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Public Works DEPARTMENT.

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No. 71 Read the following Extract from the Minutes of Consultation in the Military Department, dated 31st October 1857, No. 3797.

Read despatch from the Honorable Court of Directors, dated 2nd September 1857, No. 116.

Our Governor in Council, at Fort Saint George.

We forward for your consideration copy of a letter and its enclosures received from Mr. Abel, Chemist of the War Department, bringing to our notice the results of his scientific enquiries with the view of discovering some cheap and efficacious means for protecting wooden buildings from fire. As the composition prepared by Mr. Abel, viz. Silicate of Soda, is made from materials procurable in India, you will have no difficulty in trying any experiments which may be necessary. You will report to us the results for communication to Mr. Abel.

We are &c.

(Signed) R. D. MANGLES, and 10 others.

From F. A. ABEL, Esq., Chemist of the War Department, Woolwich, S. E; to the Secretary East India Company, dated 30th July 1857.

Sir,

I have the honor to address you upon a subject which I have been strongly recommended by Colonel Sandham, Commanding Royal Engineer at Chatham to bring to the notice of the Honorable Court of Directors of the East India Company.

During the late War, I was called upon by the Engineer authorities to suggest some simple, cheap, and efficacious means for protecting wooden hutting from fire, and at the same time I was instructed by the Secretary of State for War to examine into the merits of certain proposals laid before him for the same purpose.

The results of my experiments on this subject was the preparation of a protective material applicable even after the erection of huts, in the same manner as white-wash, tar, or paint, and which was shewn to afford such important protection to wood in case of fire, that experiments upon a proper scale were ordered by Lord Panmure to be tried at the principal camps in Great Britain, and, at the same time, permission was given me by his Lordship to patent the material of which permission however I declined to avail myself.

It was subsequently arranged by the Inspector General of Fortifications that a full trial of the value of the material should be made by Colonel Sandham and myself at Chatham. The accompanying abstract from the professional papers of the Royal Engineers contains a copy of our joint report to Lord Panmure on the results of these experiments to which I beg most respectfully to call the attention of the Honorable Court of Directors.

Unfortunately, by the time that the merits of the protective coating in question were properly established the huts at the various camps had been already coated with tar or other materials which did not admit of removal from the wood, except at considerable expense.

The silicate of soda and lime coating has however been tried and applied to a small extent at Aldershot and at Alderney.

Fifteen tons of the silicate of soda have moreover been sent by Government to China for the purpose of coating the hutting.

The advantages of the material referred to for coating timber may be embraced under the following headings.

1stly. The simplicity of its application.

2ndly. The circumstance that it forms an excellent protective to wood against weather, and may therefore be employed as a substitute for tar or paint.

The colour of the coating itself is nearly white; a small admixture of an ochre serves to remove the glazing nature of the coat.

3rdly. The cheapness of the material, the cost of coating ten square feet not exceeding two pence.

4thly. The great efficacy of the coating as a means of protection against fire as demonstrated by the experiments detailed in the accompanying report.

Although personally impressed with the idea that a knowledge of the existence of the material in question, open to general use without reserve and emanating indeed from Government itself must be of importance to the Honorable East India Company, I hesitated to adopt the step I am now taking until I had consulted Colonel Sandham, who urged me strongly to lose no time in bringing the subject to their notice.

I beg to enclose a copy of the directions for preparing timber with the material which have been drawn up by desire of the Inspector General of Fortifications and to state that it will afford me pleasure to give any further information on the subject that it is in my power to afford should the Honorable Court of Directors feel desirous of taking it into consideration.

From F. A. ABEL, Esq., Chemist of the War Department, Woolwich, S. E., 27th August 1857.

I have the honor to acknowledge the receipt of your letter of the 26th instant informing me that the Court of Directors of the Honorable East India Company have directed copies of my communication of 30th ultimo, and of printed directions to be enclosed to the several Governments in India.

With reference to the concluding paragraph of your letter referring to my statement as to the employment of silicate of soda in China, I beg to observe that from the quantity sent out (15 tons) and from the correspondence which I had at the time on the subject with the authorities at the War Office, there is no doubt that the silicate and lime is to be used in China as the coating material for the wooden erections required at stations there, and has not been sent out as a matter of experiment.

Having heard that the great risk of fire arises from the thatching employed for the roofs of hut buildings in India,—I am anxious to state for the information of the Directors and of the Government of India that the silicate of soda admits of very simple application to the thatching as a protective material.

The thatching would require soaking for a short time previous to use in a solution of silicate, and the thatched roof when dry should receive a thin coating of lime or clay stirred to a cream with solution of silicate.

It would probably be found advisable to renew the exterior coating of wash after the rainy season.

I beg again to express my readiness to furnish every information which may be required on the subject.

Remarks on the Protection of Wood from Fire, by F. A. ABEL, Esq., Chemist to the War Department, accompanied by a Report on experiments made at Chatham, by Colonel Sandham, R. E., and himself.

The attention of practical men has been for some years past directed, from time to time, to the importance of affording to wooden erections some degree of protection from the effects of fire; and numerous plans have been proposed, and to some extent tested, for lessening the combustibility of wood, and for covering its surface with a protective coating more or less unalterable by fire.

The simple application of lime or clay-wash, for example, has been found to afford some slight protection to wood, although the tendency of such materials to peel off the surface of the wood (into which they do not in any way penetrate), by exposure to heat, and the rapidity with which the coating is destroyed by atmospheric influence, render them very ineffective agents.

Several processes have been patented, even recently, for the protection of wood from fire. Some idea of the general nature of such processes will be conveyed by the following extract from an official report made on this subject:—

"The importance of obtaining an effective method of reducing the combustibility of wood, or even of protecting its surface from fire, has led to an examination into some of the methods of accomplishing this, which have been lately patented, and of the general nature of which the following is a brief statement.

I.—"*Mr. Maugham's Patent* consists in saturating dried wood with an aqueous solution of phosphat of soda and muriate or sulphate of ammonia, in certain proportions.

"It is believed by the patentee that these salts will be so affected by each other, and by the action of heat, that the fibres of the wood will be protected by an incombustible coating, while a quantity of vapour will be generated by the volatilisation, and partial decomposition, of the ammoniacal salts, which will possess the power of extinguishing flame.

"The same objects are believed to be obtained by—

II.—"*Lieutenant Jackson's Patent Process*, by which wood is impregnated with a solution of salts of zinc and of ammonia.

"The same means are adopted in both of these processes for saturating the wood.

"It is packed into large cylinders from which the air is then exhausted, the liquid being afterwards forced in with a pressure of 150 to 200 lbs., which is maintained during one or two hours. It is the same method as that employed in patent processes for preserving timber from decay.

"I am not aware whether Mr. Maugham's, process has been submitted to any extensive practical test. Numerous experiments were however instituted on Lieutenant Jackson's process, under the direction of Mr. Burnel.

"Specimens of seventeen different kinds of wood were prepared; corresponding pieces being kept unprepared, and others covered with a coating of paint. Their powers of resisting fire were tested by piling the prepared, unprepared, and painted specimens round a perforated sheet iron surface, filled to the top with a bright coke fire.

"In most cases the prepared wood resisted the action of fire for a longer period, and, when removed from the fire, ceased burning sooner than the unprepared specimens.

"It was also evident that light porous woods were more efficiently protected than those of a denser character.

"There is no doubt therefore that the combustibility of wood is more or less diminished by either of the above methods of treatment, although the protective action must be ascribed to the indestructible compounds with which the wood is to some extent impregnated, far more than to the vapours evolved by the decomposition of the small quantities of ammoniacal salts forced into the wood.

"Although by the impregnating process adopted in the above patents, the preparative solution is believed to be forced into the very centre of the wood, it is essential, if such a result is to be obtained, that the solution should be weak, since it is impossible to force strong saline solutions thoroughly into wood.

"It is evident that the protective action of the salt cannot, under these circumstances, be very powerful.

" Were it possible, on the other hand, to employ stronger solutions, the expense of the processes would be considerable.

" The necessity of costly apparatus for impregnating the wood is also a matter of serious moment."

The patentees of some of the wood-preserving processes go so far as to state that they are enabled to render wood incombustible or uninflammable, and such statements have tended to lead to the presumption that a thoroughly effective protecting agent should have the power of depriving wood of its combustibility.

