressure are not obtainable; while on the other hand excess of heat might induce dry distillation that would weaken the quality of the timber for technical purposes. This principle seems perfectly sound.

At the same time other organic changes take place. Through the heat and pressure applied, the constructive potentialities of the sap are utilised, the transformed portions being apparently incorporated into the woody tissue in the form of antiseptic substances. The changes that take place in this respect appear to resemble such as occur in the transformation of sapwood into heartwood, a change which enhances the durability of timber.

In coniferous woods a process of resinification is also very distinctly noticeable as the result of treatment, the production of resin in large quantity no doubt being due to the action of heat and pressure on the sap and also on the less durable portions of the cell-walls; for it is known that the chemical transformation of the latter assists in the natural production of resin.

The vulcanization process is said practically not to alter the weight of the timber to any considerable extent, and but little water is given off during the treatment. This seems to prove that the sap contained in the wood is for the most part transformed and incorporated into the sterilised woody tissue.

Method adopted.—The method adopted is simple. The timber to be operated on is brought in from the yard on a narrow tramway and run into one of the cylinders in which vulcanisation takes place. There are four such cylinders, each 112 feet in length (consisting of four sections of 28 feet each), so as to admit of treating the largest size of telegraph posts. The timber being operated on at the time I visited the yard were sleepers, of which some 1,410 cubic feet or 28 tons could be railed on little waggons into each cylinder. When deals are dealt with, the feeding consists of from 1,000 to 1,145 cubic feet according to the way they pack on the small trolleys.

The cylinders are built of boiler plate and are anchored at the top end, while the other portions are supported by rollers on runners to allow play for the expansion of between 1½" and 2" due to the hot air applied within.

When the load of timber has been trolled into one of the cylinders, the open end is hermetically closed by means of an enormously heavy steel lid hinged at the top and heavily counterpoised (weighing in all about 9 tons), which is opened and shut by means of a cog-wheel worked by the leverage of a hand-wheel. On the lower end being brought into position, the complete closure against air-leakage is effected by means of numerous curved levers (see Fig. 1) radiating like the spokes of a wheel from the centre of the lid, whence the levers are actuated, and pressing powerfully on the lid so as to seal it hermetically against the air pressure of 200 lbs. per square inch from within. To facilitate air-tight closure, the lip of the cylinder is coated with asbestos packing. There are 40 of such spoke-like levers, and each fits into a strong steel socket or slot (see Fig. 2). The opening or closure of the lid can take place in less than two minutes, only two men being required to work the wheel and apply all the requisite leverage. The lid having been closed on the filled cylinder, steam is turned into the pipes (see Fig. 2) and surplus moisture from the outside of the wood is expelled and run off through cocks at bottom of the cylinder. The cocks being again shut, superheated compressed air between 200° and 300° Fahr. is then driven into the cylinder (see Fig. 3). This is provided by an air-compressing machine in an adjoining chamber. The air-compressing engine (Figs. 4 and 4a) has steam (weighing about 35 tons) and air cylinders, each 18" in diameter, and with a 30" piston stroke in which the air is compressed to a pressure of 200 lbs. per square inch, while a spray of water is at the same time injected into it to absorb the heat evolved by compression. This moist compressed air is next filtered through a water separator which dries it thoroughly, after which it is pumped by the circulating engine (also of about 35 tons weight—see Figs. 4 and 4a) first through cylinders containing tubes heated by steam and then through a kind of pipe stove heated by a coke furnace, whence it is conducted to the cylinders where vulcanization takes place. It is essential that there should be constant circulation of the superheated air in the vulcanizing cylinders, and each complete stroke of the piston of the air circulating machine displaces 35 cubic feet of air. Fresh superheated air is forced into one end of the vulcanization cylinder and a corresponding quantity drawn off from the other end. From the cylinder the air passes to a tubular cooler and is conducted thence to the circulating pump for redistribution. Any loss of air-pressure due to circulation is replaced by the occasional use of the air compressing machine. Both the air-compressing and the air-circulating machines are worked at a slow rate.

15-24

The process of vulcanization depends of course on the dimensions of the timber to be operated on, but for sizes like sleepers it occupies about 8 hours; and no advantage has been found to accrue from continuing the treatment beyond this time. As the plant is not yet fully employed, the cylinders are fed in the morning, operated on during the day and allowed to cool at night, the load being taken out early next morning and replaced by fresh wood for treatment. If worked under pressure of a large business, cooling could be facilitated by gradually lowering the temperature of the air pumped into the cylinders.

Effects claimed for Vulcanization.—The effects claimed to be produced on wood by vulcanization are—

1. That it will not decay.
2. That the cheaper kinds can be utilised for sleepers, mine-props, piles, etc.
3. That the technical properties of wood become enhanced by strength being added and shrinkage diminished.
4. That the resinous, oleaginous, and other properties of the sap within the cells and fibre become solidified.
5. That the germinative principle inherent in the fluids is destroyed.
6. That all "fungi", "germs", or "insects" are killed.
7. That wood is indurated, strengthened, perfected and rendered less inflammable.

Numerous certificates and reports of physical tests are quoted by the Company to prove that the technical properties of the wood are enhanced, and detailed statistics are given in the pamphlet issued by them. Avoiding statistics, which can only be satisfactory to those who are acquainted with all the circumstances of the experiments for testing and comparing the treated and the untreated wood, the following remarks by Professor Myers of Stanford University, California, United States, America, appear to be fairly stated:—

"As vulcanizing changes the sap from the liquid to the solid or semi-solid state, does not char or make the wood brittle, saturates and seals up the pores of timber with solid matter instead of liquid soluble matter which nature provides, considerable strength and durability are added, the wood being rendered more cohesive, harder and denser."

Effects visible.—Samples of pine sleepers, said to have been in the ground for about 10 years, were shewn to me in a thorough state of preservation; and if they really are what they are said to be, they form a striking proof of the utility of vulcanization. During my visits to the works I had opportunities of examining Baltic pine baulks and sleepers under treatment for the Natal Government and of comparing them with the unvulcanized wood:

and I could not but remark the highly resinous condition of the vulcanized wood in comparison with that awaiting treatment. This resinification, this transformation of sap and of the less durable portions of cell walls into substances which become incorporated into the woody tissue, must increase considerably the resistance which the saturated fibres are able to offer to the natural processes of decay.

