motion of the apparatus. It is so regulated that the quantity of cement that it introduces into the cylinder may be varied at will.

The materials, that is to say, the stone, sand, and cement, enter simultaneously at the top of the cylinder, and during the first third of their travel are mixed, while dry, through the motion of the paddles and that of the external cylinder. The water, the quantity of which can be regulated at will, enters continuously through a tube that debouches in the second third of the length of the cylinder, so that the elements that form the beton are intimately incorporated before leaving the apparatus. When finished, the beton falls into Decauville cars, which carry it to the spot where the blocks are to be manufactured. The apparatus is capable of furnishing from 15 to 18 cubic meters per hour, and this permits of manufacturing four blocks of 50 cubic meters or seven of 30. The power of the motor is 18 horses.

The contractors arrange upon the platform for preparing the blocks 517 moulds, 120 of which are of 50 cubic meters and 397 of 30, representing a total volume of 17,910 cubic meters. With the method of carrying that they employ, they are capable of submerging, in a period of three months, all the blocks that the platform can hold.

Let us now pass to the apparatus employed for lifting, carrying, and shipping the blocks.

wires of the circuit, owing to a counterpoise at the base of the bamboo canes. Communication between these pulleys and the receiving dynamo is established by means of copper conductors covered with gutta percha. The circuit is closed through this dynamo. The current traverses a resistance apparatus which allows of the passage of the whole or a part of the e. m. f., according to the work to be effected.

The receiving dynamo makes 600 revolutions per minute, and effects the rotation of a horizontal shaft that transmits power either to the pistons of the hydraulic presses that serve to lift the blocks, and that have a maximum stroke of 0.4 meter, or to another horizontal shaft situated at right angles with the other, and upon which are mounted pinions that gear with two endless chains. The latter transmit the power to drums fixed to the front wheels of the crane. These wheels produce the motion of the entire apparatus upon the tracks at the velocity of 10 meters per minute.

The pistons of the hydraulic presses are connected by joints with the hooks that serve to suspend the blocks. The length of the hooks varies with the size of the blocks to be lifted. Each block carries two lewisons, that are set into the block at the time of its manufacture, and with which the suspension hooks engage.

When the apparatus is placed over the block to be

is to be submerged. This apparatus is set in motion by electricity. It is constructed upon the same principles as the other lifting apparatus, but its frame is not of so large dimensions, and the stroke of the pistons of its hydraulic presses is different, being seven meters.

The pumps that send the water into the cylinders and the shifting mechanism receive their motion from the dynamo that the apparatus carries with it.

Referring to the diagram illustrations:

Fig. 1. Plan of artificial block works.

Fig. 2. Front elevation of dock.

Fig. 3. Longitudinal section of same.

Fig. 4. Transverse section of same.

Fig. 5. Plan of same.

Fig. 6. Transverse section through C, D, Fig. 3.

Figs. 7, 8, 9. Float for transporting the blocks.

Figs. 10, 11, 12, 13. Wheeled apparatus for moving the blocks.—*Le Genie Civil*.

FLOATING BRIDGE AT PORTSMOUTH.*

DESCRIPTION OF THE NEW FLOATING BRIDGE BETWEEN PORTSMOUTH AND GOSPORT.

By Mr. H. GRAHAM HARRIS.

Crossing Rivers.—Many arrangements have been devised for crossing rivers or arms of the sea in those positions where it is necessary not only to facilitate the crossing, but also to keep the waterway open, so as to allow of the passage of large ships.

Opening Bridges.—One of the most notable of these, at present in course of construction, is the Tower Bridge over the Thames in London. Here a very heavy expenditure will be incurred to build a bridge connecting the north and south sides of the river between the Tower on the one side and Horselydown on the other. Fig. 1 is a diagrammatic elevation of the bridge, showing the means which have been adopted for keeping the waterway open for vessels with lofty masts, while still maintaining a possibility of traffic from side to side of the river. The central span, which is 200 ft. in width, is an opening span; that is to say, the halves of the span can be lifted, being hinged on the piers at their inner ends, so as to leave the span clear. These piers are carried upward, and at a clear height of 135 ft. above ordinary high water are connected by a fixed bridge for foot traffic, enabling that traffic to be carried on even when the central span is open for the passage of large vessels. The piers are provided with staircases and with hydraulic lifts, the opening and closing of the central span being also performed hydraulically.

