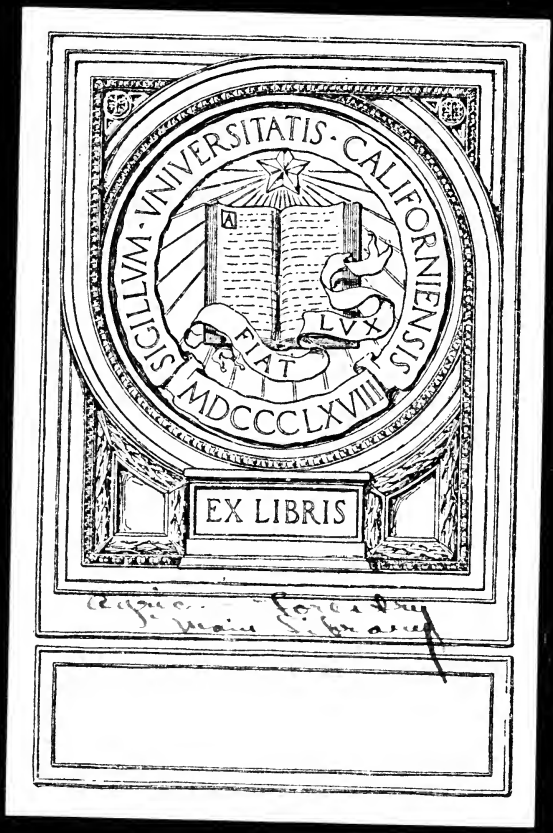
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A LECTURE

ON

THE DRY ROT,

AND ON THE MOST

EFFECTUAL MEANS OF PREVENTING IT;

DELIVERED BEFORE THE

INSTITUTE OF BRITISH ARCHITECTS,

APRIL 3, 1837,

BY ROBERT DICKSON, M.D., F.L.S.

Mess.rs Longdigges
with the Author's Comp.ts

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LONDON:
J. AND C. ADLARD, BARTHOLOMEW CLOSE.
1837.

A LECTURE,

&c.

The utility of timber, when employed in the construction of edifices and other arts of life, is greatly lessened by its perishable nature. Another unfavorable point in its character is, that it cannot be taken like the metal from the mine, and subjected to a few manipulations or processes, generally speedily performed, and then applied immediately to the purpose for which it is intended. In all cases where wood is wished to be durable, it must be submitted to processes which have hitherto been tedious, and attended with the loss of capital, thus rendered inactive during the years which were required for their completion. These processes are termed seasoning and drying; which are accomplished either by the natural powers of the air, to take up, and

carry off superfluous moisture from any body which will readily part with it, or by immersing the timber in water, which dissolves out the mucous and other viscid soluble principles which have a tendency to retain much of the moisture, and thus permit the more speedy evaporation of the watery part, upon the removal of the timber to a dry atmosphere, where there is a free circulation of air, by which the process is expedited; or, to render it still more expeditious, recourse is had to boiling or steaming, the higher temperature rendering the solution of many of the principles more easy.

Of all these means steaming appears to be that which facilitates the process to the greatest degree, "the seasoning going on more rapidly after the piece is steamed than when boiled." (*Barlow on the Strength of Timber*, p. 14.) By all of them a loss of weight is occasioned. Steaming, or boiling, "impairs the strength and elasticity of timber;" but Mr. TREDGOLD thinks "it gives another property, which for some purposes is still more desirable than strength; for boiled or steamed timber shrinks less, and stands better than that which is naturally seasoned." (*Carpentry*, p. 157.) The most expeditious of these processes still requires months for its completion, and the wood is

generally squared before even commencing them, by which a large quantity of timber is rendered useless for the purposes of construction.

The object of all of them is to counteract, or, more properly speaking, to postpone the operation of those causes of decay which are inherent in wood and all organized bodies. They effect this, however, in the majority of cases, in a very limited and inadequate degree; for still decay occurs, and succeeds in reducing these structures to dust and ashes. But that more effectual means exist for retarding this event, it will be a part of my office, this evening, to demonstrate. Decay may occur while the tree is yet standing, and is indicated by the death of the main-top (*couronnement,* of French writers), and which is generally the result of the infiltration of water into the interior of the tree, by natural cracks or accidental openings, which gradually affects the internal part of the wood, and occasions its decomposition. This extends from the heart outwards; the external or young parts resisting for a longer time,—and hence those shells of ancient trees which we frequently meet with. The progress of this kind of decay undoubtedly continues after the tree is cut down, and even fashioned, and applied to use: the order of march, however, is still the same; the layers,

or circles, successively becoming decomposed, according as they are near the centre. The whole process is slow in its operation, often requiring forty or fifty years to destroy a beam of moderate dimensions:—though this kind of decay is important, it is not necessary to speak further of it, as there exists so simple and effectual a remedy, viz., cutting down the tree before it shall have passed its zenith.

The other kinds of decay to which timber is liable are termed the *common rot*, and the *dry rot*. "The former," Sir John Barrow considers "to be occasioned by alternate exposure to the vicissitudes of the weather,—to moisture and dryness, and to heat and cold,—hence, frequent at the point where a pile is between wind and water, or where a beam enters a wall: in the latter case, the progress is from without inwards." (*Supplement to Ency. Brit.*, Dry Rot.) As the causes here are extrinsic, protecting the wood against them is often sufficient; for this purpose painting, coating with tar, &c., are had recourse to.

Widely different is the case with the *dry*-rot, the causes of which are inherent in the timber, and only require the concurrence of a few external conditions to come into action. It has

been, with propriety, proposed to designate this malady *sap*-rot, since the elements of it chiefly abound in the outer-layers of wood, and, when its direful action has begun, proceeding from the more external to the internal layers,—the entire structure, however, soon becoming involved.—The reasons of its commencing in the sap-wood are to be found in an attentive consideration of the nature of that part of the vegetable fabric.

It has been adduced as a proof of the acute observation or the physiological knowledge of Dante, that he made the youngest son of Ugolino to perish first of inanition,—the result of a principle which is nearly universal, and applicable to all young structures. The operations of life go on in them more rapidly, there is more activity in the processes of deposition, and altogether a more abundant fluidity, by means of which the nutritious particles are conveyed to their ultimate destination. Further, in the case of trees, the ascending sap, which consists of about 99 parts in the 100 of water, passes in a tree of any age, along the layers of sap-wood, they only remaining pervious, for the older layers are closed and consolidated by those juices of an insoluble nature which have been elaborated by the action of the leaves during several preceding years.