While it is easily intelligible how the transformation of aluminous substances, sap and portions of cell-walls capable of undergoing transformation under heat and pressure can and probably must increase most of the technical properties of timber, yet it is almost impossible to accept in its entirety the statement put forward that vulcanization renders wood less inflammable. Certainly for non-resinous woods this will be so, but in the case of conifers resinification must produce greater inflammability; and in all woods operated on the heating power must become enhanced. "Inflammability" and "heating-power" are not, however, synonymous terms; and for the practical uses to which vulcanization may be applicable with regard to *Indian forest produce*, this point may be left out of consideration.

Buildings and Machinery.—Both buildings and machinery are simple in construction, though the latter is solid and heavy. The former consist of two compartments and an outer shed. The shed contains the three boilers (each of 300 horse-power), only two of which are used simultaneously. In an adjoining room stand the heavy engines for compressing and circulating the air, the water pumps and reservoirs, and a centrifugal water-separating pump.

The large outer compartment contains the water-separator, the heating cylinders, the coke furnace with its heating tubes, and the cylinders where vulcanization is effected.

All the machinery was supplied in 1897 by Messrs. Galloway of Manchester, who are on the Board of Directors and are largely interested in the Company. There are three boilers, one water pump and reservoir, one centrifugal pump, two air-compressing engines, one water separator, four pressing and two air-circulating engines, one water separator, four hot air cylinders, one coke furnace with internal pipes, and four large cylinders for vulcanizing. At present only part of the machinery is employed, as the treatment does not yet seem to have acquired the popularity that it deserves. From the river the timber is lifted out of barges by a crane and laid on trolleys running along a narrow tramline towards the compartment containing the cylinders, near the doors of which the load is shunted on to a line leading straight into any particular one of the four cylinders to be fed at the moment. The handling is therefore very simple.

Establishment.—The establishment now employed at the works (Samuda's Shipbuilding Yard, Millwall on Thames) consists of:—

- 1 Trained Engineer in charge of yard and works.
- 1 Machine man.
- 1 Stoker.
- 1 Boiler cleaner.
- 4 men for charging and discharging the cylinders and for general work in the yard.

The trained engineer and foreman exercises a general supervision over the whole business of the yard and sheds (including clerical work), and sees that the machinery and the electric lighting plant are maintained in proper condition. The boilers, of which only two out of the three are worked simultaneously, have to be cleaned out with soda once a week owing to the high percentage of lime in the water obtainable. In addition there are three men employed in barge work, but the above represents the complete staff required for the working of the yard and maintenance of the whole of the machinery.

Charge made for Vulcanizing.—The charge made for vulcanizing is 2½d. per cubic foot for soft woods and about 4d. for hard woods, a reduction being made for large quantities. It is therefore somewhat cheaper than creosoting. The difference in the scale of charges between soft woods and hard woods does not arise from any difference in treatment, but is due to hard woods being usually sent in smaller quantities and in forms (e.g., veneers, cabinet woods, sounding boards for pianos, etc.) which involve more handling in the yard and during the process of vulcanization than sleepers and baulks of pine and fir. So far as the actual treatment is concerned, the vulcanization process is identical for both classes of timber, and mixed charges can be run into the cylinders. The actual cost of vulcanizing must be very small if there are regular supplies of timber to operate on.

Suitability of process for India.—Haskin's Vulcanization seems a process deserving of careful consideration in all the forest districts throughout India, where there exist supplies of timber now unmarketable owing to liability to rapid destruction from the ravages of fungi and insects. Such conditions obtain especially in hot damp climates (like Burma, for example). There can be no doubt that the effect of vulcanization on all classes of timber is to enhance its durability. Thus even the best classes of hard-woods, like the sal of Bengal and the North-Western Provinces, the pyinkado of Burma, the nageshur (*Mesua ferrea*) of Assam, and any similar woods valuable as sleepers, etc., will remain serviceable for a longer term of years if subjected to this process; while it is quite probable that inferior classes of timber, such as

the wood produced by the great majority of the forest trees throughout the wooded tracts in all provinces of India, may by vulcanization be rendered of considerable durability, and consequently of a technical and marketable value which they do not now possess in their natural condition.

This is more particularly the case when the two following facts are borne in mind:—

1. That vulcanization can take place to the best advantage when fresh, unseasoned wood is operated on.
2. That the boilers used for driving the machinery and generating the electric light can quite well be simultaneously employed in working the machinery of a saw-mill. This process could therefore be carried out wherever saw-mills are erected in the forests. Even at the maximum English rate of 2½d. per cubic foot for sleepers, this would be only 3½d. per narrow gauge sleeper (1½ cubic feet); and for this increase in price, which would probably be reduced to not more than about 1 anna per foot as the actual cost on a large scale, there would be obtained not only increased durability, but also less tendency to splitting, cracking, and breaking in handling and transport.

The only European who might in India be required to look after the machinery and the work generally is the trained engineer, and even that post might perhaps be satisfactorily filled by a competent native of India after undergoing some special training in the business.

Probable effect of Vulcanization on different kinds of Indian Woods.—It is hardly possible to predict what the effects of vulcanization may be on different kinds of Indian timber. If it causes increase in the amount of essential oil in teak and deodar, it will directly enhance the technical value, dependent as this mainly is on the essential oil contained in their woody substance. If it increases the amount of catechin, tannin or other valuable properties in woods like *eulch* and *pyinkado*, it must likewise enhance their market value and enable larger supplies of tanning and dyeing substances to be extracted from them. If it transforms the albuminous and oleaginous matter in *Dipterocarpus trees* in such a manner as to render their timber durable and make them offer no food supplies to fungi and insects, then it will enable hundreds of thousands of tons of *In ? (Dipterocarpus tuberculatus)* timber to be available for sleepers and other constructive purposes. Many *Terminalia* would also yield large supplies of useful timber if treatment can be proved beneficial in their case. Finally, there are many different kinds of wood, possessing beautiful colour and fine grain, which might ultimately come into favour as furniture woods or for decorative purposes, if it could once be shown that vulcanization

rendered them durable. But it is only by means of experiment and careful tests that any satisfactory conclusion can be arrived at with regard to the effects of vulcanization on each particular kind of timber.

