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TECHNICAL NOTES  
ON  
SOME BOULDER (W. A.) MINES.

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*(A Paper read before the Sydney University Engineering Society.)*

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BY EDWARD S. SIMPSON, B.E.,

Member of the American Institute of Mining Engineers.

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### INTRODUCTORY.

**B**OULDER, named after the first mine in the district to reach any prominence, is connected by rail with Perth, from which it is 389 miles distant, the journey occupying 19 hours by the Goldfields express. Situated within the East Coolgardie goldfield, it practically forms a suburb of Kalgoorlie, the official centre of the field.

The topography of the district, unlike its geology, is exceedingly simple. A series of low hills stretches in a general north-westerly direction from the eastern end of Kalgoorlie on the north to the Lake View Consols mine on the south. The highest point of this range is the summit of Mount Charlotte, which is 1380 feet above sea-level, and about 180 feet above the level of the surrounding plains. Several isolated conical hills rise out of the flat ground on either side of the range at short distances from it. East, north, and west of these hills, which are occupied at the south end by the mills and shaft-heads of the big mines, gently undulating plains stretch out to the horizon, all having a general slope towards a point a few miles south of Boulder, where there is a series of bare clay flats dignified by the name of Hannan's "Lake," perhaps because of the mirage so frequently to be seen on its surface.

There is no surface water anywhere, but small, half-obliterated traces of old watercourses can be seen in places. The rainfall being only about five inches in the year, all the water that reaches the ground either immediately soaks into it, or else forms small pools which dry up in a few minutes after the sun reappears.

In spite of the arid climate, the country is covered with shrubs and trees, the latter chiefly salmon gum and another species of eucalyptus. A few wattles and oaks (*casuarina* sp.) make up the balance of the larger trees, which seldom reach 50 feet in height, but are still used largely for mine timbering, and exclusively for fuel, so that the district is rapidly becoming denuded of them.

## MINING.

*The Mines.*

The mines with which we are chiefly concerned are all situated on the south end of the range referred to, or else on the low hills adjacent to it. Their relative areas and positions are shewn on the accompanying map.

The Great Boulder Proprietary is situated to the west of the range. It has an area of 85 acres, and almost surrounds the Ivanhoe property. Adjoining the Great Boulder on the east is the Lake View Consols mine, occupying 48 acres, immediately north of which is the Australia group of the Associated Gold Mines, whilst between the latter and the northern end of the Great Boulder Proprietary is the Great Boulder Perseverance. Hannan's Brown Hill lies three-quarters of a mile north of the Australia.

*Prospecting.*

The gold in these mines is found in a series of parallel "lodes" of schistose felstone varying greatly in width and richness. Of these, four are known to pass through the Ivanhoe property, and no less than thirteen through the Australia Group, one of which is 85 feet wide in the stopes near the surface.

Most of these lodes run in a more or less general N.W. and S.E. direction, and prospecting for and on them can therefore be carried out in a very simple and systematic manner. The older method was to sink a shaft upon or close to the outcrop of a lode, opening out every 50 to 100 feet in depth. At each level cross-cuts N.E. and S.W. were put in to endeavour to cut the parallel series of lodes, and on meeting one of these drives were put in to follow it and ascertain its value at various points.

This method is still the general one, but owing to the extreme hardness of the country rocks and the consequent expense of cross-cutting through unpayable material, it is being superseded in several of the mines by the use of the diamond drill to put in east and west horizontal bores to test the country. The rich parts of the lodes are generally found against one another, so that the lode stuff within any given east and west belt of country will be found to be all rich or all poor. In testing the country, therefore, with the diamond drill, the bore should if possible be put in from a rich portion of a prospected lode, so that no parallel lode may be overlooked owing to the drill having passed through a poor portion of it, since in appearance the lode stuff often differs only slightly from the country rock, and well-defined walls are not common.

In the Kalgurli mine, bores are being put in east and west from the 100 feet level of the southernmost shaft close to the boundary of the Australian Group. The bores will be continued till they reach the boundaries of the property, and should yield valuable information as to the number and size of the lodes in the Australia Hill. On the completion of this work the plant will be employed to put in similar cross-cutting bores at the 200 feet level.

Any lodes discovered in this way will of course have to be opened up in the usual way, but in the event of large stretches of barren ground being proved between the lodes, it will probably be found more

economical to open up each separately by a shaft sunk near its probable outcrop, rather than by an ore-way through the extremely hard rock in between.

