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SOME REMARKS ON AN AUSTRALIAN MARBLE CUTTING MACHINE.

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As anything that is connected with the expansion of Australian industries should have an interest for members of our Association, your attention this evening may fairly be drawn—in the absence of a more important subject—to the development of our native marble quarries, and the extended use of that beautiful material in our buildings.

For very many years it has been known that several of our country districts of New South Wales were rich in marble. When the present Government House was built (now sixty years ago), the principal chimney-pieces in the edifice were made of colonial marble. This fact is recorded by Fowles in his well-known book "Sydney in 1848."

For a number of reasons, very little headway was made during the immediately succceeding years in the working and use of colonial marble, until recently, and the reason is not far to seek. In the quarries of Italy and Belgium labour is not only very cheap, but the work there is carried out on a very large scale, and under a system which reduces waste to a minimum. In the absence of machinery the cost of cutting up great blocks into slabs by hand, and the attendant waste with the very limited demand, was practically prohibitive. Still, the use did extend, the superior wearing powers of the colonial material justifying its use, as in flooring the

Great Hall of the University, even at a great advance on the price of the imported article.

For many years now the sawing of Sydney sandstone has been an established industry, and the busy establishment of Mr. Robert Saunders, the well-known quarry master of Pyrmont, employs a great number of machines, all admirably adapted for their purpose of working stone and finishing it, either with plane faces or mouldings, the plant including a number of sawing frames.

Sandstone is relatively uniform in its texture, and a common arrangement of stone saws in Europe and America provides a positive "feed" similar to that in a timber sawmill. The sawing frame or "sash" in such machines being lowered a definite amount every stroke by means of four screws in the main supports, which are operated by a ratchet wheel and pawl from an eccentric on the driving shaft. In other cases, as at Pyrmont, the sawing frames are suspended by wire ropes or chains, connected to a common drum or to connected drums, so that the four corners of the sash are raised and lowered together. With a suspension by chains or ropes the pressure is, of course, entirely dependent on the weight of the cash and the saws, and it must be a "gravity" feed. There is thus no "positive" feed as with the screws. At the same time it is manifest that when the weight of the sash is divided among twenty or more saws the pressure on each saw is much less than when running with two or three, and the rate of cutting must be affected.

It is hardly necessary to say after this that for cutting or sawing stone the blades move horizontally and the feed is downwards, instead of the saws working vertically and the feed horizontally, as in a timber sawing frame. It must also be understood that, except for very soft stones, such as Bath, Caen, and Oamaru, of England, France, and New Zealand, respectively, there are no teeth to the sawing blades. The work of cutting is effected by an abrasive material such as sand, emery, chilled shot, or carborundum, and this with water supplied does the work under the action of the sawing blades.

The sawing machines employed in the Sydney Marble yards, until recently, were much more primitive than those in use at the Pyrmont Quarries, and were simply large bow or buck saws constructed with a heavy timber frame, having a straining piece in the centre and tension chain or bolt above; the whole saw frame is kept upright by a pair of timber guides and lightened by a rope and balance weight. These machines carrying a single blade are generally known as "Grub" saws, and the work performed by them is necessarily very slow, as only one cut is made at a time. While the stone saws, such as those at Pyrmont, will not only cut sandstone, granite, trachyte, marble, and firestone as well as sandstone, but can be made to carry twenty or thirty saws at once, as in a timber "boarding" frame.

When a few months back the author was called upon to design the machinery for a new marble works, he found that the increased demand for that material in the improved public and private buildings, now being erected in this State, would justify some advance on old methods here, he having first ascertained what was the usual and customary construction of such machinery at home and abroad.

As his clients, Messrs. A. Hordern and Sons, never do anything unless they can do it thoroughly, and wished to take advantage of the latest improvements in this case, after several consultations with Mr. Wilmshurst, the firm's manager of that department, who is an experienced marble mason, the conclusion was arrived at that a radical departure from existing machines was needed. This led to the design of the apparatus, the plans of which are now before you, and the working of which, so far, has been entirely satisfactory.

The machine is designed not only for sawing, but, by the use of cast iron "formers," for working marble mouldings if required; although sawing of blocks into thin slabs, and these thin slabs into strips, was the primary object in view. As marble is not of such uniform texture as sandstone, the resistance to cutting would be more irregular, and this presented an objection to the system of uniform downward feed by means of screws. Such feed must, of course, be slow enough to allow the

hardest veins to be cut otherwise, either the saw webs would be strained and buckled, or else broken altogether. By the adoption of a "gravity" feed, that is, a feed which results from leaving the saws with a definite weight upon the material to be operated on, and yet free to rise or fall, the feed would be automatically faster or slower in accordance with the relative hardness or otherwise of the material at the time being cut.

In most gang saws for cutting large blocks of sandstone, the saw sash is either suspended by four pendulous rods from the rising and falling frame that is worked by the vertical screws before referred to, or else hangs by chains from winding barrels. Thus, instead of the saw blades moving in parallel and straight lines, the sash, and with it the sawing webs, necessarily oscillates through the arc of a circle. This motion is said to have advantages under certain conditions, because it raises the saw webs up in the "kerf" at the two ends of the stroke and thus allows the sand to get below them; besides this, it reduces the chance of the webs getting jammed in the kerf with the grit, but it is evident the saws can only be cutting in the centre of the stroke. For cutting more precious material, such as marble, and for re-cutting thin slabs of it up into narrow strips, it has been considered essential that the sawing blades should have an absolutely straight motion similar to hand sawing. It was also made a sine qua non that in rising or falling the motion of the whole sawing frame or sash should be absolutely parallel to ensure accuracy in dealing with light and more delicate pieces of material or mouldings.