Recommendations made.—As above stated, the system seems to me based upon thoroughly sound principles; and I am strongly of opinion that its introduction into India would enhance the durability of woods now used extensively for railway sleepers, and would probably render suitable for similar use and for various constructive purposes many other kinds which in their natural state can only be considered as inferior and unsuitable owing to their liability to rapid decay in a hot damp climate.

Before Government should commit itself to any considerable outlay in the introduction of vulcanizing plant, however, I would recommend that blocks of timber of, say, from 20 to 30 of the most abundant kinds of trees growing throughout the different parts of India and Burma, should be sent to London for experimental purposes. The best dimensions would perhaps be those of the ordinary narrow gauge sleeper. Of each kind of wood four such sleepers should be prepared, one being retained and three sent to London. Of these three, two could be vulcanized and one of the two sent back to India for submission to tests in comparison with the unvulcanized wood cut from the same block. There would thus in each case be an unvulcanized and a vulcanized sleeper (cut from the same block) in London and in India. In London and on the continental *Forstliche Versuchstationen* arrangements could easily be made for microscopical and physical tests regarding their respective technical properties; while in India the tests might be of a rougher nature, such as burying the wood in ants' nests, etc.

It might take a month or six weeks or perhaps even longer to have all the necessary arrangements and experiments made; but the promise which the process holds out as being of future importance to India seems to justify some time being spent in trying to ascertain its probable value in a practical manner. The Company have stated to me that they will be very pleased to operate upon specimens sent with a view to testing the process.

Cost of Plant and Machinery.—Colonel Haskin informs me that the cost of the plant and machinery now erected at Millwall has been about £12,000, but he is of opinion that for plant consisting of two boilers, one air-compressing engine, one air-circulating engine, one water separator, set of heating apparatus, one heating stove, and two vulcanizing cylinders, each 56 feet in length (*i.e.*, consisting of two compartments 28 feet long), with the requisite short tram line, the cost would probably be from £5,000 to £6,000. Laid down *in situ* in the forest it would in this case amount to about one lakh of rupees. Mr. Bagley, late Engineer-in-Chief, Burma Railways Company, who accompanied me on my last visit

to the works on 7th December, informs me he is of the impression that £3,000 was the sum previously stated in correspondence on the subject.

Each such cylinder would contain about 15 tons or 495 narrow gauge sleepers, and the two would vulcanize up to nearly 1,000 narrow gauge sleepers a day. This is considerably more than any small forest mill can produce.

Presuming that the vulcanizing plant and sheds, etc., cost as much as R1,30,000 and estimating that it was worked in conjunction with a saw-mill (from which it would be supplied with fuel), then the working would probably cost:—

		R	
Depreciation and Amortisation Fund at 10 per cent. on R1,20,000		per annum	12,000
<i>Establishment.</i>		R	
1 Engineer at	350	per mensem.	
1 Machineman at	100	"	
1 Stoker at	30	"	
1 Boiler cleaner at	30	"	
4 Coolies at R12-8	50	"	
	560	"	
<i>Sundries.</i>		R	
Cotton waste and oil, say	40	"	
	600	"	
Occasional repairs, etc.		= per annum	7,200
		=	800
		Total	20,000

That is to say, for about R20,000 a year any number of narrow gauge sleepers up to some 350,000 could be operated upon. Even if only less than the half of that number, or, say, 160,000 were vulcanized, this would only cost *two annas a sleeper*. Speaking from my own personal experience when in charge of the Taikgyi saw-mill, from which many lakhs of pyinkado sleepers were exported to Rangoon to Madras and Calcutta in the years 1882 to 1886, *vid* Rangoon to Madras would have been a low rate to have paid for two annas per sleeper which would have tended to diminish loss any toughening process which would have tended to diminish loss from breakage and cracks arising from the rough handling given in discharging from railway trucks and in loading and unloading the sleepers. On this account, from the manufacturer's point of view alone, the introduction of vulcanizing treatment into sleeper-mills working on a large scale would pay, if experiments with Indian timbers shew that Haskinized wood is tougher and less liable to split or crack; to say nothing of the great benefit to be derived by the purchaser in obtaining wood possessing greater durability than is possessed by the timber as now utilized by him.

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Royalty.—I understand from Colonel Haskin that the Company would be prepared to sanction the use of vulcanizing machinery in India under very moderate conditions as to royalty under patent rights. This item has not been included under the estimate of working expenses given above; but this is more than counterbalanced by the low outturn estimated (160,000 out of a possibility of some 350,000 sleepers).

94, LEXHAM GARDENS, LONDON, W. }
16th December 1898.