It will be readily understood, however, that even if a piece of wood could be most thoroughly impregnated with a solution of some strength, of matter unalterable, or at any rate only fusible, by continued exposure to heat, the amount of protective material thus deposited in the pores of the wood, although it might be considered to surround each particle of fibre, would not prevent the destructive distillation of the wood by the effect of heat, the result of which would be the disengagement of inflammable vapours from the wood, and its ultimate complete ignition, if maintained for a sufficient period in the vicinity of highly heated or burning matter; or, if on the other hand, the protective agent employed be convertible by heat into vapours possessing the property of extinguishing such fire as they may completely surround, such vapours might have the effect of partially or completely extinguishing the fire in a piece of ignited wood, *after* its removal from the source of heat or fire, but otherwise the volume of vapour generated from the preparation used, would be but slight, as compared with the inflammable vapours evolved from the over-heated wood, and would have no perceptible effect on the combustion of these, while the scorched, or charred, woody fibre would be less efficiently shielded from the effect of flame than by the coating formed from an indestructible preparation.

It does not therefore appear reasonable to expect more from the most efficient protective coating or impregnating material than—

1st. That it should considerably retard the ignition of wood, exposed for some length of time to the effect of a high temperature, or of burning matter in its immediate vicinity.

2nd. That if the vapours which the wood will emit, by continued exposure to heat, become ignited, the flames thus produced shall not readily affect the fibre of the wood, and shall cease almost directly on the removal of the wood from the source of heat; and

3rd. That prepared surfaces of wood, when in actual contact with burning unprepared wood, shall have little tendency to ignite, and thereby cause the fire to spread.

In addition to such processes as those above referred to, in which the protecting material is forced into the wood by the application of considerable pressure, trials have been made with agents of different kinds, in solutions or baths, in which the wood was steeped, or allowed to soak, for some hours, so that it might be in a slight degree impregnated with the material, or that a superficial coating of the protective might, at least, be formed.

Some of these methods have been made the subject of experiments by order of Lord Panmure, with a view to test their merits.

One, proposed by W. C. Salomons, of Paris, consisted in immersing the dried wood alternately, in two baths; the one containing three parts of acid sulphate of alumina, and one part of glue, dissolved in six parts of water; the other consisting of two parts of dry chloride of calcium, one part of glue, and seven parts of water.

The objects which the inventer wishes to attain, by the use of these solutions, are, firstly, to impregnate the wood slightly with one of the salts (the chloride of calcium, for example), and then, by immersion of the wood in the second bath, to effect the decomposition of the first salt by the second, in the pores of the wood.

Thus the chloride of calcium and sulphate of alumina should become converted into sulphate of lime, and chloride of aluminum; the former an almost insoluble substance, the latter a soluble deliquescent body, possessing the property of converting the glue employed, together with the salts, into an insoluble body—a species of leather.

The pores of the wooden surfaces are therefore, by the treatment in question, to be filled up by particles of a substance nearly insoluble, and unalterable by heat, which, together with the soluble salt, also present, are to be protected and united by means of the precipitated glue, which dries up to a hard, horny substance.

The experiments made with this process showed that the glue employed in the solutions greatly impeded the penetration of the wood by the saline matter, and also caused the decomposition of the salts to be very partial.

The protective property of the coating formed on the wood, prepared by this process, was not found to be considerable, while the expense of the materials was great, as compared with others equally efficient.

The successful results obtained on the Continent by the application of alkaline silicates, as protective materials, led to an examination into the comparative value of the cheapest of these, the soluble silicate of soda, as an agent for decreasing the combustibility of wood.

The property possessed by the soluble alkaline silicates, of being readily softened by hot water, and thus converted into a state of solution, while they are but slightly affected by cold water, renders their application to wood, either in the form of a bath, or as a wash, very simple. Their dilute solutions being readily absorbed by wood the surfaces of the latter, as it dries, assume the form of a hard coating.

The experiments made in the first instance with the silicate of soda, and the results obtained, are described in the following extract from the official report:—

" Various specimens of dry wood were prepared with silicate of soda, by being soaked for a few hours in a weak solution.

" Upon examining the interior of these, after the removal from the bath and subsequent desiccation, the silicate was found to have penetrated about a quarter of an inch on all sides.

On piling the above over a fire, together with specimens of unprepared wood, and others that had been prepared by different processes, the superiority of the silicate of soda, as a protective agent, was fully established.

" Some specimens of wood were then simply painted with a moderately strong solution of silicate, and afterwards placed, together with unprepared wood, in a pool of coal-tar naptha some of the latter being thrown over the surfaces of the wood.

" Immediately on the ignition of the naptha, the wood was surrounded by flames, which soon fired the unprepared pieces, whilst those coated with the silicate only ignited after a time *at the edge*, and were scorched or baked by the heat, but not burned.

" A wooden hut, similar in construction to those at Aldershot, having been erected in Woolwich Marshes, for the purpose of testing the value of Philips's Fire Annihilator, advantage was taken of the opportunity thus offered for trying, to some extent, upon a larger scale, the merits of the silicate as a protective.

" Shortly before the experiment took place, an application was made to me, by the officers, of Royal Engineers, for the preparation, in some way, of a portion of the building with a protective agent.

" One part was painted, inside and out, with a mixture of lime and alum, which, however was not found upon experiment to act as an efficient protective against fire.

" Another part of the hut was pointed, inside and out, three times, with a solution of silicate of soda.

" Unfortunately for the fairness of the experiment, the building was constructed with a double boarding, so that it was only possible to coat or impregnate the planks on one side. Nevertheless, the value of this agent was established beyond doubt.

" A large heap of shavings was lighted in the interior of the hut, against the coated portion of the wall. The flames played fiercely upon the latter for some minutes, but only succeeded in kindling one edge of a plank, and that portion did not blaze, but smouldered for a short time.

" By the heat of the fire, the salt was drawn to the surface of the wood, and fused, forming a glazing upon it.

" Subsequently, when the whole building was destroyed by fire, after unsuccessful attempts to extinguish it by means of the " Annihilators," the fierceness of the flames was such, that few materials could have withstood it: yet, of the exterior, coated, portion of timber, several planks remained.

" Upon examining these, the unprotected surfaces which had been directly exposed to the fire were found to be completely charred, but this charring had extended only to the point to which the silicate had penetrated from the other side of the plank.

" This experiment is considered to have proved that the silicate of soda is a very valuable protective agent, and that, even when simply applied as a paint, it will serve to protect wood for a considerable time from fire, and to retard greatly the spreading of a conflagration."

Shortly after the experiments above described were made, the possibility suggested itself of rendering the coating of silicate less destructible by exposure to wet, of increasing its efficiency as a protective, and of rendering its application more economical, by combining with its use that of ordinary lime-wash.

Some pieces of plank were prepared in the following manner; a dilute solution of the silicate of soda was first applied with a brush; when this had thoroughly soaked into the wood, and dried, a thick lime-wash (made by slaking some lime, and reducing the hydrate to a smooth wash of the consistence of thick cream) was applied, and lastly, after the planks had been exposed to the air for two or three hours, they were painted with a second solution of silicate of soda, somewhat stronger than that first used.

The effects of the liquids thus applied, both upon the wood and on each other, will be more particularly pointed out in a report subjoined.

Several experiments, precisely similar to those described below, were made with the prepared planks, the result proving most satisfactorily that the protective coating resisted to a remarkable degree the action of heat, evinced no symptom of peeling off the highly heated surface of the wood, and protected the fibre to a great degree from the influence of flame playing upon its surface.

The durability of the coating was tested by exposing prepared surfaces of wood to a continuous stream of water, and to heavy, rains, for a considerable period. It was found that the rain had no effect upon the coating; in the other more severe test, the material was only to some extent removed, after a time, on that spot where the jet of water first impinged upon the wood.

A trial was made of the firmness of the coating, by applying heavy blows to the surface of the wood; the covering was only disturbed in one or two places, where the lime had been laid on rather too thickly.

Upon the results of these experiments being reported, an order was issued by Lord Panmure to have the proposed process for the protection of wood from fire, practically tested at some of the camps or stations.

It was ultimately arranged that a proper trial of the process should be instituted at Chatham, under the direction of Colonel Sandham, R. E.

The nature of the experiments performed at Chatham, and the results obtained, are detailed in the following official report:—

Report on Experiments at Chatham, from Colonel SANDHAM, R. E., and F. A. ABLE, Esq., 1st March 1857; *to the Inspector General of Fortifications.*

Sir,

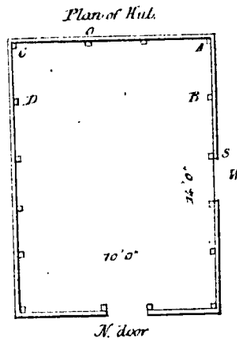
We have the honor to inform you that some experiments with silicate of soda applied in conjunction with lime-wash, as a means of protecting wood from fire, and of retarding its combustibility, have been made at Chatham, on a sufficient scale to determine practically the value of this agent, if applied as a preservative to camp-huts.