Ferries.—Another mode of obtaining the above end is that adopted in the case of the Thames ferries at Blackwall, or in the Birkenhead ferries for crossing the Mersey between Liverpool and Birkenhead. In these cases there are one or more steamers, which ply from side to side, not being confined, however, to one particular line of course; being, therefore, affected by wind and tide, and requiring to be navigated, also requiring considerable power in the engines to enable these to propel the vessel at a sufficient speed to give steerage way when contending with strong tides and winds. With ferries the difficulties of difference of level between the vessel and the shore, due to rise and fall of the tide, have to be provided for; this is usually done by a floating landing stage connected to the shore by a hinged prow or gangway.

Tunnels, etc.—A tunnel is of course an obvious mode of enabling a crossing to be made while maintaining the waterway open. Notable instances of such tunnels in Great Britain are the Severn Tunnel, the Mersey Tunnel, between Liverpool and Birkenhead, and the new tunnel between Glasgow and Govan. With tunnels, as with a high level bridge, the great difficulty which has invariably to be surmounted is that of the approaches. In order to allow of a workable incline for these, if the water to be crossed is deep and the tunnel level consequently some distance below the surface, the approaches must be of great length, or else hydraulic or other power lifts must be resorted to. Similar troubles arise with a high level bridge. In the Mersey tunnel the traffic, which is a passenger traffic, is taken up and down by hydraulic lifts, thus avoiding any length of approach. In the new tunnel in Glasgow hydraulic lifts will also be used, and will there be employed to deal with wheeled traffic, as well as with the ordinary foot traffic.

Floating Bridge.—No mode of attaining the desired end is so cheap, not only in first cost but also in working, and none is so satisfactory in many respects, as a floating bridge. Such a structure consists of a barge or vessel, which has passing through it one or more chains, supported on chain wheels, which are carried on the barge and are capable of revolution by power of some kind, carried by the bridge itself. The chains are laid from side to side of the water which has to be crossed, their ends being anchored on the shores; and the crossing is effected by the bridge hauling itself in either direction from one side to the other, lifting up the chains from the bottom, passing them through the bridge and over the chain wheels and dropping them behind as it advances. The barge or vessel is made very shallow, so that it can approach close to the shore; and it carries at each end a projecting prow or landing stage, which has its inner end hinged upon the bridge, while the outer end is capable of being raised or lowered by power carried within the bridge.

Advantages and Disadvantages.—It will be seen that the result of such an arrangement as this is that with ordinary foot or wheeled traffic very little difficulty, indeed, is experienced with the approaches, nor are the differences of level tide ordinarily of serious importance. Further, in its passage to and fro the bridge keeps to a regular and fixed course, no matter what may be the state of the wind or tide. This is of great advantage to the traffic up and down the river, or in and out of the harbor, as the case may be. In addition the bridge requires no navigating, and can be readily stopped at any moment, being held or anchored by the chains in any position in which it is brought to rest. Most important of all, the power required to move it is small, and need not be in excess of that ordinarily required, because a structure worked in this way is not much affected by winds or by currents. These,

*Paper read before the Institution of Mechanical Engineers.—*Engineering*.

SIDE VIEW OF THE LIFTING APPARATUS.

The frame of the rolling crane for lifting the blocks consists of two strong trestles of plate and angle iron connected at the upper part by two crosspieces that support a flooring 2.6 meters in width, upon which is installed the entire motive mechanism. The crane is provided with four pairs of wheels and runs upon tracks of 5.7 meters gauge, formed of Vignole rails supported by strong wooden ties. It differs but little, as a whole, from the cranes that have hitherto been constructed for the same purpose; but up to the present only manual or steam power has been used, while in this case it is electricity that actuates the lifting and shifting mechanisms and that gives motion to the various apparatus serving to carry the blocks to the place of shipment. To this effect there is installed at a certain point of the field of operations a dynamo actuated by a 60 horse power compound engine making 300 revolutions per minute. This dynamo develops an e. m. f. of 220 volts and produces a current of 200 amperes. The e. m. f. is transmitted by a non-insulated copper wire strung upon wooden poles. This conductor is established all along the beton yard, and the current may be received by the dynamo carried by the rolling crane, whatever be the spot occupied by the latter upon the tracks. To this effect, upon the sides of the platform there are two bamboo canes 3.6 meters in length, movable around a joint situated at 1.1 meters from the lower extremity.