Shafts have been sunk in every direction, with the object of testing the ground, but as most of the lodes are vertical, or very nearly so, very little information is usually gained until crosscuts are put in. Recently (April, 1898) at the Great Boulder Proprietary the ground was driven into at the 400 feet level of the main shaft, and a crosscut passed through a lode averaging  $3\frac{3}{4}$  ozs. per ton throughout.

This is the deepest prospecting yet done on any of the bigger mines, but 2 oz. stuff has been met with at a depth of 520 feet at the Golden Pike. A contract has just been let to sink the main shaft at the Lake View East a further 100 feet from the 300 feet level at £5 7s. 6d. per foot.

#### *Exploitation.*

A great deal of the material at present being sent up to the batteries for treatment is being obtained from the prospecting drives on the lodes. The country is almost invariably very firm, and the lodes seldom more than six feet wide, so that no timbering whatever is necessary in driving.

Where stoping has been commenced above any of the drives, a few 10-inch or 12-inch round hardwood sets are put in at intervals of from six to twelve feet, and the sides and roof are lined with 3-inch or 4-inch round lagging, packed tightly at the back with waste rock. As the lode is stoped away overhead, mullock is piled on the timbering to keep the roof within the reach of the miners, whilst ore-passes lined with wood are left through the filling into the drive below, whence the ore is trucked to the shaft. In Tetley's shaft at the Australia Mine, telluride ore is being removed in this way from chambers 10 feet wide in places, and in order to provide sufficient material to fill in the workings, the old tip at the mouth of the shaft is being removed and thrown down shoots into the stopes.

At the Boulder Main Reef mine, the tailings from the cyanide vats are being taken direct into the stopes to fill them up. This practice is one that should not be followed by others. It was formerly resorted to at the Lake View Consols, but was discontinued when it was found that the miners showed sign of poisoning from the vapours given off by the cyanide left in the tailings. These are still utilized for filling underground, but are first exposed for some weeks to the weather to remove any cyanide.

At the Australian East mine, oxidized ore is being stoped between the 100 feet level and the surface from a lode 80 feet wide in a chamber extending the full width of the lode, and about 100 feet long. The only supports to the roof in this stope are four or five pig sties of round timber resting on the mullock. To provide filling for this enormous chamber, a small quarry has been opened on the surface against the capping of the lode, and the stone as it is blasted out is rolled down a pass into the stopes below.

In these stopes the men are using hand-drills and working single handed, but elsewhere on the field, stoping is always done double-handed, whilst hand labour for driving and sinking is being entirely replaced by machine drills. There are already twelve Ingersoll machines at work

in the Australia Group, and many more are in daily use at the Lake View Consols and other mines.

The shafts are invariably vertical, but winzes are often sunk on the incline to prospect the lodes under the drives. All the older shafts are timbered with round timber, and are generally provided with only two 3 feet by 3 feet 6 inches compartments in each of which are wooden guides for iron safety cages. The newer shafts are lined with sawn timber and provided with three compartments in one of which is a ladder way. Some of the best work of this kind is being done at the new main shaft of the Kalgoorlie Mint and Iron King mine, where sawn Oregon is the material employed.

Most of the mines are provided with efficient pumping plants, which are required more in those which are on the flats and get the drainage from the hills. None of the mines can be considered very wet ones, but many, such as the Lake View and Boulder Junction, are making as much as 20,000 to 30,000 gallons daily, whilst even the Lake View East, which is on the spur of the range, is making 15,000 gallons in the main shaft which is down 440 feet. The water obtained from the mines is very salt, that from the Lake View and Boulder Junction, which is of average density, contains 4.9 per cent. of solids, of which 3.9 per cent. is chloride of sodium. This is salter than sea water, which contains 2.7 per cent. of that salt.

A considerable loss is inseparable from the exploitation of the telluride ores of this district. These contain the greater part of their gold in the form of the very brittle and fragile tellurides which occur sometimes (notably at the Australia mine), in solid veins an inch or more thick. In breaking this ore down, a great part of the telluride separates from it in the form of fine dust, and as no covering is used on the floor to catch the ore, much of this drops down into the crevices in the mullock and is irretrievably lost.

