

promiscuously over the whole, but follow each other in a kind of regular succession, in a diagonal direction across the sheet, red being the preponderating color. In order to accomplish this, a number of little pots, or tins, are required, about  $1\frac{1}{2}$  in. or 2 ins. wide and 2 ins. or 3 ins. deep. Small jam pots will do very well. You will also require two frames, fitted with wooden pegs, and placed at regular distances apart—about four or more inches—having the appearance of a farmer's harrow in miniature. The frames of pegs must correspond with each other in every respect, so that, if you made an impression with one frame on a sheet of paper, the other ought to fit exactly upon the impressions produced by the first; because the colors you will have to apply with the second frame will be placed exactly in the center of the color put on with the first.

The pots must now be arranged in two divisions, an equal number in each, and adjusted so as the teeth or pegs of the frames will drop in the center of each pot, as you will have to give a motion to the frame to stir the colors, as they soon settle; one of these divisions of pots must be half filled with white or ground pipeclay, the other with three different colors, arranged in the following order, the number varying according to the size of your paper. Y stands for yellow, B blue, G green:

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| G | Y | G | Y | G | Y |
| Y | B | Y | B | Y | B |
| G | Y | G | Y | G | Y |
| Y | B | Y | B | Y | B |
| G | Y | G | Y | G | Y |

Instead, however, of having pots for the white, you may have a trough or vessel the size of your frame, about three inches deep, for the reception of that color, which will answer the purpose equally well and with less trouble.

The red, which is the first color to be applied, must be sprinkled on with a brush, and the surface well covered; then lift carefully the first frame, consisting of the white, giving it a rotary motion so as to stir up the mixture, and let the extremities of the pegs with the color on them just touch the surface of the muckage in every part; put it back in the color, and quickly take the other charged with the three colors, and in like manner let that touch just in the middle of the spots of white; then with a tapering piece of wood—the handle of a brush for example—draw the colors in a parallel direction up and down, from front to back, after which draw the comb through the color, from left to right, and the pattern is complete, unless you think fit to add curls or any other device, which, of course, must be left to your own discretion.

Thus far we have gone without the aid of any other agent in the colors than gall, and there are many more varieties to be produced by the same material. There are also some very pleasing results to be obtained by the use of other agencies, but it is impossible to compress them into the compass of one single paper. I could have enlarged on this part of the subject to-night, and have mentioned many strange and interesting facts regarding this art. What I have so imperfectly revealed to-night has, I hope, proved that there are many things in everyday life which escape our notice, simply because they are common, but from which we might draw much that both interest and enlighten us, if we would but exercise the powers with which God has invested us, and placed us so far above the inferior creation. With one more experiment I will now close this paper, and that will simply be to show that whenever the paper is wetted with the solution, no color will adhere to it while the moisture remains on its surface. I will now wet some part of the paper, and, after preparing a surface of color on the trough, will lay on this sheet of paper, and, on lifting it out, you will see that the part wetted will be bare of color, while the part that remained dry is perfectly marbled.

The various methods of producing the different descriptions of marble paper were illustrated by Mr. Woolnough, who made a number of specimens in the room. Examples of the printed paper were also exhibited, as well as specimens of the materials employed.

## PRESERVATION OF WOOD.

By J. CLARK JEFFERSON, A.R.S.M.

ALL timber which is intended for immediate use in mines must be barked, otherwise rotting would soon commence beneath the bark, and spread among the timber. For this reason leaf wood should always be barked; it is, however, not of so much importance in the case of pine, in which the rotting, owing to the great amount of turpentine, spreads much less rapidly. According to Lottner the experience has been obtained in the Planitzer coal mines that where the pits are very dry, and a fungus soon appears, unbarked pine lasts four to five times as long as the most perfectly dried; it appears as if in green wood the rot proceeds from the center to the outside, while the contrary is the case with dry wood.

Timber is kept stored either under sheds or in the open air; where there is any very large quantity the latter method will be that most usually adopted. When kept in sheds the sides of such sheds are always left open, so that while the wood is preserved from sun and rain it is constantly exposed to a current of fresh air. For this latter reason the wood should never be piled close together, but always so that fresh air can circulate among it; and also for this same reason timber is usually laid alternately crosswise, and when in large quantities is often re-piled. The bottom of a pile should never rest directly on the ground, which might be damp; it is necessary, therefore, to have the timber yard properly drained. Wood which has been cut should always be kept under sheds; timber intended for use as pipes, and which it is intended to bore out, should not be subject to any drying whatever, but should be preserved under water, by which little risk is run of the timber becoming cracked.