It is requisite to know that eacn annual layer of wood is formed by the descending fibres developed by the bases of the buds situated along the stem and its branches. It requires the action of the leaves, for several successive years, upon the sap, which is conveyed to them for this purpose, to prepare those juices which are ultimately deposited in the layers previously formed, and by which the layers of sap-wood are converted into heart-wood. These principles are generally of a very insoluble nature, and confer both solidity and durability upon the parts where they are lodged. If, therefore, a tree be felled while young, there will be much sap-wood, or a large proportion of the stem will consist of the mere basis of the vegetable fabric, devoid of the principles of permanency, being, on the contrary, charged with gum, starch, or sugar, with a large proportion of albumen, and other fermentable materials, a large quantity of water being also present.

But even the least soluble of the ordinary constituents of wood—lignin, consists of 50 per cent. of water; so that there is no deficiency, in any part of the plant, of the materials of fermentation, which, when once begun, spreads with great rapidity. Nor is the alteration affected only by the play of affinities of the chemical principles

existing in the timber, aided by temperature and other atmospheric conditions, but fungi and insects come to the conflict; and, under their combined attacks, complete decomposition is brought about, all trace of organization is lost, and there remains only a mass of dry dust, similar to that which lines the sides, and lodges in the hollows of decaying trees.

I need not here either describe the ravages, or state the signs of the presence of this malady, the real nature of which seems to consist in the fermentation of the elementary principles,—the kind of fermentation being determined by the atmospheric conditions, of which the chief is temperature,—for we know that the same material, viz., wood, and its juices, would yield by fermentation, under other circumstances, an acid. The putrefactive fermentation is that which occurs from the low temperature,—being the last spontaneous change which organized bodies undergo when deprived of life, "that mysterious principle which compels all the powers of decomposition to obey its call, to change their nature, and to become powers of recomposition."

This overmastering spell being dissolved, the ordinary laws of chemical affinity again come into operation, and by their means a compound body is reduced to its simple elements.

This series of actions occurs most readily where the elements are numerous; hence substances containing four principles generally putrefy more rapidly than those containing three, such as carbon, oxygen, and hydrogen, the general constituent elements of vegetable bodies; but, as albumen, gluten, and some other proximate principles of vegetable matter contain nitrogen, these seem to play the first part in vegetable fermentation; but, when the action, however, is once begun, starch, gum, and lignin, alike yield to its influence.

From all which circumstances it follows, that the sap-wood is the part in which the decomposing operations commence; and hence the propriety of the term *sap*-rot. With regard to the share which each of the destructive agents has in the whole series of actions, it is enough to state that the fermentation excited by the albumen is the primary and essential, the agency of insects and fungi being only accessory.—Insects attack vegetable structures, both living and dead, chiefly for the saccharine or mucilaginous principles which they contain, and aggravate the evil, principally by hollowing out the substance, and permitting the access of air and moisture; but the part performed by fungi is more obscure, and hence numerous erroneous

notions exist respecting them. Some have thought that they were examples of equivocal generation—an opinion which receives no countenance from any one who has carefully studied their nature, or the mode of their production. The minuteness of their reproductive matter allows them to escape observation when scattered; but this is always prepared in definite and fixed parts of the structure of those already existing, as much so as that of the seed of a rose or of an apple; but their number surpasses that probably of any other vegetables,—while their sporidia, or reproductive particles, can retain the power of vegetating as long probably as any seeds.

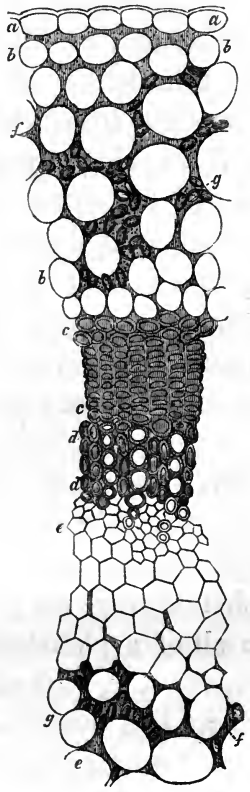
Mr. Francis Bauer, in his instructive paper (*Supplement to Penny Magazine,* March, 1833,) on the Uredo Fœtida, or Pepper-brand, a fungus which destroys the grain of wheat, states, "they are all of a globular form, and nearly of equal size, viz., $\frac{1}{1600}$ part of an inch in diameter,"—"so that no less than two millions five hundred and sixty thousand individual fungi would be required to cover one square inch." Their small size enables them to enter the minute extremities of the roots, or, what I deem not improbable, the stomata, which are relaxed and open in feeble plants, especially when the leaves are going to decay, and conveyed into the intercellular pas-

sages of the alburnum or sap-wood. Of the existence of these bodies in the stem of a plant, we have here ocular demonstration, in a plate copied from UNGER, representing the vertical section of the stem of Galium Mollugo, the dilated cells containing the Protomyces Endogenus (*Unger*,) developed in the substance of the coagulated juice of the intercellular spaces.

How they are roused into action, and what are their effects, may be stated in a few words. Fungi differ from almost all other vegetables in containing a large quantity of nitrogen, as an essential part of their constitution. They have dif-

FIG. I.

Vertical Section of the Stem of the Galium Mollugo.



a. a. Epidermis.—*b. b.* Cortical cells.—*c. c.* Cells of the liber or bark.—*d. d.* Wood.—*e. e.* Cells of the pith.—*f. f.* Dilated intercellular spaces, filled with coagulated juice of the plant.—*g. g.* Protomyces Endogenus (Unger) developed in the substance of the coagulated juice of the intercellular spaces.

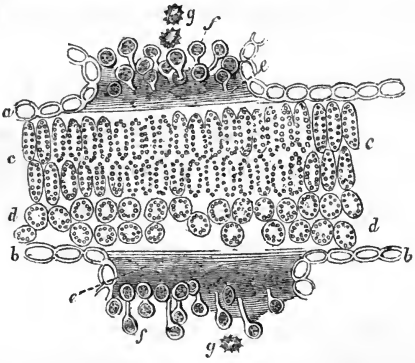
ferent habitudes with respect to air and light than other vegetables, they abstract oxygen from the air, which they never again exhale, but, on the contrary, exhale hydrogen and nitrogen.

It seems natural, therefore, that they should feed upon azotised substances, the more so that they have no power of elaborating nourishment for themselves, but are constrained to obtain it from sources where it already exists.

Hence they are all parasites, no fungus being ever found on a stone, or actually growing out of the earth, but always attached to some previously organized matter, either animal or vegetable, the juices of which they render subservient to their wants. The only principle common to animal and vegetable structures, which contains nitrogen, and which, consequently, could be available to the fungi, is albumen, on which, consequently, they prey.

Fig. II.

Vertical Section of the leaf of the Salix Retusa infected with Uredo Salicis.



