Mr. Burt, in answer to questions from the President, said, that he had purposely omitted all chemical analysis, and had restricted his paper, as closely as possible, to the practical facts of the process of creosoting, and to the consideration of the effects produced on the timber. He was so impressed with the conviction of anomalous effects being produced on the timber, prepared by the various processes under a variety of circumstances, that he determined to try a series of experiments, on pieces of timber cut from the same tree and keeping the circumstances as identical as possible; and he would, when completed, transmit the results to the Institution. At present, his impression was, that the strength of timber appeared to be increased by creosoting, if the experiment was tried immediately after the process; but that after an interval of four years, if exposed to the air, the timber lost strength; therefore he argued, that the process was better adapted for timber intended to be buried, than for that to be used above the surface; although when ample strength was allowed in the scantling, and the creosote was applied only as a preservative from decay, or from the attacks of the worm, or the white ant, he believed it would always prove successful. He condemned the London system of keeping timber in floats; it was injurious to the quality and rendered it more liable to decay; and it was more difficult to apply, satisfactorily, any system of preservation by saturation. The system of stacking, pursued at Liverpool and Gloucester was very preferable.

When it was desirable to expedite the process of saturation, by essential oils, it was necessary to remove the external ring of the timber, or to puncture it with numerous small holes. He preferred natural to artificial drying, as he believed that by the latter process the strength of the timber was diminished, and that the "shakes," or cracks were extended. He considered 8 lbs. of creosote per cubic foot, a full dose for timber for any situation; indeed it was nearly as much as could be forced in. Some sleepers which had been saturated with hot creosote, but without pressure, had taken up nearly 7 lbs. of the oil per cubic foot; they were found, after an interval of twelve years, on the Eastern Counties Railway, to be perfectly sound.

Mr. Bethell said he was very willing to afford any information, in his power, on the question of Creosoting, as the

President requested it, but whatever he could say, would only be a repetition of what he had before stated, and even published,[1] as it was well known that he had devoted much time and attention to the subject, and was largely interested, practically, in the business.

Although the means of preserving timber, from decay, had very long been an object of anxious research, and the state of the timber found in the Egyptian sepulchres and at Nineveh, furnished proof of the success of the processes of antiquity, it was not necessary for the present question, to examine further back than sixteen, or seventeen years; nor to do more than to mention the names of Kyan, Burnett, Margary, and Payne, whose processes immediately preceded the system of Creosoting, introduced by him. The three first were theoretically similar and were based on the advice of Sir Humphry Davy to the Admiralty, that the only feasible plan, of preserving timber, was to render the sap slow to putrefy, and this could only be done by entirely removing the albumen from the capillary tubes, by long immersion in water, or by coagulating it in the vessels; which could be accomplished by the exhibition of certain mineral salts; accordingly Kyan tried Chloride of Mercury, in the proportion of 1 lb. of the salt to four gallons of water; but in trials on a large scale, it was found, that the wood absorbed about 6 or 7 lbs. of the salt per load, which at 3*s.* 6*d.* per lb. (= 21*s.* or 24*s.* 6*d.* per load) was too costly; water, therefore was added to the solution, to the extent of 40 or 50 gallons per lb. of salt, and the evident consequences were repeated failures, until the system was abandoned.

Sir William Burnett used Chloride of Zinc, in the same proportion of 1 lb. of the salt to 4 gallons of water. His process lay in abeyance for some time, but had been used somewhat extensively and with advantage, for internal purposes on board vessels; it was however liable to the same objection as Kyan's, that if the solution was too much lowered, for the sake of economy, the efficacy became doubtful.

In Margary's process the Sulphate of Copper was employed, which, being a cheaper salt, was used as a stronger solution,

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[1] Vide "On Preserving Timber, and on Drying and Seasoning it," by J. Bethell. 8vo. Tract. London, 1850.

and the results ought, therefore, to have been more satisfactory, but it had been stated, that all the sleepers so prepared, on the Bristol and Exeter Railway had been found decayed and had been removed. It should be remarked, that it being a property of albumen to render innocuous the corrosive sublimate combined with it, marine worms, or white ants would immediately attack wood so prepared, as they could eat the coagulated matter without danger.

Payne's process consisted, in the successive injection of two substances in solution; the first being a metallic, or earthy solution, and the second a decomposing fluid; thus filling the capillary tubes of the timber, with an insoluble substance.

Generally speaking, if the solutions of mineral salts were used, of sufficient strength, and the process was continued long enough to coagulate all the albumen, decay would be retarded for a very long period, but still the fibre of the timber was left unprotected. Now unless the fibre was also acted upon, the process of preparation must be incomplete; therefore Mr. Bethell sought for some antiseptic, which being injected into the pores, or capillary tubes of the timber, should bring it into a condition similar to the mummy-cases, or the mummies of Egypt, which were prepared by saturating them with the petroleum, or mineral pitch, found floating on the Dead Sea. Experiment proved, that Oil of Tar, or Creosote, was perhaps the most powerful coagulator of the albumen, whilst it, at the same time, furnished a water-proof covering for the fibre, and its antiseptic properties prevented putrefaction. If then the operation of injection was well performed, there was every reason to anticipate the perfect success of the system. He found, that by forcing at least 7 lbs. of Creosote oil into each cubic foot of timber, the process was perfect, and after exposure to wet and dry alternately, and in very unfavourable positions, for thirteen years, there was not any appearance of tendency to decay. A smaller quantity of Creosote might be sufficient, but he preferred adhering to that which he had proved to be effective.

