THE NEW BROTHERS' HOME NO. 1 TIN MINING COMPANY, DERBY.

By James B. Lewis, Esq., Manager.

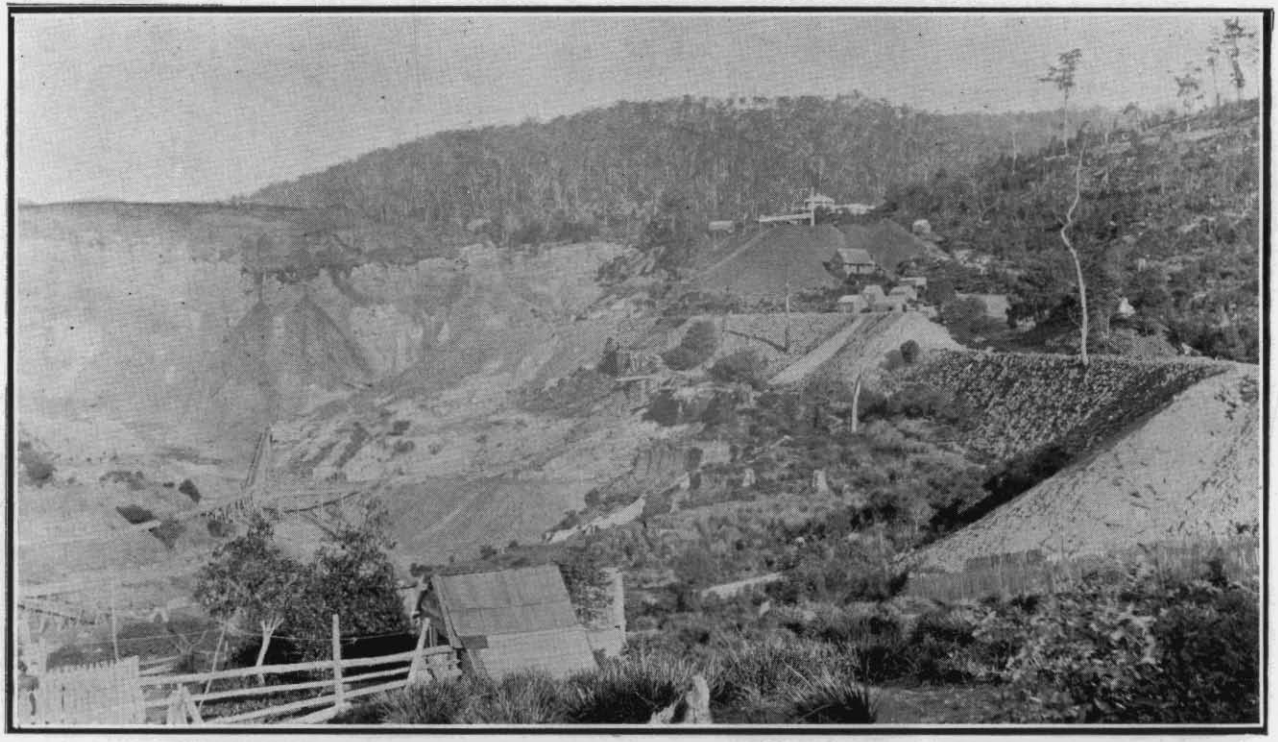
REMOVAL OF OVERBURDEN.

The overburden, averaging about 100 feet thick, consists of varying material, mostly of volcanic origin, the bottom layer being from 50 feet to 60 feet thick, and described by the Government Geologist :—"Microscopical examinations of specimens from the lower basalt mass at the Brothers' Home show the rock to be an olivine basalt, in which the felspar is mostly porphyritic, and the groundmass largely consists of small brownish crystals of augite," but locally known as "decomposed basalt," a soapy material containing hard boulders. These vary in quantity in different parts—from 25% to 50% of the whole—and also in size from that of road metal up to two or three tons weight. Over this is a layer of recent drift, poor in tin, and from 10 feet to 12 feet thick. Over this again is a layer of columnar basalt from 20 feet to 40 feet thick, containing blocks many tons in weight. Above this is a volcanic breccia of stone about 6 inches diameter, and containing boulders up to two or three hundred tons. This is of varying depth up to about 30 feet. The greatest depth of overburden over all was about 130 feet, and contained the largest and hardest rock. This was the first part attacked.