But the albumen must be in a fluid state, or capable of becoming so, before it can enter the tissues of the fungi; for they cannot, any more than other vegetables, by their roots, take up even the proper materials of their food, unless it be in a state of solution. The germs of the fungi are roused into activity by the heat accompanying the fermentation of the albumen, and other fermentable principles, just as mushroom spawn is developed by the fermentation of the dung, &c., of a mushroom bed.

The abundance of fungi in autumn, while the earth and air are still warm and much vegetable matter is going to decay, shews how far heat aids in their development.

It appears to me, therefore, that the whole theory of any successful plan for the prevention of the dry-rot must resolve itself into *the solidifying or coagulation of albumen.* This will at once prevent the commencement of the fermentation, which decomposes the original structures of the wood, and the development of fungi; which are neither the cause of dry-rot, as held by some, nor the effect, according to others, but the incidental accompaniment, when their germs happen to be present in the tissues of the wood.

Now, this is precisely what is effected by the method of Mr. KYAN, and it matters not whether he invented it or merely extended a plan in use before or suggested by others; for, though it was suggested, both by Sir Humphry Davy and Mr. Chapman, before he brought his publicly forward, yet he who by his energy and perseverance brings the method into use, deserves to be regarded as the inventor.—Who, because hints of such an apparatus, or rather such a power, as that of the steam-engine, may be found in the Marquis of Worcester's Century of Inventions, would hesitate to regard James Watt as its practical inventor?—But, passing this question, let us take up others of more moment. Dugald Stewart has with justice observed, that the essence of the philosophy of Bacon, and of Newton, consists en-

tirely in "ascertaining the universality of a fact." It will, I apprehend, be proceeding under the guidance of that philosophy, if we attempt to ascertain how far the coagulation of albumen is attended with the preservation from decay of the substances in which it exists. The ancient Egyptians, whether from the peculiarity of their religious opinions, or from the desire so natural to the human heart to shun destruction, and gain perpetuity even for our dead bodies, prepared the corpses of their deceased friends in a particular way; and how perfectly this has preserved them, the occasional opening of a mummy permits us to see. The secret of this appears to be, independent of the careful exclusion of air, in the use of means to coagulate the albumen of the various fluids of the body. What the agent was which they employed to effect this, we now know very well; it was creosote, a principle which modern chemistry has isolated from its combinations.

Creosote is now extensively employed for the preservation of animal structures for anatomical purposes, as it coagulates the albumen, besides being the principle by which smoke-dried meat is preserved. Lest these analogies should not appear satisfactory, we may appeal to the wood found in a state of perfect preservation in the

bogs of Ireland and Scotland, Yorkshire, &c. Professor Don informed me that he has found, in the Irish bogs, at the depth of 18 feet under the surface, cones of the Scotch fir (Pinus Sylvestris,) in an entire and perfect condition. Now, as the Scotch fir is not, in the present day, a native of Ireland, these cones must have been produced many centuries ago, and owe their preservation, as well as that of the wood, in addition to the exclusion of air, to the creosote existing in the bogs, which, penetrating their tissues, coagulated the albumen, and rendered them insusceptible of decay. The principle, then, thus appears to have stood the test of ages, whether applied by the hand of nature or of man.

We must now enquire if the coagulation of albumen by other means resists the tendency to decay. Animal substances, from containing more nitrogen, are more disposed to speedy decomposition than vegetable; but anatomists have long employed corrosive sublimate to preserve their preparations, even the most putrescible—the brain, which it hardens in a remarkable manner. Botanists have long used a solution of corrosive sublimate in alcohol, known by the name of Smith's Solution, to preserve the specimens in their Herbaria from the aggressions of insects.

The collateral evidence of the utility of coagulating albumen, as a means of ensuring the preservation of the substance, seems ample enough.

We must now enquire how far this method confers durability upon timber for practical purposes. We know the extremely long period which some timber will last; but we also know how liable much of it is to decay; and, as no one can be sure that any given piece of timber which he intends to use, possesses the qualities requisite for durability, it seems desirable to have recourse to some means which will confer an equal degree of durability upon all the timber employed in the construction of an edifice. We are, I think, warranted in anticipating that such will be the result of Mr. Kyan's plan; which effects the solidification of the albumen, more particularly of the sap-wood; thus preventing it being liable to fermentation, or capable of being dissolved to furnish a pabulum to fungi.

It likewise wards off the attacks of insects, with a very few exceptions, such as that of the teredo, an aggressor which no wood can resist, except an African wood, of the name of which I am uncertain, but which, if analyzed, might make us acquainted with some principle hostile to so formidable an enemy.

It is impossible for bichloride of mercury to come in contact with albumen without undergoing decomposition, a protochloride of mercury being formed on the one side, and a solid substance on the other. Bichloride of mercury is thus the established test of the presence of albumen, and so delicate is it, that the addition of corrosive sublimate to any solution of albumen will indicate the $\frac{1}{2000}$ part, by causing a flaky appearance of the fluid.* On the opposite hand —albumen is the established antidote to poisoning by corrosive sublimate, and, though white of egg is generally preferred, milk, or flour diffused through water, or anything containing albumen, may be employed with success. "Coagulated white of egg," says Mr. Brand, "even under water, long resists putrefaction." Horn is indurated albumen.

As the depth to which Kyan's solution penetrates has been made the subject of careful investigation by Professor Faraday and others, I refer, on this head, to their evidence; and rather touch upon some other points.

* M. Lassaigne calculates the composition of the albuminous precipitate to be 6·67 corrosive sublimate and 93·33 albumen, or 1 atom of sublimate and 10 atoms of albumen.—*See British Annals of Medicine*, vol. I. p. 562.

A peculiarity of oak, owing to its chemical principles, is that less alteration on the solution of the corrosive sublimate may be expected to be produced by it than most other woods, for this reason, that gallic acid does not decompose bichloride of mercury: it is worthy of remark, however, that gallic acid solidifies albumen, and therefore, in this wood, that process is effected by nature, which man is obliged to accomplish by artificial means for other trees, and hence one cause of the durability of the timber of the oak.*

Respecting the question of any accession or diminution of strength or elasticity, the following experiments, to ascertain the comparative strength of PREPARED and UNPREPARED wood, have recently been made.

* It must not be inferred from this statement that the application of the solution to oak is unnecessary, for the *outer-layers*, or the *sap-wood of oak*, are as liable to decay as any other kind of timber; it is only the heart-wood which is rendered durable by natural means.

Pieces of Wood 4 in. by 2 in., 4 feet long, and 42 inches between the bearings.