The measuring of timber is effected sometimes simply according to weight; when the pieces are all one size or shape, according to number and according to cubic capacity, either by measuring the length and taking the mean diameter at the center of the length, or by measuring three diameters (at each end and in the center), and the length from which the cubic contents are calculated by the use of tables.

Good timber can readily be judged of by the appearance of a freshly cut cross section. A dark color, if uniform over the cut surface, is indicative of strength and durability; if of a dull chalky appearance, of bad timber. A rotting core will have a darker appearance than the rest, and the surface will appear woolly and feel rough. A good timber will not readily clog the teeth of a saw with loose fibers, and the freshly cut surface should feel smooth, and have a translucent appearance; the annular year rings will be close and fine, and the wood when struck on a cross (to the axis of the stem) section with the head of an ax will have a clear sound, and, lastly, will have straight growth.

The durability of timber in a mine is generally put an end to either by being broken by pressure or destroyed by rotting. The destruction of timber by rotting takes place either by dry rot or by wet rot.

Timber which is confined in a place where there is little or no ventilation and an absence of moisture decays by dry rot, which appears to attack the whole of the timber uniformly and simultaneously, accompanied with the formation of a fungus, and the timber is finally converted into a white powder, accompanied by a peculiar sharp sweet smell. Dry rot attacks timber much more quickly than damp rot, and often completely spoils the wood within six weeks. Damp rot generally commences at knots or other irregularities in the wood, and spreads from these to the rest of the timber. In the presence of a considerable amount of moisture the outside surface of the wood becomes slimy and slippery with the formation of fungi often of considerable dimensions, which are sometimes fibrous and sometimes spongy.

Both dry and damp rot are infectious; it is, therefore, advisable for the preservation of adjoining timber to remove that which has been attacked. Damp rot mostly occurs in places subject to alternations of moisture and dryness, heat and cold, and in stagnant atmospheres, and, therefore, at the mouths of levels, day holes, at pit heads, and other places exposed to the variations of the weather and the seasons, in the distant unventilated parts of a mine, in the places exposed to the return current sooner than in places exposed to the intake current, and in the upper parts of shafts near the surface.

According to experience, the proximity of clay or clayey strata is said to lead to a rotting of the adjoining timber sooner than other kinds of strata, and those sides of timber exposed to the air currents are said to be less liable to rot, and rot less rapidly, than the side from the air currents.

The durability of timber depends, therefore, as is evident, on local conditions. In uniformly moist places the oak will often last 40 years, and fir and pine 15 years, before it is necessary to take them out and replace them. According to Ottillie, in the brown coal mines of Saxony, except in the case of extra weight or pressure, pine and deal last four years; according to Gatzschmann, in metalliferous mines the timbering lasts from five to six years, but under unfavorable circumstances from one to three years only, in coal mines often not longer than six weeks; under favorable circumstances—when kept wet, cold, and in a good air current—from 20 to 30 years, and even more; as at the Sauberg Mine, near Ehrenfriedersdorf, good timber has been observed 100 to 200 years old, and even in the "Alten Mann" old workings were constantly wet 300 years old. On the average, under ordinary circumstances of pressure, moisture and ventilation, an age of twenty-five years for oak, and from five, six, to eight years for pine, appears common.

The various modes of preserving timber in a mine, or increasing its durability, may be subdivided into natural and artificial means:

1. As the first of these must be considered that of introducing none but sound wood into a pit, and the immediate removal of all rotting timber, which would infect the sound timber; the use only of barked wood, and where pine is used to avoid cutting it, by using where possible the round wood.

2. A good current of fresh air. This, however, is a matter on which the preservation of the timber must always be but of subordinate influence.