As the two top layers—columnar basalt and breccia—contained little material that could be removed by water, and especially as our water supply was limited and get-away restricted, we decided to remove this, as far as it was economical, by dry stripping. A large heading, 8 feet by 8 feet, was started in the layer of poor drift mentioned above, which it was considered, judging by the exposed faces, would allow of its being carried through entirely in this easy material with suitable grades. Unfortunately there was a sudden dishing of the underground surfaces, and the heading rapidly ran out of the drift into the columnar basalt, and had to be continued, together with its branches, in this material. The method of excavation adopted was that frequently used in railway cuttings. The top, or back, of the heading for a third of its width on each side was covered with laths in the usual way, or where possible with longitudinal round stringers running over two or three sets. The centre of heading was covered with transverse timbers, called by the workmen "Chinamen" or "Chows." These being easily removed, a pass could be made at any time at any part of the heading. The rails used in the roads were mostly 20-lb. rails—these were light, 30-lb. rails being more suitable, but were not at the time available—spiked down to the sleepers with large dogs, and coupled with fishplates. The roads were carefully laid and ballasted, and rails on curves curved to the true radius. Mine roads frequently suffer from inferior platelaying; good work in this soon pays for itself. The dogs are usually too small, fishplates are neglected, curves carelessly laid, and ballasting neglected, while points and

crossings seem to exist rather to derail waggons than for any other purpose. The waggons were built to carry about four yards by measurement, or 2¼ to 2½ yards of material in the solid. They were fiddlestick self-tipping waggons, made on the mine—first with cast-iron wheels, which were unsatisfactory, then with steel wheels, and finally with main-line wheels and axles (cast-iron bosses, wrought-iron arms, and steel tyres). The material was picked down on to the heading when possible, or shot down, powder being generally used for shifting softer material gelignite for breaking-up hard rock. A truck would be pushed or breasted into the heading by the horse to the most convenient spot indicated by the fillers, who would withdraw two or three "Chinamen," and direct the material into the waggon, a trimmer in the heading arranging the loading with a rake. The waggon then ran down a flat grade to a turnout outside the heading, where the empty truck stood. The latter was then breasted in by the horse, which was then attached to the full waggon by a spring-bar. The waggon was drawn about a quarter of a mile to the tip; the driver then disconnected the horse by releasing the spring-bar; the horse got clear of the track; the waggon, with the momentum gained by the horse galloping a few yards before being released, ran against a bumper on the end of the tip, tipped itself, and then fell back on to the rear axle again. A fiddlestick waggon has the front wheels a little in front of the centre of gravity, and attached to the body, while the rear pedestals are not connected, thus allowing the body to tip free of them, the correct distance between the axles being kept by a frame known as a "fiddlestick." The horse was then attached to the rear of the waggon by the string-bar to draw it back to the heading. In this case only one waggon was run out at a time, the grades and curves making this a full load for one horse; but under more favourable circumstances two waggons could have been used, if branch roads were provided at the tip. This work cost a little less than 9¼*d.* per cubic yard, including horses, explosives, roads, electric light, headings, waggons, labour, &c. When the circumstances were favourable two shifts were worked; the afternoon shift, however, never worked quite as cheaply as the day shift. This disposed of nearly all the top layers, except the material on one wing, which was left to come down on the heading at the lower face, about 100 feet below this level.

The lower faces were worked with the assistance of the hydraulic nozzle, and water with 320-feet pressure. For wherever water under pressure can be applied, with even moderate success, material can be removed much more cheaply than by any other method, some Californian results being claimed at less than a halfpenny per yard. Consequently this method has fatal attractions, for the first cost is frequently extremely heavy, the securing of water rights, construction of races, and means of distribution adding frequently 3*d.* or 4*d.* per yard on to the cost of removing material. Again, where it does not complete the removal thoroughly, and subsidiary means are required, the latter are usually inadequate or quite neglected. Then the disposal of tailings—where the natural outlet is restricted—becomes a serious matter. Time also becomes of importance, and although we are told that water will wear the hardest stone, it is frequently somewhat tedious waiting for it to do so. Efforts have been made to remove this heavy overburden by hydraulicing alone. With a large body of water, a large quantity of soft material to act as



NEW BROTHERS' HOME No. 1, TIN MINE, DERBY.

General View.—In the face the darker shade shows overburden, lighter shade shows drift.