The following is an account of these experiments, and of the results obtained.

A small single-boarded hut was built in the model Battery, the material used in its construction being of the description usually employed for camp huts.

It was provided with one door, and a window-opening on one side, closed by a shutter.*

After the hut was completed, certain portions of it were prepared, on the 8th and 9th of January, with the silicate of soda in the following manner:



1st. The wood was washed over with a somewhat dilute solution of the silicate of soda, applied in the manner usually adopted for white-washing walls.

2nd. After an interval of about two hours, a coating of thick lime-wash was applied, over that of the silicate.

3rd. On the following day the prepared portions of the interior of the hut received, upon the lime, a second application of the solution of silicate of soda, a little stronger than that first applied.

Shortly afterwards the exterior prepared portion of the hut was similarly coated with the silicate.

The prepared wood therefore received.—

1st. A coating of dilute silicate of soda, which penetrated slightly into the wood, generally to the depth of about $\frac{1}{10}$th inch.

2nd. A coating of thin lime wash, and

3rd. A second coating of silicate of soda, which, acting chemically upon the lime, formed a hard protective coating with the latter on the wood.

Two opposite corners of the hut, with about one-third of each side, and a corresponding portion of the roof, were left unprotected.

One side of one of the unprotected corners of the hut received three coats of paint; a similar coating was applied, over the protective coating, to one side of a prepared corner.

Some pieces of plank were also prepared with the silicate of soda, and lime, as described above.

Experiments with the prepared hut were unavoidably deferred until the 12th of February, 1856. During the interval the hut had been repeatedly exposed to very heavy rains; but although the light wood of which it was constructed was eventually completely saturated with wet, the coating on the wood was not in the slightest degree injured, and could be removed, by knocking the wood, only in one or two places in the roof, where the surface of the boards was very rough, and the coating consequently less perfect.

* The hut was 14 feet by 10 feet, 6 feet high at eaves, and 9 feet at ridge; it was constructed of ¾ inch deal weather boarding, on quarters and rafters of deal, 3 inch by 2 inch Door, 6 feet 6 inches by 2 feet 9 inches, of 1 inch deal, and window 3 feet by 2 feet, closed by a shutter of 1 inch deal. Floor of 1 inch deal, on fir joists, 4 inches by 2 inches, the upper surface of floor being 6 inches above the ground. Both sides of the walls from O, to S, and from V, to N, were prepared. The insides of the portions A B C D were pointed with common oil paint in three coats, that at A B being laid on the prepared part, while that at C D was laid on the unprepared part.

EXPERIMENT 1.

A fire of wood, charcoal, and coke was kindled in a tall iron stove provided with numerous large openings in the sides, so as to admit of a great escape of heat in the neighbourhood of the boards.

The stove was placed in a prepared corner of the hut, at a distance of about 10 inches from the sides, and the fire was speedily raised to a sufficient degree to render the sides of the stove red hot in several places.

About one hour and a quarter elapsed, after the stove was well alight, before those portions of the sides nearest to the hotest parts of the fire evinced any symptom of igniting, although the wood was scorched, and to a great extent baked, in several places, those portions becoming at last so hot on the outside that the hand could scarcely be placed against them.

At this point the prepared side which had been painted, became ignited, the vapours emitted from it, by the baking of the wood, being very considerable.

The remainder of the heated corner inflamed instantaneously, but the flame was not so powerful as that covering the painted portion.

After the first burst of flame from the prepared planks, produced by the ignition of the vapours baked out of the wood, the fire went down considerably and made but very little progress. Now and then a small burst of flame was seen on the out side, issuing from between the joints of the weather-boarding, but it was soon evident that the fire could only with great difficulty seize permanently on the prepared surface of the wood, and that it only spread very slowly by creeping along between the overlapping portions of the planking, which were unprotected, and between the quarterings and the planks, where the surfaces of the wood could not be reached by the brush in the process of preparation.

Some pieces of plank, which had been piled against the stove in the building, having become inflamed, as also a small portion of the flooring, which was not prepared, a pail of water was thrown, from the doorway, at the stove, whereby the fire from the planks was extinguished; the water, however, scarcely reached the sides of the hut and did not affect the fire in the stove.

About an hour after the corner of the hut had been kindled, the stove, which had some time before partly fallen from some of its supports, so that it actually leaned against one side of the hut, protruded from the opening ultimately formed in the corner by the fire, which, though not interfered with, had confined itself almost to the immediate vicinity of the highly heated stove.

The latter was now removed from the hut through this opening, and a short time after, a little water was used to extinguish the fire which had been communicated to that part of floor over which the stove had been standing.

The fire which was burning here and there very slowly, in the corner of the hut, was left untouched.

EXPERIMENT 2.

Soon after the experiment above described had been commenced, and before the fire in the stove had produced any effect upon the hut, a pile of shavings and wood, with a little tar, was made in the opposite prepared corner of the hut, upon some loose prepared planks (laid down to save the unprepared flooring of the hut,) and, this having been kindled, a fierce fire was maintained for about ten minutes; the flames licking the sides of the hut and a portion of the roofing.

At the expiration of that time, the sides and upper corner of the hut were perceived to be burning in a few places, at the edges of the weather-boarding. A short time afterwards the pile of fire was withdrawn, upon which the prepared surfaces of the wood immediately ceased burning, and it was found that the fire had only to a slight extent seized permanent hold of the corner, in three places.

1st. At the bottom at the overlapping portions of two planks: the fire was soon extinguished spontaneously at this point.

2nd. About half-way up the corner between the back of the quartering and the weather-boarding, where the fire continued to smoulder on, consuming the unprepared portion of the wood in that spot.

3rd. In the upper corner, immediately under the roofing. At this spot there was necessarily a considerable portion of wood (the backs of the joists, wall plates, and planking) which could not be reached by the preparation, and which therefore served as a hold for the fire.

It was interesting to observe how in this, as in the experiment first detailed, the fire slowly crept along those small portions of wood which had escaped preparation, in the protected corners (*i. e.*, the overlapping edges of the weather-boarding, and the backs of the quarterings); while the prepared surfaces of wood exhibited no tendency to carry the fire along, and where only consumed when in contact with other burning matter, or when surrounded for a length of time by flame from unprotected portions of the wood.

Although, at the expiration of about three hours, portions of the two opposite corners of the hut were still burning; and frequent gusts of wind served to fan the fire, it was found that the hut could be left, without fear of the fire spreading so as to become unmanageable.

Upon our returning to the hut, after the lapse of about half an hour, the fire was still found smouldering here and there in both corners, having extended very little farther along the unprotected portions of the wood, as above described, particularly between three of the joists, and in the corner immediately under the roofing.

The effects of the fire were watched for a short time longer, and the few burning places in the prepared corners were then extinguished by the application of a little water from a mop.

The above experiments showed that, although the attempts to kindle the protected corners of the hut had ultimately succeeded, in one instance, by the maintenance of a fierce fire for several minutes against the wood, and in the other by the immediate vicinity, and even actual contact, of a highly heated stove with the wood, for a great length of time—.

1st. The prepared surfaces of wood, having been thoroughly baked, only burned as long as they were in close contact with burning, or highly heated matter, or for an instant when exposed to a powerful current of air; and did not possess any tendency to lead the fire along, this being only effected by the unprepared portion of the wood:

2nd. At any period during the four hours, for which time the fire was allowed to exert its uncontrolled effect upon the prepared portions of the hut, the burning parts of the building could have been with ease extinguished, by means of a couple of pails of water.

EXPERIMENT 3.

While the experiments with the hut were being carried on, some pieces of prepared and of unprepared planking were piled together in two similar heaps in the open air, and a fire of shavings and wood-chips was made up under them.

The comparative tardiness with which the prepared planks inflamed, and the difference in time required to effect the actual ignition of these and that of the unprepared planks was very evident, as was also the case with pieces of planks which had been piled up against the sides of the stoves in the building.

The prepared boards upon which the fire had been kept up in the corner of the hut were also examined, and found to be but little affected by their protracted contact with burning matter.

The wood had only caught at the edges, and was found smouldering there in two or three places.

By submitting the glimmering portion to the blast of a bellows, a small flame was produced, which went out immediately on the removal of the current of air.

EXPERIMENT 4.

In order to have convincing proof of the advantages of the preparation in retarding the ignition of wood, it was resolved to make experiments, similar to those described as Nos. 1 and 2; to observe the difference in time required for the ignition of the wood in the unprepared corners of the hut, and to ascertain the comparative power of the fire to extend, in these parts.

A fire was kindled in the stove placed in one of the unprotected corners of the hut.