3. A uniform state of either wetness or dryness, the former being preferable. In shafts it will be comparatively easy to comply with this first condition of constant wetness. In most of the shafts in the Hartz this wetting of the timber has received considerable attention, and is generally accomplished by placing flat boards, called "Traufbretter," lengthways in an inclined position beneath the horizontal stemples, in such a manner that they catch the water as it drops from one stemple and guide it on to the next below. These dripping boards, as we may call them, will generally be necessary only between those stemples on the hanging and lying wall of the shaft, underneath the former to prevent the water falling down the shaft or on to the lying wall, and beneath the latter to prevent the water dropping on to the lying wall and running down it, missing entirely all the stemples below. These dripping boards are not necessary at the ends of the shafts if they are, as in general, in a vertical plane, since the stemples are usually fixed in inclines alternately toward one side of the shaft and then the other. The wetting of the level timbering can usually only take place when the water has been collected in the shaft and carried in pipes along the levels. At suitable places the piping, generally of wood, has a small bungle hole cut in it, in which a hollow conical stopper can be inserted; the mouth of the stopper is closed by a perforated zinc or tin plate, out of which the water under a pressure in the pipes squirts, as from the spout of a garden watering can, on to the timbering in the levels. The wetting of the timbering for its preservation is also practiced at Joachimsthal, and at Neurode, in Silesia. If the timber cannot be kept regularly wet, it is better to let it remain constantly dry than alternately wet and dry.

The object of the artificial means of preserving timber is to remove the nitrogenous compounds, which are chiefly contained in the sap and which are the first cause of the rotting of the timber, or to preserve them from contact with air, which would induce an oxidation of the nitrogenous compounds. The methods which have been employed may be divided into three classes:

1. The coating, or covering over, of the outside of the wood with some substance which will preserve the sap from contact with the air. One of the simplest examples of this mode of preserving the timber from the action of air (though not coming directly under the category of coating) is the charring of the timber, which thus covers the outside for a short depth with a layer of charcoal. The substances more or less generally used for coating timber are coal tar, lime, cement, vitriol, etc. The timber should be coated at the surface before being brought into the mine and built into its place. Barked timber only is used, and should be coated, not only on the outer barked surface, but on all cut surfaces, so as to prevent as far as possible any dampness getting into the timber. In many cases results are said to have shown that the timber lasts twice as long, and in others that, on the contrary, the timber has rotted sooner. In all probability in the latter case the wood itself may have been unsound to commence with.

2. The removal of the sap either by means of water or by steam. When water is used this is best accomplished by forcing the water through the tree, washing or carrying off the sap with it. This is generally accomplished by placing the trunk of timber to be treated with the root end upward (after the root and thin end have been sawn square off). The root end is inserted in a cylinder about 6 ft. high, the connection between the tree and cylinder being made by means of an India-rubber belt, or other material by which the junction can be made water-tight. The water is forced into the cylinder

at a suitable pressure, and entering the pores of the wood passes along them, and washing out the sap flows out of the top (small) end of the tree. The operation is continued until the water is no longer colored or thick, but perfectly clear, requiring for a length of 10 feet of pine about eight hours. Sometimes steam is used instead of water, the apparatus being essentially the same. After the completion of this operation the wood is carefully dried. While steam has the advantage that the air is thereby removed from the pores of the wood, they have both the disadvantage that on drying the pores of the wood are left exposed to the air, which renders the wood liable to destruction from the oxidation of the fibers. When the empty pores of the wood are immediately filled with a solution of some substance we have—

3. The mode of artificially preserving the wood by impregnation. The substances for impregnating timber are introduced in solution, generally under a greater or less mechanical pressure. The following summary we take from Bergrath Lottner's "Manual of Mining."

The saturation by simple immersion in a solution of common salt is often practiced in the brown coal mines of Saxony. At Zscherben wood which had been so saturated was found after 13 years perfectly sound in places where wood which had no artificial treatment would have become so rotten as to require replacing in two years, and similar experience is said to have been obtained at Tollwitz, Nietleben, Eisdorf, Eggersdorf, Altenweddingen, and Stassfurt; and it is, moreover, a well-known fact that in salt mines wood is but little liable to rotting, although it is found that wood saturated with such a solution becomes brittle.

A solution of sulphide of barium, proposed by Ruttger, and tried by the Eschweiler Mines Institute, is said to have given good results. A solution of chloride of zinc has been tried on sleepers for an inclined plane at the surface of the Ibbenburen Colliery, and also on sleepers for the Hanoverian railways, and is said in both cases to have given excellent results; on the contrary, however, experimental trials with this method in the Hartz mines are said to have given unfavorable results.