J. NISBET.

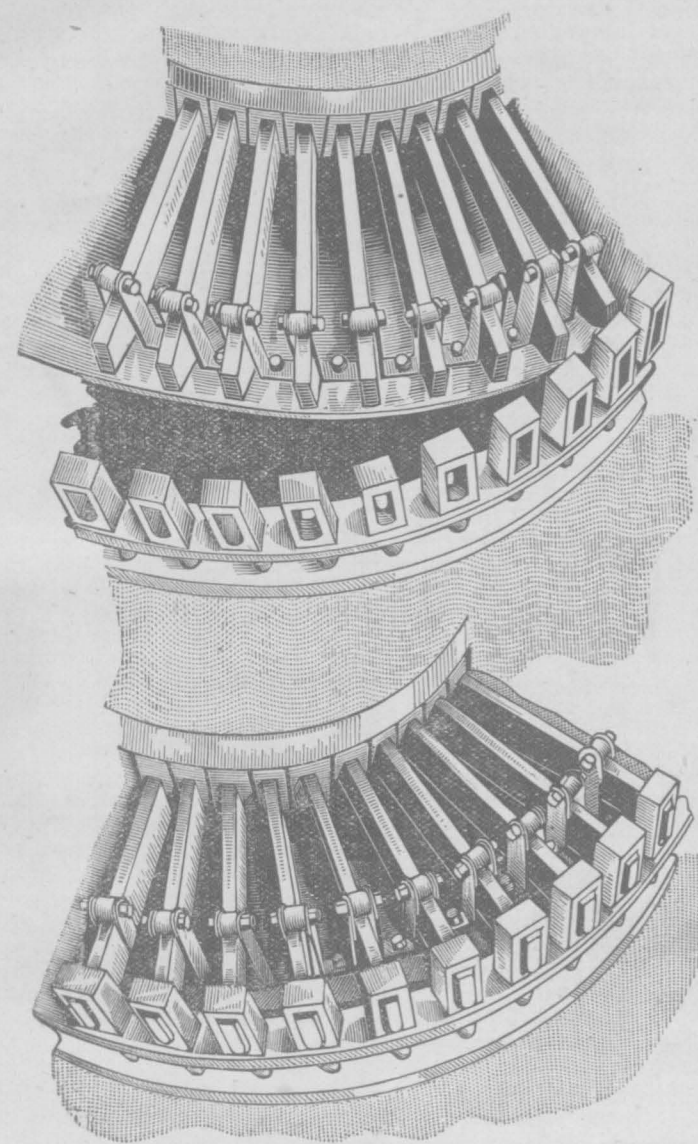


FIG. 1.—DETAIL OF DOOR LATCHES.

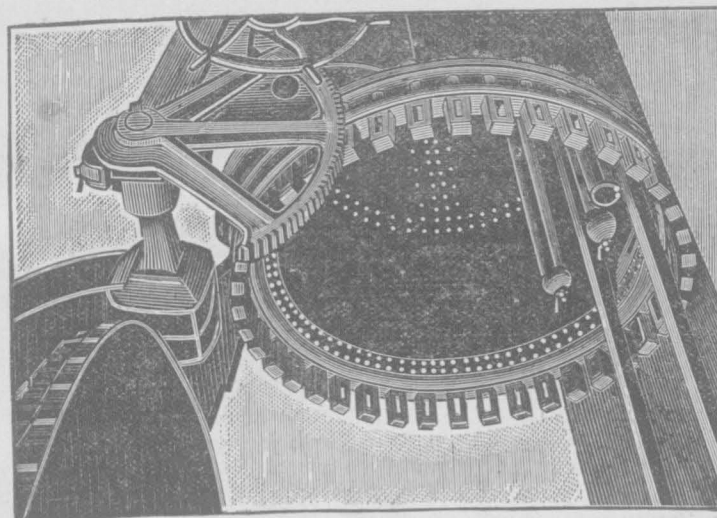


FIG. 2.-END OF CYLINDER.