At the upper part of each bamboo there is fixed a small iron pulley which bears constantly against the

lifted and carried, the hooks are introduced into the lewisons, then the machine is set in motion, and the suction pipe of the pump is opened, in order to allow water to enter the cylinders of the hydraulic presses. As soon as the pistons of the latter have lifted the block about 30 centimeters, the pipe is closed, and the wheels that control the motion of the crane upon the rails are thrown into gear. The crane, once in motion, is led over a truck or car that runs upon a transverse track. At this moment, the cylinders of the presses are emptied and the block slowly descends upon the platform of the truck. This operation finished, the hooks are disengaged and the crane moves backward over another block, which it carries to the truck as before.

The truck or car that carries the block is likewise moved by electricity. To this effect, it is provided with a receiving dynamo analogous to that of the lifting apparatus. This dynamo receives the current through copper wires. The latter are not insulated, so that at every point of their length communication may be established with the receiving apparatus and the circuit be closed through the generating dynamo.

This car is hauled under a framework consisting of two strong horizontal iron trusses supported by cross-braced wooden posts, each surmounted by a cast iron cap. The bases of these posts are set into masonry. At the upper part of the framework is situated the apparatus designed to lift the block and bring it directly over the lighter that is to carry it to the point where it

then, are the advantages to be claimed for a floating bridge. The disadvantage, which is a very serious one, is common also to steam ferries, or to any mode of crossing other than that by a fixed bridge. It is that any traffic desiring to cross, which arrives at the bridge end just after the bridge has started for the other side, has to wait until the bridge has crossed and has returned before it can continue its journey. This is a disadvantage which has been felt between Portsmouth and Gosport, and has affected the communication there.

Torpoint Floating Bridge.—The Torpoint Bridge at Devonport was designed by the late Mr. James Meadows Rendel, and was put to work in the year 1834. A sectional elevation of this is shown in Fig. 2. It is built of wood, and is roughly 55 ft. in length and 45 ft. in width, with a draught of water when fully loaded of 2 ft. 6 in. The engine was a condensing beam engine, with cylinder 19 in. in diameter and 30 in. stroke, the revolutions being 35 per minute, and the boiler pressure $3\frac{1}{2}$ lb. per sq. in.

Nile Floating Bridge.—Over the Nile, about midway between Alexandria and Cairo, there is a form of floating bridge for conveying railway trains across the river (Fig. 3). This was designed by Mr. Robert Stephenson, and was erected and put to work in 1857. It consists of a flat-bottomed barge of shallow draught,

of the harbor. Motive power is supplied to the bridge by means of hauling chains laid along the bottom, which are worked by a winding engine on the St. Servan side, thus hauling the bridge backward and forward.

Portsmouth Floating Bridge.—Prior to the year 1840 the connection between Portsmouth and Gosport, then towns of considerable size—the population of Portsmouth being 50,000, and of Gosport, including Alverstoke, upward of 14,000—was by means of the historical wherry. All readers of Marryat remember the Portsmouth wherry, which was practically similar to the boats now plying in the harbor and used by the watermen. It is an extremely useful and handy boat for the purposes for which it is intended.

An iron floating bridge to ply between the beach at Gosport and the point at Portsmouth was designed by Mr. Rendel, and was put to work on May 4, 1840. This bridge was practically similar in principle to the one at Torpoint, and practically similar to the new one which was only launched on the 13th of October, which has since been towed round from the yard of the builders, Messrs. Allsup, of Preston, and which it is hoped the members will visit.

New Floating Bridge.—Except in small details, the new floating bridge is so much like the original bridge that a description of the new one will be all that it is

upon pulleys or rollers. The mortise wheel is geared up with a shrouded pinion in the center of the length of the crankshaft of a pair of overhead compound surface condensing marine engines of ordinary type. The steam cylinders of these engines are 20 in. and 38 in. in diameter, with 30 in. stroke. The speed is 60 revolutions per minute. The engines draw their steam from two cylindrical boilers, each 6 ft. 6 in. in diameter of shell and 13 ft. long, and each having a single flue 3 ft. 3 in. internal diameter terminating in a combustion chamber, from which there are 92 tubes of $2\frac{3}{4}$ in. external diameter to the back end of the boiler; thence the products of combustion pass into the uptake and to the chimney and away.