At Chemnitz two methods of impregnating timber with a solution of sulphate of zinc and copper were tried, the one proposed by Lüdersdorf, containing 4 per cent. of sulphate of zinc and 1.6 per cent. of sulphate of copper by simple immersion, and the other proposed by Boucherie, containing 3 per cent. of sulphate of zinc and 2 per cent. of sulphate of copper introduced under pressure. The results of the trial of the first method showed that by the simple immersion the pine wood had not been thoroughly penetrated, for at the end of three years, although the core was rotten, the outside of the wood was quite sound; oak seemed to have been thoroughly penetrated by the simple immersion, since it was found quite sound; pine wood in the same mine which had had no such treatment was found completely rotten, and oak had been attacked to a depth of  $\frac{3}{4}$  in. Both kinds of wood which had been treated by Boucherie's method were found quite sound at the end of three years. Lottner recommends that the wood which had been prepared by these two methods should have been treated a second time in a solution of chloride of lime or sulphate of barium, by which sulphate of lime or baryta would have been formed. Timber which had been treated in a solution of sulphate of lime (gypsum) was found attacked at the core, but sound on the outside, at the end of three years.

## LIQUID FUELS.

RECENTLY at the Institution of Civil Engineers, London, the paper read was on "Liquid Fuels," by Mr. H. Aydon. It was stated that apparatus specifically adapted for the combustion of liquid fuels, which comprised every class of fluid hydrocarbons, might be ranged in five classes. The leading principle of their action was either the subdivision of the liquid as spray, or by percolation through a porous bed, or by preliminary conversion into vapor—when the fuel was mixed with air, or with air and steam, by the instrumentality of jets of steam or of compressed air—or it was burned simply as gas in jets. The earlier system of Mr. C. J. Richardson, in which the liquid fuel, mixed with heated air, percolated upward through a porous bed, was tried at Woolwich Dockyard, but the performance was not satisfactory, for black smoke and soot were discharged in such abundance as speedily to choke the flue-tubes and stifle the draught. By a subsequent improvement, in which a mixture of steam was introduced with the fuel, a much better performance was effected—the quantity of water evaporated having been increased from  $6\frac{1}{2}$  lbs. per pound of fuel to from 7 lbs. to  $18\frac{1}{2}$  lbs. per pound of fuel, though the formation of dense smoke was not prevented. The performance under the same boiler amounted to an evaporation of 8 lbs. of water per pound of coal.

The system of Messrs. Simm & Barff, in which the liquid fuel was vaporized in a retort placed in the furnace, and burned in jets, was tried in 1866 on board the yacht Minnie. The quantity of coal consumed amounted to one-third only of the corresponding quantity of coal. The system was afterward tried with the addition of steam, and with better results, as the intensity of the combustion was increased, and smoke was prevented.

In the fourth system, patented by the author in conjunction with Mr. Wise and Mr. Field, in 1865, the liquid fuel was summarily vaporized, by the injection of the liquid into the furnace by the instrumentality of steam, which might be superheated, the supply of air for combustion being at the same time drawn in as an induced current. By this plan the materials could be instantly and thoroughly mixed and converted into vapor or gas before ignition took place. No alteration of the ordinary furnace or grate was needed, so that either coal or oil could be used. For burning oil the grate bars were covered with thin fire slabs and a few cinders, and the ash-pit doors were closed to keep out surplus air. In March, 1867, this method of burning liquid fuel was tried at the works of Messrs. J. C. & J. Field, South Lambeth, in a Cornish boiler of 20 or 22 horse power, 5 ft. 6 ins. in diameter, with a 3-ft. flue. The results of several days' experiments showed an average of  $19\frac{1}{2}$  lbs. of water evaporated per pound of liquid fuel. The boiler previously evaporated  $6\frac{1}{2}$  lbs. of water per pound of Aberdare coal. Similarly, experiments with a double-flue Galloway boiler at the chemical works of Mr. Barnes, at Hackney Wick, gave a net evaporative performance of  $25\frac{3}{4}$  lbs. of water per pound of fuel. Experiments had been made with other boilers, in which the evaporative efficiency of the liquid fuel ranged from  $1\frac{1}{2}$  to 3 times that of coal. Equally good results in favor of liquid fuel were obtained from its employment under a marine boiler at Woolwich Dockyard.

The fifth system enumerated, the invention of Mr. Dorsett, in which the liquid fuel was vaporized in a separate boiler or retort, to be burned as a gas, was tried in 1863 at the chemical works of the inventor at Deptford, and also on board the