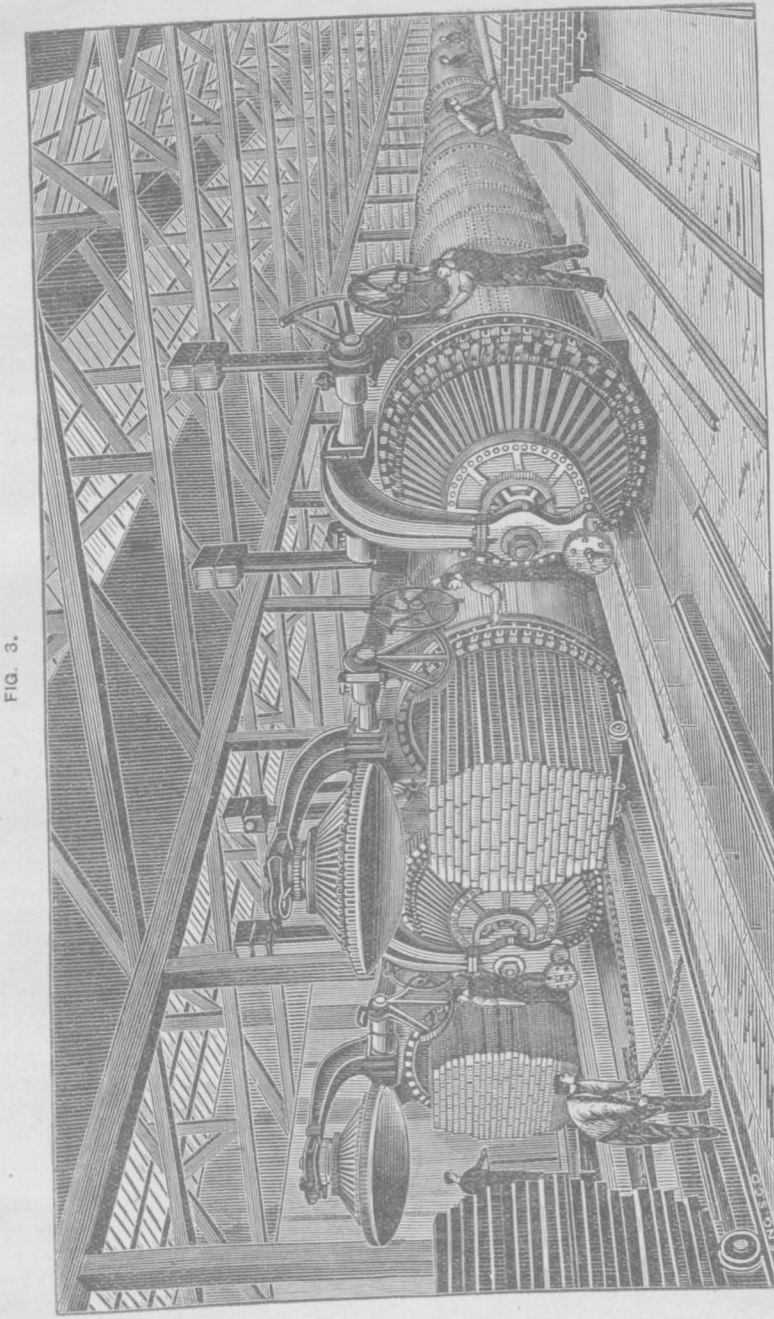
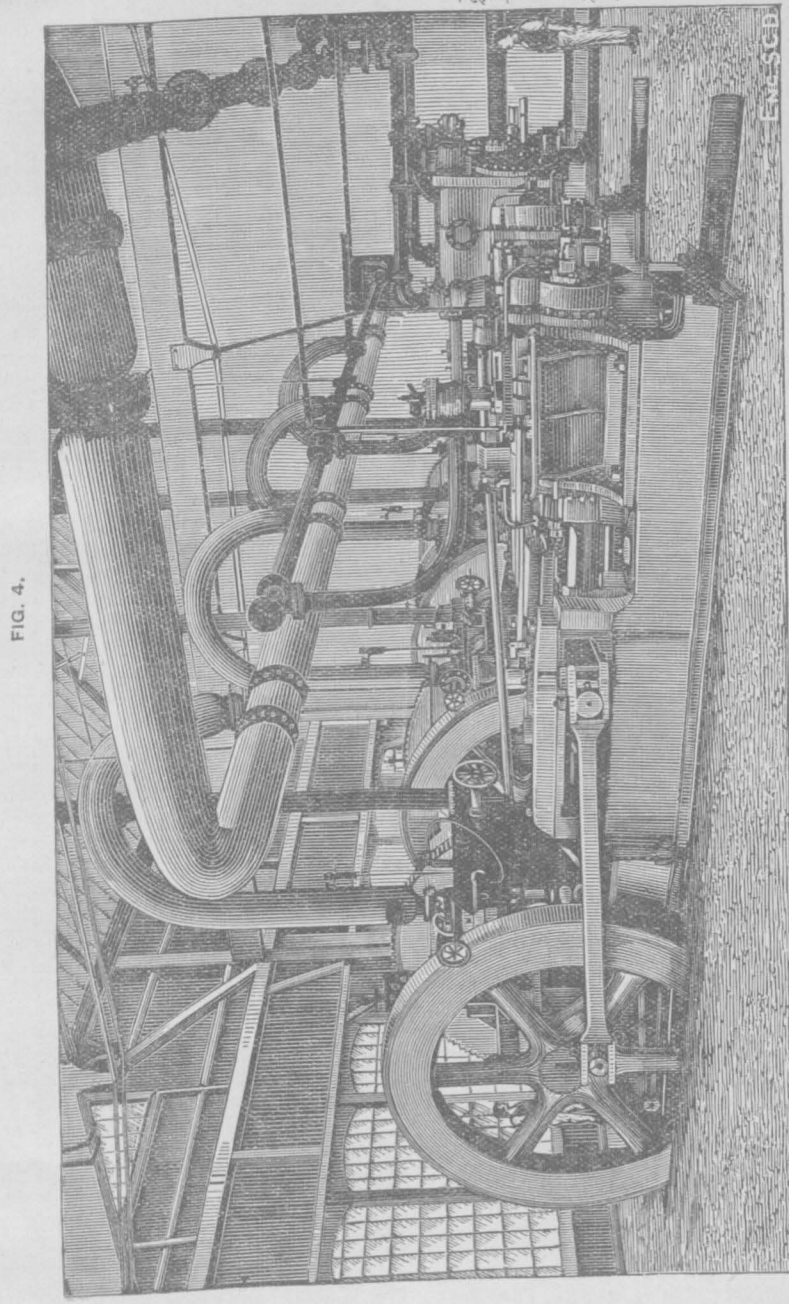


FIG. 3.

CYLINDRICAL WOOD TREATING VESSELS (used in the Haskin Wood Vulcanizing Company's Works),
[*Samuda's Shipbuilding Yard, Millwall-on-Thames, London.*]



2 Circulating Engines.
2 Compressing Engines.

FIG. 4.

AIR COMPRESSING AND COMPRESSED AIR CIRCULATING ENGINES (used in the Haskin Wood Vulcanizing Company's Works),
[Samuda's Shipbuilding Yard, Millwall-on-Thames, London.]