In about ten minutes after the stove had become thoroughly heated, the sites of the hut burst into flames, which at once rose to the roofing above, and kindled portions of it.

A heap of wood and shavings was lighted in the opposite unprepared corner, and in two or three minutes this portion of the hut was in flames.

The unprepared wood having been once kindled, the fire spread so rapidly as to be quite uamanagable in a few minutes, the flames completely filling the interior of the hut, But even under these circumstances, when the intense heat and fierce flames from the burning portions soon spread the fire to the prepared parts of the hut, it was remarkable how the flame crept along between the crevices and overlapping portions of the planks where the wood was unprepared, so that the prepared surfaces were always thoroughly surrounded by flame for a considerable time before they ignited. Some portions of the prepared planking, of which the wood had probably imbibed a rather larger quantity of silicate, in consequence of its greater porosity, offered great resistance to the fire to the very last.

We consider the experiments above detailed to have afforded conclusive proof on a practical scale, of the considerable power possessed by silicate of soda, applied simply as a coating, in conjunction with lime, of retarding the inflammability of wood.

It is, of course, impossible even by the thorough impregnation of wood with various substances, to deprive it of the property of burning; the only results to be attained by the use of a protective material are.—

1st. To shield the substance of the wood itself in a great degree from the effects of neighbouring fire, or of the vapours which will issue from over-heated wood, and burn on its surface, and.—

2nd. To deprive the wood to a considerable extent, of the power of carrying the fire along, thus rendering necessary the *continued application* of heat or fire from another source (such as an over-heated stove or unprotected portions of wood) in order to effect its thorough ignition.

An examination of the experiments just described will show that these results are obtained by the application of the silicate of soda to the wood.

This substance may be obtained in any quantity at a very reasonable rate and the method of applying it is so simple, that the wood may be properly prepared with it by ordinary workmen.

It appears to us important that, if its application to new Camp huts should be determined upon, the wood to be employed in their structure should be completely coated with the preparation, before the erection of the buildings, in order to give the latter a fair chance of resisting the action of fire, reaching the wood from any quarter.

But even in buildings already erected, it is of importance that those portions which are in any way liable to possible exposure to heat or fire (*e. g.* the portions in the vicinity of stoves,) should receive the very considerable protection which would be afforded by the application of the silicate coating, any covering of paint or paper having first been removed.

We beg to give it as our opinion that the efficiency of the protective agent in question has been sufficiently tested to obviate the necessity of further trials upon a large scale, and submit, in conclusion, that while the extensive employment of light wooden buildings for huts and temporary werkshops, renders the application of some protective material to the *interior* of these, at any rate, a matter of great importance, it is of equal consequence that such an agent, if adopted for use in the service, should be easy of application and inexpensive, and that its employment should be as completely under the control of Government as that of any ordinary coating material.

The above report was accompanied by a communication relating to the cost of the application of the silicate coating, in which it was stated that, provided the silicate of soda employed has been prepared with especial reference to this application (*i e*, so as to be readily and completely misceable with water,) one pound of the material is sufficient to prepare a surface of wood of ten

square feet; while the wholesale price of the silicate, in the form of a syrup of a certain degree of concentration, is twenty pounds per ton; so that the cost of the silicate, required to prepare the wood is at the rate of about two-pencc for a surface of ten square feet.

Experiments are just now being carried on, with a view to impart to the silicate coating the appearance of paint, by combining the use of different colouring matters with that of the lime.

The following are the directions adopted for general guidance, in preparing wood with the coating of silicate of soda, and lime.

Directions for covering Timber with a Protective Coating of the Silicate of Soda and Lime.

Materials employed.—The silicate of soda, must be in the form of a thick syrup, of a known degree of concentration, as manufactured by Messrs. Simpson and Co., Kennington Road, London.

The lime-wash should be made by slaking some good fat lime, rubbing it down with water until perfectly smooth, and then diluting it to the consistency of thick cream.

Treatment of the Wood.—The protective coating is produced by painting the wood, firstly with a dilute solution of silicate of soda; secondly, with the lime wash; and lastly, with a somewhat stronger solution of the silicate.

The surface of the wood should be moderately smooth, and any covering of paper, paint, or other material should be first removed entirely, by planning or scraping.

A solution of the silicate, in the proportion of one part by measure of the syrup to three parts of water, is prepared in a tub, pail, or earthen vessel by simply stirring the measured proportion of the silicate with the water, until complete mixture is effected.

The wood is then washed over with this liquid, by means of an ordinary white-wash brush, the latter being passed two or three times over the surface, so that the wood may absorb as much of the solution as possible. When this first coating is nearly dry, the wood is painted with the lime-wash in the usual manner.

A solution of the silicate, in the proportion of two parts by measure of the syrup to three parts of water, is then made; and a sufficient time having been allowed to elapse for the wood to become moderately dry, this liquid is applied, upon the lime, in the manner directed for the first coating. The preparation of the wood is then complete. If the lime-coating has been applied rather too thickly, the surface of the wood may be found, when quite dry, after the third coating, to give off a little lime when rubbed with the hand. In that case, it should be once more coated over with a solution of the silicate, of the strength prescribed for the second liquid.

Directions for Covering Timber with a Coating of the Silicate of Soda and Lime as a Protective from Fire.

Materials Employed.

The Silicate of Soda must be in the form of a thick syrup of a known degree of concentration, and is diluted with water when required for use, according to the prescriptions given below.

The lime-wash should be made by slaking some good fat lime, rubbing it down with water until perfectly smooth, and diluting it to the consistency of thick cream.

Treatment of the Wood.

The protective coating is produced by painting the wood, firstly with a dilute solution of Silicate of Soda; secondly with the lime-wash; and lastly, with a somewhat stronger solution of the Silicate.

The Surface of the wood should be moderately smooth, and any covering of paper, paint or other material, should be first removed entirely, by planning or scraping.

A solution of the Silicate, in the proportion of one part by measure of the syrup to four parts of water, is prepared in a tub, pail, or earthen vessel by stirring the measured proportion of the Silicate, first with a very small quantity of the necessary water until a complete mixture is produced, and then adding the remainder of the water, in successive quantities, until a perfect mixture in the requisite proportions is obtained.

The wood is then washed over with this liquid, by means of an ordinary white-wash brush, the latter being passed two or three times over the surface, so that the wood may absorb as much of the Solution as possible. When this first coating is nearly dry, the wood is painted with the lime-wash in the usual manner.

A solution of the silicate, in the proportion of one part by measure of the syrup to two parts of water, is then made as above described; and a sufficient time having been allowed to elapse for the wood to become moderately dry, this liquid is applied, upon the lime, in the manner directed for the first coating. The preparation of the wood is then complete. If the lime coating has been applied rather too thickly, the surface of the wood may be found, when quite dry after the third coating, to give off a little lime when rubbed with the hand. In that case, it should be once more coated over with a solution of the silicate of the first-named strength.

(Signed) F. A. ABEL,

ROYAL ARSENAL, WOOLWICH. *Chemist of the War Department.*

N. B. The Silicate of Soda best adapted for this purpose is manufactured by Simpons and Co., 1 Kennington Road London..

Ordered to be communicated to the Commander-in-Chief (Adjutant General's and Quarter Master General's Departments) Public Works Department, Town Major, Medical Board, Commissary General, Inspector General of Ordnance and Magazines, and to the Madras Literary Society.

2. Orders will be issued in the Public Works Department with a view to experiments being made for the purpose of testing the efficacy of the composition for protecting wooden buildings from fire, which it appears, admits of being applied to thatching also; and to a report of the result being duly submitted to Government.

3. The Medical Board are requested in communication with the Chemical Examiner to arrange for the required supplies of the composition being prepared and furnished on the requisition of the Chief Engineer D. P. W.

(True Extract and Copies.)

(Signed) C. A. BROWNE, Colonel,
Secretary to Government.

No. 72. ORDER THEREON, No. 2273; dated 7th December 1857.

Ordered to be communicated to the Chief Engineer, with a request that he will test the efficacy of the composition for protecting wooden buildings from fire, and report the result of the experiments in communication with Doctor Mayer.

(Signed) H. FORBES,
Acting Secretary to Government.

MILITARY. DEPARTMENT.

No. 3797.

Extract from the Minutes of Consultation, 31st October 1857.

Read despatch from the Honorable Court of Directors, dated 2nd September 1857, No. 116.

Our Governor in Council, at Fort Saint George.

We forward for your consideration copy of a letter and its enclosures received from Mr. Abel, Chemist of the War Department, bringing to our notice the results of his scientific enquiries with the view of discovering some cheap and efficacious means for protecting wooden buildings from fire. As the composition prepared by Mr. Abel, viz· Silicate of Soda, is made from materials procurable in India, you will have no dificulty in trying any experiments which may be necessary. You will report to us the results for communication to Mr. Abel.