He was inclined to prefer the employment of porous timber;

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[1] Vide Minutes of Proceedings, Inst. C. E., 1849-50, vol. ix., page 40.

it absorbed the Creosote more readily,—was more perfectly saturated,—was cheaper in its first cost, and when properly prepared, would last longer than heart of oak, or any other very solid timber. The tabulated records of the creosoting process of the deal baulks, used by Mr. Rendel, at Leith harbour, showed, that as much as 18 lbs. per cubic foot, had been forced into some of the piles; the average quantity of Creosote, absorbed by the timber, was $57\frac{7}{8}$ gallons, per load, or 577 lbs. weight forced into 50 cubic feet of wood. When the exhausting process was employed, it was carried to the extent of about 26 to 28 inches of mercury.

In some cases, not more than 2 lbs. per cubic foot, could be forced into oak timber, even by the heaviest pressure. This view had been strongly combated by some engineers, who had insisted on having the hardest timber, or at least the heart wood only, prepared; there could be no doubt, that if it was practicable to apply the process, to such timber, its durability would be increased; but, it might be contended, that it was more advantageous, commercially, to render cheap and inferior timber as durable as the best quality, than, to seek to extend the duration of the more expensive sorts; especially if the process could be applied with certainty to the former and was only of uncertain result when applied to the latter. Heart wood could not be creosoted with facility, as the pores were filled with "fibrin," and the mechanical passage of the Creosote, was arrested; whilst in the outer layers, the alburnum of the wood, the pores remained open, as the sap had recently circulated freely in them, and there was therefore readiness to receive the injected oil. Mr. Bethell therefore contended, that it was desirable to use round timber with all the outer layers intact, rather than squared logs, because there would be a thicker coating of fully creosoted wood, to protect the interior, or strong heart-wood. This was an important consideration for piles, exposed to the action of the worm; and it must be admitted, that it was safer to trust to fully creosoted timber, even although originally of a porous nature, which, when prepared, would resist the inroads of insects, rather than to rely upon harder woods, whose durability was daily diminished, by the boring into it of marine insects. There was no doubt, that creosoted alburnum would last longer than the soundest heart-wood unprepared. Besides, creosoted wood would scarcely absorb any moisture, and this alone was a great element of durability. The first sleepers sent to India, were half-round timber, thoroughly penetrated by the oil, and they had resisted both decay and the white ant. At Lowestoft harbour which was infested by marine worms, the prepared timber piles were, after four years immersion, quite untouched, whilst the unprepared timber was thoroughly destroyed. The best timber for use was young growing wood, thoroughly dried; if it was fresh cut, or had been floated, so as to saturate the pores with water, there was great difficulty in creosoting it, as the water in the pores prevented the entrance of the coal oil, even under a pressure of 120 lbs. per square inch. This led to the institution of experiments, as to the best method of getting rid of the moisture; ordinary desiccation was found to be too tedious, so he at last tried a system of smoking the timber, in a close stove, or oven, with double walls filled in with ashes, where wet timber in sticks of 15 feet, or 20 feet long, would in twenty-four hours, lose as much as 8 lbs. per cubic foot of moisture, and would if immediately plunged, whilst hot, into open tanks of creosote, absorb nearly 8 lbs. per cubic foot of oil, without pressure.

This system of smoking timber, might be advantageously used, for building purposes, as the empyreumatic acid and volatile oil, in the smoke, penetrated into the wood, and, whilst it dried it, aided in its preservation. Of course the process of Creosoting could not, on account of the odour, be applied to building timber. The process was at first performed, by putting the wood into a closed wrought-iron cylinder, 50 feet long and 6 feet diameter, from which the air was exhausted by an air-pump, and the oil forced into the pores of the wood, at a pressure of 60 lbs. to the inch, but by this plan a sufficient quantity of the oil could not be forced into very long timbers, and therefore the present improved mode was, first to dry out all the water from the pores of the timber, in the drying, or smoking-house, and then to put it into the cylinder and to force in heated oil at the pressure of 170 lbs. to the square inch. The heat was kept up, in order to prevent the crystallizing of the Creosote in the pores of the wood, during the process. Under this system, the timber easily absorbed from 10 lbs. to 12 lbs. of oil per cubic foot. For railway works 7 lbs. per cubic foot, would suffice, but for marine work, it was better not to have less than 10 lbs. per cubic foot.