#### *Shaft Heads.*

These are, with one or two exceptions only, of the one type; a good example of which is the newly-erected head to the main shaft of the Australian Group. It is 85 feet high, and consists of four main poles sloping inwards at an angle of about 15° connected by cross beams at four different heights. The main floor is on a level with the top of the ore bins at the back of the mill which it adjoins. The trucks of ore will therefore be run direct from the cages to the hoppers, which are only a few feet away. There are two floors above the main one, the upper one of which carries the main pulleys. Besides the floor beams, the structure is braced by diagonal beams and iron bolts.

A similar shaft-head to this is that at the Lake View East mine, which is represented in photograph.

The main shaft-head at the Lake View Consols mine differs essentially in type from these. It will be seen that it consists of two main vertical posts 60 feet high and 15 inches square in section, connected by a sill at the bottom, and two cross-pieces at the top 6 feet apart. Between the latter are the pulleys, the bearings for which are bolted into vertical beams. This vertical frame is supported against the

horizontal pull of the winding rope by two 15 x 15 inch struts mortised into the verticals five feet below the top, and checked into two sills connected with the main sill which supports the verticals. Each strut is further joined to the verticals by two horizontal beams, at heights of 12 feet and 24 feet respectively. In front of the verticals is an ore bin, from which the trucks for the aerial tram to the mill are filled.

## TREATMENT.

*The Ore.*

Before discussing the question of the treatment adopted at the various mines, it will be as well to glance at the nature of the ore to be treated.

The unoxidised lode stuff found in these mines at depths varying from 10 feet to 200 feet below the surface consists of a highly foliated felstone impregnated with carbonates of lime and magnesia, derived from the surrounding masses of diorite, and also with pyrites and various tellurides of the noble metals. The peculiar composition of this undecomposed schist is shewn by the following analysis made by the author of a sample from the 300 feet level in the Lake View Consols mine.

Analysis of Lake View Schist:—

	Water, H <sub>2</sub> O	{ Hygroscopic ...	402
		{ Combined... ..	1809
Soluble in Hydrochloric Acid.	{	Carbonate of Lime, CaCO <sub>3</sub> ...	10882
		"    Magnesia, MgCO <sub>3</sub> ...	6315
		"    Iron, FeCO <sub>3</sub> ...	1553
		Ferrous Oxide, FeO ...	1360
		Ferric Oxide, Fe <sub>2</sub> O <sub>3</sub> ...	1541
		Alumina, Al <sub>2</sub> O <sub>3</sub> ...	1326
		Manganese protoxide, MnO ...	Trace.
		Phosphoric acid, P <sub>2</sub> O <sub>5</sub> ...	Trace.
Soluble in Nitric Acid.	{	Iron, Fe ...	3990
		Sulphur, S ...	4417
		Tellurium, Te ...	Trace.
Insoluble.	{	Silica, Si O <sub>2</sub> ...	51271
		Titamic Oxide, TiO <sub>2</sub> ...	226
		Alumina, Al <sub>2</sub> O <sub>3</sub> ...	12519
		Ferrous Oxide, FeO ...	311
		Lime, CaO ...	313
		Magnesia, MgO ...	1159
		Undetermined and Loss ...	606
			<u>100000</u>
	Gold ...	9 ozs. 12 cwts. 18 grs. per ton.	
	Silver ...	6 " 7 " 8 " "	

This Schist usually contains numerous stringers of quartz running through it.

The upper portions of the lodes consist of the oxidised and leached schist. A sample of ore of this class from the Boulder Perseverance

mine, which was rather more ferruginous than usual, was found by the author to have the following composition:—

Analysis of Boulder Perseverance Oxidised Schist:—

	Water H <sub>2</sub> O	{ Hygroscopic ... ..	·730
		{ Combined ... ..	5·951
Soluble in Hydrochloric Acid.		{ Ferrous oxide, FeO ... ..	1·600
		{ Ferric oxide, Fe <sub>2</sub> O <sub>3</sub> ... ..	36·285
		{ Alumina, Al <sub>2</sub> O <sub>3</sub> ... ..	3·120
		{ Manganese dioxide, MnO <sub>2</sub> ... ..	·969
		{ Sulphate of Lime, CaSO <sub>4</sub> ... ..	Trace.
Insoluble.		{ Silica, SiO <sub>2</sub> ... ..	39·760
		{ Alumina, Al <sub>2</sub> O <sub>3</sub> ... ..	11·485
		{ Ferrous oxide, FeO ... ..	Trace.
		{ Magnesia, MgO ... ..	Trace.
			99·900

Gold ... 5 ozs. 2 dwts. 8 grs. per ton.