Chains.—The old chains will be used for the new bridge. They are anchored at the shore ends by being connected in vertical pits to heavy weights, which are assisted by strong springs, thus allowing of a certain amount of elasticity at the anchorage. The chains pass over pulleys at the top of the pits. The links are of mild steel $1\frac{1}{2}$ in. in diameter, and are of the ordinary shape and without studs. The chains are of excessive strength for the work required of them; but this is one of those cases where the mere weight of metal is of advantage, for this weight allows of the chains being at a very steep angle with the horizontal when the bridge is crossing, thus permitting vessels

FLOATING BRIDGE

carrying a vertical iron structure, in which is a platform extending the whole length of the barge, and sufficiently wide to carry two lines of rails of the ordinary gauge. The platform is capable of being raised and lowered in the iron structure which supports it. An allowance of 27 ft. between high and low Nile during the year has to be provided for. This variation occurs at the rate of about a few inches per day, and the platform is daily adjusted to the requisite height in the structure. The nicer adjustment required for transferring the railway carriages from the barge rails to those of the timber jetties on each side of the river is made by short lengths of hinged rails. The bridge is moved from side to side of the river by engines carried in the bridge, in a manner similar to that in which the Torpoint Bridge is moved and similar to that in which the floating bridge forming the subject of this paper is moved.

St. Malo Traversing Bridge.—In Fig. 4 is illustrated another method of crossing a tideway, by means of a traversing bridge, as employed across the harbor entrance between St. Malo and St. Servan. The distance to be traversed is about 110 yards, the spring tides here rising to a height of 34 ft., though at low water of these tides the passage is dry for some hours. The bridge consists of a platform supported from the bottom of the harbor at a height of 36 ft. on four wrought iron braced columns. These columns rise from a framework carried on four wheels, which run on rails laid on the bed

necessary to give. The new bridge is shown in Figs. 5, 6 and 7.

In plan it is a rectangle, 100 ft. in length of hull by 62 ft. in width, and draws 1 ft. 6 in. of water. At each end there are two prows; those on each side and at opposite ends are connected with each other by chains and wire ropes passing over pulley wheels on the bridge, so that they counterbalance. The inner ends of the prows are hinged to the structure of the bridge; and either of them can have its outer end lowered so that it may allow of connection with the shore, at the same time raising its fellow at the other end of the bridge. The fellow prows are connected by a deck at a level of about 3 ft. above the water; this deck forms the standing place for the wheeled traffic. The longitudinal center portion of the bridge is occupied by cabins, and engine and boiler room, with an upper or promenade deck approached by a flight of steps from either end.

Gearing and Engines.—In the center of the length of the vessel there is a cross shaft, carrying a mortise wheel with wooden cogs, 12 ft. 4 in. in diameter to the pitch line; and on each end of this shaft there is a chain wheel 10 ft. 6 in. in diameter, over which the hauling chains pass. The chains travel through the vessel in water-tight iron troughs, which form part of the structure and are employed to assist in bracing it; the chains enter and leave through holes considerably above the water line, and are supported in the troughs

drawing a great depth of water to approach nearer to the bridge. The angle at which the chains enter the bridge at the forward or hauling end is practically one of 45° to 50° , so that at some few feet from the front of the bridge there is from 20 ft. to 30 ft. depth of water over the chains. Further than this, the chains are the portion of the work which most readily wears out and which requires most frequent renewal. Their wear is largely due to their rubbing upon the gravel bottom of the harbor; and careful investigation has shown that it is desirable to make the chains as heavy as possible, with the object of preventing the necessity for their frequent replacement. The chain wheels on the bridge, by which the hauling is done, are made with fitted cast steel whelps or cogs, bolted into the hollow rim of the cast iron wheel, and shaped to suit the links of the chain. These are capable of ready renewal when worn.