In 1848 there was a large speculative importation of sleepers, many of which remained unsold, and being stacked in the air, for some years, in the docks, became thoroughly seasoned, and many of them full of 'shakes,' or wind cracks; these, when plunged into the open tanks, were soon perfectly saturated with creosote, and absorbed a larger quantity than was at all necessary. If the Scotch larch sleepers, before being sent here, were stacked and dried, they would benefit more from the process of Creosoting, and would endure much longer.

Mr. Bethell had experienced so much difficulty in procuring a proper quality of oil of tar, that he was compelled to establish manufactories and to distil it, to suit his own purposes. Without entering into the chemistry of the manufacture, it would suffice to say, that in distilling the coal-tar obtained from the gas-works, the first product got rid of was, the ammonia which was the prejudicial substance, in the use of raw gas tar, and which dried up and destroyed the wood it was applied to; then came a light empyreumatic oil; and then the oil of tar, called Creosote, because it contained a certain amount of that substance. The product of Newcastle coal contained a quantity of naphthalin, which passed off in distillation after the naphtha; this was not liked by some Engineers; but Mr. Bethell was an advocate for its use.

The Pitch, or residuum of the distillation, on being subjected to a further process, produced coke of peculiar purity, quite free from sulphur, and earthy particles, in fact nearly approaching to pure carbon; it had been used in Birmingham for remelting iron, and it was found that the furnace could be blown clear out, without leaving any slag.[1]

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[1] In reporting upon this coke, Dr. Ure says:—"This coke consists of carbon, nearly pure, being entirely free from the sulphur present in all coke, obtained from coals, and therefore admirably adapted to the refining of iron, into a state fit for making steel, and also bar iron of the best quality. It contains, besides carbon, merely from 3 to 4 per cent. of ferruginous ashes. It affords intense heat in burning."—[EDITOR.]

In answer to questions from Members, Mr. Bethell said it was probable, that any metallic salt, would corrode the iron bolts and fastenings, inserted into timber so prepared. The natural juices of some woods did this; as was exhibited by the specimen on the table, wherein a bolt which had united a beam of elm to one of pitch pine, was corroded almost entirely through, at the junction of the two woods.

He could only account for any difference, in the degree of saturation of various pieces of timber, from the same tank, by supposing that some were sap-wood and the others heart-wood.

He was not at all satisfied with any of the experiments he had seen, on the comparative strength of prepared and unprepared timber. Timber, whilst wet, was stronger than after being dried; and it was not improbable, that the drying and the subsequent saturation of the pores, by a foreign matter, might have some influence on the elasticity of timber, though he doubted its materially reducing the strength.

Mr. Hawkshaw said uniform strength was so important, in engineering structures, that however desirable it might be to prevent decay, if this could only be attained by the employment of a process which was liable to injure the elasticity, or to diminish the strength, it was preferable to use only the best quality of timber at a good price. He certainly would not recommend the use of sap-wood, because of its power of absorbing Creosote; indeed, for any purpose of resisting impact, or bearing strains, nothing but the best timber should be used. It would be safer, and more economical in the end, to pay greater attention to the quality of the wood than to rely on any process for preventing decay. He had laid down baulks of yellow pine in 1836, and had, on a recent examination, found them in a good sound condition, although they had not been submitted to any process. He had also examined some timber which had been Kyanized, and found that the solution of corrosive sublimate had not penetrated beyond the outer coats of the wood, and in some cases only to the depth of a little more than one-tenth of an inch. It should be stated that this was only by immersion, and not applied under pressure.

On a line of railway where he had recently replaced a quantity of longitudinal timbers, originally of good sound yellow pine baulk, the timber was generally perfectly sound and free from decay, although from the scantling being too light for the traffic, the rails had worn into the timber to a considerable depth, and had rendered necessary the removal of the baulks. If for such uses, good sound yellow pine was selected, without sap-wood, and exposed for a sufficient period to light and air, it would last longer, free from any appearance of decay, than it would resist the crushing effect of the force travelling over it; therefore, it might be stated, that Engineers could not adopt a more fatal system than to use inferior timber, merely because it would readily absorb creosote, or any other antiseptic.

He had tried all the principal systems, and would not generally employ any except Creosoting. Kyan's was inefficient, Burnett's was not satisfactory, and Payne's rendered the wood brittle. He had certainly never seen an instance of decay in creosoted timber, even in the most unfavourable position; still he did not think it was practicable to force any solution, by pressure, into the pores of timber, without injuring its elasticity and strength; how far the same effect would be produced by the system of absorption of Creosote by hot timber, described by Mr. Bethell, it was not possible to say without direct experiment.

Lieutenant Jackson, R.N., thought that erroneous opinions were entertained of Sir William Burnett's process; it was entirely chemical. The influence of the chloride of zinc appeared to pervade the entire log of timber, and he had never seen an instance of metallic salt having been removed from the wood, after it had been properly saturated.

Mr. J. T. Cooper said the decay of wood by dry-rot might be traced to the putrefying of the sap, or, in other words, to the process of the circulation of the sap, as when growing, not having been arrested. This was done either by soaking timber in water to wash out the sap,—by exposing it to the sun and wind, to dry up the sap naturally, or by baking to dry it up artificially; or else by injecting some metallic salt to combine with the albumen, or some antiseptic, or other substance; such were all the processes he had examined.