We are &c.,

(Signed) R. D. MANGLES, and 10 others.

From F. A. Abel Esquire, Chemist of the War Department, Woolwich, S. E., 30th July 1857; to the Secretary East India Company.

I have the honor to address you upon a subject which I have been strongly recommended by Colonel Sandham Commanding Royal Engineer at Chatham to bring to the notice of the Honorable Court of Directors of the East India Company.

During the late War, I was called upon by the Engineer authorities to suggest some simple, cheap, and efficacious means for protecting wooden hutting from fire, and at the same time I was instructed by the Secretary of State for War to examine into the merits of certain proposals laid before him for the same purpose.

The result of my experiments on this subject was the preparation of a protective material applicable even after the erection of huts, in the same manner as whitewash, tar, or paint, and which was shewn to afford such important protection to wood in case of fire, that experiments upon a proper scale were ordered by Lord Panmure to be tried at the principal camps in Great Britain, and, at the same time, permission was given me by his Lordship to patent the material of which permission however I declined to avail myself.

It was subsequently arranged by the Inspector General of Fortifications that a full trial of the value of the material should be made by Colonel Sandham and myself at Chatham. The accompanying abstract from the professional papers of the Royal Engineers contains a copy of our joint report to Lord Panmure on the results of these experiments to which I beg most respectfully to call the attention of the Honorable Court of Directors.

Unfortunately, by the time that the merits of the protective coating in question were properly established the huts at the various camps had been already coated with tar or other materials which did not admit of removal from the wood, except at considerable expense.

The silicate of soda and lime coating has however been tried and applied to a small extent at Aldershot and at Alderney.

Fifteen tons of the silicate of soda have moreover been sent by Government to China for the purpose of coating the hutting.

The advantages of the material referred to for coating timber may be embraced under the following headings.

1stly. The simplicity of its application.

2ndly. The circumstance that it forms an excellent protective to wood against weather, and may therefore be employed as a substitute for tar or paint.

The colour of the coating itself is nearly white; a small admixture of an ochre serves to remove the glazing nature of the coat.

3rdly. The cheapness of the material, the cost of coating ten square feet not exceeding two pence.

4thly. The great efficacy of the coating as a means of protection against fire as demonstrated by the experiments detailed in the accompanying report.

Although personally impressed with the idea that a knowledge of the existence of the material in question, open to general use without reserve and emanating indeed from Government itself must be of importance to the Honorable East India Company, I hesitated to adopt the

step I am now taking until I had consulted Colonel Sandham, who urged me strongly to lose no time in bringing the subject to their notice.

I beg to enclose a copy of the directions for preparing timber with the material which have been drawn up by desire of the Inspector General of Fortifications and to state that it will afford me pleasure to give any further information on the subject that it is in my power to afford should the Honorable Court of Directors feel desirous of taking it into consideration.

From F. A. Abel Esquire, Chemist of the War Department, Woolwich, S. E., 27th August 1857.

I have the honor to acknowledge the receipt of your letter of the 26th instant informing me that the Court of Directors of the Honorable East India Company have directed copies of my communication of 30th ultimo, and of printed directions to be enclosed to the several Governments in India.

With reference to the concluding paragraph of your letter referring to my statement as to the employment of silicate of soda in China, I beg to observe that from the quantity sent out (15 tons) and from the correspondence which I had at the time on the subject with the authorities at the War Office, there is no doubt that the silicate and lime is to be used in China as the coating material for the wooden erections required at the stations there, and has not been sent out as a matter of experiment.

Having heard that the great risk of fire arises from the thatching employed for the roofs of hut buildings in India,—I am anxious to state for the information of the Directors and of the Government of India that the silicate of soda admits of very simple application to the thatching as a protective material.

The thatching would require soaking for a short time previous to use in a solution of silicate, and the thatched roof when dry should receive a thin coating of lime or clay stirred to a cream with solution of silicate.

It would probably be found advisable to renew the exterior coating of wash after the rainy season.

I beg again to epxress my readiness to furnish every information which may be required on the subject.

Remarks on the Protection of Wood from Fire, by F. A. Abel, Esq., Chemist to the War Department, accompanied by a Report on experiments made at Chatham, by Colonel Sandham, R. E., and himself.

The attention of practical men has been for some years past directed, from time to time, to the importance of affording to wooden erections some degree of protection from the effects of fire; and numerous plans have been proposed, and to some extent tested, for lessening the combustibility of wood, and for covering its surface with a protective coating more or less unalterable by fire.

The simple application of lime or clay-wash, for example, has been found to afford some slight protection to wood, although the tendency of such materials to peel off the surface of the wood (into which they do not in any way penetrate), by exposure to heat, and the rapidity with which the coating is destroyed by atmospheric influence, render them very ineffective agents.

Several processes have been patented, even recently, for the protection of wood from fire. Some idea of the general nature of such processes will be conveyed by the following extract from an official report made on this subject:—

"The importance of obtaining an effective method of reducing the combustibility of wood, or even of protecting its surface from fire, has led to an examination into some of the methods of accomplishing this, which have been lately patented, and of the general nature of which the following is a brief statement.

I.—"*Mr. Maugham's Patent* consists in saturating dried wood with an aqueous solution of phosphate of soda and muriate or sulphate of ammonia, in certain proportions.

"It is believed by the patentee that these salts will be so affected by each other, and by the action of heat, that the fibres of the wood will be protected by an incombustible coating, while a quantity of vapour will be generated by the volatilisation, and partial decomposition, of the ammoniacal salts, which will possess the power of extinguishing flame.

"The same objects are believed to be obtained by—

II.—"*Lieutenant Jackson's Patent Process*, by which wood is impregnated with a solution of salts of zinc and of ammonia.

"The same means are adopted in both of these processes for saturating the wood.

"It is packed into large cylinders from which the air is then exhausted, the liquid being afterwards forced in with a pressure of 150 to 200 lbs., which is maintained during one or two hours. It is the same method as that employed in patent processses for preserving timber from decay.

"I am not aware whether Mr. Maugham's, process has been submitted to any extensive practical test. Numerous experiments were however instituted on Lieutenant Jackson's process, under the direction of Mr. Brunel.

"Specimens of seventeen different kinds of wood were prepared; corresponding pieces being kept unprepared, and others covered with a coating of paint. Their powers of resisting fire were tested by piling the prepared, unprepared, and painted specimens round a perforated sheet iron surface, filled to the top with a bright coke fire.

"In most cases the prepared wood resisted the action of fire for a longer period, and, when removed from the fire, ceased burning sooner than the unprepared specimens.

"It was also evident that light porous woods were more efficiently protected than those of a denser character.

"There is no doubt therefore that the combustibility of wood is more or less diminished by either of the above methods of treatment, although the protective action must be ascribed to the indestructible compounds with which the wood is to some extent impregnated, far more than to the vapours evolved by the decomposition of the small quantities of ammoniacal salts forced into the wood.

"Although by the impregnating process adopted in the above patents, the preparative solution is believed to be forced into the very centre of the wood, it is essential, if such a result is to be obtained, that the solution should be weak, since it is impossible to force strong saline solutions thoroughly into wood.

"It is evident that the protective action of the salt cannot, under these circumstances, be very powerful.

"Were it possible, on the other hand, to employ stronger solutions, the expense of the processes would be considerable.

"The necessity of costly apparatus for impregnating the wood is also a matter of serious moment."

The patentees of some of the wood-preserving processes go so far as to state that they are enabled to render wood incombustible or uninflammable, and such statements have tended to lead to the presumption that a thoroughly effective protecting agent should have the power of depriving wood of its combustibility.

It will be readily understood, however, that even if a piece of wood could be most thoroughly impregnated with a solution of some strength, of matter unalterable, or at any rate only fusible, by continued exposure to heat, the amount of protective material thus deposited in the pores of the wood, although it might be considered to surround each particle of fibre, would not prevent the destructive distillation of the wood by the effect of heat, the result of which would be the disnegagement of inflammable vapours from the wood, and its ultimate complete ignition, if maintained for a sufficient period in the vicinity of highly heated or burning matter; or, if on the other hand, the protective agent employed be convertible by heat into vapours possessing the property of extinguishing such fire as they may completely surround, such vapours might have the effect of partially or completely extinguishing the fire in a piece of ignited wood, *after* its removal from the source of heat or fire, but otherwise the volume of vapour generated from the preparation used, would be but slight, as compared with the inflammable vapours evolved from the over-heated wood, and would have no perceptible effect on the combustion of these, while the scorched, or charred, woody fibre would be less efficiently shielded from the effect of flamee than by the coating formed from an indestructible preparation.