Electric Lighting.—There is nothing of especial note to comment upon in the engines or machinery of the bridge; and practically the main difference between the new bridge and that which it will displace is that the new one is of steel, and will be lit electrically, and that the engines and boilers are more modern in design and construction; while the old bridge was of iron and was lit by gas, which was filled into a gasholder carried in the bridge by a flexible pipe connected to the shore at the Portsmouth end at those times when the bridge was waiting there for traffic. The electric light plant of the new bridge consists of two vertical high pressure engines, each coupled by a belt to a Paterson and Cooper dynamo. There are in all on the bridge lights equal to thirty-nine lamps of 16-candle power; and in addition to these sufficient power has been allowed in the engines for two arc deck lights of 1,200-candle power each. One of the engines and dynamos will do the whole of the work, the other being kept as a stand-by. Advantage has been taken of the fact of having these engines to make arrangements by which, in case of accident to the main engines, or if for any reason these cannot be worked, the bridge could be slowly brought to land by means of gearing working the main cross shaft through its mortise wheel. This gearing can also be worked by hand if desired.

The hull of the bridge is divided by transverse water-tight bulkheads into five compartments; and there are two continuous longitudinal girders, one on each side of the bridge, formed by the sides of the cabins carried down to the skin of the vessel to strengthen it longitudinally. A journey is made by the present bridge, and will be made by the new one, in about five or six minutes, the distance being about 660 yards or three-eighths of a mile. The advertised time for the starting of the bridge from the Portsmouth side is at the half hour and at the hour, and from the Gosport side at the quarter to and at the quarter past the hour. Under

these circumstances it will be seen that it may be necessary, should a wheeled vehicle desiring to cross arrive just as the bridge has started to the other side, for it to wait for nearly half an hour before it can proceed on its journey. This is a disadvantage which has to be borne by the wheeled traffic; but in the case of the ordinary foot traffic the bridge company have provided, in addition to the bridge itself, a service of steam launches crossing in the intervals between the times of the bridge starting, so that as a fact it is possible for a passenger to cross without having to wait for more than some seven to ten minutes at the utmost. It is only within the last few years that these launches have been established. Previously it was necessary to wait for the bridge or to take a Portsmouth wherry, there being a regular waterman's ferry plying for fares between these points. The bridge will take across as a maximum 1,200 foot passengers, or say one full regiment of soldiers.

TOGGLE JOINT FOR MULTIPLYING MOTION.

IN arranging a treadle to be operated by foot power, it can easily be connected up in such a manner that the foot will rise in almost any portion of a revolution

FIG. 1.

and take the remainder of the turn to make the descent again. Some prefer having a treadle rise quickly, and take nearly three-quarters of a turn to allow it to fall again, thinking that all the power applied by the foot will be made the most use of, while others prefer just the reverse, on the grounds that the leverage is the greatest by this method, when in reality there can be no difference in the power deriving by either arrangement. There may be a convenience that will work in handy, depending on the class of work that is to be done, and this has much to do with the way a new device may take on the market. We have been taking an interest in a device for giving two treadle

FIG. 2.

movements for one turn of the flywheel where the toggle joint is made use of, and have already applied it to a high speed engine, in the hope of reducing the speed of the driving wheel, or rather allowing the reciprocating parts to double their ratio of speed without disturbing the rotative parts of the engine. The piston is made to operate the crank of a flywheel by means of a piston and two connecting rods jointed together, as shown in Fig. 1. The piston, A, moves back and forth for a short distance, drawing the two connecting rods, B, C, and C, D, first out into a straight line, then pitching them up into the form of a pair of rafters, first up and then down, as shown by the dotted lines, giving

FIG. 3.

two strokes to the piston for one stroke from C to E. With this knuckle joint all that is required now is to connect this joint with the crank arm, F, G, by means of a connecting rod, C, F, and the engine is ready for its valve motion.