Silver ... 1 ,, 14 ,, 16 ,, ,,

As the oxidised ore was naturally the first to occupy the attention of the metallurgists, we will consider its treatment first. The gold in this ore occurs in three forms: First, the exceedingly fine powder known locally as "mustard gold;" second, spongy gold in porous masses, from the size of a pin's head to that of a man's fist; third, ordinary "reef" gold. The major portion of it seems to reside in the softer portions of the stone, and not in the quartz leaders or other hard portions, so that crushing through a fine mesh is unnecessary when the ore is to be subjected to a leaching process. One of the most distinctive features of this field is the course mesh of the screens on the crushing machines at some of the biggest mines.

The three methods of crushing in vogue at present are:—

- (1) Simple battery amalgamation, with or without recovery of concentrates.
- (2) Coarse dry crushing and direct cyanidation.
- (3) Wet crushing and amalgamation in stamp batteries, followed by concentration and cyanidation of the tailings.

The first of these was the one adopted by most of the mines in the early days, owing to its simplicity, and, although it gives very unsatisfactory results with this ore, is still followed by the less progressive mines. Elsewhere it is being superseded by the third method. The second is giving every satisfaction at the Hannan's Brown Hill and Australia Group, and, where stamps have not already been erected, is cheaper than the third.

I shall now pass on to the details of the treatment adopted at some of the more important reduction works in the locality.

*Hannan's Brown Hill—Old Mill.*

The oxidised ore is trucked direct from the shaft-head along an overhead line to the top floor of the mill to which it is tipped over a 1-inch grizzly, which separates out the finer portions of the ore. Two men break up the biggest lumps with spalls and feed the ore through a hole in the floor into a rock-breaker immediately below. The breaker

reduces the ore to the size of a walnut, and it drops directly into the hopper of a Challenge ore feeder, into which also the fine material from under the grizzly falls. The ore is fed automatically by this machine into a revolving cast-iron drying cylinder of the White-Howell type 20 feet long and 3 feet 6 inches in diameter, driven by a cog off the main power shaft. In this it is dried sufficiently by the flames from the fire box at the discharge end to be fitted for finer crushing.

From the sump at the side of the furnace the still hot ore is raised by a bucket elevator to a bin above a pair of Krupp ball-mills with 16 mesh screens. From these the crushed material, 50 per cent. of which will pass a 90 mesh screen, is again elevated to a "Stag" patent pneumatic separator, in which the ore is divided into sands and slimes. A second separator of this type is being placed into position to allow of the material being more completely classified. In dealing with an ore in which the gold is for the most part extremely fine, a serious drawback to these machines is the large amount of dust which they create.

The leaching vats, six in number, stand in a row passing beneath the separator, from which the sands are delivered to them by travelling canvas bands. Two of the vats are made of pine hooped with bar iron, and the remaining four of riveted steel boiler plate. The latter are considered to be the most useful in every way, and entirely do away with any loss by leakage. Each vat is 20 feet in diameter, and eight feet deep, and is capable of holding about 100 tons of ore; but owing to the difficulty experienced in getting a good percolation in even the partially separated sands, the vats are never in practice made to take more than 50 tons of ore, which stands about four feet deep. These vats take six days to leach, a solution containing .3% of cyanide being employed. They are discharged by hand through two 18-inch circular holes direct into the trucks, which run on light rails underneath. A vat can be emptied in this way in half a shift, *i e*, four hours. The dumping ground for the tailings is, as with most of the Boulder mines, very restricted in area, whilst the very slight fall in the surface of the ground is a source of great inconvenience.

A vacuum of 10 to 15 lbs is maintained under the ore during leaching to accelerate the process. The solution is drawn off through a 2-inch iron pipe into a regulating tank, from which a steady stream of solution passes into two zinc boxes each 18 feet long by 2 feet by 2 feet divided into twelve compartments, eleven of which carry trays of zinc shavings, whilst the twelfth contains some lumps of lime to neutralise the magnesia in the water and acid salts in the ore. The water used for leaching is obtained from the mine, and is, as elsewhere on the field, intensely saline. After leaving the zinc boxes, the solution runs down into one of several sumps under the floor, according to its strength in cyanide, and remains there until pumped up for use over again.