Many specimens of variously-prepared timber had been submitted to him professionally for examination; among others, some portions of Kyanized piles from Dover harbour. After nearly three years immersion in the sea, no traces of corrosive sublimate remained in them. He had also examined many specimens of timber, canvas, cordage, &c., which had been "Burnettized," and, after long immersion in cold water, he always found evidence of the chloride of zinc. Portions of timber so prepared were burned, to destroy the fibre, and in the ashes he found oxide of zinc. He then took some sawdust, moistened it with the solution of chloride of zinc, dried it, charred and consumed it, and in the residuum he found traces of the oxide of zinc, showing how intimate was the combination of the metallic salt with the timber. He believed there was a great facility in the albumen for combining with the chloride of zinc, and that the compound formed was not soluble in cold water.[1]

Captain Moorsom had tried the processes of Kyan and Margary somewhat extensively; the first required great care, and even then the results were not satisfactory. The preservation of the timber was not insured, and the transverse strength was injured to the extent of three, or four per cent., although the process was not performed under pressure. To satisfy himself on this point, he caused some experiments to be made in 1839, placing them under the charge of Mr. G. D. Bishopp.

The corresponding pieces, between which the comparisons were made, were cut out of the same plank, each side by side with its fellow. One of these pieces was then prepared by Kyan's process, in the usual way, but without pressure, and the other was left in the natural state.

The transverse clear bearing was, in every case, 36 inches.

The length of each piece was 42 inches.

The weights were suspended from the centre of each piece, in ordinary cwts., half cwts., and lbs.

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[1] Vide "Account of Sir W. Burnett's Process for the Preservation of Timber, Canvas, Cordage, &c." 8vo. Tract. London. No date. And "Report of the Proceedings and Evidence before the Privy Council on the Petition of Sir W. Burnett, for the extension of his Patent," &c. 8vo. Tract. London, Feb. 7, 1852.

The following were the results:—

AMERICAN YELLOW PINE.

Pieces in the Natural State.			Pieces prepared by Kyan's Process.		
Sizes.	Marked.	Broke with.	Sizes.	Marked.	Broke with.
Sq. In.		lbs.	Sq. In.		lbs.
$1\frac{1}{4}$	A	232	$1\frac{1}{4}$	C	182
,,	B	252	,,	D	252
,,	F	308	,,	G	294
$1\frac{1}{2}$	I	539	$1\frac{1}{2}$	H	525
,,	L	476	,,	M	469
1	Q	161	1	P	154
ARCHANGEL DEAL.					
1	5	210	1	6	182

The piece marked C broke suddenly, at a knot near the centre, and in any resultant, it seems proper to throw this piece, and its fellow, marked A, out of the scales.

The result, in the aggregate, of the American pine (exclusive of the pieces A and C), shows that the ratio of strength, in the natural state, was as 1,736 to 1,694 in the prepared state, or as 1,000 to 976.

And in the Archangel deal, the ratio of strength, in the natural state, was as 1,000 to 867, in the prepared state.

He was inclined to think well of Margary's process, as timber which had been left in copper mines, and had been saturated with the mine water, appeared to be very hard and almost indestructible.

Mr. WALKER said that in the year 1837-38 he caused an apparatus to be erected for Kyanizing the sleepers used on the Hull and Selby Railway; the process was first by exhaustion, and then under pressure. He had every reason to be satisfied with the result, as none of the sleepers had shown any symptoms of decay. He believed that dry-rot in timber was a local disease, and if the diseased parts were once cleared away, the return of the disease need not be feared. This was frequently shown on board vessels, where, after a searching investigation and cutting away of faulty planks and timbers, the dry-rot was completely eradicated. He believed the best preservative for timber was the natural process of air-seasoning, by being stacked for a considerable time in the docks. 'Greenheart' timber, unprepared, was generally found to resist the marine worms, even in the worst situations.[1] An instance was on record of a ship, in the port of London, having nearly the whole of the bottom planking eaten into by worms, with the exception of one plank, which proved to be of Greenheart timber. As a general rule, the worm was a more serious enemy to deal with than the dry-rot.

Mr. Rendel,—President,—said that Mr. Hartley, had great confidence in the durability of Greenheart timber, which he used for sheathing dock gates, for the cills of sluices and other purposes where the failure of ordinary timber might produce serious effects. It was however unfortunately so expensive, costing from 4*s*. to 5*s*. per cubic foot, that its use for piles, or other large timber works, was almost prohibited.

He recalled to the recollection of the Members some specimens of timber from Western Australia, called "Jarrah" wood, which had been exhibited at a meeting of the Institution in the Session 1849-50.[2] That wood was stated to possess the property of resisting the worm and the white ant; to be easily procured of any dimensions, and at a reasonable cost; if that statement was correct, the announcement was important, as the introduction of such a timber would be very useful to engineers and naval architects.