It does not therefore appear reasonable to expect more from the most efficient protective coating or impregnating material than—

1st. That it should considerably retard the ignition of wood, exposed for some length of time to the effect of a high temperature, or of burning matter in its immediate vicinity.

2nd. That if the vapours which the wood will emit, by continued exposure to heat, become ignited, the flames thus produced shall not readily affect the fibre of the wood, and shall cease almost directly on the removal of the wood from the source of heat; and

3rd. That prepared surfaces of wood, when in actual contact with burning unprepared wood, shall have little tendency to ignite, and thereby cause the fire to spread.

In addition to such processes as those above referred to, in which the protecting material is forced into the wood by the application of considerable pressure, trials have been made with agents of different kinds, in solutions or baths, in which the wood was steeped, or allowed to soak, for some hours, so that it might be in a slight degree impregnated with the material, or that a superficial coating of the protective might, at least, be formed.

Some of these methods have been made the subject of experiments by order of Lord Panmure, with a view to test their merits.

One, proposed by W. C. Salomons, of Paris, consisted in immersing the dried wood alternately, in two baths; the one containing three parts of acid sulphate of alumina, and one part of glue, dissolved in six parts of water; the other consisting of two parts of dry chloride of calcium, one part of glue, and seven parts of water.

The objects which the inventor wishes to attain, by the use of these solutions, are, firstly, to impregnate the wood slightly with one of the salts (the chloride of calcium, for example), and then, by immersion of the wood in the second bath, to effect the decomposition of the first salt by the second, in the pores of the wood.

Thus the chloride of calcium and sulphate of alumina should become converted into sulphate of lime, and chloride of aluminum; the former an almost insoluble substance, the latter a soluble deliquescent body, possessing the property of converting the glue employed, together with the salts, into an insoluble body—a species of leather.

The pores of the wooden surfaces are therefore, by the treatment in question, to be filled up by particles of a substance nearly insoluble, and unalterable by heat, which, together with the soluble salt, also present, are to be protected and united by means of the precipitated glue, which dries up to a hard, horny substance.

The experiments made with this process showed that the glue employed in the solutions greatly impeded the penetration of the wood by the saline matter, and also caused the decomposition of the salts to be very partial.

The protective property of the coating formed on the wood, prepared by this process, was not found to be considerable, while the expense of the materials was great, as compared with others equally efficient.

The successful results obtained on the Continent by the application of alkaline silicates, as protective materials, led to an examination into the comparative value of the cheapest of these, the soluble silicate of soda, as an agent for decreasing the combustibility of wood.

The property possessed by the soluble alkaline silicates, of being readily softened by hot water, and thus converted into a state of solution, while they are but slightly affected by cold water, renders their application to wood, either in the form of a bath, or as a wash, very simple. Their dilute solutions being readily absorbed by wood the surfaces of the latter, as it dries, assume the form of a hard coating.

The experiments made in the first instance with the silicate of soda, and the results obtained, are described in the following extract from the official report:—

"Various specimens of dry wood were prepared with silicate of soda, by being soaked for a few hours in a weak solution.

"Upon examining the interior of these, after the removal from the bath and subsequent desiccation, the silicate was found to have penetrated about a quarter of an inch on all sides.

On piling the above over a fire, together with specimens of unprepared wood, and others that had been prepared by different processes, the superiority of the silicate of soda, as a protective agent, was fully established.

"Some specimens of wood were then simply painted with a moderately strong solution of silicate, and afterwards placed, together with unprepared wood, in a pool of coal-tar naptha some of the latter being thrown over the surfaces of the wood.

"Immediately on the ignition of the naptha, the wood was surrounded by flames, which soon fired the unprepared pieces, whilst those coated with the silicate only ignited after a time *at the edge*, and were scorched or baked by the heat, but not burned.

"A wooden hut, similar in construction to those at Aldershot, having been erected in Woolwich Marshes, for the purpose of testing the value of Philips's Fire Annihilator, advantage was taken of the opportunity thus offered for trying, to some extent, upon a larger scale, the merits of the silicate as a protective.

"Shortly before the experiment took place, an application was made to me, by the officers, of Royal Engineers, for the preparation, in some way, of a portion of the building with a protective agent.

"One part was painted, inside and out, with a mixture of lime and alum, which, however was not found upon experiment to act as an efficient protective against fire.

"Another part of the hut was painted, inside and out, three times, with a solution of silicate of soda.

"Unfortunately for the fairness of the experiment, the building was constructed with a double boarding, so that it was only possible to coat or impregnate the planks on one sidea Nevertheless, the value of this agent was established beyond doubt.

"A large heap of shavings was lighted in the interior of the hut, against the coated portion of the wall. The flames played fiercely upon the latter for some minutes, but only succeeded in kindling one edge of a plank, and that portion did not blaze, but smouldered for a short time.

"By the heat of the fire, the salt was drawn to the surface of the wood, and fused, forming a glazing upon it.

"Subsequently, when the whole building was destroyed by fire, after unsuccessful attempts to extinguish it by means of the "Annihilators," the fierceness of the flames was such, that few materials could have withstood it: yet, of the exterior, coated, portion of timber, several planks remained.

"Upon examining these, the unprotected surfaces which had been directly exposed to the fire were found to be completely charred, but this charring had extended only to the point to which the silicate had penetrated from the other side of the plank.

"This experiment is considered to have proved that the silicate of soda is a very valuable protective agent, and that, even when simply applied as a paint, it will serve to protect wood for a considerable time from fire, and to retard greatly the spreading of a conflagration."

Shortly after the experiments above described were made, the possibility suggested itself of rendering the coating of silicate less destructible by exposure to wet, of increasing its efficiency as a protective, and of rendering its application more economical, by combining with its use that of ordinary lime-wash.

Some pieces of plank were prepared in the following manner; a dilute solution of the silicate of soda was first applied with a brush; when this had thoroughly soaked into the wood, and dried, a thick lime-wash (made by slaking some lime, and reducing the hydrate to a smooth wash of the consistence of thick cream) was applied, and lastly, after the planks had been exposed to the air for two or three hours, they were painted with a second solution of silicate of soda, somewhat stronger than that first used.

The effects of the liquids thus applied, both upon the wood and on each other, will be more particularly pointed out in a report subjoined.

Several expirments, precisely similar to those described below, were made with the prepared planks, the results proving most satisfactorily that the protective coating resisted to a remarkable degree the action of heat, evinced no symptom of peeling off the highly heated surface of the wood, and protected the fibre to a great degree from the influence of flame playing upon its surface.

The durability of the coating was tested by exposing prepared surfaces of wood to a continuous stream of water, and to heavy, rains, for a considerable period. It was found that the rain had no effect upon the coating; in the other more severe test, the material was only to some extent removed, after a time, on that spot where the jet of water first impinged upon the wood.

A trial was made of the firmness of the coating, by applying heavy blows to the surface of the wood; the covering was only disturbed in one or two places, where the lime had been laid on rather too thickly.

Upon the results of these experiments being reported, an order was issued by Lord Panmure to have the proposed process for the protection of wood from fire, practically tested at some of the camps or stations.

It was ultimately arranged that a proper trial of the process should be instituted at Chatham, under the direction of Colonel Sandham, R. E.

The nature of the experiments performed at Chatham, and the results obtained, are detailed in the following official report :—

Report on Experiments at Chatham, from Colonel Sandham, R. E., and F. A. Able, Esquire, 1st March 1856; to the Inspector General of Fortifications.

Sir,

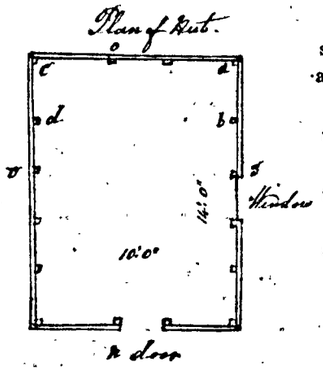
We have the honor to inform you that some experiments with silicate of soda applied in conjunction with lime-wash, as a means of protecting wood from fire, and of retarding its combustibility, have been made at Chatham, on a sufficient scale to determine practically the value of this agent, if applied as a prescrvative to camp-huts.

The following is an account of these experiments, and of the results obtained.

A small single-boarded hut was built in the model Battery, the material used in its construction being of the description usually employed for camp huts.

It was provided with one door, and a window-opening on one side, closed by a shutter.*

After the hut was completed, certain portions of it were prepared, on the 8th and 9th of January, with the silicate of soda in the following manner:



1st. The wood was washed over with a somewhat dilute solution of the silicate of soda, applied in the manner usually adopted for whitewashing walls.