Wt.	Ash.		Oak.		Canada Pine.		Memel.	
				DEFLEXION.				
Cwt.	Prep.	Unprep.	Prep.	Unprep.	Prep.	Unprep.	Prep.	Unprep.
15	.81		1.02	1.00	.80	.80	.81	.75
15½	.87		1.06	1.06	.81	.84	.87	.78
16	.92		1.12	1.10	.85	.90	.92	.84
16½	.98		1.20	1.18	.90	.97	.96	.88
17	1.02		1.25	1.22	.94	1.01	1.05	.94
17½	1.07		1.30	1.30	.98	1.09	1.13	1.00
18	1.14		1.35	1.35	1.05	1.15	1.21	1.08
18½	1.18		1.45	1.45	1.08	1.3	1.32	Broke slowly.
19	1.29		1.60	1.55	1.16	Broke one minute after 18½ Cwt.	Broke slowly.	
19½	1.38		1.75	1.65	Cracked after 19 Cwt.			
20	1.44		1.81	1.75				
20½	1.50		2.00	2.00				
	Did not break with 27 cwt.		Broke suddenly at 21½ Cwt.	Broke suddenly at 22½ Cwt.				

Remarks.—All the Deals broke short,—the Pines went suddenly; the Memels more slowly.—The *Prepared*, in both instances, bore ½ cwt. more than the *Unprepared*.

The Prepared Ash did not break; its elasticity was so great that it reached the ground, and would otherwise have slipped between the bearings. It had then a load of 27 cwt. The unprepared was not tried, as there was nothing to institute a comparison.

On a consideration of the experiments now made, I think it may fairly be inferred that the preparation makes no change in the strength of the wood, at least in the direction which has been tried. The greatest difference (the Oak) was only 4½ per cent., which would probably be found to exist between any two pieces that might be experimented upon, however similar the circumstances might be.

(Signed)

JAMES EASTON,

May 29th, 1837. *Engineer.*

With regard to the second point, there seems

no sufficient reason to expect that the elasticity of wood should be lessened, for this process does not remove any of that water which is of necessity a component element in organized matter, (and the presence of a certain quantity of which is necessary to the exercise of the property of elasticity,) but merely solidifies the albumen, and renders it incapable of being acted upon by the water, still present, but now harmless.

The solidification of the albumen and other principles, renders timber so prepared less hygrometric, and less disposed, when seasoned, (a process which is much accelerated by this plan,) to absorb atmospheric moisture.

One of the sources of the destructive power of fungi is their great hygrometric property.—One of the most formidable of the tribe of fungi is the *Merulius Lachrymans,* (often called *the* Dry-rot,) of which the following accurate description is given by Dr. Greville: "Whole plant generally resupinate, soft, tender, at first very light, cottony, and white. When the veins appear, they are of a fine yellow, orange, or reddish-brown, forming irregular folds, most frequently so arranged as to have the appearance of pores, but never anything like tubes, *and distilling, when perfect, drops of water.*" Hence the epithet *lachrymans,* as if weeping.

There is another point which it would be unpardonable in me, as a physician, to overlook, which is, whether the quantity of mercury remaining in the wood could injuriously affect the health of the inhabitants of houses or ships constructed with prepared timber. The dread of this prevented Sir H. Davy and Professor Faraday urging the employment of corrosive sublimate as a means of preventing the ravages of the book-worm in Earl Spencer's library at Althorp. It is probable that these eminent chemists had in their minds the occurrence of violent, even fatal salivation of the sailors on board H. M. S. Triumph, in 1810, from the rupture of bladders of quicksilver, and the escape of it about the ship. This event, brought before the Royal Society, and the public, by Sir Wm. Burnett, had probably impressed them with the dread which influenced them. But there can be no parallel between such a quantity of mercury and the inconceivably small quantity which is sufficient to coagulate a large proportion of albumen. I cannot conceive how any injury can possibly result from it; while some circumstances incline me to think that it may render no small service in a way at present little thought of. The following extract from Mr. Wade's Treatise on the Dry-rot will aid in explaining what I allude to. "It was formerly the practice to let

ships of war remain on the stocks *in frame* for two or four years, to season, as it was called; but there never was, says Sir J. Barrow, (Ency. Brit.) a more mistaken notion. When a ship," Mr. Wade goes on to state, "is built, exposed to the weather, the lower part forms a grand reservoir for all the rain that falls, and, as the timbers in that part are placed as close together as possible, the wet escapes very slowly. Those timbers are always soaked with moisture, and to some distance from the keel exhibit a green matter, which, when viewed through the microscope, is found to be a beautiful and completely formed moss, which vegetates at the expense of the timber." This is the *green matter* of Priestley, well known to all those who investigate the rudimentary conditions of vegetable matter, and which will form, in any water which is stagnant, even in distilled water, without being in contact with wood, but still more rapidly if it be so. Now, it is a remarkable fact that "distilled water over quicksilver does not produce any green matter." "It is very possible," adds Carus, to whom I am indebted for a knowledge of this fact, (See Taylor's Scientific Memoirs, vol. I., p. 233,) "that the quicksilver, on account of its property of counteracting production, may destroy or prevent the infusorial fermentation, as it has been called."

The timbers near the basement of a house, if prepared by Kyan's process, will not, I think, generate that green matter, which is at once unsightly, and, by keeping up a perpetual dampness, injures the wood, and the health of those who dwell in the lower floor of a house.

It is also worthy of mention, that the bilge-water appears to remain sweet in ships built of prepared wood.

Holding the question of the preventive power of Kyan's plan to be settled in the affirmative, as far as the dry-rot, in the strictest sense of the term, is concerned, it may be proper to adduce some proof of its preservative effects against insects and fungi. Mr. Curtis, the distinguished author of the "British Entomology," has informed me, that since *palings of prepared wood* have been used in the Regent's Park, he can no longer find those insects which formerly abounded there. Farther, the Rev. Miles Berkeley, author of that part of "Smith's English Flora" which treats of fungi, and who publishes Fasciculi of Dried Fungi, in illustration of that volume, having been annoyed by a fungus called Thelephora puteæna springing up in a cupboard, which it rendered constantly damp, he applied a solution of corrosive sublimate to the woodwork; and so

effectual did the application prove, that he cannot now procure a single specimen of that fungus, though it would be invaluable to him for the completion of his work.

Having the evidence of so many different individuals in favour of this plan, none of whom have any pecuniary interest in its being adopted, we must either question their competency to judge of its merits, or admit its validity; since we may well ask—

"Or how, or why
Should all conspire to cheat us with a lie?"

END OF LECTURE.

APPENDIX.

DOCUMENTS

RELATIVE TO

THE SHIP "SAMUEL ENDERBY."

THE "Samuel Enderby," of 420 tons, was built by Mr. White, at Cowes, in 1834, and the whole of her Timber, Spars, Blocks, &c. were prepared by the Patent Process.

She sailed from the river Thames in October, 1834, for the South Sea Fisheries, and returned to England in March, 1837.