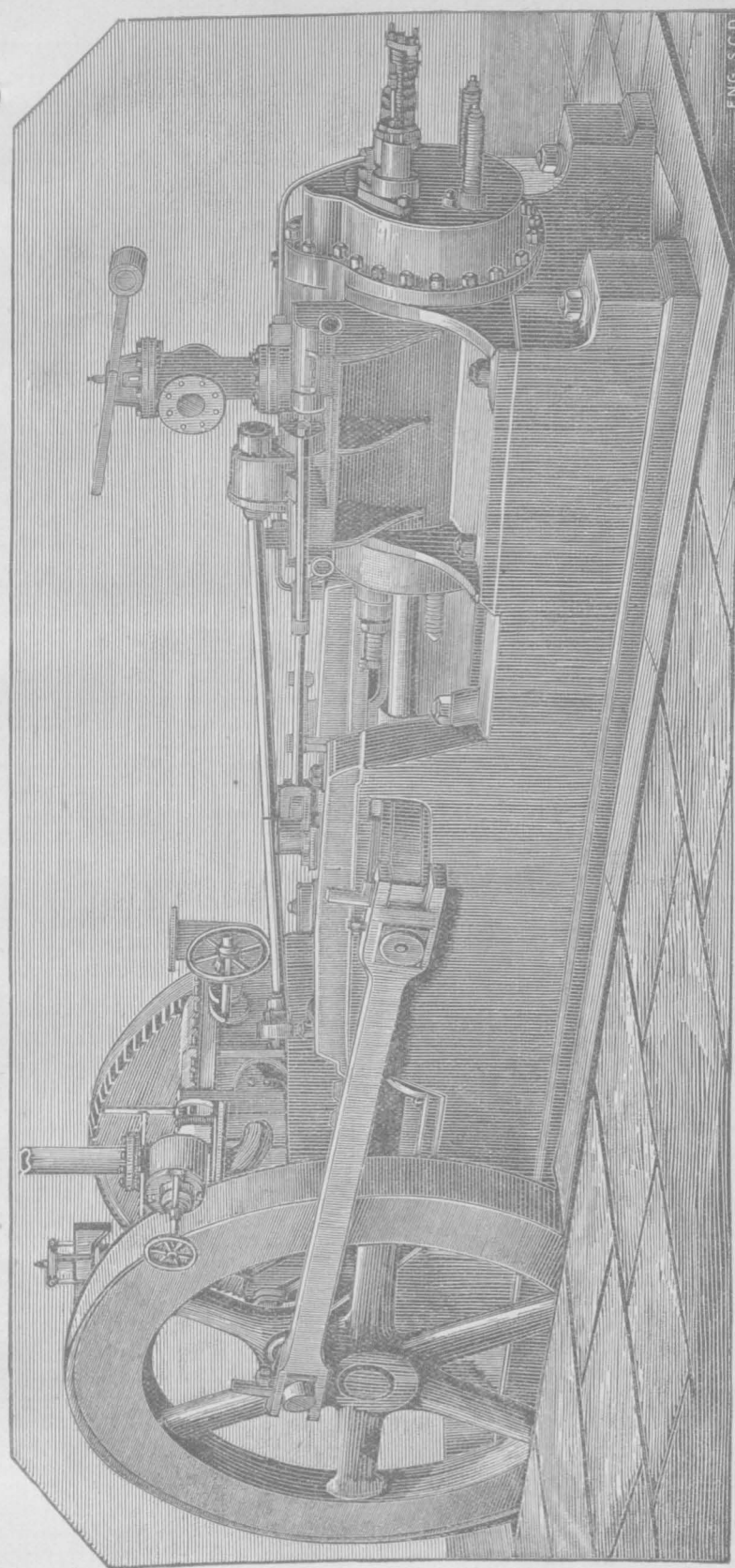


FIG. 42.-AIR COMPRESSING ENGINE.

ENG. SEC.

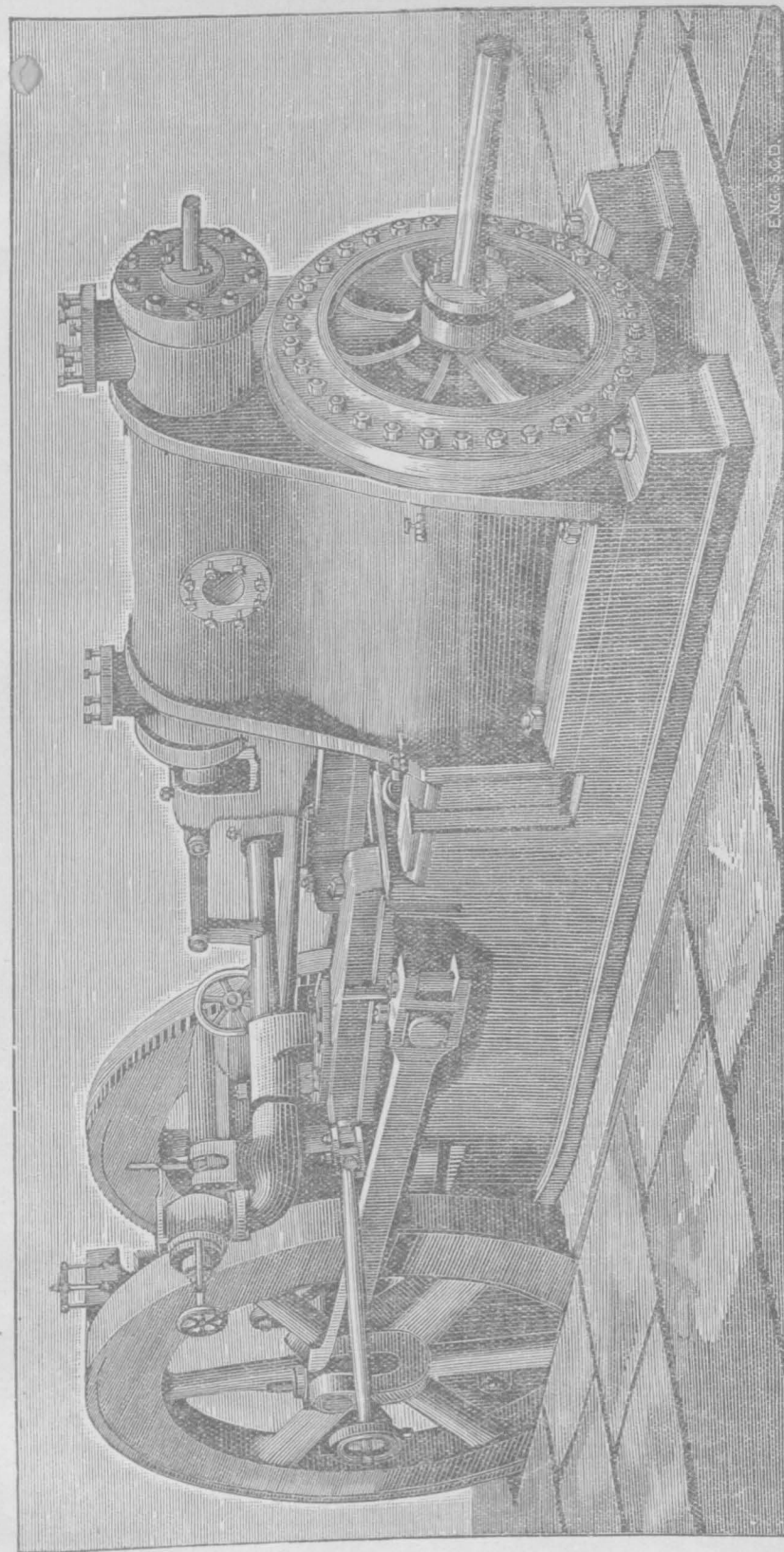


FIG. 41.- AIR CIRCULATING ENGINE.