2nd. After an interval of about two hours, a coating of thick lime-wash was applied, over that of the silicate.

3rd. On the following day the prepared portions of the interior of the hut received, upon the lime, a second application of the solution of silicate of soda, a little stronger than that first applied.

Shortly afterwards the exterior prepared portion of the hut was similarly coated with the silicate.

The prepared wood therefore received.—

1st. A coating of dilute silicate of soda, which penetrated slightly into the wood, generally to the depth of about $\frac{1}{10}$ inch.

2nd. A coating of thin lime wash, and

3rd. A second coating of silicate of soda, which, acting chemically upon the lime, formed a hard protective coating with the latter on the wood.

Two opposite corners of the hut, with about one-third of each side, and a corresponding portion of the roof, were left unprotected.

One side of one of the unprotected corners of the hut received three coats of paint; a similar coating was applied, over the protective coating, to one side of a prepared corner.

Some pieces of plank were also prepared with the silicate of soda, and lime, as described above.

Experiments with the prepared hut were unavoidably deferred until the 12th of February, 1856. During the interval the hut had been repeatedly exposed to very heavy rains; but although the light wood of which it was constructed was eventually completly saturated with wet, the coating on the wood was not in the slsghtest degree injured, and could be removed, by knocking the wood, only in one or two places in the roof, where the surface of the boards was very rough, and the coating consequently less perfect.

Experiment 1.

A fire of wood, charcoal, and coke was kindled in a tall iron stove provided with numerous large openings in the sides, so as to limit of a great escape of heat in the neighbourhood of the boards.

* The hut was 14 feet by 10 feet, 6 feet high at eaves, and 9 feet at ridge; it was constructed of ¾ inch deal weather boarding, on quarters and rafters of deal, 3 inch by 2 inch Door, 6 feet 6 inches by 2 feet 9 inches, of 1 inch deal, and window 3 feet by 2 feet, closed by a shutter of 1 inch deal. Floor of 1 inch deal, on fir joists, 4 inches by 2 inches; the upper surface of floor being 6 inches above the ground. Both sides of the walls from *c* to *s*, and from *v* to *n*, were prepared. The insides of the portions *a b*, *c d* were painted with common oil paint in three coats, that at *a b* being laid on the prepared part, while that at *c d* was laid on the unprepared part.

The stove was placed in a prepared corner of the hut, at a distance of about 10 inches from the sides, and the fire was speedily raised to a sufficient degree to render the sides of the stove red hot in several places.

About one hour and a quarter elapsed, after the stove was well alight, before those portions of the sides nearest to the hotest parts of the fire evinced any symptom of igniting, althougth the wood was scorched, and to a great extent baked, in several places, those portions becoming at last so hot on the outside that the hand could scarcely be placed against them.

At this point the prepared side which had been painted, became ignited, the vapours emitted from it, by the baking of the wood, being very considerable.

The remainder of the heated corner inflamed instantaneously, but the flame was not so powerful as that covering the painted portion.

After the first burst of flame from the prepared planks, produced by the ignition of the vapours baked out of the wood, the fire went down considerably and made but very little progress. Now and then a small burst of flame was seen on the outside, issuing from between the joints of the weather-boarding, but it was soon evident that the fire could only with great difficulty seize permanently on the prepared suface of the wood, and that it only spread very slowly by creeping along between the overlapping portions of the planking, which were unprotected, and between the quarterings and the planks, where the surfaces of the wood could not be reached by the brush in the process of preparation.

Some pieces of plank, which had been piled against the stove in the building, having become inflamed, as also a small portion of the flooring, which was not prepared, a pail of water was thrown, from the doorway, at the stove, whereby the fire from the planks was extinguished; the water, however, scarcely reached the sides of the hut and did not affect the fire in the stove.

About an hour after the corner of the hut had been kindled, the stove, which had some time before partly fallen from some of its supports, so that it actually leaned against one side of the hut, protruded from the opening ultimately formed in the corner by the fire, which, though not interfered with, had confined itself almost to the immediate vicinity of the highly heated stove.

The latter was now removed from the hut through this opening, and a short time after, a little water was used to extinguish the fire which had been communicated to that part of floor over which the stove had been standing.

The fire which was burning here and there very slowly, in the corner of the hut, was left untouched.

Experiment 2.

Soon after the experiment above described had been commenced, and before the fire in the stove had produced any effect upon the hut, a pile of shavings and wood, with a little tar, was made in the oposite prepared corner of the hut, upon some loose prepared planks (laid down to save the unprepared flooring of the hut,) and, this having been kindled, a fierce fire was maintained for about ten minutes; the flames licking the sides of the hut and a portion of the roofing.

At the expiration of that time, the sides and upper corner of the hut were perceived to be burning in a few places, at the edges of the weather-boarding. A short time afterwards the pile of fire was withdrawn, upon which the prepared surfaces of the wood immediately ceased burning, and it was found that the fire had only to a slight extent seized permanent hold of the corner, in three places.

1st. At the bottom at the overlapping portions of two planks: the fire was soon extinguished spontaneously at this point.

2nd. About half-way up the corner between the back of the quartering and the weather-boarding, where the fire continued to smoulder on, consuming the unprepared portion of the wood in that spot.

3rd. In the upper corner, immediately under the roofing. At this spot there was necessarily a considerable portion of wood (the backs of the joists, wall plates, and planking) which could not be reached by the preparation, and which therefore served as a hold for the fire.

It was interesting to observe how in this, as in the experiment first detailed, the fire slowly crept along those small portions of wood which had escaped preparation, in the protected corners (*i. e.*, the overlapping edges of the weather-boarding, and the backs of the quarterings); while the prepared surfaces of wood exhibited no tendency to carry the fire along, and where only consumed when in contact with other burning matter, or when surrounded for a length of time by flame from unprotected portions of the wood.

Although, at the expiration of about three hours, portions of the two opposite corners of the hut where still burning; and frequent gusts of wind served to fan the fire, it was found that the hut could be left, without fear of the fire spreading so as to become unmanageable.

Upon our returning to the hut, after the lapse of about half an hour, the fire was still found smouldering here and there in both corners, having extended very little farther along the unprotected portions of the wood, as above described, particularly between three of the joists, and in the corner immediately under the roofing.

The effects of the fire were watched for a short time longer, and the few burning places in the prepared corners were then extinguished by the application of a little water from a mop.

The above experiments showed that, although the attempts to kindle the protected corners of the hut had ultimately succeeded, in one instance, by the maintenance of a fierce fire for several minutes against the wood, and in the other by the immediate vicinity, and even actual contact, of a highly heated stove with the wood, for a great length of time—.

1st. The prepared surfaces of wood, having been thoroughly baked, only burned as long as they were in close contact with burning, or highly heated matter, or for an instant when exposed to a powerful current of air; and did not possess any tendency to lead the fire along, this being only effected by the unprepared portion of the wood:

2nd. At any period during the four hours, for which time the fire was allowed to exert its uncontrolled effect upon the prepared portions of the hut, the burning parts of the building could have been with ease extinguished, by means of a couple of pails of water.

Experiment 3.

While the experiments with the hut were being carried on, some pieces of prepared and of unprepared planking were piled together in two similar heaps in the open air, and a fire of shavings and wood-chips was made up under them.

The comparative tardiness with which the prepared planks inflamed, and the difference in time required to effect the actual ignition of these and that of the unprepared planks was very evident, as was also the case with pieces of planks which had been piled up against the sides of the stoves in the building.

The prepared boards upon which the fire had been kept up in the corner of the hut were also examined, and found to be but little affected by their protracted contact with burning matter

The wood had only caught at the edges, and was found smouldering there in two or three places.

By submitting the glimmering portion to the blast of a bellows, a small flame was produced, which went out immediately on the removal of the current of air.

Experiment 4.

In order to have convincing proof of the advantages of the preparation in retarding the ignition of wood, it was resolved to make experiments, similar to those described as Nos. 1 and 2; to observe the difference in time required for the ignition of the wood in the unprepared corners of the hut, and to ascertain the comparative power of the fire to extend, in these parts.

A fire was kindled in the stove placed in one of the unprotected corners of the hut.

In about ten minutes after the stove had become thoroughly heated, the sides of the hut burst into flames, which at once rose to the roofing above, and kindled portions of it.

A heap of wood and shavings was lighted in the opposite unprepared corner, and in two or three minutes this portion of the hut was in flames.