Mr. Brunel, V. P., had employed the various processes very extensively, and latterly he had used Sir William Burnett's system, as he had found it efficacious and less expensive. It would however appear, that but little was positively known of the relative value of the various preparations, or of the mode of using any of them. Instances were given of unprepared yellow pine enduring for seventeen years without decay, and then only being removed because it was destroyed by the weight of the traffic passing over it. The best antiseptic preparation could not have accomplished more than that. It did however appear, that the injection of Creosote enabled the timber to resist the marine worms. Mr. Brunel had found this in piles so prepared and used at Plymouth and on that coast, which was

[1] Vide "Minutes of Proceedings, Inst. C.E., 1840," vol. i., page 84.
[2] Vide "Minutes of Proceedings, Inst. C. E., 1849-50," vol. ix., p. 40.

much infested by the worm. The metallic salts did not appear to have the same effect on animal life. Perhaps this might, in some degree, be attributed to insufficient preparation, or more properly speaking, to some amount of carelessness in the preparation, or the use of indifferent material. In spite of all assertion to the contrary Mr. Brunel must maintain, that he had seen some very bad Creosote and had prohibited its use; as he was convinced, that unless good Creosote was employed the timber was damaged.

His present experience induced him to prefer the use of chloride of zinc for all purposes, under cover, and creosote for out-of-door use. He was of opinion, that the former, when properly applied under pressure, did enter the heart of the timber, and as the latter was readily absorbed by the sap-wood, whenever it was desirable to prepare the timber thoroughly, and expense was not a material object, both processes should be employed; the salt first and the Creosote afterwards. Dry-rot, the effect of damp, and the attacks of the worm would thus be equally guarded against. Thorough preliminary drying was essential under all circumstances.

It was stated, that Dr. Faraday had found traces of corrosive sublimate in the heart of a piece of pine timber 26 inches square, prepared by Dr. Kyan's process under pressure.

Mr. Vignoles corroborated the statement, as to the durability of good, well selected, dry yellow pine; he had found unprepared sleepers, laid under such circumstances, perfectly free from decay, after being down for sixteen years, and they had only been removed because they were literally crushed by the traffic; that alone, by inducing shakes which let in the water, would have sufficed, with an inferior quality of timber, to have caused decay. It appeared to be an admitted fact, that the injection of Creosote did effectually preserve the timber from decay and enable it to resist the attacks of marine worms; these were valuable points, and as it was stated, that previous drying rendered the process more effective, he would suggest the employment of steam of high density (vapeur rouge) at a temperature of 400° or 500° Fahrenheit, driven through the cylinders at considerable velocity, so as to pass among the logs of timber.

Mr. Bethell had already directed his attention to that system of desiccating, and had in fact incorporated it in one of his patents in 1848, but from further experience he was inclined to prefer his present stove; it was less expensive, and more easy to work than the high-pressure steam, and he attributed a powerful effect to the antiseptic property of the smoke in the drying stove.

Mr. Davison, through the Secretary, said he must offer his testimony in favour of the system of creosoting timber, for all purposes where it was exposed to wet. He was of opinion, that the process of desiccating was most essential for the success of any preparation, as it was only by the removal of the sap and moisture from the capillary tubes of timber, that it could be preserved from decay. Impressed with this, as an axiom, he had paid great attention to a process for desiccating timber, by means of heated air, and would explain to the meeting a slight sketch of the system, and of the effects produced.

The desiccating process, consisted in rapidly impelling currents of highly-heated air through a chamber, or chambers containing the wood; spaces being left between the ranges, or tiers, for the heated air to act uniformly upon all sides of the timber; the moisture, as it was evolved from the surface, was instantly driven away through openings left for that purpose, the wood remaining in the chamber until it was ascertained, by weighing a sample from time to time, that the whole of the aqueous matter had been expelled from its pores. This was the substance of the process; but, the practical and successful working of it depended upon a variety of details and circumstances, which he would endeavour to describe.

1st. Different woods, and different thicknesses of wood, required different degrees of heat.

2nd. Hard woods, and thick pieces of wood, required a moderate degree of heat, from 90° to 100° Faht.

3rd. The softer woods, such as pine, might be safely exposed to 120° or even to a higher temperature; and when cut exceedingly thin and well clamped 180° or 200° Faht. had been found rather to harden the fibre and to increase its strength.

4th. Honduras mahogany, in boards of one inch in thickness, might be exposed, with advantage in point of colour, beauty, and strength, to a heat as great as 280° or 300° Faht.

As a proof of this, a slab of Honduras mahogany 1½ inch thick, cut fresh from the log, was wholly deprived of its moisture, amounting to 36 per cent., by exposure to the temperature of 300° for 50 consecutive hours.

