sunk in the sea. The father, hearing this, begged them to point out the spot where he disappeared; then, throwing off his clothes, he plunged into the sea, and dived to the bottom, assuming, as he did so, the form of a fish. At the bottom of the sea he came upon a large carved house, and, as he drew near to it, he saw his little son fixed up as the tekoteko. As he approached, the child cried out to him; but he took no heed, and continued his search for the occupants of the house. Presently he me ta woman, Hine-matiko-tai, and questioned her about her people. She told him that they were all away at their work; but that, if he waited till sundown, they would all return, but be careful, she said, to close up every aperture through which light may enter; then enter the house and hide yourself. Ruapupuke paid great attention to what the woman told him, and did exactly as she directed. By and by the occupants of the place, with a loud noise, came pouring in, till the house was quite full. Then Ruapupuke asked Hine-matiko-tai what he was to do. 'Do nothing,' she said; 'the sunlight will kill them. Only stop up all the gaps, that no warning gleam of light may call them forth before sunrise.' At the usual hour for waking, Tangaroa, the chief, asked, 'Is it not daylight?' 'No,' replied the old woman, whose business it was to watch for dawn; 'it is the long night; the dark night of Hine-matiko tai! Sleep on; sleep soundly.' So they slept till the sun rose high in the heavens. Then Ruapupuke let in the light, and set fire to the house, and it was burnt, all except the verandah, of which he brought away the four side-posts, the ridge-pole, and the door and window frames, and so introduced the knowledge of carving to the world." Hinga nga roa built the first carved house, called Te Rawe-oro, at Uwawa, the dwelling-place of Te Kani o Takirau. After him lived Te Wirakau, who was a carver of wood, and, in later times, Tukāki, and, lastly, Honu Taahu, the builder of Hau-te-ana-nui-o-Tangaroa, attached to the Christchurch Museum.

Art. XIV.—*Notes on Quartz Crushing at the Thames Gold-fields.*

By J. Goodall, C.E.

[*Read before the Auckland Institute, 13th September,* 1875.]

Although many of our members are well acquainted with the entire process of quartz-crushing, for the sake of those who are not conversant with the process, I will give a short account of quartz-crushing, as now conducted, before I proceed to make a few remarks on the apparatus used and the method of treatment.

Quartz-crushing comprises not only what the name implies, pulverising the quartz, but the entire system of gold extraction. At the Thames, that system may be designated as the wet crushing and amalgamating in battery process. This title will distinguish it from processes used on other fields. It is accomplished thus—the quartz, as it comes from the mine, is shovelled from time to time into a stamper box, in which usually work five stampers, of about eight cwts. each, at about seventy (70) strokes a minute. Water is conducted into the box to the amount of about eight (8) gallons per stamp per minute. The quantity of water varies according to the material operated upon, whether it be mullocky or not. A small quantity of quicksilver is poured into the box, to amalgamate the gold with which it may come in contact. In front of the box there is a perforated iron grating, through which the pulverised quartz, when fine enough, is forced by the impact of water caused by the continuous fall of the stamps. The constant outflow of crushed quartz and water from the stamp boxes is received on a table, having on it grooves or ripples, containing quicksilver and a large extent of amalgamated copper plates smoothly nailed on. This may be called the silver table; it catches a large proportion of the free or amalgamated gold which escapes from the battery. The flow then passes over blanket tables, which arrest mechanically all the heavier particles. The blankets are frequently washed in tanks, to remove the rich deposit on them. The blanket tailings thus produced are treated in large berdans with quicksilver, one berdan being allowed for five stamps. By this means a fair proportion of extra gold is extracted from them. Settling pits are provided beyond the blanket tables, so that, if deemed advisable, the tailings are saved for after treatment, or for sale to those who make it their special business to manipulate tailings. The entire battery is cleaned up at the end of each crushing, or once a week, if the crushing be continuous. All the amalgam from the stamp boxes, from the silver tables, and berdans are carefully cleaned and retorted in cast iron retorts, to separate the gold from the quicksilver. The spongy gold is then taken out, and sent to the bank for melting. Such is the usual process resorted to for private or public crushings; and the object of this paper is to criticise the *modus operandi*; to point out what I consider its errors, and to suggest a method of working which is likely to prove more profitable.

The engine-power required will vary according to circumstances, such as weight of stamps, size and number of berdans, and the amount of water required to be pumped. If each stamp be not heavier than eight cwts., and there is a berdan of five feet in diameter to five stamps, and water is required to be raised, say 20 feet, for battery purposes, one and a half horse-power to each stamp will be about the required power. I have known engines working beyond that, but it was not considered profitable, as the speed became variable, and a larger proportion of coal was consumed in comparison to the steam-power obtained.