Great St. Helen's; April 4.

DEAR SIR,

Accompanying this, we send you a report from Captain Lisle, the master of our ship, the "Samuel Enderby," the first ship wholly saturated with Mr. Kyan's preparation for the prevention of dry-rot and mildew. We delayed obtaining the report alluded to until such a survey had been held on the ship as to have warranted an

opinion on a subject of so much importance to the public; and we beg now to state, that we feel so well satisfied of the beneficial effects of the preparation on the timber, that in any cases where we may have occasion either to build or repair our ships, we shall continue to use it, and in like manner for the masts; and in which particular, we think, we have derived considerable benefit from its application.

The iron fastenings, of which she has but few, are not in so satisfactory a state as we had reason to expect, but we are not prepared to attribute the cause to Mr. Kyan's preparation; and, with respect to the copper bolts, they appear as good as on the day they were driven.

The sails and cordage appear not to have worn so well as we anticipated, and for which we cannot account; as, from the numerous satisfactory experiments we have made, and from the most favorable reports we have received of similar canvass, so prepared, in other vessels, we had considered that point long since settled.

We remain, your obedient servants,

C. H. and G. ENDERBY.

CHARLES TERRY, Esq.

MESSRS. ENDERBY,

SIRS,

In compliance with your orders to report, as soon as I arrived in England, on the state of the "Samuel Enderby," in reference to the several points mentioned in your memorandum, in order to give information on the ship, she being the first vessel built whose timbers and sails have been prepared according to Kyan's Patent Process, I beg now to state the following particulars, in the same order as put down by you, viz.—Sailing and trim of the ship,—Health of the crew during the voyage,—Effect of the process on the bilge-water,—State of the timbers and masts,—State of the sails and rigging,—Effect on the metal bolts by the prepared timber.

We sailed from London on the 11th of October, 1834, and returned to Gravesend on the 7th of March, 1837, being absent from England twenty-nine months. We

reached the Celebes Islands, lon. 125° east, lat. 1° 04′ south, on the 20th February, 1835, and remained in those latitudes fishing until October, 1836. The ship was nearly at sea during the whole period, crossing the line several times.

Respecting the Ship sailing.—During the whole voyage, having met with many English and American vessels, I have found none whose sailing qualities were equal to the Samuel Enderby's, and am persuaded (according to my humble opinion,) she is the best ship adapted for the Southern Fishery.

Health of the Crew.—During the whole voyage all the crew have been more than usually healthy: indeed, I have never known the crew of any ship return from the South-Sea Fisheries so free from sickness; therefore, I have no hesitation in stating it is my firm opinion that the Patent Process, in its application to ships' timbers, must in some way improve the internal atmosphere of the ship; for, as you are all well aware, we frequently use the water-hose over the casks of oil, between decks and in the hold, by which, in southern latitudes, the hold is filled with steam, from evaporation and intense heat, and that circumstance, in ordinary cases, affects the timbers and iron-work, as well as increasing the putrescence of the bilge-water; but, in the "Samuel Enderby," from the time she was launched at Cowes, in August, 1834, until her return to England, in March, 1837, the bilge-water has been much sweeter, and more free from noxious smells, than any ship previous that I have been in on the same voyages.

Timbers.—As regards the timbers, the ship is perfectly sound in every respect, and shows no symptoms or indication of decay in any part throughout the whole ship; and it is my belief that the timber and plank have shrunk less than any new ship I have witnessed. Being at Cowes, inspecting the ship from the time her keel was laid until she was launched, and the greater part of the deck-beams being made from green timber just felled, and afterwards submitted to the process, they are now perfectly sound, and as firm as if cut from the most seasoned timber. These facts I consider to be strong evidence in favour of the process; and I am so satisfied myself of its good effect on timber, that I should recommend new ships to be built of

timbers prepared when quite green, and to let it be quite dry before placing it in the ship.

Masts and Yards.—As to her masts, the lower ones are from the usual Canada white or yellow pine timber, the others are the red pine; all of which remain in a good state, and have not lost any during the voyage from the ill effects of dry rot.

Metal Bolts.—Since my return to England, the ship, after being discharged, was put into dry dock, and many of the bolts, iron and copper, have been driven out: the latter are perfectly sound, and in good condition as possibly can be. The iron bolts are, from some cause I cannot comprehend, much corroded, probably from the effect of salt water being so frequently thrown on them.

Sails and Cordage.—The effect of the process on the sails has not been so satisfactory as you anticipated, for they have worn out sooner than I expected. The standing rigging has given way in some places, and, as a precautionary measure, I tarred it, to prevent the effect of the wet weather. Whether the sun has had any particular effect on the canvass and rigging so prepared, as we were for the most part under the meridian sun, or whether the solution in which the canvass and rigging were prepared was too strong, I cannot pretend to say; but it requires further trials, in my opinion, in similar voyages, to establish the efficacy of the process on sails and rigging.

I remain, Sirs, your obedient servant,

WILLIAM LISLE,

Commander of the "Samuel Enderby."

London; March 28.

London; 30th March, 1837.

Sir,

Whilst the "Samuel Enderby" was building in Mr. White's yard at Cowes, I was sent in the "True Briton" cutter to Red Bridge, to fetch the timber, which was then quite green, being just felled. It was then steeped in the

tank for Kyan's Patent, in Mr. White's yard, and was immediately used for the cross-beams of the upper deck.

I made the voyage to the South Seas in the "Samuel Enderby," and, since her return, have examined the ship; and I hereby certify that there is no trace of decay to be found in any of the timbers of the ship.

I am, Sir, your obedient servant,

WILLIAM MILLER,
Mate of the "Samuel Enderby."

To CHARLES ENDERBY, Esq., *Great St. Helen's.*

Lloyd's, in Captains' Room; 7th April, 1837.

GENTLEMEN,

IN compliance with your request, I have been on board the ship "Samuel Enderby," lately returned from a South Sea voyage, and have minutely inspected the hull, inside and out, and a number of pieces of the planks of the bottom were shown to me, that were cut out for the purpose of inspection; I also saw the masts and yards; and I have to report, the whole of the woodwork appears to be in a perfect sound state, without the least appearance of rot or incipient decay. The copper bolts are perfectly sound; and, although there is a little rust upon a few of the iron bolts, I do not think that is caused by the process used to preserve the wood materials; and where there was the smallest appearance of sap, still it was hard, which would not have been the case if it had not been under the process.

I am, Gentlemen, your most obedient servant,

JOSEPH BRINDLEY,
Surveyor of Shipping.

To the Directors of the Anti Dry-Rot Company.

31*st March*, 1837.

GENTLEMEN,

I have this day inspected the "Samuel Enderby," now lying in dock at Rotherhithe; she having lately discharged her cargo, after a voyage of two years and five months to the South Seas.