This was however only stated, to show that a high degree of heat might be applied, when for some purposes it was considered desirable, as for instance, for cabin-fittings near to boilers, or for furniture for tropical climates, &c., but in practice it was found, that from 115° to 120° enabled almost every kind of wood, in slabs of moderate thickness, to go on steadily and safely towards complete desiccation, in a comparatively short space of time, for instance, one week to every inch in thickness, within a certain limit, say up to 4 inches thick in 4 weeks,—6 inches thick in 7 weeks,—8 inches thick in 10 weeks, and so on in something like that ratio. This, however, supposed the current to be kept up only during the day of 12 hours, and then the chamber to be closed until the following morning, that being the customary mode of working, but in the example just quoted that which ordinarily occupied nine, or ten days, according to the usual practice, would be done in little more than two days and nights, under a continuous and increased temperature. By a proper arrangement of chambers for different woods, and various thicknesses, and likewise a proper system of adjusting the temperature of the currents, suited to continuous day and night work, almost every description of wood might be thoroughly seasoned, in little more than three days, on an average, for every inch in thickness. Many instances of exceedingly quick, and at the same time, successful seasoning, could be adduced, but there were some woods which would not admit of such treatment. English oak required considerable care. Such timber should never, under any circumstances, be exposed for any great length of time to a higher temperature than 105°. A higher heat was proved to act upon the gallic acid, or on the fibres, in some peculiar way, so as to cause internal fissures, as though numerous small explosions had taken place; but such appearances did not present themselves, until after several days' exposure to the heated currents, and no appearance of fissures, or cracks were to be found on the external surface.

Heat without a current, like that of an oven, and heat in a moving state, were totally different in their effect upon wood. In the one case the fibre was rendered short, brittle, and weak, in the other, all that was valueless was driven away,—the albumen became solidified, or coagulated, and the fibres were rendered much stronger and more rigid.

It had been found, that 100 feet per second was the best velocity, and, with a proportionate area of inlet pipe, was a sufficient volume to cause a complete displacement of all the air and moisture in the chamber, in three minutes; or, in other words, supposing a desiccating chamber, to contain 30,000 cubic feet, it was usual to propel into it 10,000 cubic feet of air per minute; always taking care, that the area of the outlet, or outlets for the escape of the moisture, should be something beyond the area of the inlet; in this system no moisture could under any circumstances remain lodged about the timbers, but was instantly expelled through the ventilating apertures.

One of the most convincing proofs of the efficiency of the system was to be found, in the fact, that Her Majesty's Board of Ordnance had, during the last four years, employed it for seasoning nearly the whole of the gun-stocks required for the service. It was formerly the practice for the Government, previous to the adoption of the process, to have about 400,000 stocks in the course of seasoning, all requiring to be turned over once, or more every year, to prevent the ravages of the worm, or decay; whereas they could now, by the use of the desiccating process season about 10,000 stocks in the course of two, or three weeks, at a very trifling cost.[1]

[1] In a Report, dated from the Tower, June 2, 1849, Mr. Lovell, H.M. Inspector of Small Arms, states:—"I will candidly confess, that from the failure of all the experiments I had previously made, or read of, for seasoning wood, by means of steam, hot air, boiling water, &c. &c. (and they had been numerous, and most carefully conducted), I was prepossessed with the idea, that a large proportion of those first sixty stocks would be spoiled; but at the same time, I was determined that the desiccating plan should have a full and fair trial: one half of the number were quite fresh cut, and green wood; the other moiety had been about twelve months in store; the total weight, before the process, was 536 lbs. 9 oz., and after ten days' exposure to a current of air, heated to 110° or 114° Faht., that weight was reduced to 413 lbs. 14½ oz.; that is to say, 122 lbs. 10½ oz. of moisture had been driven off. Some of the stocks had been purposely selected with sun cracks in the butts, and other faults; for I expected, that those cracks and faults would be exaggerated, by the heat of the chamber; but the result was not so—on the contrary, they were closed, considerably, behind the marks that had been stamped upon the ends of them, before they were put in, and the whole number of stocks came out in good condition, and fit for immediate use. [It

In laying down the ornamental flooring of the New Coal Exchange, about three years since, where green and almost wet woods were used, in no case did one out of the 4,000 pieces, of which the floor was composed, exceed ten days in seasoning. The floor had stood well—no part having exhibited symptoms of shrinkage, except in a few instances where the workmen were short of material, and in the hurry had to make use of such as had not sufficient time allotted for its seasoning. The floor had cost nearly £800.

It was a well-known fact, that flooring-boards, after being down for upwards of a century, on being taken up, and having their edges "re-shot," would again shrink, nearly as much as though they had never been seasoned. This must arise from the fact, that all woods received an external hardening, or casing, from exposure to the atmosphere, which prevented the whole of the moisture from escaping; and thus after the skin was removed, and the wood was allowed to breathe again, another shrinkage ensued. Not so with wood which had been exposed to an artificial mode of seasoning, under a continuous artificial current and temperature. This point had been

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"It would be tedious to go into the detail of all the other tests that the process has been put to; it may suffice to say, that after every possible trial, all my doubts have been removed, by the only safe guide, that of experience; and it gives me great pleasure to be able to state, that the desiccating process, as applied to the seasoning of walnut wood for musket stocks, is entirely satisfactory. The wood is better seasoned, than when dried in the open air; 1st. Because the albumen, being dried in the pores and capillary tubes, renders the fibre stronger and less liable to absorb moisture. 2nd. The wood is stronger, tougher, and of course more capable of withstanding the effects of violent vibration, from the lateral adhesion of the fibre being better preserved. 3rd. It works smoother and more waxy under the chisel, and has less tendency to 'speel' and crumble away, which is generally the great fault of steam-dried timber.