An attempt has been made to connect two crank arms in this manner, with the view of driving one with twice the number of turns as the other. The crank, A, in Fig. 2, operates the two rods knuckle-joint fashion, one end being made fast by a hinge on the floor, at E. The driven crank arm, D, is connected with the knuckle joint, at B, which has a stroke equal to the diameter of the crank pin circle of the driven crank arm for over two turns of the driving crank. It has been found that the motion of the driven wheel is very irregular, with as many as four dead centers for every turn of the wheel, but it is hoped that, by having

an elastic connecting rod, and weighty flywheels, a smooth running movement will be obtained. This dead center movement was first attempted as a foot power for driving a beading hammer, as shown in Fig. 3. The hammer, A, B, was jointed to a knuckle joint near the fulcrum, at C. To operate this knuckle joint another joint of the same class was arranged at right angles, H, C, F, with one side extended far enough for the foot, I, to rest upon. It is plain to be seen that when the foot is raised to the position shown at K, and brought down again, that the hammer must strike four rapid blows. Raising the foot one-half this distance diminishes the number accordingly, and to bring the hammer to correspond with the treadle only requires the foot to rise and fall but one-fourth its full travel. The joint also serves to guide the point where the foot is applied in a straight line. Such a device as this, where nothing but link work is used, should be available for other purposes, such as for driving jig saws and mortising machines, where foot power is relied upon as a motive power.—*Boston Journal of Commerce.*

HEAVY FREIGHT CARS.

THE Pennsylvania Railroad Company are now engaged upon the construction of the strongest car ever made in this or any other country. It is designed for the conveyance of the 124 ton Krupp gun, which, notwithstanding the report to the contrary, originating we believe with the *Army and Navy Journal*, and generally circulated by the press, will form an interesting feature of the exhibit of that company at the World's Columbian Exposition. As will be seen by the accompanying sketch, the car will be mounted upon four 8 wheel trucks, each pair of which will be connected with each other by an iron framework, the ends of which will be pivoted to the center of the truck. These frames will be in turn surmounted by another and

CAR FOR 124 TON KRUPP GUN.

larger frame, which will be pivoted on the centers of each of the other two and upon which it will rest. This upper framework, which, like the other two, is wholly of iron, may be compared to a huge trough, in which the gun will rest during its journey.

The second car is designed for the transportation of a 65 ton gun, which will also be a part of the same exhibit. It is of somewhat similar construction, as may be seen by the sketch, which is also shown herewith. These two guns will be landed at Sparrow's Point, near Baltimore, that being the only place on the Atlantic coast where a derrick of sufficient size to handle these guns is located. From this point they will be transported to Chicago by the Pennsylvania and Pittsburgh, Ft. Wayne and Chicago Railroads. These guns are expected to arrive in this country early in the ensuing year, together with several other pieces of heavy ordnance, and an immense armor plate manufactured by the Krupp Co. The negotiations which have been pending between the Pennsylvania Railroad Co. and the American representatives of the Krupp Co. for several months, for the construction of suitable cars and the transportation of the cannon, were lately consummated and a formal contract for the work has been executed.

According to the terms of the contract the Pennsylvania Railroad Co. agrees to build and have ready to

CAR FOR 65 TON KRUPP GUN.

deliver by January 1, 1893, the two cars referred to. It is possible that arrangements will be made whereby these cars may form a part of the exhibit of the Pennsylvania Railroad at the exposition.—*Railway Review.*

THE DOLCOATH TIN MINE, CORNWALL.

WM. P. BLAKE.

THE short notice of the celebrated Dolcoath tin mine of Cornwall which appeared in the *Engineering and Mining Journal* of September 24 was very welcome to me, as it must also have been to many of your readers, for Dolcoath may be regarded as a typical mine, and the leading tin mine of the world. But the notice seemed too brief for such a grand old mine as the Dolcoath truly is—a mine with a history of a century or more; with three shafts, each more than half a mile in depth; with levels at regular distances, following a lode which yields copper ore near the surface and tin ore below. There is not a mine which is worked with more system and regularity, nor one more interesting to the mining geologist and the practical miner. Having had the privilege of visiting it, and of being entertained by its manager, Captain Josiah Thomas, one of the ablest of the many able Cornish mine captains, I may be excused for asking you to give space to this somewhat more extended notice.

On the occasion of the visit of the Royal Institution of Cornwall to the mine at the end of last August, the members and their friends were entertained at luncheon by Captain Thomas, who presented them with a printed card giving the salient facts concerning the property.