I report—I have carefully examined the whole of the timbers, planks, masts, and other woodwork of the said ship; and, as far as I can see, I find them all in a perfectly sound state, and free from indication of dry-rot or decay of any sort; and I notice that the sap, which has been left on in certain places, is as hard and as sound as the other parts of the wood. And that the joints of the external planking and boarding were perfectly close, the planking and boarding not having shrunk.

WM. INWOOD, *Architect and Surveyor*,
6, *Southampton Place, Euston Square.*

19, *Southampton Row; April* 14, 1837.

GENTLEMEN,

AT your request, I last week inspected the "Samuel Enderby," a vessel constructed with your prepared timber; and, having carefully examined the more than usually oxidized iron bolts, with a view to ascertain if such rusting could in any way be attributed to the Corrosive Sublimate employed in preparing the wood, I have great satisfaction in being able to inform you that I have not detected a particle of mercury, or its salts, in the rusts or decayed parts of the bolts, which would have been the case had any action taken place between the sublimate and the iron.

My attention was also directed, by your chemical assistant and operator, Mr. Giles, to a few spots on the surface of some of the planks: they appeared to me fatty matter, probably spermaceti, quite unconnected with the wood, and of no importance whatever; all the timber I examined being quite sound.

I am, Gentlemen, your obedient servant,
T. N. R. MORSON.

To the Directors of the Anti Dry-Rot Company.

Report from PROFESSOR FARADAY *on the Bilge Water, Canvass, and Metal Bolts of the "Samuel Enderby."*

I HAVE received various articles from the ship "Samuel Enderby," with the object of examining their present state and condition, and of ascertaining, as well as may be, how far that state has been affected by the circumstance of the timber of the ship, &c., having been prepared according to Kyan's Process for the prevention of Dry-Rot.

One of these articles was a bottle of bilge-water, sealed up and labelled, "*No.* 1, *Bilge Water from the Samuel Enderby*, 13 *March*, 1837, S. E." This water was turbid, yellowish, and saline: it was quite sweet in smell, having no degree of putrescent or offensive odour about it. The turbidness was due to rust of iron, the water having evidently been in contact with iron bolts or some other iron article. I examined it carefully for Mercury, but did not find any there.

Another article was part of a sail, considered, I believe, to have been prepared with Kyan's solution. This sail-cloth was weak and rotten, the fibres in one direction were much weaker than those in the cross direction; the two sets having, no doubt, been originally different in strength and quality. As to the cause of the diminution of strength in this case, I cannot speak to it; nor do I know whether the canvass has or has not suffered more than might be expected from the wear and tear it has undergone. I examined it very closely by a voltaic process for Corrosive Sublimate, or Mercury, but could not find any in it.

Certain bolts of copper and iron were also brought to me; those of copper had, as far as I could judge, worn well; they did not appear to be in any way injured; and, upon examining those parts which had been in contact with the prepared wood, I could find no indication of any particular action of the wood on them, nor any appearance of the precipitation of mercury there, or action of a mercurial preparation.

The iron-bolts were considerably corroded, and more in

some parts than in others. The degree of corrosion is not more than would easily be produced by the action of salt water; but I do not know from what part of the vessel they came, or to what degree they have been exposed to the action of the sea or salt water; and those who from experience know the average condition of iron bolts in other ships, which have been exposed for the same time in the same way to salt water, can best judge as to the degree of corrosion. I sought very carefully, both by voltaic action and in other ways, for the presence of mercury in one form or another about the corroded parts, but I was unable to detect that metal in any proportion. Hence a strong presumptive proof that the solution of Corrosive Sublimate has not caused the rusting and oxidation of the iron at those places.

M. FARADAY.

Royal Institution; 17*th April*, 1837.

Great St. Helen's; 15*th May*, 1837.

Sir,

Mr. Terry having handed me your letter of the 12th inst., requesting some contradiction of the report that the sublimate had injured the iron fastenings in the ship "Samuel Enderby," in conformity with such request, I beg to state that it is my firm opinion, (since I have had an opportunity of examining into the subject,) the iron was not in any way affected by the sublimate, and the corrosion was to be entirely attributed to the acid in the oak timber, and the salt water.—I have the pleasure to remain,

Yours truly,

CHARLES ENDERBY.

To George Vertue, Esq., *Leith.*

London: 16*th May*, 1837.

Sir,

We beg to acknowledge the receipt of your favour of the 13th, and, in compliance with your request, give you our opinion of Kyan's Patent Solution, as applied to our ship, the "Samuel Enderby."

The Ship alluded to, of 422 Tons, was built at the Isle of Wight, of Seasoned Oak from Southampton; she was laid down in January, 1834, and launched in the August following; the whole of the timbers, planks, masts, and blocks having been saturated according to the Patentees' directions: she may be termed wholly copper fastened, having only a few iron bolts in the chain plates, the knees, and standards.

We should first remark, that the hull of the Ship, including the masts and spars, have returned from a South Sea voyage, in a tropical climate, in most excellent condition; and the crew, consisting of 32, have been more than usually healthy; this we attribute to the vessel having been free from the effluvia that arises from bilge water, and which is usually worse in a new ship than in an old one. The timber (including several beams in the upper deck which were cut green) scarcely exhibits the slightest shrinkage; neither should we have touched the hull of the ship, except for the satisfaction of the Patentees, Lords of the Admiralty, and Lloyd's Surveyors; and, to satisfy them, we opened the Ship in such parts as they pointed out, and also drew out both copper and iron bolts, every part of which proved satisfactory, with the exception of the iron, which was, in every instance, much corroded; this we attributed, in the first instance, to Kyan's Solution; but, on consideration, we are satisfied we are in error, for in fir and other woods, where the test has proved the solution to have penetrated a considerable way into the heart, we have seen iron not in the slightest degree corroded; whilst in oak, where it cannot be tested to have penetrated beyond the one-eighth of an inch, (although Professor Faraday has given his opinion that it is equally effective,) we have found that the iron bolt driven through the chain-plate, the plank, the timber of nine inches, and the ceiling, that

there is no perceptible difference in any one part of the bolt as compared with the other; consequently, it should not have been so bad in the heart of the Oak timber as in the plank. We have replaced all the timber taken out with new, having it first saturated, and shall have no hesitation in again introducing iron fastenings, but shall put a little white lead before driving them. The corrosion of the iron may be attributed to the acid of the Oak, or to the nature of the iron itself, which, we are informed, is, if very good, the more likely to corrode. With respect to it being common to drive out the iron fastenings in Whaling Ships every voyage, we would observe that you have been misinformed, although, from the constant practice of watering the ships with salt water during the voyages, such practice must have a tendency to destroy it.