"I have now worked nearly 30,000 desiccated stocks, none of which had been under the process more than twenty-one days, and my opinion is very decided, that the wood is more thoroughly seasoned, and with much greater certainty, than if it had been merely exposed to the open air, in the usual way, for three, or four years.

"The Desiccating Chamber, erected in the Royal Manufactory at Enfield, continues in full activity. The heat is kept down to a medium degree between 90° and 100°; and at this temperature, it delivers the stocks, perfectly seasoned, in fourteen to sixteen days, according to the quality of wood—whether of sap, or heart; and I propose to subject the whole of the stocks to it in future, whether they have been air-dried previously, or not; in order to make sure that the whole shall have been equally seasoned."

accurately tested, and it was found that no second shrinkage occurred, after being properly treated with the heated currents.

A number of very interesting experiments were made for the Admiralty, but in consequence of want of attention to minutiæ, although they were sufficiently convincing for all who followed the course of experiments, they could scarcely be given intelligibly otherwise than by diagrams, which were exhibited.

As to the effect of currents of hot air upon wood: about six years ago, in a chamber erected for seasoning wood, there were placed a considerable number of bearers, to act as supports for the timber sent to be seasoned. These bearers were still in use, after being subjected night and day for that period, if not always to the currents, at all events to 115° or 120° of heat, which the chamber invariably stood at. All were found to be perfectly sound and in first-rate condition: one of them a piece of Riga pine, showed considerable external wear and tear; but without in the slightest degree being affected in the inside; another piece of American elm did not show any external rubbing, or wear and tear. They proved very decidedly, that the process alluded to, did not, though continued for such a length of time, injure in the slightest degree, the fibre, or strength of the wood.

M. Boutigny (d'Evreux), through the Secretary, said it was admitted, that the decay of timber arose from the action of humidity and of the oxygen of the atmosphere, which penetrated to the heart by absorption and infiltration; this action was active upon the fibre, and engendered a slow and spontaneous process analogous to what had been designated by Liebeg as 'eremacausis.'

These elements of destruction appeared to act chiefly from the ends of the timber, following the natural course of the sap. If then, it was argued, after thoroughly depriving the timber of moisture, the ends of the pores were hermetically sealed, all absorption would be prevented, and there would not be any tendency to decay. Acting upon this principle Mr. Boutigny had, in conjunction with Mr. Hutin, introduced a system, chiefly adapted for beams and timbers for buildings, the extremities of which were peculiarly liable to decay from dry rot, where they were fixed into the walls, or where there was not any circulation of air. The process consisted in desiccating the timber, partially charring the ends, and then immersing them in oil of Schistus, or some analogous substance, which penetrated with rapidity; then after blazing off the ends, they were plunged, for the length of a few inches, into heated pitch, tar, or gum-lac, the mastic was slightly absorbed by the pores and fibre, and the ends were completely sealed against the entrance of either moisture, or air. If considered necessary, it was, under certain circumstances, advantageous to pitch the whole surface of the timber.

They had been induced to introduce this process, because they were convinced of the inefficiency and of the generally prejudicial effects of the ordinary methods of preserving timber.

Corrosive sublimate (Chloride of Mercury) was expensive, and produced ill effects on the health of persons inhabiting buildings, where the timber so prepared had been used.

Arsenious acid was cheaper, but was so dangerous as to have been abandoned. The chlorides of calcium, of sodium, and of zinc, were deliquescent, and there was some doubt as to their chemical action.

The sulphates of copper and of iron, had been much used; the former was dangerous, and moreover it was apt to corrode the fibre of the wood and thus to render it permeable to moisture; also by the combination of the oxygen with the wood and the consequent disengaging of the sulphuric acid and its action on the fibre, the strength of the timber was liable to be injured. The same objections held good, to a certain extent, against the sulphate of iron; it was well known how soon a spot of iron-mould became a hole in a piece of linen, which was composed of vegetable fibre.

Of all the systems hitherto proposed, that of injecting resinous oils was the most rational, and scientific, although the most ancient of which there was any trace, and it did appear, as far as M. Boutigny's limited knowledge of English permitted him to judge, that the statements made in the paper and by Mr. Bethell were calculated to be very useful. He regretted being obliged to make his communication in French, but trusted to the indulgence of the Members in receiving the Secretary's translation of his remarks.

LIEUTENANT JACKSON, R.N., exhibited specimens of timber, rendered uninflammable, by Sir W. Burnett's process (Chloride of Zinc). It was stated, that in the most intense fire, timber, or even linen, so prepared, could only be charred, and would never burst into flame. This process was calculated to be very useful in shipbuilding, and was now extensively used in H. M. Navy.