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Stamp boxes are generally constructed to hold five stamps; they are of cast iron in one piece, are three inches thick at the bottom and an inch and a half to one inch at the sides. The bottoms and sides are protected from the corroding action of the stamps and quartz by cast iron dies and linings. The boxes have two hoppers behind for feeding, and two openings in front for the gratings, to screen the crushed quartz. It has been attempted to have grating openings behind the box as well, but found not to answer, there being greater trouble to regulate the flow of water over the two tables. This remark applies to side openings also. The stamp boxes used at present are excellent, the only improvement I can suggest in them is that the openings for the gratings, which are now made vertical, should have a forward inclination on the top. This, I think, would allow the crushed material to escape more freely.

The shoes of the stamps and dies in the boxes, as well as the linings, are at present made of comparatively soft iron. They should be made of the hardest white iron, and chilled. If battery proprietors took the trouble of sending to England for their shoes, dies, and linings, they would find it to their advantage, not so much in cost as the great saving in material and time lost in changing the different parts when worn out.

The cams for raising the stamps are very seldom of a proper shape; they are either too curved or too straight. They should be so constructed that the motion of the stamp be uniform, and, as soon as the stamp is raised to its greatest height, it should drop, and not for one moment before it is elevated for the next stroke. There is no trouble in constructing a cam with the necessary curve to do exactly as required, and, if so constructed, a battery may be driven up to 80 strokes a minute, without the risk of the discs striking the cams.

The screens or grates for sifting the crushed quartz usually used are perforated iron plates; the number of perforations are from 100 to 132 holes to a square inch, the greater the number the finer the holes. It is surprising how this kind has not been superseded by the iron wire grating, which is superior in many respects, especially in allowing more material to pass through in a given time, thus causing a great saving in cost of crushing; and I am further convinced more gold would also be saved, as, by the present use of quicksilver in the boxes, the amalgam formed is unnecessarily battered and converted into black and spongy amalgam, from being pulverised with base minerals. This sickened amalgam will pass over silver tables, blankets, and even the settling pits, and no device can save it. The silver tables are sometimes made in one plane, but generally in two or three steps; the inclination is usually one in ten. The quicksilver ripples are three inches broad, three-eighths of an inch deep at the top, and half an inch at the bottom; this enables the quicksilver and amalgam to be scooped up readily when cleaning up. It is usual to keep two ripples nearly as full of quicksilver as they will hold, and, when the lower one is too full, a part of the quicksilver is lifted from it and put back into the battery box. The length of the tables is about ten feet, and they are as wide as the front of the battery box. The blanket strakes below the silver tables are about 20 feet long; they are so arranged that a part of them may be washed from time to time without stopping the flow of water from the rest, or allowing it to go on the part from which the blanket had been removed. Instead of blanket, baize and coarse plush have been used with advantage. Shaking tables were not tried excepting at one battery. They proved very serviceable, but the wear and tear was great, and, as the miners were not willing to pay an extra price for its use, it was discontinued.

The blanket tailings or blanketings, as they are otherwise called, consist mostly of iron pyrites and other sulphides, combined with quartz, and contain a fair proportion of gold and some quicksilver and amalgam that had escaped over the silver tables. These tailings are treated in berdans with extra quicksilver and ground up. The berdans now in use at the Thames, I think, exceed in size, those in use in any other gold-fields; they are generally five feet in diameter, and I have seen one six feet. At one time a couple of rotating balls were considered sufficient for the amount of crushing required; now, the general practice is to have a loose ball as well as a stationary one attached to a chain, and it is called a drag ball; this drag does more work than a loose ball, but takes more power than should be used in grinding, for the drag grinds the bowl as much as the tailings. I am convinced that grinding and amalgamation can be better accomplished in pans, such as Wheeler's or Hepburn's, than in berdans. Pan treatment, however, has the same fault as berdan treatment; in both cases the same material is continually re-ground, thus a deal of labour is lost, and quicksilver is used while grinding. This system accounts for the great waste of quicksilver at the Thames, and if quicksilver is lost, gold is lost also.

This battering and grinding of quicksilver and amalgam seem to me to be the chief fault of crushing at the Thames. It is the basis of the system there, and I fear will not be stopped for some time. How many thousands of pounds worth of gold has been carried away with sickened quicksilver, it will be impossible to calculate; but I am convinced a great proportion of it could have been saved.

Having pointed out the chief errors of quartz-crushing, I shall, on a future occasion, shew how they may be avoided.