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2096RS 10/11/77
G. of S.

Print line
mail stamp

REPORT

ON

SENILISATION OF WOOD.

BY

E. R. ROBSON, F.R.I.B.A., F.S.A., F.S.I.

REPORT ON SENILISATION OF WOOD; BY E. R. ROBSON,
F.R.I.B.A., F.S.A., F.S.I.

In accordance with instructions, I have visited the works of the "*Société Anonyme pour la Sénilisation rapide des bois et matières fibreuses*," and have there witnessed a series of experiments and demonstrations of the process "*Nodon-Bretonneau*."

It is, in reality, a method of seasoning wood by the aid of electricity. The first of its kind.

Having been familiar for half a century with the enormous difficulties which have always beset the thorough, final, and innocuous seasoning of timber, so as to render shrinkage and warping impossible, by a method not itself introducing the seeds of decay; having myself believed time to be the natural and only true medium, and having observed the failure of all the various attempts hitherto made on other lines, I may frankly premise that I approached this investigation in the full expectation of not being able, at most, to do more than admit the process to be a step in advance. Hitherto, all processes have failed to penetrate fully to the middle of the timber, or have succeeded only at the expense of impaired quality, or of converting the wood into something else—say lignite. One and all were too unnatural, too unscientific, too incomplete, and too expensive for general use.

The genesis of this new process appears to have been that during the year 1896, Mr. Albert Bretonneau, manufacturer of pipes and wind instruments, sought to effect improvements in clarinet pipes, and to that end caused experiments to be made with the aid of M. Albert Nodon, Engineer, formerly of the Observatory of Physical Astronomy of Paris, and now attached to the Laboratory of Physical Research at the Sorbonne. The first result was the production of the "*Bretonneau pipes*," whose superiority is admitted.

This success caused M. Nodon to suggest the application of the same principle to all woods and wood fibres. Finding a laboratory insufficient, a workshop was taken at Puteaux, 47, Quai National, where experiments were carried on with marked success. Finally, M. Nodon succeeded in effecting the removal of sap from large timbers, and their permeation with an aseptic solution, by the aid of two processes of electricity. The invention was then protected by patents. (See "*Notice industrielle, etc.*" "*Les Bretons*.")

A company was accordingly, on April 29th, 1898, brought out in Paris, with a capital of 1,200,000 francs, in shares of 100 francs.

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These, so far as issued, are now quoted at 425 francs. Admirably-planned shops are in course of erection, which, with the necessary machinery, capable of working at 100 volts, will cost about £8,000, with a capacity of treating 2,700 cubic feet per day. The charge for treatment is to be 5½d. per foot, while the cost price is only about 2d. Taking a full day's work at 3d., this would give a profit of £33-15s. per day. It may be noted that the price will, naturally, be varied according to the bulk and character of the wood treated.

The application of the process is very wide and far-reaching, including railway sleepers, street paving, school desks and fittings, block floors, parquet, all kinds of carpentry and joinery, cabinet making, wheels, casks, shipbuilding and fitting, works of art, organs, pianos, violins and other stringed instruments, pipes and wind instruments, and, in short, every purpose to which wood of any kind, size or quality is, or can be, applied. The results claimed are:—

- (1) Saving of time. One month's interest on capital, instead of years. In the case of hard woods, such as oak and yew, many years.
- (2) Power of utilizing cheap or damaged woods, hitherto almost useless, and of applying them to new purposes.
- (3) Facility of dyeing woods to prescribed colours throughout their entire thickness, and rendering painting unnecessary.
- (4) Gain in treating green woods without loss of time. The greener the wood, the quicker the action of the process.
- (5) Complete freedom from shrinkage, twisting and warping.
- (6) Immunity from damage by the insect or the animalcule.
- (7) Great reduction in inflammability.
- (8) Increased strength and better surface.
- (9) Resistance to damp or moisture.
- (10) Extraordinary increase in the resonance and fine tone of music instruments.
- (11) Economy of application.
- (12) Enormous diminution in the destruction of forests so far as arising from premature rot in the quantity actually sold.
- (13) Practicability of rendering wood fireproof, if required, at a very small additional cost, by one further process. (See "Notice Industrielle, etc." "Les Procédés.")

The experiments witnessed by me were made in the temporary shops, with a portable engine of seven-horse power and a small dynamo.

Process No. 1. A piece of ordinary Norway red pine was put into a quadrangular shallow tank of soapy water, immersed to rather more than half its depth, and the electric current was applied through a metallic conductor so arranged as to distribute it throughout the area. In the space of four minutes the sap commenced to exude visibly at the lower part of the end of the wood, forming a line of viscid froth. In the space of six hours the sap was seen, by the ceasing of exudation, to be entirely extracted. The wood was then taken out.

Process No. 2. (Capillary.) The second process took place immediately after the first, and while the wood was wet. The septic solution was forced from below into the pores denuded of sap by an electro-capillary method. Duration three hours.

After the two electrical processes have been completed, the wood undergoes two drying processes: (1) By being placed for two or three, or more, weeks in covered sheds, provided with a constant through current of fresh air. If of large, scantling, or obstinate nature, a longer period is allowed. (2) By being placed for three or more days in the hot, dry rooms. The processes are then all complete, after lasting about a month.

ILLUSTRATIONS.

(No. 1) I was shown a piece of ash 3' 4" x 1' 2" x 4 1/4" which had been fully treated six weeks previously. In appearance, it presented only the ordinary characteristics of the wood, without any change. Although actually heavier and harder, it presented no appreciable difference in facility of being worked by chisel, plane, saw, or other tool.

(No. 2) In the case of a piece of oak, also fully treated, it was pointed out that the discoloured outside portions, such as are commonly called "sappy," and hitherto invariably rejected as liable to speedy rot, were here sound and capable of use, although their discolouration remained. This feature applies to all the kinds of wood treated.

[Note.—During these experiments, M. Locher, Engineer in charge of the streets of Paris, was present. He expressed himself perfectly satisfied as to its suitability for use in the wood pavement of the streets of Paris.]