We remain, your obedient Servants,

C. H. & G. ENDERBY.

To Mr. Charles Philip, *Leith.*

DOCUMENTS

RELATIVE TO

THE SHIP "JOHN PALMER."

THE "John Palmer," Captain R. P. Lawrence, sailed from England in 1833, and returned in 1837 from the South Seas.

She was repaired in London in 1833, in the East Country Dock, with Timbers, as well as new Sails, prepared by Kyan's Process.

EXTRACTS *from* EVIDENCE *before the* COMMISSIONERS *appointed by the* ADMIRALTY.

BENJAMIN ROTCH, Esq., senior, stated, that he has a ship called the "John Palmer," a South Sea whaler, which had been largely repaired with timber prepared on Mr. Kyan's plan. The whole of the ship's ceiling and the sleeping berths of the men consisted of this timber. He had received a letter from the master, dated 18th March, 1834, on the Line,—crew all well; and a second letter, dated 7th July, 1834, from the Straits of Timor,—crew all well.

Mr. George Waters Sweeting; is a ship-builder at Rotherhithe, and repaired the "John Palmer" in the autumn of 1833 extensively. She had new timbers and new top-sides from the light water-mark, with a new stern and head; the interior was also new from the lower deck upwards, with new beams, breast-hook, and new upper deck. The whole of the timber used on these works, as also the plank for the men's fitted sleeping berths, were prepared on Mr. Kyan's plan. There had been no ill effect on the health of the men employed in putting the timber into the tank and taking it out. The plank was more stubborn in bending after being prepared. Did not observe any effect on the surface of the solution after the timber was immersed. A piece of fir timber 14 inches square, for the waterways, was dipped 10 or 12 days. It was perfectly dry in the interior when cut, and had a sort of blue stain equally diffused from the edge to the centre. The stain was more apparent in plank. A similar effect was observable in African oak, though not to the same extent. He has made experiments as to the process. He had several pieces of timber cut into four or five inches square; one piece of African oak remained a week in the solution, it was then cut, and worked as hard as a stone; the unprepared was comparatively as soft as fir. He placed a piece of fir 18 inches long and 8 inches square on its end in the solution, which was about 10 inches deep. It remained two or three days, and he observed a kind of froth issuing from the centre of the end out of the water. It dried off and left a blue stain. The canvass of the sails of the "John Palmer" was dipped in bolts in the solution, as also the twine for making them. The canvass was run through cold water once before it was made up, and placed on the grass to dry.

London; May, 1837.

Sir,

The ship "John Palmer" left the East Country Dock, December 13, 1833, on a South Sea Whale Voyage, and returned on the 22d of April, 1837, being out three years and four months. Previous to her sailing, underwent a thorough repair; great part of the timber, masts, bowsprits, sails, and cordage were saturated with Kyan's Patent. The timber, from what I had observed during the voyage, and at the present time, is in the highest state of preservation. We have been most of our time exposed to a tropical sun, and the planks in the sides have not shrunk in the least. The masts are in the highest state of preservation; the main-mast has proved itself to be a good one. In heaving in a 40-barrel whale's head, the ship gave a heavy roll, and the head came on board before it was high enough, and before it could be secured it rolled out-board with a heavy surge. I expected it to have sprung the mast; it was examined, but nothing found to be amiss with it. The main top-mast backstays have been well tried; they have only stretched nine inches during the voyage, and appear to be perfectly sound. I am of opinion that the Patent Process has done every thing for the canvass that was expected: it has prevented mildew and rot, though not wear and tear. The ship will be taken into dock next spring, to undergo a thorough repair. I shall have a fair opportunity of inspecting her, as her stern will be opened, and several bolts drifted out for inspection, and report accordingly.

I am, Sir, your obedient servant,

R. P. LAWRENCE,

Master of the Ship "John Palmer."

To J. H. Kyan, Esq.

MEMORANDUM *of Survey of the* "JOHN PALMER," *a South Sea Whaler, repaired with Timber prepared according to Kyan's Process.*

HAVING been requested to survey and report on the state of the "John Palmer," which ship has been employed on a South Sea Whaling Voyage for nearly three years and a half, and had, previous to her departure from London, new topsides and other woodwork, new sails, and a quantity of rigging, all prepared by the process of Kyan's Patent, we, the undersigned, in compliance with the said requisition, commenced our survey this day, and have to state, upon attentively observing the topsides and other parts of the ships which had been prepared with the solution, that we were particularly struck with the closeness of the seams throughout the whole of the new work; and we cannot avoid remarking, that we never before witnessed anything of the kind in ships that had performed a voyage of three years and a half duration—two years of which, as we were informed, this ship was whaling within a few degrees of the equator, under which circumstances her upper works must have, of course, been exposed to the action of a tropical sun, and yet the planking has not shrunk in the least; so that no caulking was necessary from the period of her sailing, and not the smallest leak in any part of the new work. This evidence of the plank having so closely kept to its original dimensions, and thereby continuing the strength and durability of both workmanship and materials, we consider of great importance in ship-building: for it has frequently happened, that in consequence of the planks of new ships having shrunk when approaching the tropics, immediate caulking has become indispensably necessary; and if the ship has not been in a situation to allow of its being done, the upper works have leaked, and, on return home, have been found to be considerably decayed.

With the owner's permission, we caused some of the planking of the topsides, and other parts of the ship that had been saturated with the Patent, to be opened, for the purpose of obtaining every possible proof of the state of

the timber, and we found every part in as perfectly sound condition as it was the day it was wrought in the ship.

Several iron bolts and nails were driven out, all of which were in excellent condition; and we noticed that that portion of the bolt which was in the plank, that had been saturated, the iron was less affected by rust, and wear and tear, than the remaining part of the same bolt, which had been lodged in the timber that was not saturated.

The mainmast and foremast were both saturated; and the mast-maker declares them to be in such sound and good condition as to render it quite unnecessary to have them out for the usual and customary examination on the out-fitting of the ship for another voyage; and, we are of opinion, the masts are perfectly sound, and fit to perform any further service.

The treenails are in a most perfect state of preservation, showing the same peculiar effect of the process as the ship's timbers.

Having also examined the sails, all of which were prepared, we are of opinion, that they are in a very superior condition to what they would have been had the canvass not been subjected to the process.

We submit it (with deference) to the notice of the Company, that if the hemp and flax, or the yarn, or thread, were saturated previous to the article being made up into rope and sail-cloth, it would not only render the expense of bleaching canvass unnecessary, but it would possibly more effectually increase the durability of the rope and sails.

From all the circumstances which have come under our observation upon this survey, relative to the operation of Kyan's Patent upon the materials put into the "John Palmer," we give our decided opinion, that it has preserved them from decay, and prevented, in an extraordinary manner, the shrinking of the wood.