The dry ore slimes from the pneumatic separator are collected in a chamber, and fed by means of a screw conveyor into two wooden agitating vats nine feet in diameter, and five feet deep. In these they are stirred up by iron mullers for six hours with a .3% solution of cyanide, after which the pulp flows into a vertical rivetted-iron cylinder, in which a compressed air pipe passes from the top almost to the bottom. Air is kept bubbling through the pulp all the time the pressure cylinder is being filled, so as to prevent any settlement of the ore. When it is

full, the cover is screwed down. The cylinder then holds sufficient slime to fill a  $1\frac{1}{2}$  ton filter press, with which it is connected. Air at a pressure of 30 lbs. per square inch is turned on to the top of the pulp, which is thus forced into the filter press until the latter is full, when weak cyanide solution is forced through it at 150 lbs. pressure, and subsequently wash water. The leaching is then complete, and the pressed cake is dropped through conical shoots into trucks below.

The whole process, including filling and emptying, takes only  $1\frac{1}{4}$  to  $1\frac{1}{2}$  hours. Two men can attend to the agitators, and press and truck away the tailings. No figures are available as to the cost of this part of the treatment, but where an air compressing plant is already installed for driving rock drills, it should not cost more than 3s. or 4s. per ton of slimes. The canvas requires renewing about every fortnight.

The solution is drawn off from the press through an iron gas pipe, and goes to the precipitation room, where it flows through a separate zinc box 20 feet long, three feet wide, and two feet deep.

An additional press is already being placed in position to deal with the slimes from the second separator. The capacity of the mill is at present about 30 tons per diem, but with increased facilities for dealing with the slimes, this should be raised to 40 tons.

The following are some figures with regard to this mill for the current year :—

During March, the mill ran 389 hours, an average of 13·5 hours per day, crushing 857 tons. 1,003 tons of ore were leached as follows :—

453 tons of slimes assaying 1 oz. 9 dwts. 8 grs. per ton.  
550 „ sands „ 2 „ 3 „ 21 „ „

The gold extracted according to assay was 1595 ozs., or an average extraction all round of 85·2% ; an excellent result when one considers the large proportion of slimes, some of which still remain with the sands. This is of course all oxidised ore.

For the quarter ended 31st March, 1898—

2,822 tons of ore were milled.  
2,733 tons of ore were cyanided.

This ore yielded 4,613 ozs. of bullion worth about £3 17s. 6d. per oz. The cost of mining, milling, and cyaniding was £1 15s. 6d. per ton.

Here, as elsewhere at Boulder, the telluride ore is still shipped away to be smelted at Dry Creek in South Australia. For the quarter ended 31st March, 1898, 227 tons were smelted for 1339 ozs. fine gold at a total cost of about £4 10s. per ton.

#### *New Mill*

A new mill is being erected for this Company alongside the present mill by the London and Hamburg Gold Extraction Coy. It is somewhat difficult to obtain access to this yet, so that but little information can be given with reference to it.

The buildings themselves are constructed of corrugated iron on a rolled iron frame-work. It is to have a capacity of 120 tons per diem, and the process will be very similar to that at present in use in the

older mill. The ore will be calcined in a pair of 40 feet revolving cast-iron cylinders, from which it will pass to four Krupp ball-mills, thence to a series of pneumatic separators. The sands will be cyanided in vats whilst the slimes will be treated in filter presses.

### *The Australia Mill.*

This is the property of the Associated Gold Mines of W.A., and is situated on the summit of Australia Hill. It is at present employed solely on the oxidised ore from the Australia East Lease.

The plant was first arranged to cyanide the ore after a coarse crushing, then crush fine in three Huntington mills and amalgamate; the final tailings being concentrated on canvas tables. By this means an extraction of 97% was obtained; but as the residues after cyanidation only assayed 3 dwts. per ton, the gold recovered by the subsequent amalgamation and concentration barely paid for its extraction, so that this latter part of the process has been dispensed with altogether.

The present treatment of the ore—an oxidised felstone schist carrying a little free quartz in veins—is to break it to a 1-inch gauge in two Dodge crushers, then pass it through a short inclined cast-iron furnace to dry it, then through a revolving trommel by which all stuff under  $\frac{1}{8}$ -inch gauge is sifted out, and goes direct to the ore-box. The remainder is fed into two Krupp ball-mills where it is crushed dry to  $\frac{1}{8}$ -inch gauge. From the ore boxes under these mills the whole of the ore is elevated to a bin from which it is trucked to the vats on a line passing over the top of them.