Mr. Bidder, had been much interested in discovering a process which would effectually protect timber from the worm, as the harbour at Lowestoft was, perhaps, more infested with marine insects than any other port in England. He, therefore, examined carefully into the results of all the systems. Mr. Gibbons assured him, that Kyanized piles only resisted for one year, at Kingstown harbour; after that time they were speedily destroyed. Payne's process utterly failed at Fleetwood, and the reports from other quarters, as to the other processes, were so discouraging, that he resorted to the use of Creosote. At the beginning, some of the piles were inefficiently operated on, and the worm had made partial inroads, but they soon got into a good system, and had been very successful. For piles he would advise a longer time, than usual, being devoted to the process, in order that the heart-wood might be penetrated. He was now trying the system of boring an inch-hole vertically to some depth in the centre of the pile and keeping it constantly supplied with Creosote. He thought this would tend to the preservation of the piles.

On the Northern and Eastern Railway the prepared sleepers, laid twelve years ago, were still in excellent condition; indeed if it were always possible to command a good quality of timber, and proper precautions were taken, in draining beneath them and admitting the air, the timber would last a very reasonable length of time, but when works were required to be executed in great haste, timber of inferior quality was brought on to the ground and was of necessity used, to avoid the greater loss, by the non-performance of the work within a given time; thus such a system as Creosoting had become so useful, as by it inferior timber was rendered even more durable than good wood.

Mr. Errington said the result of his experience was, that if really good Scotch larch was used for sleepers, with even ordinary care in draining the ballast, the timber would be found in a good state, as to soundness, at the end of fourteen years, and by that time the seats of the chairs would probably be so galled and worn away, as to require the renewal of the sleepers.

Mr. Rendel (President) said all Engineers having to erect timber structures must be interested in this subject, as it was not always practicable to obtain a proper quality, therefore it was a great boon to have, by some process, the means of giving durability to inferior qualities of wood. The marine worm was a sad foe to timber structures on some parts of the coast, and in many of the estuaries. Such was the case at the Royal Pier at Southampton, and there the 'Terebrans' had, within four years, reduced pine baulks of 14 inches square to about 4 inches; all kinds of preparations had been tried, but hitherto unsuccessfully. In order to test the efficiency of Creosote, he had, in 1848, requested Mr. Doswell the resident Engineer, to have attached to the piles which were most eaten by the worm, some specimens of timber, prepared by the processes of Payne and of Bethell, as such a practical test was more valuable than all theory. The result was exhibited by the specimens laid before the meeting. The pieces of fir timber had been attached to the piles on the 22nd February 1848, at the heights of low-water of spring tides; low-water of neap tides; and high-water of neaps. They were detached in January 1853, when it was found, that whilst the pieces of unprepared and the 'Payneized' timber were entirely converted, by the worm, into masses of disintegrated fibre, the Creosoted timber remained perfect and was untouched by those marine insects.

As it was very desirable to have an opportunity of testing the value of a system of preparing timber, the President offered permission to any one, to attach, in an identical position, specimens of timber prepared by any process, and to bring them, after a given time, before the Institution, to enable the merit of the system to be practically ascertained.

He was so convinced of the superior efficiency of the Creosoting process, that he devoted great attention to its being thoroughly performed, at Leith and on other works under his direction, and he recommended Engineers not to be satisfied with the ordinary mode of Creosoting; but to have the timber weighed into and out of the cylinder, to test the absorption by the actual increase of weight, and not to consider the process complete, unless 7 to

10 lbs. of Creosote, by weight and not by measure, had been taken up by each cubic foot of timber.

Greenheart timber, which had been mentioned, was full of a powerful empyreumatic oil, to which was due the power of resisting the attacks of marine insects. In Demerara it was familiarly called 'torch-wood,' because it burned as freely as pitch-pine torches. It cost in England about 4*s*. 6*d*. per cubic foot; whereas creosoted pine cost about 2*s*. per cubic foot.

January 18, 1853.

JAMES MEADOWS RENDEL, President, in the Chair.

The discussion upon the Paper No. 881—"On the Preservation of Timber," by Mr. H. P. Burt,—being continued, was extended to such a length, as to preclude the reading of any other communication.

January 25, 1853.

JAMES MEADOWS RENDEL, President, in the Chair.

At the conclusion of the discussion "On the Preservation of Timber," The PRESIDENT directed attention to the Dublin Exhibition, and Mr. C. P. Roney, Assoc. Inst., C.E. (the Secretary), stated, that the undertaking was progressing most favourably, the original size of the building would be nearly doubled, and to meet the additional outlay, Mr. Dargan had increased his donation from £20,000. to £50,000.

It was believed, that the department of machinery in motion would be quite as interesting and attractive as that in the Great Exhibition of 1851, in London.

The Society of Arts (of London) had determined, that their East Indian Exhibition and all the influence of their body should be transferred to the Dublin Exhibition. There would also be a Mediæval court, and an Archæological collection, which would show that Ireland, though of late years not progressing