(Signed) JOS. BRINDLEY,
Surveyor of Shipping, Lloyd's, in Captains' Room.

GEORGE HAWKES,
Surveyor of Shipping to the Royal Exchange Assurance Company.

JAMES BAKER,
June 15, 1837. *Surveyor of Shipping.*

June 26th, 1837.

SIR,

In answer to your request to forward to you a report of the present state of the Saturated Timber wrought in the ship "John Palmer," in the year 1833, I beg to say, that during the past week the whole of the upper works have been thoroughly caulked and examined; and I am happy to inform you the result has been most satisfactory, by our not having found the slightest appearance of Dry-Rot or Decay in any of the Prepared Planks, the seams of which are as fine now as when they were first wrought: a strong proof that it is very essential, inasmuch as it prevents the wood from shrinking: in addition to which, as the Captain states, the ship was two years and a half at sea, under a burning sun, before any of the new work required caulking, and then only partially.

For the purpose of examination, I have taken out two pieces of plank, one in the topsides, the other in wale; and I have found them,—as well as the timbers beneath them,—as free from decomposition as when originally placed there.

We have also driven out several of the treenails and iron bolts: the treenails we find in the highest state of preservation; the bolts also are in very good order, having a slight appearance of corrosion, but not more than is generally observed after four years' service.

The whole of the masts have been examined, and are perfectly sound and good.

I am, Sir,

Yours most respectfully,

G. W. SWEETING.

To J. H. KYAN, Esq.

EXTRACT *from the* NAVAL AND MILITARY GAZETTE, *of July* 15*th*, 1837, *relative to the* BOARD OF ORDNANCE.

THE Royal Engineers have lately adopted the judicious system of publishing the various reports made by members of the corps, and compiling them annually, or as often as need be, into volumes, so as to render the information they contain available to their brother officers, wheresoever they may be stationed. One of these compilations has just fallen under our notice, and amongst several other highly interesting reports, elucidated by drawings to scale, we find those of Lieut. Colonel Harding, Capt. Alderson, and the Assistant Inspector of the Royal Carriage Department at Woolwich, all testifying in high terms to the efficacy of Kyan's Patent Solution, which, having undergone the ordeal of trial, is now extensively used in that establishment.

It appears that, owing to the position of the arsenal in a low swampy piece of ground, the dry-rot had committed great havoc in woodwork of every description. In the public buildings alone the annual repairs rendered necessary from this cause were estimated at several hundred pounds. In the gun-carriages, waggons, &c., the evil was of far greater consequence; for, as these were subject to be called for suddenly, it was imperative to watch their repairs narrowly; and it appears that the dry-rot was frequently detected, when least expected, making its rapid and insidious progress to an enormous extent.

To remedy this, various means had been proposed and adopted, but all proved insufficient until the reputation of Kyan's Patent becoming pretty generally known, Lieut.-Colonel Harding, commanding Engineers, having by experiments, performed under his own directions, on the flooring of the Academy, as well as by inspection of various others, and the reports of scientific men, become convinced of the efficacy of the Patent in preserving timber from dry-rot, as well as seasoning green timber, and by preventing its shrinking, rendering it fit for immediate use, applied to the Inspector-General of Fortification, Sir F. Mulcaster, and

obtained his permission to erect a tank within the arsenal, wherein every article subject to dry-rot is now saturated prior to use.

From the various reports and testimonials which we have seen, in addition to these, we are fully convinced of the value of this invention; and there cannot be a doubt but it will be eventually generally adopted. Its application to sails and cordage may not have been so successful as could be desired, but this proceeds, in our opinion, from a want of due caution in saturating the material; but, even were its effects confined to timber alone, its benefit is incalculable, when we consider the millions sacrificed by the operation of dry-rot upon ships, built and repaired, which never performed a day's service.

We regret to say its introduction into the Dock-yards, and in Government ship-building, has been hitherto limited; but this proceeds from a practice established in the Naval Departments, of refraining from trials of preventives on a large scale, until their efficacy has been fully tested by *time;* and this proceeding is adopted in consequence of disappointment occasioned by the failure of other means which have been extensively tried. We may instance Sir Robert Seppings' concrete. Another reason advanced against the adoption of Kyan's Patent is the expense, and the difficulty of constructing every part of the ship with prepared timber, &c. The last objection may be answered by the fact that, if the plan is a good one, it should be *universally* adopted, and that without delay, at home and abroad; and as regards the first, we may state, that the Ordnance Report estimates the expense of the solution at one pound and a half of corrosive sublimate (costing six shillings) to every load of timber containing 50 cubic feet; and this will enhance the price of such about two and a half per cent.—a sum incomparably small in proportion to the advantage gained. But as the timber need not be saturated until converted, and, moreover, many parts now cut away as unsound might remain under the new process —a saving equal to the value of the solution would be effected in that respect. To this it is only necessary to add the small premium paid to the Patentee for the use of his invention, and the prime cost of the tanks.

Extract from THE TIMES, *of July* 7, 1837.

SOME very strong, and indeed conclusive evidence, in favour of the process adopted under Kyan's Patent, for the prevention of the dry-rot in timber, and the decay of other substances, is afforded in a recent publication, not printed for sale, entitled "Papers on subjects connected with the Duties of the Corps of Royal Engineers," and intended to give energy to those duties, both military and civil, imposed upon officers in that branch of the service, and which are in some danger, owing to the long peace, of falling into neglect. One of these papers, prepared by Capt. Alderson, of the Royal Engineers, is specially devoted to the consideration of Kyan's process, the extensive adoption of which he strongly recommends in his department. Permission was obtained, it seems, for the introduction of the process in the engineer department in September last, on the application of Lieutenant-Colonel Harding, who addressed a letter to Major-General Sir Frederick Mulcaster, Inspector-General of Fortifications, on this subject. In this letter he refers to an examination of some timber prepared by this process in 1834, and put up experimentally in the house of the Lieutenant-Governor, which was found perfectly sound, while some unprepared timber, put up at the same time, was much decayed. In other letters, which form an appendix to Captain Alderson's essay, further experiments are detailed, and a very striking one may be quoted from them, in which pieces of oak, ash, and elm, which came to the Royal Carriage Office in a green state, with the bark and some leaves upon them, were split down the middle and marked. Half of each specimen of the wood was returned to be saturated with the patent, and when sent back the whole were put down in March, 1835. These were taken up in September last, and at the end of a year and a half it was found that the prepared pieces, even to the preservation of the bark and sap, were perfectly sound, and the unprepared quite rotten. There seems ground for believing, on the statement of Captain Alderson, that this process will be found as effectual a safeguard against a principle of decay, that of the de-

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