The vats are nine in number; seven have a capacity of 64 tons, one of 75, and one of 175 tons. Two more of the latter are to be added to the plant, which will then have a capacity of 200 tons per diem. The vats are all built of Oregon bound with bar iron. The smaller ones rest on wooden supports, between which runs a single truck line, the vats being emptied through the bottom directly into the trucks. The 175 ton vats are being built upon stone cut foundations consisting of three parallel walls, between which run two truck lines, whilst outside these again are two arc-shaped walls to support the extreme sides of the vats. To facilitate the filling, the ore line above them is made capable of travelling laterally on rails at each end, so that ore can be dumped out of the trucks against the sides of the vat farthest away from the centre line of the ore track. This effects a considerable saving in time and labour in distributing the ore during the filling. These vats, which are probably amongst the largest that have ever been built of wood, are 24 feet in diameter, and 6 feet 6 inches deep. They are bound by seven hoops of  $1\frac{1}{2}$ -inch round iron in 15 feet lengths, screwed at each end and connected together by iron castings.

There are two separate zinc boxes of the usual pattern for precipitating the gold. The precipitate is charged wet into a cast-iron muffle with an area of 3 feet by 18 inches. In this it is first dried and then roasted to remove the zinc, after which it is smelted in pots with fluxes.

The water used in leaching is all obtained from wells sunk in the water-bearing serpentines on the shores of Hannan's "Lake." A sample of this water taken by myself from the tanks at the latter place, from which they were pumping, was perfectly clear and free from sediment.

Its specific gravity was 1.12012, and it contained 17.1210 per cent. of solid matter, of which by far the larger portion was common salt. Like the water used at Brown Hill mill, it contains a considerable amount of magnesium sulphate, and as this salt slowly decomposes a solution of potassium cyanide, it is always precipitated by limestone before using the water. The large amount of sodium chloride in it does not apparently have any deleterious influence upon the leaching.

Until quite recently all the telluride ore obtained from the Australia mines has been shipped to the Illawarra and other smelting works in the East, but it is now intended to proceed immediately with the erection of a plant having a capacity of 250 tons per diem to deal with this class of ore. The stone will then be passed through Gates breakers, then crushed dry in Krupp ball-mills, and roasted in three 175-foot Ropp automatic furnaces, and finally cyanided.

#### *Lake View Consols Mill.*

This is the largest and best equipped wet crushing plant in the whole colony, and is doing excellent work on the oxidised schist and quartz from the upper levels of the mine. Unlike the Brown Hill and Australia Mills, both of which are adjacent to their respective main shafts, the Lake View mill is situated on the crest of the range at a distance of about 20 chains N.E. of the main shaft.

The ore is brought up from the rock-breaker at the shaft-head by a Reichert system aerial tram to the ore floor, where it is tipped into the ore bins at the back of the mill. The bins discharge into ten Challenge feeders, one for each five head of stamps.

There are ten batteries of five stamps each, arranged in pairs, and built with frameworks of Oregon pine. They are driven by belt gearing from a main shaft running the full length of the building at the back of the batteries under the feeder floor. This shaft is connected by rope gearing at one end to a 14-foot fly-wheel weighing  $19\frac{1}{2}$  tons on the crank-shaft of a 400 h.p. double expansion engine made by Martin, of Gawler, South Australia. The fly-wheel makes 30 revolutions per minute whilst the stamps, which are fitted with gib tappets, make 80 drops per minute. The chuck blocks are fitted with amalgamated plates, and the pulp is discharged through 450 punched iron screens, which are not protected by splash-boards, on to the apron; the latter is in two sections, the upper five feet being separated from the final ten feet by a mercury well. A second well is placed at the lowest end before the pulp passes into launders, where it is mixed with a little more water, and then flows over canvas concentrating tables.

The latter consist of a large sloping floor of pine covered with canvas, each 18-inch strip of which is kept in place and separated from its neighbour by a light wooded batten. Each strip is 25 feet long, and the pulp from ten head of stamps is distributed over eight of them. In its flow over these tables the heavier particles of the pulp settle down on to the rough surface and are caught there. Once every shift the pulp is cut off from each of these strips in turn, and the concentrates are swept down with a broom into a wooden launder, which carries them