The mine was worked in the last century to a depth of 160 fathoms, and is believed to have produced about £1,250,000 worth of copper ore. The present company commenced working in 1799. The total amount of calls

made is £45,252, and from this investment the mine has received as follows:

Copper ores sold.....	£2,328,435
Tin ores sold.....	3,249,386
Arsenic, silver, cobalt, etc., sold.....	23,156

Total dividends.....	£5,600,975
Dividends paid on copper to 1836....	157,541
Dividends paid on tin from 1853 to the last meeting.....	699,788

Total dividends.....	£5,757,329
At the quarterly meeting last June the accounts showed:	

		Per ton of tin.
Labor cost.....	\$62,905*	\$105.50
Tribute	6,525	10.95
Supplies.....	32,160	54.10
Stannary dues.....	9,385	15.75
Hospital, etc.....	2,110	3.55
	\$113,085	\$189.85

Net receipts from the sale of 594.5 tons of black tin at \$281.40 per ton were \$157,280; the net profits for the 12 weeks were therefore \$44,195. For the 12 weeks ended September 3 the profits amounted in round figures to \$55,000. A dividend of £9,400 was declared for each quarter.

The engine shaft had then reached a depth of 13 fathoms below the 412 fathom level, but since then it has been carried to a depth of 455 fathoms, or 2,742 ft. The number of hands employed is about 1,300. Many young women, "bal maidens," are employed in light work upon the dressing floors. It is a very interesting sight to see 100 or more young women, neatly dressed, and with large snowy white aprons and caps, working together at the buddles, concentrating black tin and singing Wesleyan hymns in unison as they work.

Between the years 1836 and 1853 no dividends were paid, the mine having become poor in copper ore, and not very rich in tin. Dolcoath is no exception to the general rule in Cornwall that where the lodes pass from the killas (slate) into the granite, the copper ore found in the slate gives out and tin ore comes in. I found this to be the case in every instance. In the slaty rocks the lodes bear copper ore, and in the granite tin ore. One of the Cornish mines has been cited as an example of this by some writers, but it is the rule for all.

The deepest run upon the Dolcoath lode is 440 fathoms from grass, and the lode at that depth is richer in tin ore than it was found to be at any level above it, showing no lack of mineralization at this great depth. In the new east shaft, which in June was down 8 fathoms below the 312 fathom level, the lode has a fine appearance for the whole of the distance, varying in value from £80 to £100 per fathom. A massive and rich run of ore was expected for at least 80 fathoms east of this shaft. It is claimed to be a striking characteristic of Dolcoath that as the mine has deepened so the mineral wealth has increased, and as the deepest point yet reached is the richest, this claim is not without foundation. It is a fact which has great significance and value to all mines, and is separately commented upon in another article.

In the central and northern portion of the mine there

is a piece of poor ground for about 80 fathoms in length, where Capt. Thomas, instead of driving levels as usual 19 fathoms apart, has only driven two levels below the 254 fathom level, one at the 314 fathom and the other at the 375 fathom level, thus saving considerable expense. He has recently introduced power drills for opening and breaking ground.

At the June meeting the manager directed the attention of the shareholders to the importance of adding to the stamping capacity of the dressing works, in order to be able to stamp the tin stuff as fast as raised from the mine. He highly commended to them the American or Californian pattern of stamps mills as far superior to the old fashioned Cornish stamp, an opinion which he has made more emphatic since his recent brief visit to the tin mines of Dakota. At a banquet on his return he said that he saw one stamp mill in the United States stamping more stuff daily than all the mills together in Cornwall.

The plans for the new 40 stamp mill were shown in June and the contract was given to the Hayle Foundry at £2,775, but the total cost, perhaps including the engine, is estimated at £5,000. The firm of Messrs. Harvey & Co. has been making stamp mills upon the Californian pattern for the gold fields of Africa. It is expected at Dolcoath that with the mine improving in depth for tin ore, and the increased stamping capacity above, the production of black tin will be largely increased. The new mill is erecting on the eastern side of the valley going toward Cook's Kitchen.

The Dolcoath set, nearly 1,100 fathoms long, adjoins Cook's Kitchen, and there is a space of only about 25 fathoms unworked between them, but the Cook's Kitchen lode is said to be heaved 70 fathoms to one side, so that connection of the two mines is not expected.

Captain Thomas was intrusted with the manage-

* Estimating the pound sterling at \$5.