The unprepared wood having been once kindled, the fire spread so rapidly as to be quite unmanageable in a few minutes, the flames completely filling the interior of the hut. But even under these circumstances, when the intense heat and fierce flames from the burning portions soon spread the fire to the prepared parts of the hut, it was remarkable how the flame crept along between the crevices and overlapping portions of the planks where the wood was unprepared, so that the prepared surfaces were always thoroughly surrounded by flame for a considerable time before they ignited. Some portions of the prepared planking, of which the wood had probably imbibed a rather larger quantity of silicate, in consequence of its greater porosity, offered great resistance to the fire to the very last.

We consider the experiments above detailed to have afforded conclusive proof on a practical scale, of the considerable power possessed by silicate of soda, applied simply as a coating, in conjunction with lime, of retarding the inflammability of wood.

It is, of course, impossible even by the thorough impregnation of wood with various substances, to deprive it of the property of burning; the only results to be attained by the use of a protective material are.—

1st. To shield the substance of the wood itself in a great degree from the effects of neighbouring fire, or of the vapours which will issue from over-heated wood, and burn on its surface, and.—

2nd. To deprive the wood to a considerable extent, of the power of carrying the fire along, thus rendering necessary the *continued application* of heat or fire from another source (such as an over-heated stove or unprotected portions of wood) in order to effect its thorough ignition.

An examination of the experiments just described will show that these results are obtained by the application of the silicate of soda to the wood.

This substance may be obtained in any quantity at a very reasonable rate and the method of applying it is so simple, that the wood may be properly prepared with it by ordinary workmen.

It appears to us important that, if its application to new Camp huts should be determined upon, the wood to be employed in their structure should be completely coated with the preparation, before the erection of the buildings, in order to give the latter a fair chance of resisting the action of fire, reaching the wood from any quarter.

But even in buildings already erected, it is of importance that those portions which are in any way liable to possible exposure to heat or fire (*e. g.* the portions in the vicinity of stoves), should receive the very considerable protection which would be afforded by the application of the silicate coating, any covering of paint or paper having first been removed.

We beg to give it as our opinion that the efficiency of the protective agent in question has been sufficiently tested to obviate the necessity of further trials upon a large scale, and submit, in conclusion, that while the extensive employment of light wooden buildings for huts and temporary workshops, renders the application of some protective material to the *interior* of these, at any rate, a matter of great importance, it is of equal consequence that such an agent, if adopted for use in the service, should be easy of application and inexpensive, and that its employment should be as completely under the control of Government as that of any ordinary coating material.

The above report was accompanied by a communication relating to the cost of the application of the silicate coating, in which it was stated that, provided the silicate of soda employed has been prepared with especial reference to this application (*i e*, so as to be readily and completely miscible with water,) one pound of the material is sufficient to prepare a surface of wood of ten square feet; while the wholesale price of the silicate, in the form of a syrup of a certain degree of concentration, is twenty pounds per ton; so that the cost of the silicate, required to prepare the wood, is at the rate of about two-pence for a surface of ten square feet.

Experiments are just now being carried on, with a view to impart to the silicate coating the appearance of paint, by combining the use of different colouring matters with that of the lime.

The following are the directions adopted for general guidance, in preparing wood with the coating of silicate of soda, and lime.

Directions for covering Timber with a Protective Coating of the Silicate of Soda, and Lime.

Materials employed.—The silicate of soda, must be in the form of a thick syrup, of a known degree of concentration, as manufactured by Messrs. Simpson and Co., Kennington Road, London.

The lime-wash should be made by slaking some good fat lime, rubbing it down with water until perfectly smooth, and then diluting it to the consistency of thick cream.

Treatment of the Wood.—The protective coating is produced by painting the wood, firstly with a dilute solution of silicate of soda; secondly, with the lime wash; and lastly, with a somewhat stronger solution of the silicate.

The surface of the wood should be moderately smooth, and any covering of paper, paint, or other material should be first removed entirely, by planing or scraping.

A solution of the silicate, in the proportion of one part by measure of the syrup to three parts of water, is prepared in a tub, pail, or earthen vessel by simply stirring the measured proportion of the silicate with the water, until complete mixture is effected.

The wood is then washed over with this liquid, by means of an ordinary white-wash brush, the latter being passed two or three times over the surface, so that the wood may absorb as much of the solution as possible. When this first coating is nearly dry, the wood is painted with the lime-wash in the usual manner.

A solution of the silicate, in the proportion of two parts by measure of the syrup to three parts of water, is then made; and a sufficient time having been allowed to elapse for the wood to become moderately dry, this liquid is applied, upon the lime, in the manner directed for the first coating. The preparation of the wood is then complete. If the lime-coating has been applied rather too thickly, the surface of the wood may be found, when quite dry, after the third coating, to give off a litte lime when rubbed with the hand. In that case, it should be once more coated over with a solution of the silicate, of the strength prescribed for the second liquid.

Directions for Covering Timber with a Coating of the Silicate of Soda and Lime as a Protective from Fire.

MATERIALS EMPLOYED.

THE SILICATE OF SODA must be in the form of a thick syrup of a known degree of concentration, and is diluted with water when required for use, acerding to the prescriptions given below.

The lime-wash should be made by slaking some good fat lime, rubbing it down with water until pefectly smooth, and diluting it to the consistency of thick cream.

TREATMENT OF THE WOOD.

The protective coating is produced by painting the wood, firstly with a dilute solution of Silicate of Soda; secondly with the lime-wish; and lastly, with a somewhat stronger solution of the Silicate.

The Surface of the wood should be moderately smooth, and any covering of paper, paint or other material, should be first removed entirely, by planing or scraping.

A solution of the Silicate, in the proportion of one part by measure of the syrup to four parts of water, is prepared in a tub, pail, or earthen vessel by stirrig the measured proportion of the Silicate, first with a very small quantity of the necessary water until a complete mixture is produced, and then adding the remainder of the water, in successive quantities, until a perfect mixture in the requisite proportions is obtained.

The wood is then washed over with this liquid, by means of an ordinary white-wash brush, the latter being passed two or three times over the surface, so that the wood may absorb as much of the Solution as possible. When this first coating is nearly dry, the wood is painted with the lime-wash in the usual manner.

A solution of the Silicate, in the proportion of one part by measure of the syrup to two parts of water, is then made as above described; and a sufficient time having been allowed to elapse for the wood to become moderately dry, this liquid is applied, upon the lime, in the manner directed for the first coating. The preparation of the wood is then complete. If the lime coating has been applied rather too thickly, the surface of the wood may be found, when quite dry after the third coating, to give off a little lime when rubbed with the hand. In that case, it should be once more coated over with a solution of the Silicate of the first-namad strength.

(Signed) F. A. ABEL,
Chemist of the War Department.

ROYAL ARSENAL, WOOLWICH.

N. B. The Silicate of Soda best adapted for this purpose is manufactured by Simpson and Co., 1 Kennington Road, London.

Ordered to be communicated to the Commander-in-Chief (Adjutant General's and Quarter Master General's Departments) Public Works Department, Town Major, Medical Board, Commissary General, Inspector General of Ordnance and. Magazines, and to the Madras Literary Society.

2. Orders will be issued in the Public Works Department with a view to experiments being made for the purpose of testing the efficacy of the composition for protecting woodeu buildings from fire, which, it appears, admits of being applied to thatching also; and to a report of the result being duly submitted to Government.

3. The Medical Board are requested in communication with the Chemical Examiner to arrange for the required supplies of the composition being prepared and furnished on the requisition of the Chief Engineer D. P. W.

(True Extract & Copies.)

Secretary to Government.

To the Adjutant General.
„ Quarter Master General.
„ Public Works Department. With 2 Spare Copies.
„ Town Major.
„ Medical Board.
„ Commissary General.
„ Inspector General of Ordnance.
„ Madras Literary Society.
„ Chemical Examiner.
„ Chief Engineer D. P. W.

Exd. R. Spears.

Public Works 1857 Disp.th
Do Cons.s 8th December
No 2326.

Extract from the Minutes
of Cons.s in the Military
Disp.th

Dated 31st Octr
Recvd 23d Novr 1857
No 3797

Communicating copy of
a Despatch from the Hon.
Court of Directors on the subject of the discovery by Mr
Abel Chemist of the War
Dept.t, some cheap & efficacious means for protecting
wooden buildings from fire,
& suggesting trying any experiments, as the materials
are procurable in India, & to
report its result.

Write acc.s order &
No 2273. 7th December

No 27 1872.

Cy 28th Nov.r

No 2273.

Ordered to be communicated to the Chief Engineer,
with a request that he will test
the efficacy of the composition
for protecting wooden buildings
from fire, and report the result
of the experiments in communication with Dr Brayer.

Frost. H. McGrath
7th Dec.r 57

1 Copy to the Chief Engr Disp.t-8
1 " to Dr Brayer Disp.t-17