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slurry-rounded boulders, and a steep tail-race, suitably lined, it can be done, but the achievement is neither speedy nor economical. Consequently some other method of handling the rock becomes necessary. Too often it is simply thrown back out of the way of the immediate work, to be handled again and again; sometimes wheelbarrows and planks are used; sometimes the stone is stacked carefully on the top of valuable drift; sometimes tram-roads are laid and hand-trucks used, the cost of removal in the latter case varying, according to circumstances, from 1*s.* 6*d.* to 2*s.* 6*d.* per cubic yard. Better results are claimed than achieved, as the stone is measured in the loose, as if it were solid, and trucks containing half a yard or three-quarters of a yard are reckoned as yard trucks, and, of course, tallies are not always reliable. In many cases it is a question whether automatic plant—some form or adaptation of a travelling-crane or steam navvy—might not be advantageously used in shifting this rock, and the matter was carefully considered in this case. But the first cost of such, the frequently scattered state of the rock, which would make the working of such unprofitable, and the difficulty of working it in conjunction with the water, would make its success problematical. Headings were, however, driven in the drift under the overburden, similar to those described in the first part of the paper, but with heavier timbering, and extended out in front in the form of a stage, and falls of overburden were brought down on these with the nozzle by undercutting in the drift. The small stuff was washed out where possible down temporary sluices, and the larger stone dropped down through the "Chinamen" into large waggons in the ordinary way, and as described before. When stone was plentiful and easily got, this cost, including all charges, about 8½*d.* per yard. When the face worked back from the heading and the slopes were flat, requiring the stone to be handled, the cost went up to 11*d.* Where there was not enough stone in the face to justify the use of headings, numbers of branch roads and sluices were brought up to the faces, and followed them up closely. When a fall came down here, as much stuff as possible was washed out of it with the nozzle and down the sluices, and the large stone left was then loaded into small fiddlestick waggons, containing about 1¼ cubic yard each, or about 3 tons. Two of these were run out together, switched on to different lines at the tip, and tipped separately. These were made very low for convenience of loading, the backs were hinged and let down for the purpose of rolling large boulders in without lifting them; they were light, easily handled, and cheap of construction. Sometimes a small temporary stage was constructed level with the back of the truck, and the stones rolled down on to this were readily rolled into the waggons. These took but two or three minutes to erect consisting of a spar supported at the ends and decked with laths. The cheapest cost of trucking here was 9½*d.* per yard, and the highest 11½*d.* As time went on this cost would probably have been lessened as means of improvement were discovered. The cost of hydraulicing the remainder of the overburden was not cheap, on account of the disabilities under which we laboured. The regulations did not permit us to send anything into the river over 2½ inches diameter, we had no dumping ground, the river was always in a bad state on account of the materials sent in by the different mines, and on account of the dry seasons. For the latter reason, also, our water supply was very unsatisfactory,

being frequently short, for months failing altogether, and usually only available at night. The cost was first 4 ·64*d.* per cubic yard, including all charges, but this afterwards increased to 5 ·17*d.* per cubic yard as the difficulties increased. With a supply varying from nothing to 8 sluice-heads, and about 40 men, the maximum amount removed was 15,225 cubic yards in a month, of which 8913 were trucked and 6312 sluiced; or for two years about 213,165 cubic yards, at an average cost, including all charges, of 8¼*d.* per cubic yard. In removing the overburden a quantity of drift had also to be sluiced, but being the highest and poorest, it contained a minimum amount of tin. This was saved by placing ripples in the tail-races, and shaking them up whenever any great amount of drift was sent down. These were cleaned out about twice a year, and the results indicated that with this rough method practically all the tin was saved, and without hampering or delaying the removal of overburden, which was considered the most urgent and important work.

The quantity of water required per cubic yard of material sluiced was at first 6039 gallons, but later, as disabilities increased, 8137 gallons. The Californian experience varies from 2455 gallons up to 9000 gallons—usually about 3860 gallons to the cubic yard of material removed. The higher figure has been frequently exceeded in this neighbourhood.

As the working arrangement with the Briseis Company removes two of the disabilities under which we have been working—shortness of water and lack of dumping ground—and as the worst of the hill is probably now removed, the future cost of removal of overburden should be reduced and the speed increased.

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Lower Face.—Showing Stage, &c., and Hand Trucks.