(No. 3) I paid a visit to M. Schneider, Furniture Manufacturer, 2, Rue de la Roquette, who explained the differences he had found, for furniture uses, between woods seasoned in the ordinary manner and those treated by the new.

(No. 4) Table-tops had ordinarily required five consecutive layers or thicknesses of wood to secure a surface not liable to shrink or warp. As a contrast, he exhibited one made two years ago, in which the wood had undergone the process, and which was

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absolutely true and satisfactory, although made in only one thickness.

(No. 5) He then produced an ordinary framed house door, in which all the usually rejected "sappy" edges had been retained, because he had confidence in their durability and fitness.

(No. 6) Also, he showed a piece of oak plank from Lorraine $1\frac{1}{2}$ " thick, which, although green in March last, had been rendered, after a treatment of two months, perfectly dry and fit for use.

(No. 7) M. Amédée Thibout, head of the celebrated firm of Henri Herz, Pianoforte Makers, 28, Rue Victor Massé, explained the great advantages which his pianos had derived from the use of the process. Among others, that soft woods, when "senilised," are proved to be better than hard woods seasoned by ordinary methods. Without going into the history of the gradual development of the piano as now we know it, or its complicated mechanism, he laid great stress on the *table d'harmonie*, or sound board, as being the vital part of the actual construction and the life and soul of the higher quality of a piano. The bridge pressure on the strings being 15,000 kilos, or about 15 tons, the *table d'harmonie* was always liable to give way.

(No. 8) He exhibited one sound board which had been made from green wood, treated for only nineteen hours, and which was found to be so dry, hard and strong, that it could be used at once. In spite of the large size, the thickness was only a quarter of an inch.

(No. 9) It was afterwards noticed, with surprise, that the use of "senilised" wood had immensely improved the quality and tone of the instruments. The softer sounds had become sweeter, the louder more resonant, the whole more penetrating.

(No. 10) In approaching the consideration of the subject in relation to violins, we tread on delicate ground. Pine, as we know, is used for the belly of the instrument, maple for the other parts. The former should come from the Valtellina, the Simmenthal, the Lac de Joux Valley, Les Brasses, the southern slopes of the Jura, Bernois, etc., while the latter should be from the southern slopes of the Carpathians or the Tyrol. Also, that all these require five or six years' seasoning *at the least*.

(No. 11) Finally, in spite of the innumerable processes for depriving wood of water, acid, resins, etc., which have been tried at different times, and with varying degrees of apparent success, we find, on a high and reliable authority, that "all artificial preparations, baking and tampering," *only ultimately spoil the violin*.

It is thus clear that the new process must create a veritable revolution in violin-making, and much sensation among the makers and players, now that electricity is brought to bear. The tests of the process as applied to so delicate and subtle an instrument as the

violin are of the most complete character, and appear to sweep away all preceding methods. No more complete demonstration as to the value of the invention, in its larger uses and more commercial sense, could, in my opinion, be made than from this apparently small one.

(No. 12) M. Audinot Leuthier, of Paris, has a celebrity known to every connoisseur of violins, and was good enough to give me, in much detail, the result of his experience.

(No. 13) Pointing to a piece of wood $2\frac{3}{8}" \times 1\frac{1}{6}" \times 2"$ average thickness of Hungarian Yew, he complained that, although ten years had passed since its cutting down in bulk, it was so warped and superficially corrugated during the last twelve months, that half of it was wasted, and it had cost £4. He had no personal interest in this new treatment, but it was imperative for him to have the most suitable wood for his purpose.

(No. 14) He compared specimens of wood so treated, with other wood known to be 100 years old, and declared the former to be better after a seasoning of only one month.

(No. 15) He found it to be, also, closer in texture, finer in quality, harder, more sonorous, not so liable to take stains, and, lastly, better for receiving the varnish—so important a point in violins.

(No. 16) He had the same evidence in comparing old and new Austrian pine.

(No. 17) In point of cost he considered it far more economical than any preceding process for violins.

(No. 18) Being extensively employed to restore and repair old violins, he said he could not now do without the "senilised" wood, and exhibited the upper part of an old violin in actual process of repair, which was in so bad a state that without "senilised" wood, repair would have been impossible.

(No. 19) In one violin, the wood, 100 years' old, showed objectionable roughness round any holes or borings, while those in the new wood, "senilised," were quite true and smooth.

(No. 20) In the new instruments which he had made from wood treated by the process, he had succeeded surprisingly better than before, and now anticipated the production of violins of much higher tone and quality.

This practical testimony is proverbially worth a ton of theory. The acoustics and making of violins need not here be gone into. The first important point is the kind, quality and dryness of the wood used.

Other experts in wood may be expected to approach the consideration of this remarkable invention with an incredulity equal to my own.

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Observation of the same experiments, and a careful consideration of the same evidence, cannot fail to be equally convincing.

Any fear that the effects may not be lasting are rather based on past sad experiences of other methods than upon any justification derived from the process or the probabilities to be deduced therefrom.

Durability is, for absolute proof, essentially a question of the future, and is inherently incapable of mathematical certainty in advance. Yet, here is, for the first time, a method of seasoning timber which is in harmony, instead of being in conflict, with nature; utilising, as it does, in a scientific manner that electricity of which we have yet so much to learn, and is eminently calculated to preserve and maintain the properties of wood, to enhance its quality and to prolong its durability.

I came to the final conclusion that the process is eminently successful, satisfactory and practical. That it can be applied with commercial advantage and profit to numerous purposes which require timber in bulk, while its use in small quantity for musical instruments requiring certainty of dryness and quality must be very profitable, and that it has scientifically solved a problem which has hitherto baffled mankind.

At a later stage it would be necessary to test large pieces of timber, one half treated, the other not, so as to determine accurately the increase of strength and of capacity for resisting strains.

October 18th, 1898.

P. S.—Since this report was in type I am informed that an enormous improvement has taken place, by which the two electrical processes are taken together and occupy five hours only.