Further than this (as it was intended to build the machine after the most modern ideas and all of metal instead of with timber framing, and to make it an engineer's machine tool in fact, instead of a rough and tumble carpenter and blacksmith affair), it was clearly desirable that all the working parts should be kept well out of the way of the copious streams of sand and water which are employed in the operation of sawing.

With these preliminaries settled as to the problem to be attacked, the machine shown on the drawings was designed as a solution, and its construction will now be described.

In its working so far it has given such satisfaction that it is proposed by the courtesy of Messrs. A. Hordern and Sons to give any members of the Association who may so desire an opportunity of seeing it at work at an early date.

This saw sash is constructed of four steel tubes, the upper pair of which run in the aforesaid guides, and take the weight and guidance of the whole horizontal frame. The lower pair of tubes keep the saws strained as the sides of the sash proper. The centre, both horizontally and vertically, of these four tubes is about 4ft. 6in. This sawing frame is stiffened at the ends and sides by diagonal stays F., which keep it in shape, and it will be seen that it is able to cut down into a block of marble 4 feet wide and 4 feet deep before the guides come near the work.

To prevent any tendency to rock in the sash, which might ensue from the varying angle of the connecting rods during the working, they are not connected to the sash directly, but to two pendulous levers L., which are suspended from the ends of frame C. These pendulums thus rise and fall with the sash, and owing to the very small versed sine of the arc traversed by the pin in their lower ends, the connecting links M. to the sash have practically a horizontal motion, whatever may be the elevation of the sawing frame, and whatever may be the inclination of the connecting rods J.

Power is applied by means of crank pins in a pair of spur wheels, the pinions gearing into which are driven by a pulley on the same shaft, the whole mounted on carriage Q., too obvious to need detail description.

As the weight of the two frames, that is, the one moving verticaly only and the one moving horizontally carried by it, can be counterbalanced to any extent; it is evident that when the saws are set in motion by the belt, the whole of them with their sash can be freely moved up and down. It is also clear that by regulating the amount of balance weight, the saws can be made to act with any desired pressure on the material to be cut, and with more saws in the sash more balance weight can be taken off; and thus the descent may be faster or slower—with a variable feed—although the

reciprocating speed of the saws is uniform. By the application of a spur segment to two of the bell cranks, and the rope wheel and pinion shown on one of the general drawings, the attendant can raise or lower the saws, and regulate the pressure at starting a cut or going through a thin slab while the saws are in motion.

The machine was first erected inside a workshop, primarily for splitting up slabs, but as the room was required for an extension of other machines, and it showed itself capable of dealing with large blocks of material from the quarries, it has been re-erected where it can have a traveller in atendance to lift on the blocks to be sawn, and has been fitted with a travelling bed instead of the solid one more common to marble works.

The speed of cutting so far has averaged about 5 to 6 inches per day of 8 hours, 30 per cent. above ordinary, but as there is nothing in the Arbitration Act to force the machine to join a Union, it could, of course, easily double that output with two attendants. Apart from such pleasantry, however, it is a reasonable hope that the use of such machines as that now described may be extended to work up many more of our natural productions, and that the vast sums of money now sent to Europe and America for luxuries, of which marble is one, may be materially reduced, the result being the finding of increased employment for our own people, and the keeping of our money at home. It is believed that New South Wales possesses great varieties of beautifully variegated marbles that should be made use of with increased interest in home manufactures.

Mr. A. Christie said, in opening his discussion, that our local products and industries were not brought into the prominence they deserved, and the paper they had just listened to proved conclusively that marble of good quality was at our doors waiting to be operated upon and placed upon the market here.

Mr. Jas. Shirra desired to know if the machine cuts both ways, or was there any difficulty in the back stroke.

Mr. Selfe explained that the pendulum would slide down on the vertical guide bars till it was level. The machine cuts both ways and cuts all the time.

Mr. R. Symmonds desired information as to the size of the blocks of marble that could be produced locally, and if it would be possible to get blocks large enough for pillars locally?

Mr. R. Sinclair said he was interested in a large marble quarry just opened up, the blocks from which can be got 50 feet long. He expressed his great interest in the machine designed by the author, and certainly would not miss the opportunity of seeing it at work. In conclusion he considered the members were much indebted to Mr. Selfe for his practical and valuable paper dealing with a local subject of so much interest to them all.

Mr. J. L. C. Rae said he had much pleasure in endorsing Mr. Sinclair's remarks on the paper. The opportunity of seeing the machine at work would make it possible for them all to discuss the machine and its qualities at a later meeting, and he suggested this course be adopted.

Mr. Selfe briefly replied to the remarks made, and in doing so said that Mr. H. J. Vale constructed the machine, so any improvements required, he must come in for his fair share of. He would be pleased indeed to record the suggestions of any member for improvements in design.

Mr. H. J. Vale said the machine as yet was only in its infancy, so any alterations would simply be improvements. He hoped the visit of the members to the machine (whcih had only been a few weeks in work) would prove interesting in the extreme.